



## QUEENSLAND URBAN UTILITIES

**SP033 Adam Street Wynnum North**

Contract : C1011-045 Order No: C1314-146

Job Number : 43402225

## ELECTRICAL INSTALLATION

***OPERATIONS and MAINTENANCE MANUAL***

### INSTALLATION BY:

SJ Electric Group(Qld) Pty Ltd  
19 Elliot Street  
Albion Qld 4010

Telephone: 07 3256 1522 Fax: 07 3256 1533

# 1. General

## 1.1 General Workplace Health and Safety

- The Workplace Health and Safety Act (2011) sets out the laws about Workplace Health and Safety for all workplaces, workplace activities and specified high risk plant. The Electrical Safety Act (2002) sets out the laws covering electrical safety. Nothing in this document is designed, in any way, to undermine the authority of the Acts.
- All reasonable care must always be taken to ensure the plant is without risk to the health and safety of personnel operating and maintaining plant and equipment.
- Employers have an obligation to ensure the workplace health and safety of all personnel at work.
- It is employer responsibility to ensure that all persons entering or working on the premises use appropriate personal protective equipment.
- Personal protective equipment includes gloves, safety glasses, hard hats, ear protection, safe foot ware and, where necessary, specialist protective clothing for hazardous areas.
- Any item of equipment should always be isolated before maintenance or repairs commence to ensure that inadvertent operation of the item does not result in risk to the health and safety of any person.
- Where the item is isolated, any total or partial shutdown should not allow a hazardous situation to be created.
- Where the item cannot be isolated, another person should be stationed at the controls of the item and an effective means of direct communication should exist between the persons carrying out the maintenance and the person at the controls.

## General Operating Principles

- All persons working the premises must be qualified Electrical Engineers or electrical trades persons capable of performing the required tasks competently. All personnel must also be familiar with plant and equipment.
- Adequate information, instruction, training and supervision must be provided to enable personnel to perform work without risk to health and safety.
- Work in an orderly way.
- Plan work in advance to avoid hazardous situations.
- Warn others of any hazards.
- Make inquiries before starting work, particularly on any unfamiliar installation or equipment.
- Before any work begins ensure that any instructions received or given are fully understood.
- Concentrate on the task on hand.
- Do not distract others or allow yourself to be distracted by foolish actions.
- Work from a safe and convenient position that provides a maximum working space that you do not have to over reach, you cannot slip, trip or stumble and so endanger yourself and others.
- Keep the working area tidy and free of unwanted materials and equipment.
- Use insulated tools where possible.
- Inspect tools and equipment regularly and ensure that any necessary maintenance is carried out.
- Keep yourself in good health.
- Do not work if ill or over tired, to the extent that your concentration, movement or alertness is affected. Illness or fatigue can endanger yourself and others.

## 1.2 Project Overview

Contract C1011-045 Order No: C1314-146 was for the manufacture and testing of six (6) new sewage pump station switchboards at various locations and the relocation of an existing switchboard at Rosebeery Parade, Woodend.

Equipment provided by SJ Electric ensures safe and efficient operation of the pump station. Equipment supplied and installed by SJ Electric includes: -

- Switchboards
- Field Wiring

The switchboard incorporates the latest technology in motor control, power monitoring, and instrumentation. It is important engineers, technicians and operators are familiar with the equipment installed before attempting any adjustments, modifications or maintenance.

The following Sections of this manual contain a comprehensive description of all equipment supplied, by SJ Electric. It is recommended that this manual be referred to before carrying out any work on any equipment.

### 1.3 Plant Maintenance

To ensure proper operation of the plant the following should be observed: -

- The plant should be kept clean and tidy at all times. Not only is this of aesthetic value, it extends equipment life.
- Check that all plant and equipment is operating correctly. Correctly operating equipment promotes overall plant efficiency.
- All items and areas of equipment should be cleaned regularly.

#### **WARNING**

- **Avoid directly hosing any drive motor or electrical item.**

- All maintenance, service, modifications and significant deviations from Normal operating conditions should be recorded in the Plant Service Log
- After a month of operation, check the tension of all bolts associated with the plant and thereafter periodically. Bolted connections on painted surfaces can loosen due to thinning of the paint underneath the bolt head-bearing surface. Motor mounting bolts and other bolted connections subjected to vibration should be periodically checked for loosening.

#### **WARNING**

- **Before starting work on any item ensure that the power supply is isolated, tagged off, and the item cannot be started.**

- The importance of preventative maintenance cannot be over-emphasized. Regular maintenance and suitable care of the equipment will ensure a long and reliable service life of the equipment.
- Many stoppages can be avoided by following the recommended maintenance procedures. Do not wait until you hear the grinding of equipment that has broken down. If you see any item wearing down, replace it, before it causes damage to other associated items.

## Preventive Maintenance

Maintenance procedures recommended to extend switchboard life are outlined as follows: -

- Switchboard exterior should be regularly wiped down with a solvent base cleaner such as "Spray & Wipe". This will ensure longevity of the powder-coated surface.
- Accessible areas like distribution boards and motor starter panels should be cleaned with a vacuum cleaner to remove dust and foreign matter.
- PLC panels should be maintained as dust free as possible. Dusting with a dry rag is recommended - taking care not allows dust inside the I/O modules or processor.
- When removing or installing PLC modules care should be taken to ensure that power is turned off to the rack before modules are removed or installed.
- Connections and efficient operation of circuit breakers, contactors and isolators should be checked every 12 months - especially where connected to busbars.
- Busbar connections should be checked every 12 months.
- Globes for indicator lights should be checked on a weekly basis with any faulty lamps replaced.
- Cubicle Fans Filter should be inspected and cleaned frequently.

## 1.4 Electrical Control System

### General Description

The switchboards are manufactured from 3mm aluminium and are suitable for location outdoors; the switchboards have been designed by QUU and contain several separate sections including:

- Incoming Section.
- Motor Starter Section.
- Distribution Section.
- RTU Section.

## 1.5 Control and Monitoring System.

The control and monitoring of the system is performed by the Queensland Urban Utilities telemetry system and was not included in this contract.

## 2. Manufacturers Technical Data

## **TECHNICAL DATA SHEET**

**Equipment Type:** Circuit Breaker

**Location:** Power Distribution

**Model Numbers:** various

**Manufacturer:** Terasaki

**Supplier:** NHP Pty Ltd

16 Riverview Place  
Murarrie  
(07) 3909 4999

# CIRCUIT BREAKER PRODUCTS PRICE LIST 2013



**NHP**

**CPB**

MINIATURE CIRCUIT  
BREAKERS (MCBs)

**01**

PANELBOARDS,  
LOADCENTRES  
& MCB CHASSIS

**02**

MOULDED CASE  
CIRCUIT BREAKERS  
(MCCBs)

**03**

CHASSIS ASSEMBLIES  
(MCCBs)

**04**

TRANSFER SWITCHES  
& CONTROLLERS  
(MCCBs)

**05**

TEMBREAK 1,  
TO 400 A / 1000 V  
(MCCBs)

**06**

AIR CIRCUIT  
BREAKERS (ACBs)  
& ARC DETECTION  
SYSTEMS

**07**

EARTH LEAKAGE  
RELAYS

**08**

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Proudly Supporting  
Australian Made and Owned

The Terasaki Electric Company, Japan, was founded in 1923 in the industrial city of Osaka. In its early beginnings it started with the manufacture of air circuit breakers. Terasaki later expanded its operations in the late 40s when they entered the marine industry manufacturing a complete line of moulded case circuit breakers.

Terasaki is world famous for its installations of marine switchgear, including air and moulded case circuit breakers in a majority of the world's ocean-going marine vessels.

Terasaki has developed systems beyond basic switchgear requirements for guidance and monitoring of ships on the high seas.

Terasaki is very proud of its achievements in this area, proving that quality and reliability of Terasaki products is recognised where service conditions are sometimes arduous and severe.

In the 1960s Terasaki expanded their production facilities to enable them to enter the industrial market as well as continuing to expand within the well established marine business. Terasaki have a total of four factories throughout Japan, mainly in the Osaka area, as well as affiliated companies in the UK, Malaysia, Spain, Italy, Finland, Sweden, Brazil and China.

Terasaki were the pioneers and the first circuit breaker company to introduce current limiting circuit breakers to the world in 1963 utilising the contact repulsion principle, which was first introduced in the TL range of moulded case circuit breakers.

NHP was appointed sole agent for Terasaki products in Australia in 1979 and in New Zealand in 1999. From that time until now, NHP has established Terasaki products as a standard in the market.



Prices shown in published catalogues or price lists are recommended selling prices only and there is no obligation on the part of any reseller to maintain the same prices. Prices are subject to change without notice and all orders are accepted by the Company on the condition that they will be invoiced at the prices ruling at the date of despatch.

Prices are nett unless otherwise stated, are shown in Australian Dollars, are valid only for sales within Australia and are subject to GST.

Products offered for sale in this pocket book are subject to our standard Conditions of Sale, applicable at the date the order is placed. NHP standard Conditions of Sale can be viewed on our website at <http://ecat.nhp.com.au> or by requesting a copy from any NHP office.

NHP has a policy of continuous product improvement and we reserve the right to alter any product at any time without notice. All detail is subject to change without notice and should be confirmed at the time of purchase. All price lists and quotations are issued on an Errors & Omissions Excepted basis (E&OE).

## Miniature circuit breakers (MCBs) and acc.

Safe-T MCBs, Din-T MCBs Din-T6, 10, 10H and 15, Din-Safe RCDs and safety switches, Din-T MCB accessories. Surge diverters, contactors and time switches.

1

## Panelboards, loadcentres and accessories

Insulated and metal loadcentres, general purpose, multi-purpose and premier panelboards, busbar chassis and fuses.

2

## Tembreak 1 and 2

### Moulded Case Circuit Breakers (MCCBs)

Thermal magnetic and electronic type MCCBs, earth leakage switches, DC and plug-in MCCBs.

3

## Chassis assemblies for the TemBreak range

Temway XA / XB, PXB, XB SS and XC series, chassis to suit 125 - 250 AF MCCBs, terminal covers and HC high current chassis.

4

## MCCB transfer switches and controllers

Manual, basic and automatic transfer switches, logic panels, transfer switch options and accessories.

5

## TemBreak 630 A - 1600 A and 1000 V mining MCCBs

Thermal-magnetic and electronic MCCBs, 1000 V mining MCCBs and MCCB isolating switches.

6

## Air Circuit Breakers and Arc detection relays

Standard air circuit breakers, main power circuit terminals, overcurrent relays and serial communication options. Arc detection relays.

7

## Earth leakage relays

Surface mounting type TZS, DIN rail mounting type RD3A and RD1B, panel mounting type RD1DF, RD1EP, RD3E2 and RD1G2 and mining earth leakage relays.

8

## Technical reference

MCB, MCCB general technical information, motor starting tables, DC applications, discrimination (selectivity) cascading, Type '1' and '2' co-ordination data. Electronic MCCB setting details.

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## Explanation of Terms

This price list catalogue is segregated into sections. A guide to the contents of each section is situated at the front of the price list catalogue, and the first page of each section has its own index for easier product selection.

A product listing index is situated at the front of this price list.

Each page has a bold section number for prompt page location and is identified by both its section number and its page number eg. 1-16 signifies this is section 1 page 16. All **catalogue numbers** are bold and shaded.

### All prices are in \$AUS (exclusive of GST)

Prices for equipment fitted with coils, apply to standard voltages only.

Non-standard voltages shown are available on request at additional cost.

An alphanumeric index by catalogue number is located at the rear of the price list catalogue. Items prefixed **I** in the alphanumeric index are available on indent only. These items are not stocked and will be brought in only on a customer request, the item can not be returned for credit. For more information on indent items please contact NHP customer service. Items prefixed **A** in the alphanumeric index are assembled to customer order/ requirements.

Current NHP standard conditions of sale apply to this price list catalogue.

The prices in this price list catalogue are recommended prices only (exclusive of GST) and there is no obligation on resellers to comply with the recommendation.

Product group	Page contents																																																										
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Cat. No. of product is shown next to the applicable price. The catalogue numbers are bold and shaded for quick identification.	<b>DIN-T6</b> <b>2-in-1 Double the capacity of your load centre</b>  <b>6 kA 'C' curve</b> <ul style="list-style-type: none"> <li>■ Standard AS/NZS 60898</li> <li>■ Approval No. NSW24783</li> <li>■ Current range 2 - 40 A</li> <li>■ C curve tripping characteristics</li> <li>■ Saves up to 50 % space</li> <li>■ DIN rail mounting</li> <li>■ General purpose light and power</li> </ul> <p>Curve type: C (5 - 10 in)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">1 pole + 1 pole</th> <th style="text-align: right;">2 pole</th> </tr> <tr> <th style="text-align: left;">Single module width (18 mm)</th> <th style="text-align: right;">Single module width (18 mm)</th> </tr> </thead> <tbody> <tr> <td style="text-align: left;">In (A)</td> <td style="text-align: right;">Cat. No.</td> </tr> <tr> <td style="text-align: left;">2</td> <td style="text-align: right;"><b>DTCBD61102C</b></td> </tr> <tr> <td style="text-align: left;">4</td> <td style="text-align: right;"><b>DTCBD61104C</b></td> </tr> <tr> <td style="text-align: left;">6</td> <td style="text-align: right;"><b>DTCBD61106C</b></td> </tr> <tr> <td style="text-align: left;">10</td> <td style="text-align: right;"><b>DTCBD61110C</b></td> </tr> <tr> <td style="text-align: left;">16</td> <td style="text-align: right;"><b>DTCBD61116C</b></td> </tr> <tr> <td style="text-align: left;">20</td> <td style="text-align: right;"><b>DTCBD61120C</b></td> </tr> <tr> <td style="text-align: left;">Must be same phase.</td> <td style="text-align: right;">1P + 1P</td> </tr> <tr> <td style="text-align: left;">25</td> <td style="text-align: right;"><b>DTCBD6225C</b></td> </tr> <tr> <td style="text-align: left;">32</td> <td style="text-align: right;"><b>DTCBD6232C</b></td> </tr> <tr> <td style="text-align: left;">40</td> <td style="text-align: right;"><b>DTCBD6240C</b></td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">3 pole</th> <th style="text-align: right;">4 pole</th> </tr> <tr> <th style="text-align: left;">Double module width (36 mm)</th> <th style="text-align: right;">Double module width (36 mm)</th> </tr> </thead> <tbody> <tr> <td style="text-align: left;">In (A)</td> <td style="text-align: right;">Cat. No.</td> </tr> <tr> <td style="text-align: left;">2</td> <td style="text-align: right;"><b>DTCBD6302C</b></td> </tr> <tr> <td style="text-align: left;">4</td> <td style="text-align: right;"><b>DTCBD6304C</b></td> </tr> <tr> <td style="text-align: left;">6</td> <td style="text-align: right;"><b>DTCBD6306C</b></td> </tr> <tr> <td style="text-align: left;">10</td> <td style="text-align: right;"><b>DTCBD6310C</b></td> </tr> <tr> <td style="text-align: left;">16</td> <td style="text-align: right;"><b>DTCBD6316C</b></td> </tr> <tr> <td style="text-align: left;">20</td> <td style="text-align: right;"><b>DTCBD6320C</b></td> </tr> <tr> <td style="text-align: left;">25</td> <td style="text-align: right;"><b>DTCBD6325C</b></td> </tr> <tr> <td style="text-align: left;">32</td> <td style="text-align: right;"><b>DTCBD6332C</b></td> </tr> <tr> <td style="text-align: left;">40</td> <td style="text-align: right;"><b>DTCBD6340C</b></td> </tr> <tr> <td style="text-align: left;">Must be same phase.</td> <td style="text-align: right;">3 Pole</td> </tr> <tr> <td style="text-align: left;">25</td> <td style="text-align: right;"><b>DTCBD6425C</b></td> </tr> <tr> <td style="text-align: left;">32</td> <td style="text-align: right;"><b>DTCBD6432C</b></td> </tr> <tr> <td style="text-align: left;">40</td> <td style="text-align: right;"><b>DTCBD6440C</b></td> </tr> </tbody> </table> <p><b>Notes:</b> 16 mm tunnel terminals. Not suitable for chassis mounting. Compatible with NHP Terasaki auxiliaries and accessories.</p>	1 pole + 1 pole	2 pole	Single module width (18 mm)	Single module width (18 mm)	In (A)	Cat. No.	2	<b>DTCBD61102C</b>	4	<b>DTCBD61104C</b>	6	<b>DTCBD61106C</b>	10	<b>DTCBD61110C</b>	16	<b>DTCBD61116C</b>	20	<b>DTCBD61120C</b>	Must be same phase.	1P + 1P	25	<b>DTCBD6225C</b>	32	<b>DTCBD6232C</b>	40	<b>DTCBD6240C</b>	3 pole	4 pole	Double module width (36 mm)	Double module width (36 mm)	In (A)	Cat. No.	2	<b>DTCBD6302C</b>	4	<b>DTCBD6304C</b>	6	<b>DTCBD6306C</b>	10	<b>DTCBD6310C</b>	16	<b>DTCBD6316C</b>	20	<b>DTCBD6320C</b>	25	<b>DTCBD6325C</b>	32	<b>DTCBD6332C</b>	40	<b>DTCBD6340C</b>	Must be same phase.	3 Pole	25	<b>DTCBD6425C</b>	32	<b>DTCBD6432C</b>	40	<b>DTCBD6440C</b>
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# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma National Manufacturing and Distribution Centre

NHP prides itself on being able to provide customers with tailored solutions that suit their individual needs. Whilst we have significant stockholdings and expertise at all our locations throughout Australia and New Zealand, the purpose of our National Manufacturing and Distribution Centre in Laverton, Melbourne is to develop these solutions through manufacturing, assembly, servicing and design and engineering.

## SIZE

Warehouse 7,000 m<sup>2</sup>  
Manufacturing 5,000 m<sup>2</sup>

## STAFF

270+ Employees

## OPERATING HOURS

6.00am - 11.30pm, Monday-Friday

## STOCKHOLDING

- 45,000+ line items (20,000 stocked)  
- Approximately \$70 M

## ITEM THROUGHPUT

- Approximately 5,500 per day (6,000 lines throughout Australasia)

## FACTS

- Orders released for picking before 3.00 pm are despatched the same day.
- The Supply Chain team strives to achieve 95 % customer service based on an 'on time in full, first time' measurement.



NHP NATIONAL MANUFACTURING AND DISTRIBUTION CENTRE



Scan the QR code to view the Laverton Tour brochure.



Scan the QR code to view our Concept Express video



## Creating a sustainable future

Adopting emerging technologies to support sustainable practices

A major push towards more sustainable practices by many in the industrial electrical industry is today clear for all and a major focus at NHP is to provide sustainable solutions for our customers as well as throughout our own operations.

In 2010 we designed and constructed our very own Sustainability Centre - located at our existing National Manufacturing and Distribution Centre in Laverton, Melbourne.

Housing cutting-edge technology and equipment enabling research & development and testing, the Centre aids investigation into ways to effectively introduce and manage sustainable practices. Sustainable technologies within the centre include:

- A horizontal axis wind generator
- Solar photo-voltaic systems
- Grid interactive systems
- Off-grid hybrid systems
- Dual axis solar tracker, and
- Energy Management & control systems

NHP are also proud participants in the Victorian Government's electric vehicle trial which will provide valuable insights to assist in future business planning, as well as help the wider community understand the process, timelines and barriers for transitioning to electric vehicle technologies in the future.

These initiatives highlight our commitment to sustainable practices across all facets of the workplace. Our aim is to remain at the forefront of the industry, as leaders in providing alternative energy solutions for commercial and industrial applications.

Working closely with Melbourne University, RMIT University and Victoria University, NHP is also proud to educate young electrical engineers in this growing and important industry sector.



ONE OF NHP'S ELECTRIC CARS ON DISPLAY AT THE SUSTAINABILITY CENTRE IN LAVERTON, MELBOURNE



## Products and Brands

To assist customers in finding what they want, we have classified our extensive product range into the following categories.

### 1. Market Categories

#### AUTOMATION SYSTEMS

The automation system relies on information from the field to control the process. NHP's switching and sensing suite of products cover all field sensing requirements including standard and hazardous area applications.

 **Allen-Bradley**

**Rockwell Software**



#### SPECTRUM CONTROLS

**WAGO**

**ESA**

**MITSUBISHI**

**CARLO GAVAZZI**

#### POWER DISTRIBUTION & PROTECTION

Most processes, even if automated, still require some manual control and NHP provides a complete range of control products and systems for this purpose.

 **TERASAKI**  
Innovators in Protection Technology

 **DIN-T**

 **socomec**  
Innovative Power Solutions

 **CPT** cirprotec

 **CONCEPT**

 **KATKO**

 **GRIZZ-BAR**

 **NHP**  **MOD6**

 **NHP**  **NLINe**

 **NHP**  **MODbreak**

 **NHP**  **MODpower**

**ALLEN-BRADLEY**

**ERICO**

**WOHNER**

#### MOTOR CONTROL & DRIVES

Divided into two distinct product ranges, NHP's plugs and sockets provide solutions for a wide range of applications and are available in a wide range of amperages and pin configurations.

 **sprecher+ schuh**

 **AB Allen-Bradley**

 **NHP**  **ampcom**

 **NHP** **Liquid Resistance Starters**

**AUCOM**

**SANTERNO**

**GHISALBA**

**MICROELETTRICA**

#### POWER QUALITY

NHP offer a large variety of quality safety products that meet international standards, with products ranging from emergency stop switches, light curtains, and safety monitoring relays all the way up to fully integrated safety PLC systems and SIL3 rated Safety Critical Shutdown systems.

 **NHP** **Power Factor Correction Systems**

 **SCHAFFNER**

**ELECTRONICON**  
**BELUK**



## ENCLOSURES & CLIMATE CONTROL

NHP has a complete range of mild steel, stainless and plastic enclosure options in a variety of IP ratings and configurations including modular switchboard systems.

To complement NHP's enclosure systems, a wide range of climate control solutions are also available.

**CUBIC**

**ELDON**

**NLINE**

**ZANARDO**

**FIBOX**

**NHP** **MODULAR**

**COSMOTEC**  
**STEGO**  
**IBOCO**

## SIGNALLING DEVICES

With an extensive range of audible and visual signalling devices, NHP provides solutions for hundreds of applications, be it general safety warning, process control, fire or evacuation.

**klaxon**

**MOFLASH**  
SIGNALLING

**Allen-Bradley**

**REM/LIVE**

## TERMINATION & WIRING SYSTEMS

NHP has a wide range of screw and screw-less terminals, terminal accessories (such a DIN rail and jumper pins), cable ducting and pre-wired cable looms for Allen Bradley automation systems which significantly reduces labour intensive wire termination.

**sprecher+schuh**

**WAGO**  
INNOVATIVE CONNECTIONS

**Allen-Bradley**

**BOCCHIOTTI**

**ERICO**

## TIMERS & CONTROL RELAYS

NHP offers a range of control relays and timers that can be used in conjunction with a conventional automation system to switch higher loads or in stand alone applications where the only basic single function control is required.



**Allen-Bradley**

**finder**

**GRASSLIN**

### FIELD SWITCHING & SENSING

The automation system relies on information from the field to control the process. NHP's switching and sensing suite of products cover all field sensing requirements including standard and hazardous area applications.



CARLO GAVAZZI  
STEUTE

### PLUGS & SOCKETS

Divided into two distinct product ranges, NHP's plugs and sockets provide solutions for a wide range of applications and are available in a wide range of amperages and pin configurations.



PROCONNECT

### OPERATOR CONTROL DEVICES

Most processes, even if automated, still require some manual control and NHP provides a complete range of control products and systems for this purpose.



ELEKTRA  
SPOHN + BURKHARDT  
TER

### SAFETY PRODUCTS

NHP offer a large variety of quality safety products that meet international standards, with products ranging from emergency stop switches, light curtains, and safety monitoring relays all the way up to fully integrated safety PLC systems and SIL3 rated Safety Critical Shutdown systems.



Guardmaster®





### HAZARDOUS AREA EQUIPMENT

NHP provided a world class range of hazardous area equipment for explosive environments including light fittings, enclosures and terminal boxes, control stations and intrinsically safe automation products.



**WAGO**  
**STEUTE**  
**ALLEN-BRADLEY**

### METERING

Energy Metering is the essential component to understanding your energy consumption and power quality. NHP has a complete range of energy meters and power quality analysers to meet the most demanding of applications.

### IME



### Allen-Bradley

### RENEWABLE ENERGY PRODUCTS

NHP offers a large selection of products and solutions tailored towards renewable energy applications including Solar and Wind.



### SERVICES & TRAINING

NHP has a wide range of services including technical support, field service and maintenance contracts, repair services and training.

### Allen-Bradley



Service

## Products and Brands

### 2. Application Classes

#### HAZARDOUS AREA EQUIPMENT

When servicing important industries such as the oil and gas, petrochemical and grain handling there is no room for complacency. At NHP our aim is to provide a world class range of hazardous area equipment for the hazardous market which includes light fittings, terminal boxes, control stations and an extensive suite of automation products. NHP has been in this field for many years and has acquired a comprehensive knowledge on explosion protection products, so wherever explosive atmospheres are prevalent, NHP can provide the safest solution.



WAGO

STEUTE

ALLEN-BRADLEY

#### SAFETY

For any industrial application, the safety of employees and the general population is of major importance. NHP has a long history in the safety industry and can be a trusted destination for all your safety application needs. NHP offer a large variety of quality products that meet all relevant international standards, with products ranging from simple emergency stop switches, to light curtains, safety monitoring relays all the way up to fully integrated safety PLC systems. Our product range extends further into SIL3 rated Safety Critical Shutdown systems.



STEUTE

KATKO

#### PROCESS CONTROL

Like the principles which drive the process industry, NHP is committed to delivering products of continuous quality to assist our customers in achieving process optimisation. Encompassing a wide range of industries including oil refining, petrochemicals, water and sewage treatment, food processing, and pharmaceuticals, the NHP process control product portfolio offers complete system integration.





## 3. Application Solutions

## ENERGY MANAGEMENT

NHP can provide Energy Management Metering and Software solutions that monitor and record energy information so operators can identify consumption trends and take corrective actions. Real-time measurements of these electrical parameters, such as voltage variations or distortions, may have alarm thresholds set to warn managers if preset limits are reached. These real-time measurements also allow site managers to anticipate overload conditions that could, for example, trip a circuit breaker. NHP can provide a wide range of products to complement any Energy Management Solution.

## SUSTAINABILITY

With an increasing focus on the state of global warming and the requirement to decrease our carbon footprint, the use of sustainability is becoming a popular phenomenon. Our partnerships with many of the industries best suppliers from around the world means that NHP offer a large selection of products and solutions tailored towards renewable energy applications including Solar and Wind. From high DC rated protection and switching devices, solar panel control and monitoring products through to a range of inverters and power factor correction, NHP has an extensive offering.



# HOM ON THE

With NHP's Price Lists available for download online, you can now access product information anytime, anywhere!



QR CODE

E OR  
E ROAD

Scan the QR code below or go to  
[www.nhp.com.au](http://www.nhp.com.au) to download the  
latest NHP catalogues and price lists.



Q-Pulse Id:AdME13079204529 of 1633

## Information at your fingertips

The latest NHP and industry news is never far away through NHP's communications technology platforms

With technology constantly evolving, so too are the ways in which we communicate and at NHP we recognise that what works today, will not necessarily work tomorrow. In line with this approach, NHP ensures it remains at the cutting edge of new communication platforms to ultimately provide timely, relevant and most of all valuable information to our customers.

By utilising the latest platforms such as smart phone and tablet technology (complete with a range of iTunes and Android compatible Apps), the social networking revolution, Quick Response (QR) codes, and much more, NHP are able to share the right messages in the right ways – the ways that our customers want to receive them.



Please scan the QR code to view our corporate website.



Scan the QR code to view our new interactive pulp and paper website



Everything you ever need to download for your Apple or Android device is located in the one convenient location. Scan the QR code to view NHP's mobile content



Scan the QR code to subscribe to NHP Connect

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma Events

Setting the industry standard for events

While NHP is renowned for providing quality products and service to our customers, we also know how to put on a great event.

Be it a customer function, new product launch, a road show or training and seminars, NHP looks to provide an event that will not only get people interested in coming along, but also to keep them entertained and informed from when they arrive.

With a dedicated Events team that prides itself on customer satisfaction, whether it be hands-on and interactive displays, informative speakers, quality training, giveaways, competitions and much more, NHP's events will always leave you wanting more.



Scan the QR code to view NHP's past and upcoming events

## NHP Electrical Engineering Products



NHP NATIONAL MANUFACTURING AND DISTRIBUTION CENTRE

NHP Electrical Engineering Products (NHP) specialises in motor control, power distribution and automation systems.

NHP offers the Australasian market the complete industrial electrical and automation solutions package. As authorised distributors for Rockwell Automation and their Allen-Bradley® products in our designated areas of Australia and throughout all of New Zealand, NHP is partnered with the leading global provider of industrial automation solutions and switchgear components.

An Australian owned company, NHP is committed to serving the Australasian industry with quality products and customer support. This is achieved through a 1000+ strong team which is distributed across 25 branches and 24 regional locations throughout Australia and New Zealand.

While NHP stock an impressive 45,000+ line items, we are much more than a component supplier. NHP source the highest quality products from leading global suppliers, and customise these into solutions for the local Australian and New Zealand markets, providing a complete fit to purpose systems and solutions service.

At NHP we have a strong customer focus and we look to provide the right product and product solutions for our customers' requirements and applications, all at a competitive price. We value and care for our customers and support them by offering personalised service and assistance to meet their every need and demand. Our customers can have 100% confidence in our ability to support them when, where and how it is needed.

Put simply, NHP is 'easy to do business with'.



Please scan the QR code to view our corporate presentation.



Scan the QR code for career opportunities at NHP

"Corporate DNA"  
The NHP Value Proposition





CORP-PROJECTS-ADS-CPB

## THINK MAJOR PROJECTS. THINK NHP.

When it comes to Major Projects, our staff involvement is always driven by long term results, actively seeking to support you with the right product and technical solutions before, during and after project completion.

### Major Projects Team

No matter what the project, from the initial stages of concept design, through to post-commissioning and future upgrades, NHP's Major Projects Team is there to see the project through together with you - our customer.

Our quality people have a diverse reach across Australia and New Zealand and their vast industry experience is sure to be there for you when you need it.

Think Major Projects. Think NHP.

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## Miniature circuit breakers and accessories (MCBs)

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## Miniature circuit breakers Safe-T & Din-T



Miniature Circuit Breakers	Safe-T	DIN-T6	Din-T10
<b>Standard (AS/NZS)<sup>1)</sup></b>	3111 / 2184 <sup>2)</sup>	60898	60898
<b>No. poles &amp; module width</b>			
1P	25 mm	18 mm	18 mm
2P	50 mm	36 mm	36 mm
3P	75 mm	54 mm	54 mm
4P	100 mm	-	72 mm
<b>Mounting</b>	Clip tray	DIN rail	DIN rail
<b>Current ratings</b>	6 A - 100 A	2 A - 63 A	0.5 A - 63 A
<b>Short circuit rating (kA)</b>	6 kA	6 kA	10 kA
<b>Curve types</b>	General	C & D	B, C & D
<b>Rated AC voltage 1P/2,3,4P</b>	240/415 V	240/415 V	240/415 V
<b>Rated DC voltage</b>	250 V -2P 5 kA	48 V 1P 110 V 2P	48 V 1P 110 V 2P
<b>Sealable in ON-Off position</b>			
<b>Trip-free mechanism</b>	Yes	Yes	Yes
<b>Centre trip position</b>	Yes	No	No
<b>Padlock facility- non captive</b>	Yes	Yes	Yes
<b>Padlock facility- captive</b>	Yes	Yes	Yes
<b>Busbar connection- On-top</b>	Fork	Pin	Pin
<b>Busbar connection- OFF-bottom</b>	Fork	Fork/Pin	Fork/Pin
<b>Terminal size- On-top</b>	-	35 mm <sup>2</sup>	35 mm <sup>2</sup>
<b>Terminal size- OFF-bottom</b>	-	35 mm <sup>2</sup>	35 mm <sup>2</sup>

**Notes:** <sup>1)</sup> UL listed MCB refer to NHP.

<sup>2)</sup> AS only.



Din-T15	Din-T10H	Din-T 2-in-1	Din-T DC	Din-T Easy-Fit
60947-2	60947-2	60898	60898	60898
18 mm	27 mm	18 mm	18 mm	18 mm
36 mm	54 mm	18 mm	36 mm	-
54 mm	81 mm	36 mm	-	54 mm
72 mm	108 mm	36 mm	81 mm	-
DIN rail	DIN rail	DIN rail	DIN rail	DIN rail
0.5 A - 63 A	80 A-125 A	2 A-40 A	0.5 A-63 A	6 A-63 A
15 kA - 50 kA	10 kA	6 kA	6 kA T15	6 kA
C	C & D	C	B & C	C
240/415 V	240/415 V	240/415 V	240/415 V	240/415 V
48 V 1P 110 V 2P	125 V 2P 250 V 4P	-	250 V 1P 500 V 2P 880 V 4P	-
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
No	No	No	No	No
Yes	Yes	Yes	Yes	Yes
Yes	Yes	No	Yes	No
Pin	Pin	Pin	Fork/Pin	-
Fork/Pin	Pin	Pin	Fork/Pin	Pin
35 mm <sup>2</sup>	70 mm <sup>2</sup>	16 mm <sup>2</sup>	35 mm <sup>2</sup>	4 mm <sup>2</sup> 6 A-20 A 35 mm <sup>2</sup> 25 A - 63 A
35 mm <sup>2</sup>	70 mm <sup>2</sup>	16 mm <sup>2</sup>	35 mm <sup>2</sup>	35 mm <sup>2</sup>

## Miniature circuit breakers Safe-T & Din-T



Residual Current Devices	Safe-T SRCB	Din-Safe DSRCD	Din-Safe DSRCBS
<b>Standard (AS/NZS)<sup>1)</sup></b>	3111 /3190 <sup>2)</sup>	61008	61009
<b>No. poles &amp; module width</b>	1P + N - 25 mm	2P - 36 mm, 4P - 72 mm	1P + N - 18 mm
<b>Mounting</b>	Clip tray	DIN rail	DIN rail
<b>Current ratings</b>	10 A, 16 A, 20 A	40 A, 63 A, 80 A, 100 A & 125 A	6 A, 10 A, 16 A, 20 A, 25 A & 32 A
<b>Trip sensitivity</b>	10 mA & 30 mA	30 mA, 100 mA, 300 mA, 500 mA	30 mA
<b>Sensitivity type</b>	AC	AC, A, AI, S & B	AC & A
<b>Short circuit rating (kA)</b>	6 kA	Inc-10 kA MCB or fuse backup	6 kA
<b>Curve types</b>	General	-	B & C
<b>Rated AC voltage</b>	240 V	240 V/415 V	240 V
<b>Sealable in ON-Off position</b>	No	Yes	Yes
<b>Trip-free mechanism</b>	Yes	Yes	Yes
<b>Centre trip position</b>	Yes	No	No
<b>Padlock- non captive</b>	No	Yes	Yes
<b>Padlock- captive</b>	Yes	No	No
<b>Busbar connection- On-top</b>	Fork	Pin	-
<b>Busbar connection- OFF-bottom</b>	Fork	Fork/Pin	Pin
<b>Terminal size- On-top</b>	-	50 mm <sup>2</sup>	16 mm <sup>2</sup>
<b>Terminal size- OFF-bottom</b>	-	50 mm <sup>2</sup>	35 mm <sup>2</sup>

**Notes:** 1) UL listed MCB refer to NHP.

2) AS only.



Din-Safe DSRCBH	Din-Safe DSRCB	Din-Safe DSRCB-P	Din-Safe DSRCM	Din-Safe Easy-fit
61009	61009	61009	3190 <sup>2)</sup>	61008
1P + N - 18 mm	2P - 36 mm	2P - 36 mm	1P + N, 3P & 3P + N	2P - 36 mm, 4P - 72 mm
DIN rail	DIN rail	DIN rail	DIN rail	DIN rail
6 A, 10 A, 16 A, 20 A, 25 A, 32 A & 40 A	6 A, 10 A, 16 A, 20 A, 25 A, 32 A & 40 A	6 A, 10 A, 16 A, 20 A, 25 A, 32 A & 40 A	32 A, 63 A	40 A, 63 A
10 mA & 30 mA	10 mA & 30 mA	10 mA & 30 mA	30 mA, 100 mA & 300 mA	30 mA
A	AC & A	AC & A	AC	AC
10 kA	10 kA	10 kA	-	Inc - 10 kA MCB or fuse backup
C	C	C	-	-
240 V	110 V/240 V	110 V/240 V	240 V/415 V	240 V/415 V
Yes	Yes	Yes	No	Yes
Yes	Yes	Yes	Yes	Yes
No	No	No	No	No
Yes	Yes	Yes	No	Yes
Yes	Yes	Yes	No	No
-	Pin	-	-	-
Fork/Pin	Fork/Pin	Fork/Pin	-	Pin
25 mm <sup>2</sup>	25 mm <sup>2</sup>	25 mm <sup>2</sup>	32 A- 16 mm <sup>2</sup> 63 A- 25 mm <sup>2</sup>	50 mm <sup>2</sup>
35 mm <sup>2</sup>	35 mm <sup>2</sup>	35 mm <sup>2</sup>	-	50 mm <sup>2</sup>

## Safe-T series

### 6-100 A

**6 kA**

- Standard AS 3111 AS 2184<sup>1)</sup>
- Approval No. V99347
- UL 489 fluorescent switching duty<sup>1)</sup>
- Lloyd's register
- Current range 6 -100 A 1, 2, 3 and 4 pole
- Clip-tray mounting. Suits CT type busbar chassis
- General purpose light and power distribution

**Technical data**

**Interrupting capacity:** 6 kA at 250 V AC (sym) 1 pole  
 6 kA at 400 V AC (sym) 2 & 3 pole  
 5 kA at 125 V DC 2 pole

**Thermal setting:** Fixed (40 °C)

**Magnetic setting:** Fixed

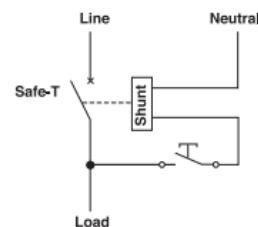
**Tropic proofed:** Standard

**Shunt Trip - Coil rating**

Voltage (V)	Current peak (A)
120-440 V AC	4.88 (440 V)
48-250 V DC	2.32 (250 V)

**Warnings**

Short time rated coil.  
 Coil burnout will result if coil remains energised.



**Shunt trip wiring diagram**



**Notes:** 1) Fluorescent light switching duty – UL 489

All Safe-T MCBs are by design suitable for fluorescent light switching duty as per the requirements of UL 489 issued by Underwriters Laboratories (USA). Performance standards to regularly switch banks of fluorescent lights ON and OFF require the MCB to withstand the higher inrush current (up to 30 times normal rating). If the MCB cannot withstand this inrush current, contact erosion and excess temperature rise will be experienced. Safe-T MCBs have been designed to withstand this type of duty. (Refer NHP)

Backup fuse data, refer to page 9 - 10. Accessories, refer to page 1 - 9.

## Safe-T series

### 6-100 A

Amp rating	Cat. No.	1 pole Price \$	Cat. No.	2 pole Price \$
6	SAFET6106	61.50	SAFET6206	190.00
10	SAFET6110	61.50	SAFET6210	190.00
16	SAFET6116	61.50	SAFET6216	190.00
20	SAFET6120	61.50	SAFET6220	190.00
25	SAFET6125	61.50	SAFET6225	190.00
32	SAFET6132	61.50	SAFET6232	190.00
40	SAFET6140	61.50	SAFET6240	190.00
50	SAFET6150	61.50	SAFET6250	190.00
63	SAFET6163	61.50	SAFET6263	190.00
80	SAFET6180	138.00	SAFET6280	355.00
100	SAFET61100	138.00	SAFET62100	355.00
63	SAFET6163NA <sup>2)</sup>	65.50	SAFET6263NA <sup>2)</sup>	164.00
100	SAFET61100NA <sup>2)</sup>	103.00	SAFET62100NA <sup>2)</sup>	220.00

Amp rating	Cat. No.	3 pole Price \$	Cat. No.	3P + N <sup>1)</sup> Price \$
6	SAFET6306	225.00	SAFET6406	315.00
10	SAFET6310	225.00	SAFET6410	315.00
16	SAFET6316	225.00	SAFET6416	315.00
20	SAFET6320	225.00	SAFET6420	315.00
25	SAFET6325	225.00	SAFET6425	315.00
32	SAFET6332	225.00	SAFET6432	315.00
40	SAFET6340	225.00	SAFET6440	315.00
50	SAFET6350	225.00	SAFET6450	315.00
63	SAFET6363	225.00	SAFET6463	315.00
80	SAFET6380	405.00	SAFET6480	495.00
100	SAFET63100	405.00	SAFET64100	495.00
63	SAFET6363NA <sup>2)</sup>	200.00	SAFET6463NA <sup>2)</sup>	285.00
100	SAFET63100NA <sup>2)</sup>	285.00	SAFET64100NA <sup>2)</sup>	440.00

**Notes:** <sup>1)</sup> Neutral pole is switched but does not provide overcurrent or short circuit protection.

<sup>2)</sup> NA – Non-Auto MCB without overcurrent or short circuit protection, suitable for main switch.

Refer page 9 - 10 for back-up fuse data. Accessories refer page 1 - 9.

## Safe-T series

### 6-100 A fitted with shunt trip

Amp rating	Cat. No.	1 pole Price \$	Cat. No.	2 pole Price \$
6	SAFET6106SHT	190.00	SAFET6206SHT	325.00
10	SAFET6110SHT	190.00	SAFET6210SHT	325.00
16	SAFET6116SHT	190.00	SAFET6216SHT	325.00
20	SAFET6120SHT	190.00	SAFET6220SHT	325.00
25	SAFET6125SHT	190.00	SAFET6225SHT	325.00
32	SAFET6132SHT	190.00	SAFET6232SHT	325.00
40	SAFET6140SHT	190.00	SAFET6240SHT	325.00
50	SAFET6150SHT	190.00	SAFET6250SHT	325.00
63	SAFET6163SHT	190.00	SAFET6263SHT	325.00
80	SAFET6180SHT	270.00	SAFET6280SHT	475.00
100	SAFET61100SHT	270.00	SAFET62100SHT	475.00
63	SAFET6163NASHT <sup>2)</sup>	184.00	SAFET6263NASHT <sup>2)</sup>	285.00
100	SAFET61100NASHT <sup>2)</sup>	225.00	SAFET62100NASHT <sup>2)</sup>	350.00

Amp rating	Cat. No.	3 pole Price \$	Cat. No.	3P + N <sup>1)</sup> Price \$
6	SAFET6306SHT	350.00	SAFET6406SHT	440.00
10	SAFET6310SHT	350.00	SAFET6410SHT	440.00
16	SAFET6316SHT	350.00	SAFET6416SHT	440.00
20	SAFET6320SHT	350.00	SAFET6420SHT	440.00
25	SAFET6325SHT	350.00	SAFET6425SHT	440.00
32	SAFET6332SHT	350.00	SAFET6432SHT	440.00
40	SAFET6340SHT	350.00	SAFET6440SHT	440.00
50	SAFET6350SHT	350.00	SAFET6450SHT	440.00
63	SAFET6363SHT	350.00	SAFET6463SHT	440.00
80	SAFET6380SHT	540.00	SAFET6480SHT	630.00
100	SAFET63100SHT	540.00	SAFET64100SHT	630.00
63	SAFET6363NASHT <sup>2)</sup>	335.00	SAFET6463NASHT <sup>2)</sup>	425.00
100	SAFET63100NASHT <sup>2)</sup>	425.00	SAFET64100NASHT <sup>2)</sup>	560.00

#### Operation

For remote tripping of Safe-T MCB (1 to 4 poles), manual resetting of MCB required. Inline shunt trip requires no extra pole spaces; refer to page 1 - 10 for connection diagram.

#### Application

Emergency stop and isolation of industrial socket outlets.

**Notes:** <sup>1)</sup> Neutral pole is switched but does not provide overcurrent or short circuit protection.

<sup>2)</sup> NA – Non-Auto MCB without overcurrent or short circuit protection, suitable for main switch.

Backup fuse data, refer to page 9-10.

Accessories to suit Safe-T MCBs, refer to page 1 - 9.

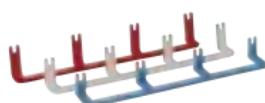
## Safe-T series

### Options, hardware and accessories

Description		Cat. No.	Price \$
Handle lock	Yellow	TAA5LY <sup>1)</sup>	3.30
Padlock attachment	1 pole	TKB50SGL <sup>1)</sup>	21.20
	3 pole	TKC50SG <sup>1)</sup>	21.20
Padlock attachment kits (captive)	12 pack and resin	SAFETLCK 12 <sup>1)</sup>	159.00
	24 pack and resin	SAFETLCK 24 <sup>1)</sup>	210.00
Tunnel terminal	35 mm <sup>2</sup> Safe-T (6-63 A)	7T1ST <sup>1)</sup>	13.00
	70 mm <sup>2</sup> Safe-T (80-100 A)	7T2ST <sup>1)</sup>	15.60
T-off plastic caps		TH250TOPC	0.60
Pole fillers		SAFETPF	1.80
Clip-tray (per 12 pole pieces)		TDB50SG12	20.20
Link bar (1 phase)	18 pole	LB18	27.00
Link bar (3 phase)	12 pole	LB3PH12	153.00
120 A	18 pole	LB3PH18	215.00



3 phase wiring harness



3 phase link bars



1 phase link bar



Tunnel terminals



TAA5LY



TKC50SG  
Locking attachments

**Notes:** <sup>1)</sup> Doesn't suit SRCB.

## Safe-T series (RCBO)

### Single pole width residual current circuit breakers

- Standard AS 3111 AS 3190
- Approval No. N15251
- Current rating: 10, 16 and 20 A
- Voltage 240 V AC 50/60 Hz (not suitable for 415/440 V)
- Short circuit protection 6000 A
- Earth leakage protection 30 mA and 10 mA



#### Operation

Safe-T single pole width residual current circuit breakers offer overload, short circuit and earth leakage protection in a single module width unit.

Mounting arrangements are identical to those throughout the Safe-T MCB range utilising the NHP clip-tray mounting system in panelboards and loadcentres.

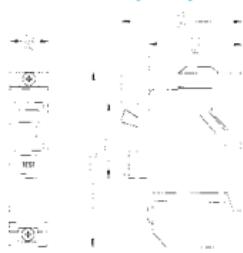
Amp rating	No. of poles	Modules	Trip sensitivity (mA)	Cat. No. <sup>1)</sup>	Price \$
10	1	1	30	SRCB 1030	325.00
16	1	1	30	SRCB 1630	325.00
20	1	1	30	SRCB 2030	325.00
10	1	1	10	SRCB 1010	360.00
16	1	1	10	SRCB 1610	360.00
20	1	1	10	SRCB 2010	360.00

\* For other current ratings or for 3 phase, refer to ELR relay page 1-11.

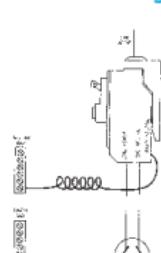
#### Accessories

Description	Cat. No.	Price \$
Padlock attachment kit (captive)	12 pack and resin	SRCBLCK 12
	24 pack and resin	SRCBLCK 24
Adaptor kit	Eaton, Cutler-Hammer (Quicklag)	SRCBWA
	Heinemann	SRCBHA

#### Dimensions (mm)



#### Connection diagram



Adaptors - allows SRCB to be fitted to Heinemann and Eaton chassis



Padlock attachment kit

**Notes:** 1) Neutral not switched.

**Nuisance tripping may be experienced in VFD and motor starting applications, refer NHP.**

## Safe - T series (ELR)

### Earth leakage relay

- Standard AS 3190
- Approval No. N15380
- NHP clip-tray mounting (CT chassis)

#### Application

The ELR is identical in width to the single pole Safe-T MCB. The ELR is clip-tray mountable alongside the Safe-T MCB when fitted to the CT chassis, as found in the CST/CPS series panelboards.

When the ELR is combined with a Safe-T MCB fitted with a shunt trip, the resulting combination offers overload, short circuit and earth leakage protection and can be retrofitted into an existing installation or installed in a new installation.

**Suitable for commercial and industrial applications.**

#### Test function

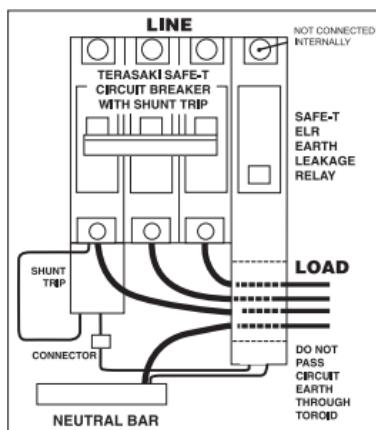
A test button is provided on the unit to functionally test the detection and tripping circuits.

It is recommended a functional test be performed monthly.

No. of Poles	Sensitivity (mA) <sup>1)</sup>	Voltage (AC)	Cat. No.	Price \$
1	10	240	50/60 Hz	<b>ELR24010</b> 590.00
1	30	240	50/60 Hz	<b>ELR24030</b> 590.00
1	100	240	50/60 Hz	<b>ELR240100</b> 590.00
1	300	240	50/60 Hz	<b>ELR240300</b> 590.00
1	30	415-440	50/60 Hz	<b>ELR44030</b> 590.00

#### Technical data

- Operation: Instantaneous
- Frequency: 40-60 Hz
- Output ratings: I peak 8 A,  
I average 0.5 A
- Toroid window: 4 x 35 mm<sup>2</sup>  
(aperture diameter  
35 mm)
- Dimensions: H = 152 mm  
W = 25 mm  
D = 60 mm
- Weight: 0.16 kg



**Notes: Nuisance tripping may be experienced in VFD and motor starting applications, refer NHP.**

## Din-T series

### General features

#### Advantages of the Din-T series miniature circuit breakers

- Short circuit breaking capacity of 6, 10 and 15 kA at 415 V AC
- Increased rating up to 63 kA when backed up with HRC fuses (Refer page 9 - 10)
- Rated current range from 0.5 A to 125 A
- Silver graphite contacts
- Input connection by lifting cage terminal with capacity of up to 35 mm<sup>2</sup> giving fast and practical connection
- Output terminals offer finger and hand protection with a capacity of up to 35 mm<sup>2</sup>
- Snap fixing with two stop locations, for normal DIN rail mounting
- Approval number N17481
- Conforms to AS/NZS 60898 and AS 60947-2 as applicable

#### Brief description

The Din-T series miniature circuit breakers have inverse time delayed thermal and instantaneous magnetic trips and are suitable for mounting in distribution boards or in switchgear panels and consumer units.

#### Operation

Protection against overheating of electrical conductors, excess currents due to overload, short circuit or earth fault.

#### Application

In switching, control, distribution and measurement systems for domestic, commercial and industrial installations.

#### Tripping characteristics

##### Thermal release

In case of overload, the release is initiated by a bi-metal strip. Standards AS/NZS 60898 and AS 60947 define the range of release for specific overload values. Reference ambient temperatures are 30 °C and 40 °C for the respective standards.

##### Magnetic release

In case of short circuit, an electromagnet with plunger ensures instantaneous tripping. AS/NZS 60898 describes the characteristics for the following curve types:

Curve Type	Test current	Application
B	3 - 5 x I <sub>n</sub>	Resistive loads
C	5 - 10 x I <sub>n</sub>	Protection of general distribution loads - lighting - socket outlets - motors etc.
D	10 - 20 x I <sub>n</sub>	Protection of circuits having high inrush transient currents - high inertia motor starting - transformers - welders

## Din-T series

### General features

#### Handle

Sealable and padlockable with quick-make and quick-break type mechanism. The handle is sealable in ON and OFF position. Due to the free-tripping mechanism, the MCB contacts open through overload or short circuit even when the handle is sealed in the ON position on all types.

#### Input terminal ('OFF' side)

Box terminal with lifting screw for copper and aluminium conductors: maximum capacity 1 x 35 mm<sup>2</sup> or 2 x 16 mm<sup>2</sup>.

When unscrewing the screw, the head lifts; however, on pushing the screw head, the box terminal opens. This system enables the MCBs to be linked with a cable and fork or pin type bus comb. The MCB is delivered with a half open box terminal and a lifted screw head.

#### Output terminal ('ON' side)

Box terminal with captive terminal screw for copper and aluminium conductors: max. 1 x 35 mm<sup>2</sup> or 2 x 16 mm<sup>2</sup>.

The box terminals are always delivered in the open position. Output terminal screw has IP 20 protection against direct finger contact by standard design.

#### Arc chamber

Contains arc extinction plates, (de-ionising type) designed to break up and dissipate the arc which is generated during interruption of all types of faults.

#### Electromagnet

Operating the plunger which opens the contacts instantaneously.

#### Arc magnetic blowout system

Short circuit currents do not flow through the bi-metal but are directed by the blowout magnet in such a way that the arc is transferred to a special arc runner, therefore taking the bi-metal out of the circuit, which ensures the thermal trip characteristics remain unchanged after an MCB has been exposed to a fault current.

- This combination of the electromagnet (with a plunger rapidly opening the contacts), the blowout magnet and the arc chamber, results in an extremely high short circuit breaking capacity, and very low let through energy.

#### Catalogue Number construction for Din-T MCBs (6, 10, 10H and 15)

Product series code	XX	-	X	-	XX	-	X	CurveType
Product series code								
Din-T Circuit Breaker	6	6000		Short circuit capacity (A)		Current (A)		B 3 In - 5 In
	10	10000	1	Polarity	05 0.5		C 5 In - 10 In	
	10H	10000	2		01 1		D 10 In - 20 In	
	15	15000	3		02 2			
	DC	6000	1N	1 pole	03 3			
	D6	6000	4	2 pole	04 4			
	E6	6000	11	3 pole	06 6			
				1P + N	10 10			
				3P + N	13 13			
				1P + 1P	Etc			

## Din-T6

### Series 2-63 A

#### 6 kA 'C' curve

- Standard AS/NZS 60898
- Approval No. N17481
- Current range 2-63 amps 1, 2 and 3 pole
- Sealable and lockable handle
- DIN rail mounting
- Padlockable in OFF position
- Suits CD, NC or GB chassis
- General purpose light, power and motor starting



#### Curve type: C (5 – 10 In)

#### Single pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
2	DTCB6102C	37.00	20	DTCB6120C	37.00
4	DTCB6104C	37.00	25	DTCB6125C	37.00
6	DTCB6106C	37.00	32	DTCB6132C	37.00
10	DTCB6110C	37.00	40	DTCB6140C	37.00
13	DTCB6113C	37.00	50	DTCB6150C	37.00
16	DTCB6116C	37.00	63	DTCB6163C	37.00

#### Double pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
2	DTCB6202C	131.00	20	DTCB6220C	131.00
4	DTCB6204C	131.00	25	DTCB6225C	131.00
6	DTCB6206C	131.00	32	DTCB6232C	131.00
10	DTCB6210C	131.00	40	DTCB6240C	131.00
13	DTCB6213C	131.00	50	DTCB6250C	131.00
16	DTCB6216C	131.00	63	DTCB6263C	131.00

#### Triple pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
2	DTCB6302C	166.00	20	DTCB6320C	166.00
4	DTCB6304C	166.00	25	DTCB6325C	166.00
6	DTCB6306C	166.00	32	DTCB6332C	166.00
10	DTCB6310C	166.00	40	DTCB6340C	166.00
13	DTCB6313C	166.00	50	DTCB6350C	166.00
16	DTCB6316C	166.00	63	DTCB6363C	166.00

**Notes:** The LINE-side is the OFF or bottom of the MCB, and connects to CD, NC or GB chassis tee-offs.

Suitable for the following side mounted accessories:

- AUX/ALM switches – refer page 1 - 40
- Shunt trip and UVT Trip – refer page 1 - 39
- Clip-on RCD module and Din-Safe-M module- refer page 1 - 32
- Din-T terminals and accessories – refer page 1 - 50

## Din-T6

### Series 2-63 A

#### 6 kA 'D' curve

- Standard AS/NZS 60898
- Approval No. N17481
- Current range 2-63 amps 1, 2 and 3 pole
- Sealable and lockable handle
- DIN rail mounting
- Padlockable in OFF position
- Suits CD, NC or GB chassis
- Motor starting and transformer applications



#### Curve type: D (10 – 20 In)

##### Single pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
2	DTCB6102D	51.00	20	DTCB6120D	51.00
4	DTCB6104D	51.00	25	DTCB6125D	51.00
6	DTCB6106D	51.00	32	DTCB6132D	51.00
10	DTCB6110D	51.00	40	DTCB6140D	54.50
13	DTCB6113D	51.00	50	DTCB6150D	54.50
16	DTCB6116D	51.00	63	DTCB6163D	54.50

##### Double pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
2	DTCB6202D	153.00	20	DTCB6220D	153.00
4	DTCB6204D	153.00	25	DTCB6225D	153.00
6	DTCB6206D	153.00	32	DTCB6232D	153.00
10	DTCB6210D	153.00	40	DTCB6240D	164.00
13	DTCB6213D	153.00	50	DTCB6250D	164.00
16	DTCB6216D	153.00	63	DTCB6263D	164.00

##### Triple pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
2	DTCB6302D	215.00	20	DTCB6320D	215.00
4	DTCB6304D	215.00	25	DTCB6325D	215.00
6	DTCB6306D	215.00	32	DTCB6332D	215.00
10	DTCB6310D	215.00	40	DTCB6340D	225.00
13	DTCB6313D	215.00	50	DTCB6350D	225.00
16	DTCB6316D	215.00	63	DTCB6363D	225.00

**Notes:** The LINE-side is the OFF or bottom of the MCB, and connects to CD, NC or GB chassis tee-offs.

Suitable for the following side mounted accessories:

- AUX/ALM switches – refer page 1 - 40
- Shunt trip and UVT Trip – refer page 1 - 39
- Clip-on RCD module and Din-Safe-M module- refer page 1 - 32
- Din-T terminals and accessories – refer page 1 - 50

**Din-T6****2-in-1 Double the capacity of your load centre**

1

**6 kA 'C' curve**

- Standard AS/NZS 60898
- Approval No. NSW24783
- Current range 2 - 40 A
- C curve tripping characteristics
- Saves up to 50 % space
- DIN rail mounting
- General purpose light and power

**Curve type: C (5 – 10 ln)****1 pole + 1 pole****Single module width (18 mm)****2 pole****Single module width (18 mm)**

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
2	DTCBD61102C	182.00	2	DTCBD6202C	171.00
4	DTCBD61104C	182.00	4	DTCBD6204C	171.00
6	DTCBD61106C	182.00	6	DTCBD6206C	171.00
10	DTCBD61110C	182.00	10	DTCBD6210C	171.00
16	DTCBD61116C	182.00	16	DTCBD6216C	171.00
20	DTCBD61120C	182.00	20	DTCBD6220C	171.00
Must be same phase.			25	DTCBD6225C	171.00
			32	DTCBD6232C	171.00
			40	DTCBD6240C	171.00

**3 pole****Double module width (36 mm)****4 pole****Double module width (36 mm)**

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
2	DTCBD6302C	275.00	2	DTCBD6402C	390.00
4	DTCBD6304C	275.00	4	DTCBD6404C	390.00
6	DTCBD6306C	275.00	6	DTCBD6406C	390.00
10	DTCBD6310C	275.00	10	DTCBD6410C	390.00
16	DTCBD6316C	275.00	16	DTCBD6416C	390.00
20	DTCBD6320C	275.00	20	DTCBD6420C	390.00
25	DTCBD6325C	275.00	25	DTCBD6425C	390.00
32	DTCBD6332C	275.00	32	DTCBD6432C	390.00
40	DTCBD6340C	275.00	40	DTCBD6440C	390.00

**Notes:** 16 mm tunnel terminals.

Not suitable for chassis mounting.

Compatible with NHP Terasaki auxiliaries and accessories.

## Din-T DC

### Series 0.5-63 A

#### 6 kA 'C' curve

- Standard AS/NZS 60898
- Approval No. NSW 24265
- Current range 0.5 - 63 A 1P and 2P
- C curve tripping characteristic
- DC Voltage 250 V 1P, 500 V 2P
- AC Voltage 230 V 1P, 400 V 2P
- Sealable and lockable handle
- DIN rail mounting
- Suit CD, NC and GB chassis
- Industrial applications



1 Pole



2 Pole

#### Operation

Din-T DC MCBs are equipped with a permanent magnet which aids arc extinguishing under fault conditions, making this range of MCBs suitable for voltages up to 250 V DC (1 pole), 500 V DC (2 pole) and 880 V DC (4 pole). Din-T DC 1P and 2P MCBs are also suitable for AC voltages. Polarity labeling must be respected due to the permanent magnet in the MCB.

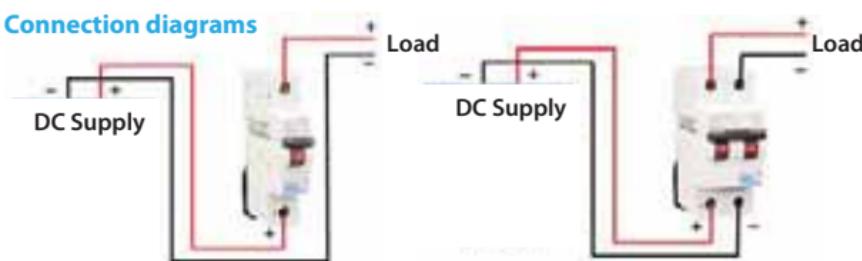
#### Curve type: C (5 - 10 $I_n$ )

##### Single pole

##### Double pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
0.5	DTCBDC105C	126.00			
1	DTCBDC101C	126.00	1	DTCBDC201C	265.00
2	DTCBDC102C	126.00	2	DTCBDC202C	265.00
4	DTCBDC104C	126.00	4	DTCBDC204C	265.00
6	DTCBDC106C	126.00	6	DTCBDC206C	265.00
10	DTCBDC110C	126.00	10	DTCBDC210C	265.00
16	DTCBDC116C	126.00	16	DTCBDC216C	265.00
20	DTCBDC120C	126.00	20	DTCBDC220C	265.00
25	DTCBDC125C	126.00	25	DTCBDC225C	265.00
32	DTCBDC132C	126.00	32	DTCBDC232C	265.00
40	DTCBDC140C	126.00	40	DTCBDC240C	265.00
50	DTCBDC150C	126.00	50	DTCBDC250C	265.00
63	DTCBDC163C	126.00	63	DTCBDC263C	265.00

#### Connection diagrams



# Din-T DC

## Series 0.5-63 A

1

### 6 kA 'B' curve

- Standard AS/NZS60898
- Approval No. NSW 24265
- Current range 10 - 63 A 4P
- B curve tripping characteristic
- DC Voltage 880 V 4P (1000 V PV systems)
- Sealable and lockable handle
- DIN rail mounting
- Industrial applications



### Operation

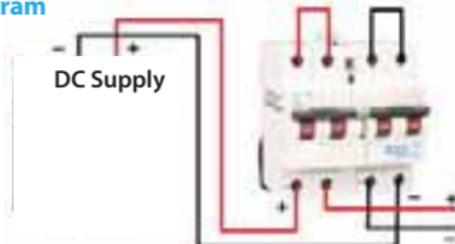
Din-T DC MCBs are equipped with a permanent magnet which aids arc extinguishing under fault conditions, making this range of MCBs suitable for voltages up to 250 V DC (1 pole), 500 V DC (2 pole) and 880 V DC (4 pole). Din-T DC 1P and 2P MCBs are also suitable for AC voltages. Polarity labeling must be respected due to the permanent magnet in the MCB.

### Curve type: B (3 – 5 $I_n$ )

### Four pole

In (A)	Cat. No.	Price \$
10	DTCBDC410B	580.00
16	DTCBDC416B	580.00
20	DTCBDC420B	580.00

### Connection diagram



**Notes:** Suitable for the following side mounted accessories:

- AUX/ALM switch – refer page 1 - 40
- Shunt trip – refer page 1 - 39
- UVT trip – refer page 1 - 39
- Clip-on RCD module – refer page 1 - 32
- Din-T terminals and accessories – refer page 1 - 50

## Din-T10

### Series 6-63 A

#### 10 kA 'B' curve

- Standard AS/NZS 60898
- Approval No. N17481
- Current range 6 - 63 A 1, 2, and 3 pole
- Sealable and lockable handle
- DIN rail mounting
- Padlockable in OFF position
- Suits NC, CD or GB type chassis
- Resistive load applications

Great  
for long  
cable runs  
(Carpark  
lighting)



**Curve type: B (3 – 5 I<sub>n</sub>)**

#### Single pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
6	DTCB10 1 06B	66.50	6	DTCB10 2 06B	188.00
10	DTCB10 1 10B	66.50	10	DTCB10 2 10B	188.00
16	DTCB10 1 16B	66.50	16	DTCB10 2 16B	188.00
20	DTCB10 1 20B	66.50	20	DTCB10 2 20B	188.00
25	DTCB10 1 25B	66.50	25	DTCB10 2 25B	188.00
32	DTCB10 1 32B	66.50	32	DTCB10 2 32B	188.00
40	DTCB10 1 40B	78.50	40	DTCB10 2 40B	194.00
50	DTCB10 1 50B	91.00	50	DTCB10 2 50B	220.00
63	DTCB10 1 63B	109.00	63	DTCB10 2 63B	230.00

#### Triple pole

In (A)	Cat. No.	Price \$
6	DTCB10 3 06B	220.00
10	DTCB10 3 10B	220.00
16	DTCB10 3 16B	220.00
20	DTCB10 3 20B	220.00
25	DTCB10 3 25B	220.00
32	DTCB10 3 32B	220.00
40	DTCB10 3 40B	230.00
50	DTCB10 3 50B	305.00
63	DTCB10 3 63B	365.00

**Notes:** The LINE-side is the OFF or bottom of the MCB, and connects to NC, GB or CD chassis tee-offs.

A range of UL standard MCBs is available on indent (Ref DTCBUL10...C)

Suitable for the following side mounted accessories:

- AUX/ALM switch – refer page 1 - 40
- Shunt trip and UVT trip – refer page 1 - 39
- Clip-on RCD module - refer page 1 - 32
- Din-T terminals and accessories – refer page 1 - 50

## Din-T10

### Series 0.5 - 63 A

#### 10 kA 'C' curve

- Standard AS/NZS 60898
- Approval No. N17481
- Current range 0.5 - 63 A 1, 2, 3 and 4 pole
- Sealable and lockable handle
- DIN rail mounting
- Padlockable in OFF position
- Suits NC, CD or GB chassis
- General purpose light, power and motor starting



#### Curve type: C (5 - 10 I<sub>n</sub>)

##### Single pole

In (A)	Cat. No.	Price \$	In (A)	Double pole	Price \$
0.5	DTCB10 1 05C	58.50	0.5	DTCB10 2 05C	179.00
1	DTCB10 1 01C	58.50	1	DTCB10 2 01C	179.00
2	DTCB10 1 02C	58.50	2	DTCB10 2 02C	179.00
4	DTCB10 1 04C	58.50	4	DTCB10 2 04C	179.00
6	DTCB10 1 06C	58.50	6	DTCB10 2 06C	179.00
10	DTCB10 1 10C	58.50	10	DTCB10 2 10C	179.00
13	DTCB10 1 13C	58.50	13	DTCB10 2 13C	179.00
16	DTCB10 1 16C	58.50	16	DTCB10 2 16C	179.00
20	DTCB10 1 20C	58.50	20	DTCB10 2 20C	179.00
25	DTCB10 1 25C	58.50	25	DTCB10 2 25C	179.00
32	DTCB10 1 32C	58.50	32	DTCB10 2 32C	179.00
40	DTCB10 1 40C	58.50	40	DTCB10 2 40C	179.00
50	DTCB10 1 50C	58.50	50	DTCB10 2 50C	179.00
63	DTCB10 1 63C	58.50	63	DTCB10 2 63C	179.00

##### Triple pole

In (A)	Cat. No.	Price \$	In (A)	Four pole	Price \$
0.5	DTCB10 3 05C	215.00			
1	DTCB10 3 01C	215.00	1	DTCB10 4 01C	255.00
2	DTCB10 3 02C	215.00	2	DTCB10 4 02C	255.00
4	DTCB10 3 04C	215.00	4	DTCB10 4 04C	255.00
6	DTCB10 3 06C	215.00	6	DTCB10 4 06C	255.00
10	DTCB10 3 10C	215.00	10	DTCB10 4 10C	255.00
13	DTCB10 3 13C	215.00	13	DTCB10 4 13C	255.00
16	DTCB10 3 16C	215.00	16	DTCB10 4 16C	255.00
20	DTCB10 3 20C	215.00	20	DTCB10 4 20C	255.00
25	DTCB10 3 25C	215.00	25	DTCB10 4 25C	255.00
32	DTCB10 3 32C	215.00	32	DTCB10 4 32C	255.00
40	DTCB10 3 40C	215.00	40	DTCB10 4 40C	265.00
50	DTCB10 3 50C	215.00	50	DTCB10 4 50C	280.00
63	DTCB10 3 63C	215.00	63	DTCB10 4 63C	290.00

## Din-T10

### Series 0.5 - 63 A



#### 10 kA 'D' curve

- Standard AS/NZS 60898
- Approval No. N17481
- Current range 0.5 - 63 A 1, 2, 3 and 4 pole
- Sealable and lockable handle
- DIN rail mounting
- Padlockable in OFF position
- Suits NC, CD or GB type chassis
- Motor starting and transformer applications

**Curve type: D (10 – 20  $I_n$ )**

#### Single pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
0.5	DTCB10 1 05D	66.50	0.5	DTCB10 2 05D	188.00
1	DTCB10 1 01D	66.50	1	DTCB10 2 01D	188.00
2	DTCB10 1 02D	66.50	2	DTCB10 2 02D	188.00
4	DTCB10 1 04D	66.50	4	DTCB10 2 04D	188.00
6	DTCB10 1 06D	66.50	6	DTCB10 2 06D	188.00
10	DTCB10 1 10D	66.50	10	DTCB10 2 10D	188.00
13	DTCB10 1 13D	66.50	13	DTCB10 2 13D	188.00
16	DTCB10 1 16D	66.50	16	DTCB10 2 16D	188.00
20	DTCB10 1 20D	66.50	20	DTCB10 2 20D	188.00
25	DTCB10 1 25D	66.50	25	DTCB10 2 25D	188.00
32	DTCB10 1 32D	66.50	32	DTCB10 2 32D	188.00
40	DTCB10 1 40D	84.50	40	DTCB10 2 40D	205.00
50	DTCB10 1 50D	109.00	50	DTCB10 2 50D	230.00
63	DTCB10 1 63D	133.00	63	DTCB10 2 63D	255.00

#### Triple pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
0.5	DTCB10 3 05D	220.00	0.5	-	
1	DTCB10 3 01D	220.00	1	-	
2	DTCB10 3 02D	220.00	2	-	
4	DTCB10 3 04D	220.00	4	DTCB10 4 04D	265.00
6	DTCB10 3 06D	220.00	6	DTCB10 4 06D	265.00
10	DTCB10 3 10D	220.00	10	DTCB10 4 10D	265.00
13	DTCB10 3 13D	220.00	13	DTCB10 4 13D	265.00
16	DTCB10 3 16D	220.00	16	DTCB10 4 16D	265.00
20	DTCB10 3 20D	220.00	20	DTCB10 4 20D	265.00
25	DTCB10 3 25D	220.00	25	DTCB10 4 25D	265.00
32	DTCB10 3 32D	220.00	32	DTCB10 4 32D	265.00
40	DTCB10 3 40D	230.00	40	DTCB10 4 40D	280.00
50	DTCB10 3 50D	305.00	50	DTCB10 4 50D	365.00
63	DTCB10 3 63D	365.00	63	DTCB10 4 63D	550.00

## Din-T10H

### Series 80-125 A

**10 kA 'C' Curve**

**7.5 kA 'D' Curve**

- Standard AS/NZS 60947 - 2
- Current range 80 - 125 A 1, 2, 3 and 4 pole
- Module width = 27 mm
- DIN rail mounting
- Suits NCH or CDH hybrid type chassis
- Industrial applications



**Curve type: C (5 – 10 I<sub>n</sub>)**

#### Single pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
80	DINT10H180C	128.00	80	DINT10H280C	330.00
100	DINT10H1100C	151.00	100	DINT10H2100C	350.00
125	DINT10H1125C	189.00	125	DINT10H2125C	470.00

#### Triple pole

#### Four pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
80	DINT10H380C	400.00	80	DINT10H480C	700.00
100	DINT10H3100C	400.00	100	DINT10H4100C	700.00
125	DINT10H3125C	590.00	125	DINT10H4125C	1040.00

**Curve type: D (10 – 20 I<sub>n</sub>)**

#### Single pole

#### Double pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
80	DINT10H180D	182.00	80	DINT10H280D	355.00
100	DINT10H1100D	182.00	100	DINT10H2100D	400.00
125	DINT10H1125D	210.00	125	DINT10H2125D	530.00

#### Triple pole

#### Four pole

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
80	DINT10H380D	455.00	80	DINT10H480D	780.00
100	DINT10H3100D	455.00	100	DINT10H4100D	780.00
125	DINT10H3125D	650.00	125	DINT10H4125D	1140.00

**Notes:** The LINE-side is the OFF or bottom of the MCB, and connects to NCH or CDH chassis tee-offs.

Din-T10H MCBs do not fit NC or CD chassis with 18mm pole pitch.

All poles include overcurrent and short circuit protection.

Suitable for the following side mounted accessories:

- AUX/ALM switch – refer page 1 - 40
- Shunt trip – refer page 1 - 39
- Din-T terminals and accessories – refer page 1 - 50

## Din-T15

### Series 6 - 63 A

#### 15 kA, 20 kA, 25 kA, 50 kA 'C' curve

- Standard AS/NZS 60947 - 2
- Current rating 6 - 63 A 1, 2, 3 and 4 pole
- Sealable and lockable handle
- DIN rail mounting
- Suits NC or CD type chassis
- Industrial applications



#### Curve type: C (5 - 10 ln)

##### Single pole

In (A)	Cat. No.	Price \$	In (A)	Double pole	Price \$
6	DTCB15 1 06C	150.00	6	DTCB15 2 06C	270.00
10	DTCB15 1 10C	150.00	10	DTCB15 2 10C	270.00
13	DTCB15 1 13C	150.00	13	DTCB15 2 13C	270.00
16	DTCB15 1 16C	150.00	16	DTCB15 2 16C	270.00
20	DTCB15 1 20C	150.00	20	DTCB15 2 20C	270.00
25	DTCB15 1 25C	150.00	25	DTCB15 2 25C	270.00
32	DTCB15 1 32C	150.00	32	DTCB15 2 32C	270.00
40	DTCB15 1 40C	150.00	40	DTCB15 2 40C	270.00
50	DTCB15 1 50C	150.00	50	DTCB15 2 50C	270.00
63	DTCB15 1 63C	150.00	63	DTCB15 2 63C	270.00

##### Triple pole

In (A)	Cat. No.	Price \$	In (A)	Four pole	Price \$
6	DTCB15 3 06C	420.00	6	DTCB15 4 06C	490.00
10	DTCB15 3 10C	420.00	10	DTCB15 4 10C	490.00
13	DTCB15 3 13C	420.00	13	DTCB15 4 13C	490.00
16	DTCB15 3 16C	420.00	16	DTCB15 4 16C	490.00
20	DTCB15 3 20C	420.00	20	DTCB15 4 20C	490.00
25	DTCB15 3 25C	420.00	25	DTCB15 4 25C	490.00
32	DTCB15 3 32C	420.00	32	DTCB15 4 32C	490.00
40	DTCB15 3 40C	420.00	40	DTCB15 4 40C	490.00
50	DTCB15 3 50C	420.00	50	DTCB15 4 50C	490.00
63	DTCB15 3 63C	420.00	63	DTCB15 4 63C	490.00

#### Short circuit capacity

In (A)	No. poles	Voltage (V)	Icu (kA)
6-25	1	240	25
	2-4	240/415	50/25
32-40	1	240	20
	2-4	240/415	40/20
50-63	1	240	15
	2-4	240/415	30/15

**Notes:** The LINE-side is the OFF or bottom of the MCB, and connects to chassis.

Ics = 50 % Icu.

**Din-T6****Easy-Fit MCB and RCCBs – Tool-free connection****6 kA 'C' curve**

- Standard AS/NZS 60898
- Approval No. NSW 24783
- Current range 2 - 63 A
- C curve tripping characteristic
- Cable clamping technology
- Line side- Plug in or screw in busbar comb
- Load side- Screw-less cable connection up to 20 A
- DIN rail mounting
- General purpose light and power

**Curve type: C (5 – 10 In)****Single pole****Triple pole**

In (A)	Cat. No.	Price \$	In (A)	Cat. No.	Price \$
6	DTCBE6106C <sup>1)</sup>	40.50	6	DTCBE6306C <sup>1)</sup>	166.00
10	DTCBE6110C <sup>1)</sup>	40.50	10	DTCBE6310C <sup>1)</sup>	166.00
16	DTCBE6116C <sup>1)</sup>	40.50	16	DTCBE6316C <sup>1)</sup>	166.00
20	DTCBE6120C <sup>1)</sup>	40.50	20	DTCBE6320C <sup>1)</sup>	166.00
25	DTCBE6125C <sup>2)</sup>	40.50	25	DTCBE6325C <sup>2)</sup>	166.00
32	DTCBE6132C <sup>2)</sup>	40.50	32	DTCBE6332C <sup>2)</sup>	166.00
40	DTCBE6140C <sup>2)</sup>	40.50	40	DTCBE6340C <sup>2)</sup>	166.00
50	DTCBE6150C <sup>2)</sup>	40.50	50	DTCBE6350C <sup>2)</sup>	166.00
63	DTCBE6163C <sup>2)</sup>	40.50	63	DTCBE6363C <sup>2)</sup>	166.00

**Din-Safe RCD**

- Standard AS/NZS 61008
- Approval No NSW 17482
- Current range 40 - 63 A
- 2 pole and 4 pole configurations
- 30 mA sensitivity
- Cable clamping technology
- Line side- Screw terminal
- Load side- Screw terminal or plug in busbar comb
- DIN rail mounting



No. poles	Trip sens.	Amp rating	Voltage	Cat. No.	Price \$
2P (1P+N)	30 mA	40 A	240 V	DSRCDE24030	250.00
		63 A	240 V	DSRCDE26330	285.00
4P (3P+N)	30 mA	40 A	240/415 V	DSRCDE44030	335.00
		63 A	240/415 V	DSRCDE46330	360.00

**Notes:** <sup>1)</sup> Screw-less cable clamping 'load-side' connection.<sup>2)</sup> Screw 'load-side' connection.

Double pole and 'D' Curve available on request.

## Din-Safe

### Safety switches (RCCB)

1

- Standard AS/NZS 61008
- Approval No. N17482
- Current ratings 40, 63, 80 and 100 A
- 2 and 4 pole configuration
- Accepts Din-T side mounting accessories
- Handle sealable and padlockable

*High immunity type*



No. poles	Trip sens.	Amp rating	Voltage	Cat. No.	Price \$
2P (1P+N)	30 mA	40 A	240 V	DSRCD24030	240.00
		63 A	240 V	DSRCD26330	265.00
		80 A	240 V	DSRCD28030	295.00
	100 mA	40 A	240 V	DSRCD240100	290.00
		80 A	240 V	DSRCD280100	355.00
		40 A	240 V	DSRCD240300	330.00
	300 mA	80 A	240 V	DSRCD280300	370.00
		40 A	415 V	DSRCD44030	315.00
		63 A	415 V	DSRCD46330	335.00
4P (3P+N)	30 mA	80 A	415 V	DSRCD48030	375.00
		100 A	415 V	DSRCD410030	560.00
		40 A	415 V	DSRCD440100	340.00
	100 mA	63 A	415 V	DSRCD463100	425.00
		80 A	415 V	DSRCD480100	475.00
		100 A	415 V	DSRCD4100100	560.00
	300 mA	40 A	415 V	DSRCD440300	370.00
		100 A	415 V	DSRCD4100300	560.00
		500 mA	100 A	415 V	DSRCD4100500

#### High immunity type

2P (1P+N)	30 mA	40 A	240 V	DSRCD24030AI	290.00
		63 A	240 V	DSRCD26330AI	335.00
4P (3P+N)	30 mA	40 A	415 V	DSRCD44030AI	350.00
		63 A	415 V	DSRCD46330AI	435.00

#### Selective type (40 ms delay)

2P (1P+N)	100 mA	63 A	240 V	DSRCD263100S	365.00
	300 mA	63 A	240 V	DSRCD263300S	400.00
4P (3P+N)	100 mA	63 A	415 V	DSRCD463100S	445.00
	100 A	415 V		DSRCD4100100S	610.00
	300 mA	63 A	415 V	DSRCD463300S	510.00
	100 A	415 V		DSRCD4100300S	620.00

**Notes:** 30 mA tripping characteristics:  $0.5 \times \Delta n = \text{no tripping}$ ,  $1 \times \Delta n = T \leq 300 \text{ mS}$ ,  $2 \times \Delta n = T \leq 150 \text{ mS}$ ,  $5 \times \Delta n = T \leq 40 \text{ mS}$

## Din-Safe

### Safety switches (RCCB)

- Standard AS/NZS 61008
- Approval No. N17482
- Current ratings 40, 63, 80 and 100 A
- 2 and 4 pole configuration
- Accepts Din-T side mounting accessories
- Handle sealable and padlockable

*High immunity type*



#### Type A RCD

No. poles	Trip sens.	Amp rating	Voltage	Cat. No.	Price \$
2P (1P+N)	30 mA	40 A	240 V	DSRCD24030A	265.00
		63 A	240 V	DSRCD26330A	340.00
	100 mA	80 A	240 V	DSRCD28030A	400.00
		40 A	240 V	DSRCD240100A	365.00
4P (3P+N)	100 mA	80 A	240 V	DSRCD280100A	365.00
		40 A	415 V	DSRCD44030A	375.00
	30 mA	63 A	415 V	DSRCD46330A	395.00
		100 A	415 V	DSRCD410030A	630.00
	500 mA	63 A	415 V	DSRCD463100A	445.00
		80 A	415 V	DSRCD480100A	560.00

#### Type B

4P (3P+N)	30 mA	63 A	240 V	DSRCD46330B	2780.00
	100 mA	63 A	240 V	DSRCD463100B	2780.00
	500 mA	125 A	415 V	DSRCD4125500B	2780.00
	300 mA	63 A	415 V	DSRCD463300BS <sup>1)</sup>	2780.00

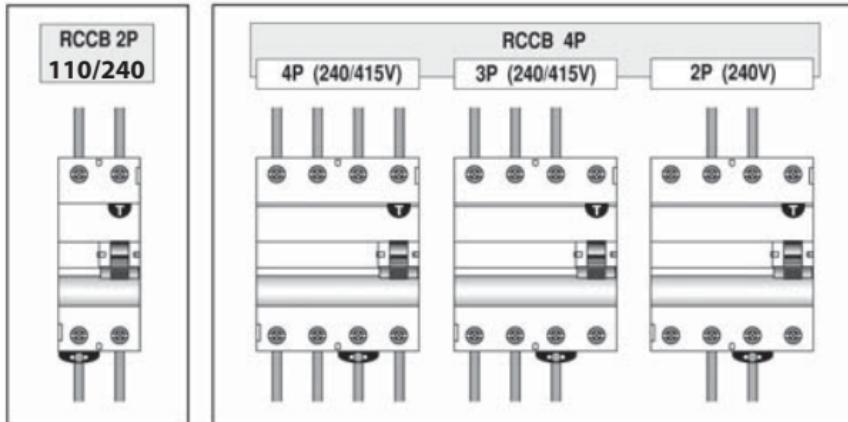
**Notes:** 1) Selective type.

30 mA tripping characteristics:  $0.5 \times \Delta n = \text{no tripping}$ ,  $1 \times \Delta n = T \leq 300 \text{ mS}$ ,  $2 \times \Delta n = T \leq 150 \text{ mS}$ ,  $5 \times \Delta n = T \leq 40 \text{ mS}$

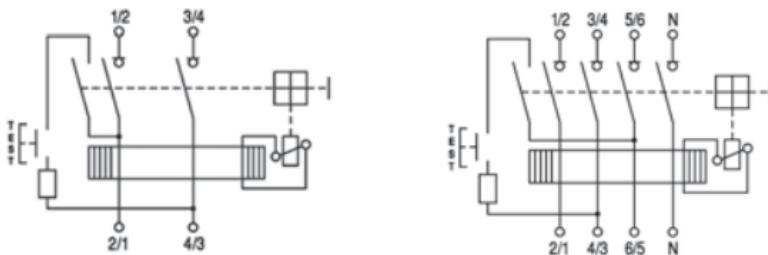
## Din-Safe

### Safety switches (RCCB)

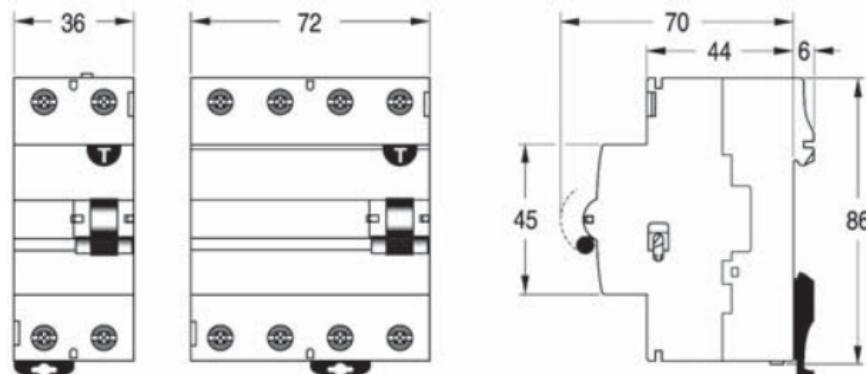
#### Connection details



#### Circuit diagrams



#### Dimensions (mm)



## Din-Safe

**Compact single pole width residual current circuit breaker (RCBO) Same dimensions as a standard MCB**

**6 kA**

- Standard AS/NZS 61009
- Approval No. NSW24576
- Current range 6 - 32 A
- C curve tripping characteristic
- Short circuit, overcurrent and earth leakage protection
- Sensitivity 30 mA
- DIN rail mounting
- Dual DIN clip
- Suits NC, CD and GB chassis
- Suitable for loadcenters and panelboards
- General purpose light and power



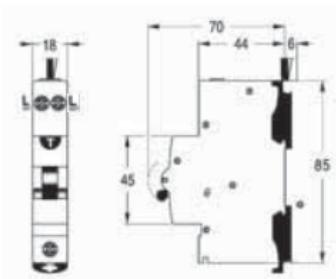
**Curve type: C (5 - 10 ln)**

Trip sens.	No. of poles	Voltage	Short circuit cap.	In (A)	Cat. No. <sup>1)</sup>	Price \$
30 mA	1 pole	240 V AC	6 kA	6	DSRCBS0630C	320.00
				10	DSRCBS1030C	320.00
				16	DSRCBS1630C	320.00
				20	DSRCBS2030C	320.00
				25	DSRCBS2530C	320.00
				32	DSRCBS3230C	320.00

**Curve type: B (3 - 5 ln)**

Trip sens.	No. of poles	Voltage	Short circuit cap.	In (A)	Cat. No. <sup>1)</sup>	Price \$
30 mA	1 pole	240 V AC	6 kA	6	DSRCBS0630B	320.00
				10	DSRCBS1030B	320.00
				16	DSRCBS1630B	320.00
				20	DSRCBS2030B	320.00
				25	DSRCBS2530B	320.00
				32	DSRCBS3230B	320.00

**Dimensions (mm)**



**Connection diagram**



**Notes:** 1) Insert 'A' at end of part number for Type A RCD e.g. DSRCBS-20-30-CA.  
Nuisance tripping may be experienced in VFD and motor starting applications, refer NHP.

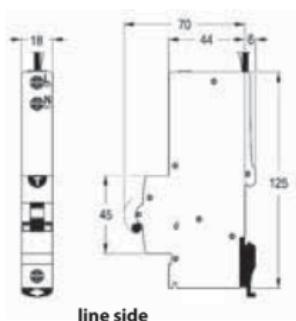
**Din-Safe****Single pole width residual current circuit breaker (RCBO)****10 kA**

- Standard AS/NZS 61009
- Approval No. N17482
- One module wide (18 mm)
- Short circuit, overcurrent and earth leakage protection
- Short circuit capacity 10 kA
- Sensitivity 10 and 30 mA
- Suits NC, CD or GB chassis
- Type 'A' RCD

*Higher immunity to harmonics*

**Curve type: C (5 – 10 In)**

Trip sens.	No. of poles	Voltage	Short circuit cap.	In (A)	Cat. No. <sup>1)</sup> <sup>2)</sup>	Price \$
30 mA	1 Pole	240 V AC	10 kA	6	DSRCBH0630A	310.00
				10	DSRCBH1030A	310.00
				16	DSRCBH1630A	310.00
				20	DSRCBH2030A	310.00
				25	DSRCBH2530A	310.00
				32	DSRCBH3230A	310.00
				40	DSRCBH4030A	310.00
				6	DSRCBH0610A	400.00
				10	DSRCBH1010A	400.00
				16	DSRCBH1610A	400.00
10 mA	1 Pole	240 V AC	10 kA	20	DSRCBH2010A	400.00
				25	DSRCBH2510A	400.00
				32	DSRCBH3210A	400.00
				40	DSRCBH4010A	400.00

**Dimensions (mm)****Connection diagram**

**Notes:** The LINE-side is the OFF or bottom of the MCB, and connects to chassis tee-offs.

<sup>1)</sup> Neutral not switched.

<sup>2)</sup> Will not accept Din-T side mounting accessories.

30 mA tripping characteristics:  $0.5 \times I_{\Delta n} = \text{no tripping}$ ,  $1 \times I_{\Delta n} = T \leq 300 \text{ mS}$

$2 \times I_{\Delta n} = T \leq 150 \text{ mS}$ ,  $5 \times I_{\Delta n} = T \leq 40 \text{ mS}$

Nuisance tripping may be experienced in VFD and motor starting applications refer NHP.

## Din-Safe MCB (RCBO)

### 10 kA MCB without Pigtail (RCBO)

- Standard AS/NZS 61009
- Approval No. N17482
- Switched neutral
- Suits 3 P+N NC or GB chassis or special CD chassis
- Suits loadcenters



Din-Safe MCB is a combined MCB/RCD providing overload, short circuit and earth leakage protection in the one integral unit.

#### Curve type: C (5 – 10 In)

#### Type AC RCD

Trip sens.	No. of poles	Voltage (AC)	Phase	In (A)	Cat. No.	Price \$
30 mA	2 Pole	110/240	1 P+N	6	DSRCB0630	275.00
				10	DSRCB1030	275.00
				16	DSRCB1630	275.00
				20	DSRCB2030	275.00
				25	DSRCB2530	275.00
				32	DSRCB3230	275.00
				40	DSRCB4030	275.00

#### Type A RCD

Trip sens.	No. of poles	Voltage (AC)	Phase	In (A)	Cat. No.	Price \$
30 mA	2 Pole	110/240	1 P+N	10	DSRCB1030A	285.00
				16	DSRCB1630A	285.00
				20	DSRCB2030A	285.00
				25	DSRCB2530A	285.00
				32	DSRCB3230A	285.00
				40	DSRCB4030A	285.00
				6	DSRCB0610A	285.00
				10	DSRCB1010A	285.00
Trip sens.	No. of poles	Voltage (AC)	Phase	In (A)	Cat. No.	Price \$
10 mA	2 Pole	110/240	1 P+N	16	DSRCB1610A	285.00
				20	DSRCB2010A	285.00
				25	DSRCB2510A	285.00
100 mA	2 Pole	110/240	1 P+N	10	DSRCB10100A	305.00
				16	DSRCB16100A	305.00
				20	DSRCB20100A	305.00

**Notes:** 30 mA tripping characteristics:  $0.5 \times I_{\Delta n} = \text{no tripping}$ ,  $1 \times I_{\Delta n} = T \leq 300 \text{ mS}$   
 $2 \times I_{\Delta n} = T \leq 150 \text{ mS}$ ,  $5 \times I_{\Delta n} = T \leq 40 \text{ mS}$

## Din-Safe MCB (RCBO)

### 10 kA MCB with Pigtail (RCBO)

- Standard AS/NZS 61009
- Approval No. N17482
- Un-switched neutral
- Suits NC, CD or GB chassis

Complete with revised terminal configuration and neutral pigtail, will fit standard Din-T 3 ph chassis.



### Curve type: C (5 – 10 In)

#### Type AC RCD

Trip sens.	No. of poles	Voltage (AC)	Phase	In (A)	Cat. No.	Price \$
30 mA 2 Pole	110/240	1P+N		6	DSRCB0630P	280.00
				10	DSRCB1030P	280.00
				16	DSRCB1630P	280.00
				20	DSRCB2030P	280.00
				25	DSRCB2530P	280.00
				32	DSRCB3230P	280.00
				40	DSRCB4030P	280.00

**Notes:** 30 mA tripping characteristics:  $0.5 \times I\Delta n = \text{no tripping}$ ,  $1 \times I\Delta n = T \leq 300 \text{ mS}$   
 $2 \times I\Delta n = T \leq 150 \text{ mS}$ ,  $5 \times I\Delta n = T \leq 40 \text{ mS}$

## Din-Safe-M

### Add-on earth leakage modules

- Standard AS/NZS 3190
- Approval No N11974
- Current ratings 32 and 63 amps
- Sensitivity  $I\Delta n$  30, 100 and 300 mA
- Suits Din-T6, 10 and 15
- Can identify trip is either earth leakage or overload/short circuit



#### Tripping characteristics

$0.5 \times I\Delta n$	no tripping
$1 \times I\Delta n$	$t \leq 300 \text{ ms}$
$5 \times I\Delta n$	$t \leq 40 \text{ ms}$

#### Din-Safe-M modules to suit Din-T6, 10 and 15

No. of poles <sup>1)</sup>	Sensitivity	MCB rating <sup>3)</sup>	Width mods. <sup>2)</sup>	Cat. No. <sup>1)</sup>	Price \$
1P+N <sup>4)</sup>	30 mA	32 A	2	DSRCM32301PN	435.00
		63 A	2	DSRCM63301PN	550.00
	100 mA	32 A	2	DSRCM321001PN	455.00
		63 A	2	DSRCM631001PN	570.00
	300 mA	32 A	2	DSRCM323001PN	510.00
		63 A	2	DSRCM633001PN	620.00
3P	30 mA	63 A	3	DSRCM63303P	590.00
	100 mA	63 A	3	DSRCM631003P	640.00
	30 mA	32 A	2	DSRCM32303PN	495.00
		63 A	3	DSRCM63303PN	580.00
3P + N	100 mA	32 A	2	DSRCM321003PN	580.00
		63 A	3	DSRCM631003PN	640.00
	300 mA	32 A	2	DSRCM323003PN	580.00
		63 A	3	DSRCM633003PN	640.00

#### Din-Safe-M space requirements

Type	Without MCB fitted neutral not switched	MCB fitted neutral not switched	MCB fitted neutral switched
1P + N 32/63 A	2 modules (36 mm)	3 modules (54 mm)	4 modules (72 mm)
3P + N 32 A	2 modules (36 mm)	5 modules (90 mm)	6 modules (108 mm)
3P + N 63 A	3 modules (54 mm)	6 modules (108 mm)	7 modules (126 mm)
3P 63 A	3 modules (54 mm)	6 modules (108 mm)	N/A

**Notes:** <sup>1)</sup> 1P+N and 3P+N type supply neutral connected by 'pigtail' cable.

<sup>2)</sup> Dimensions of Din-Safe-M unit only; add MCB width for total installed width.

<sup>3)</sup> 'MCB rating' refers to the max. MCB rating the module can be fitted to.

<sup>4)</sup> 1P + N suitable for 415 V 2P applications.  
Not suitable for Din-T10H MCBs.

## Din-Safe-M

### Modules to be combined with Din-T MCBs

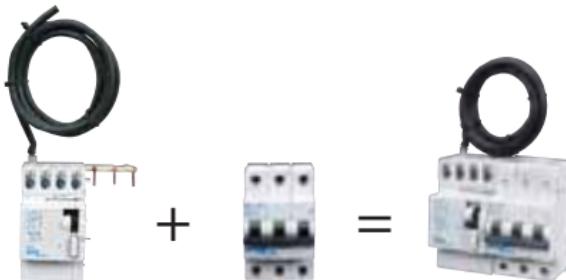
#### **Operation**

The combined Din-T MCB/Din-Safe-M earth leakage module has two operating toggles which indicate the reason for the trip action taking place.

- When an overload or short circuit occurs the Din-T MCB will operate. In this case the Din-Safe-M toggle will remain in the ON position.
- If an earth leakage fault occurs both toggles will move to the OFF position. In order to reset the MCB the Din-Safe-M unit must be reset first.
- In both instances – if the cause of the trip operation has not been rectified, a trip operation will occur as soon as the MCB is turned to the ON position. The trip free mechanism of the MCB ensures that a successful trip operation takes place even when the toggle is held in the ON position.

#### **Assembly**

- Place the MCB and Din-Safe-M unit on a flat surface. Be sure that both the MCB and the Din-Safe-M toggles are in the ON position.
- Slide the two units towards each other inserting the connecting bars or links into the MCB tunnel terminal, ensuring no undue pressure is applied to the metal tripping pin of the Din-Safe-M unit.
- Push in the connecting clips, locking the unit together.
- Check that the MCB trips when the toggle on the Din-Safe-M is moved to the OFF position.
- Tighten the busbar connections between the MCB and the Din-Safe-M and fit the insulating cover supplied.
- If the pigtail and N connections are reversed, the breaker will trip as soon as load is energised. Reset Din-Safe-M module before switching MCB 'ON'.
- In the case of a three phase 3 wire system (no neutral) use 3 phase models. 3P+N models will operate satisfactorily but test button will only function if neutral pigtail is connected.



- Din-Safe-M modules are an earth leakage module only. To complete the functional unit a Din-T6, Din-T10 or Din-T15 MCB must be added as shown.

## Din-Safe-M

### Modules to be combined with Din-T MCBs

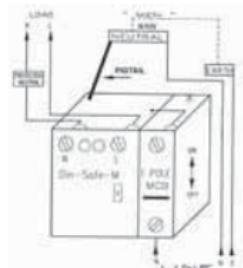
#### Testing

The MCB/Din-Safe-M combination must be connected with the line conductors to the LINE side (OFF/Bottom side) of the MCB and the load conductors connected to the Din-Safe-M terminals. The MCB/Din-Safe-M combination must be tested with the supply connected before connecting the load.

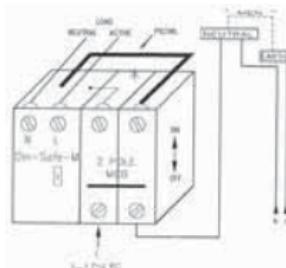
First switch the Din-Safe-M unit 'ON' then the MCB. When the test button is pressed, both handles should trip. It is recommended that the test button is operated periodically to test the detection and tripping functions of the combined unit.

- Both 1P+N and 3P+N models have a neutral pigtail connection. 3P modules have no neutral connection at all.

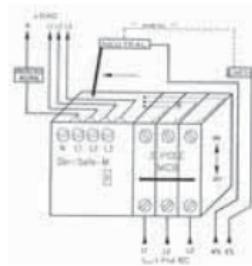
#### Din-Safe-M 1P+N with 1 pole MCB (neutral not switched)



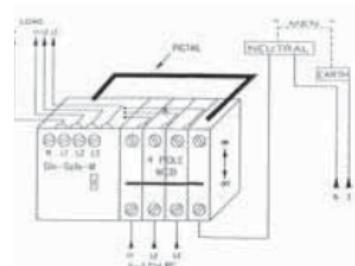
#### Din-Safe-M 1P+N with 2 pole MCB switching active and neutral



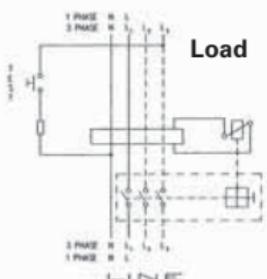
#### Din-Safe-M 3P+N with 3 pole MCB (neutral not switched)



#### Din-Safe-M 3P+N with 4 pole MCB switching active and neutral



#### Connection diagram



## Accessories

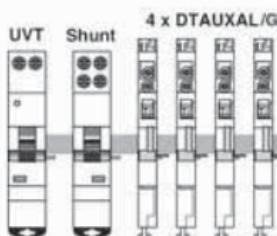
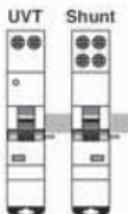
### Mounting of add-on devices onto MCBs, RCCBs and RCBOs

Type/Description	Din-T, DC, 6, 10, 15	Din-T 10H	DSRCB, DSRCD	DSRCM	DINTMS	Change -over switch
<b>DTAUXAL</b> Signal or AUX contact	L - R	-	R	R	L - R	L - R
<b>DTAUXALG</b> Signal or AUX contact, gold	L - R	-	R	R	L - R	L - R
<b>DINT10HHS</b> Signal or AUX + AUX contact	-	R	-	-	-	-
<b>DTPBS</b> Panelboard switch	L - R	-	R	-	-	-
<b>DINTSHT</b> Shunt trip	-	L	-	-	-	-
<b>DTSHT</b> Shunt trip	L - R	-	R	R	-	-
<b>DTUVT</b> Undervoltage trip	L - R	-	R	R	-	-
<b>DTMD</b> Motor operator	L - R	-	R	R	-	-

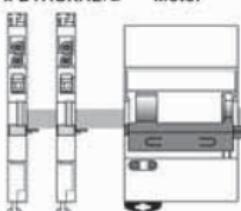
**L** = Left mounting    **R** = Right mounting

## Accessories

### Mounting on the left-hand side



2 x DTAUXAL/G      Motor



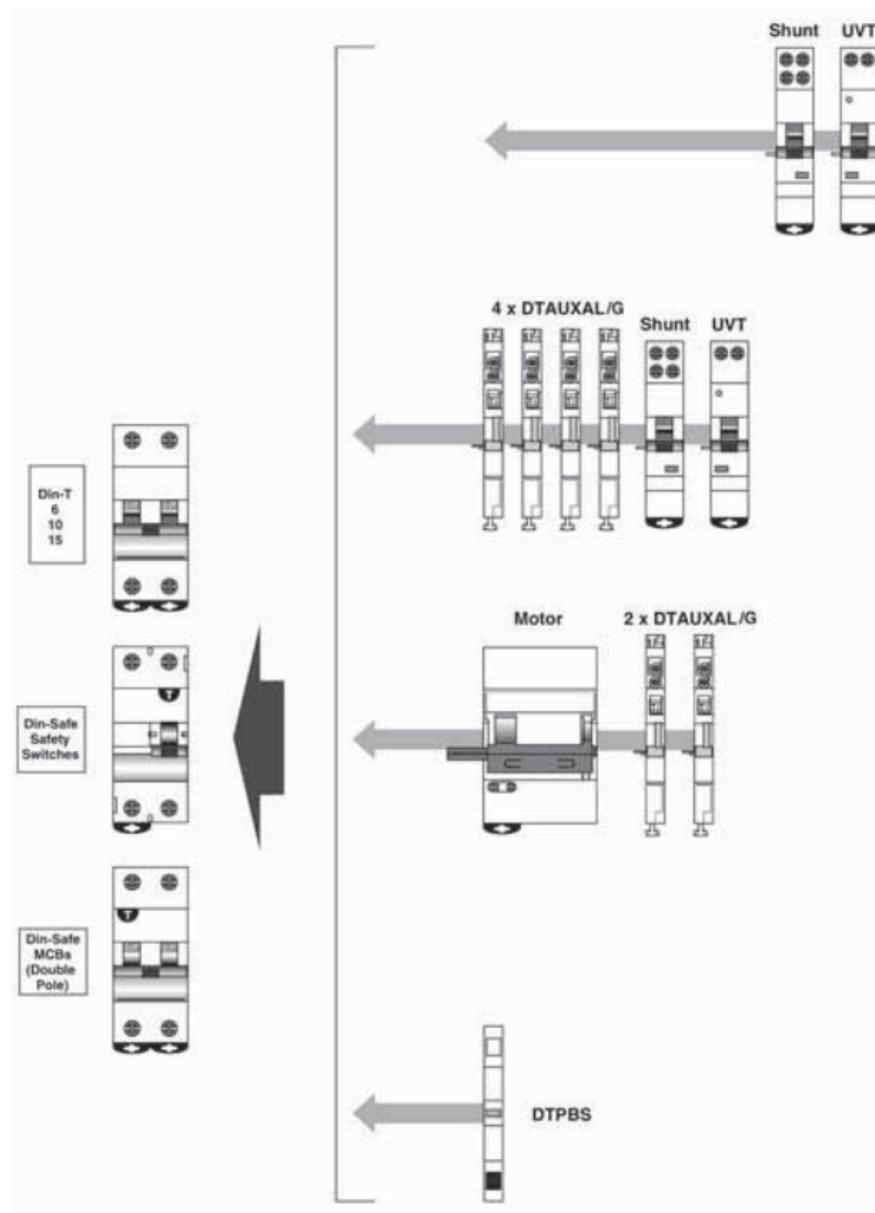
Din-T  
6  
10  
15

DTPBS

**Notes:** The above accessories will not fit to Din-T10H MCBs.  
Shunts and auxiliaries, refer to pages 1 - 39 and 1 - 40.

## Accessories

### Mounting on the right-hand side



**Notes:** DSRCBH and DSRCBS - Single pole RCD/MCB will not accept side mounted accessories.

DINTMS - Main switches will accept side mounting auxiliary contacts only.

## Din-TMS 63-100 A

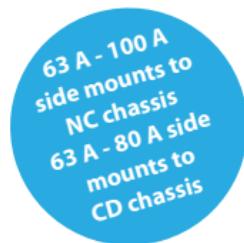
### Main switch DIN rail mount

- Standard IEC 60947-3
- Double-break contacts
- Padlockable handle
- Handle sealable in ON and OFF position
- DIN rail mount
- Suits NC, CD or GB type chassis

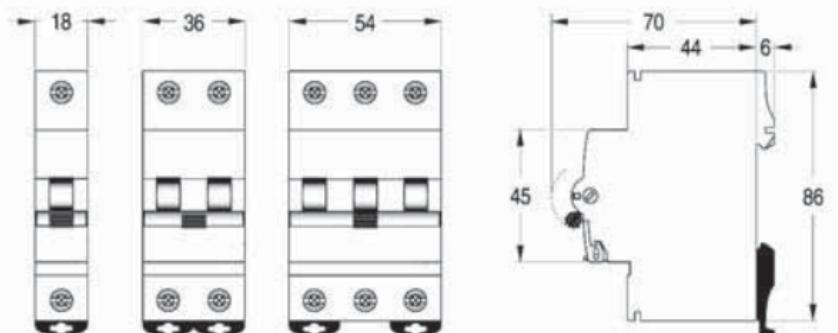


Din-T main switches have the same profile as Din-T MCBs and are suitable for use as a main switch (isolator) in loadcentres and distribution boards

No. of poles	Rated current (A)	Cat. No.	Price \$
1	63	DINTMS631	42.00
	80	DINTMS801	45.00
	100	DINTMS1001	48.00
2	63	DINTMS632	56.00
	80	DINTMS802	67.00
	100	DINTMS1002	75.00
3	63	DINTMS633	86.50
	80	DINTMS803	102.00
	100	DINTMS1003	115.00



#### Dimensions (mm)



**Notes:** AUX/ALM switch, refer to page 1 - 40.

The LINE-side is the OFF or bottom of the isolator, and connects to NC or CD chassis tee-offs.

## Din-T

### Shunt and undervoltage trip



DTSHT 110415V

#### Din-T shunt trip

- Couples to left or right side of MCB
- Modular width – 18 mm
- Busbar cavity both ends
- Field assembly
- Continuously rated
- Terminals for remote indication

#### Operation

The shunt trip makes it possible to remotely switch the MCB by energising C1 & C2 terminals of the shunt trip.

#### Shunt trip - Din-T6, 10 & 15

Rated voltage	Current rating	Operating time (ms)	Cat. No.	Price \$
110 to 415 V AC 110 to 125 V DC	110 V - 0.3 A	10	DTSHT110415V	158.00
	240 V - 0.6 A	4		
	415 V - 1.0 A	2		
24 to 60 V AC 24 to 48 V DC	24 V - 1.0 A	10	DTSHT2460V	158.00
	48 V - 2.0 A	4		

#### Shunt trip - Din-T 10H

Rated voltage	Current rating	Operating time (ms)	Cat. No. <sup>1)</sup>	Price \$
110 to 415 V AC 110 to 125 V DC	110 V - 0.3 A	10	DINTSHT110415U	164.00
	240 V - 0.6 A	4		
	415 V - 1.0 A	2		
24 to 60 V AC 24 to 48 V DC	24 V - 1.0 A	10	DINTSHT2460U	164.00
	48 V - 2.0 A	4		

#### Din-T undervoltage trip <sup>2)</sup>

- Couples to left or right side of MCB
- Modular width – 18 mm
- Busbar cavity both ends
- Field assembly

The Din-T UVT trips the MCB when the operating voltage threshold is lower than  $0.5 \times Un$ . Adjustable time delay up to 300 ms eliminates nuisance tripping.



DTUVT240VAC

Rated voltage	Cat. No.	Price \$
230 V AC	DTUVT240VAC	171.00
12 V AC/DC	DTUVT12VDC	171.00
24 V AC/DC	DTUVT24VDC	171.00

Power loss 3 VA

**Notes:** <sup>1)</sup> Shunt fits to left side of Din-T10H MCBS only.

<sup>2)</sup> UVT does not suit Din-T10H MCBS.

## Din-T

### Auxiliary contacts for MCBs

- Suitable for Din-T 6, 10 & 15
- Suitable for 2P RCBO and 2P & 4P RCCB <sup>1)</sup><sup>3)</sup>
- Stack up to 4 units left or right side <sup>2)</sup>
- Field fittable, includes all fitting accessories
- Includes busbar cavity for chassis mounting
- Changeover contact
- Current rating 5 A



DTAUXAL

#### Din-T auxiliary contact - Din-T 6, 10, 15, DSRCBH, DSRCB

Contact function	Contact material	Module width	Cat. No.	Price \$
H or S	Silver	0.5	DTAUXAL	102.00
H or S	Gold	0.5	DTAUXALG	123.00

'H' = auxiliary switch    'S' = alarm switch

#### Din-T auxiliary contact – Din-T10H

Contact function	Contact material	Module width	Cat. No.	Price \$
H+H/S	Silver	0.5	DINT10H - HS <sup>2)</sup>	114.00

#### Din-T auxiliary contact - DSRCBS

Contact function	Contact material	Module width	Cat. No. <sup>3)</sup>	Price \$
H	Silver	0.5	DSRCBSAX	102.00
H or S	Silver	0.5	DSRCBSAXAL	114.00
H or S	Gold	0.5	DSRCBSAXALG	125.00

- Notes:**
- 1) DTAUXAL type contact fits right side only on 2P RCBO and 2/4P RCCB.
  - 2) Auxiliary contacts for Din-T10H MCBs are not stackable and fit to right side only.
  - 3) Fit right hand side only.

## Din-T Motor operator for MCBS

### Din-T motor operator DTMD

- Suitable for Din-T 6, 10 & 15
- Suitable for 2P RCBO and 2P & 4P RCCB
- Field fittable, includes all fitting accessories
- Fits left or right side of device
- Padlockable in the OFF position
- Manual operation is possible



DTMD240VAC

Rated voltage	Module width	Cat. No.	Price \$
240 V AC	3	DTMD240VAC	660.00

### Technical

Rated voltage Un	240 V AC
Impulse to switch ON/OFF	>50 ms
Closing time	500 ms
Opening time	200 ms
Electrical endurance	10,000 ops
Terminal capacity	2.5 mm <sup>2</sup>
Weight	380 g

**Notes:** DTMD240VAC fits right side only on 2P RCBO and 2/4P RCCB.  
DTMD240VAC is not suitable for use with Din-T10H MCBS.

## DIN mount housing to suit 22.5 mm devices

- DIN rail mount
- Mounts 22.5 mm panelmount devices
- Suitable for loadcentres and panelboards



Holder is DIN rail mounted, and is designed to allow mounting of 22.5 mm panelmount devices in loadcentres and Concept family of panelboards. Ideal for mounting pilot lights, pushbuttons and key selector switches.

Description	Cat. No.	Price \$
Holder DIN profile suit 22.5 mm devices	M22IVS	23.40

### Panelboard switch (DTPBS)

The panelboard switch coupled to a main device is intended to switch off any 2 - 63 A MCB in case the front cover of the enclosure is removed. It is a mechanical safety device, which reduces the risk of electric shock in case of manipulation of the panelboard.

The panelboard switch can easily be coupled either to the right or left-hand side of the main device, according to the instructions below.

No. modules wide <sup>1)</sup>	Cat. No.	Price \$
0.5	DTPBS	59.00

### Kilowatt hour meters

- 8 Digit LCD
- Displays - Total active energy
  - Total reactive energy
  - Partial active energy
  - Partial reactive energy
  - Power demand
  - Maximum demand (power)
- Active energy: Class 1
- Input current 1 A or 5 A CT



CE4DTO4A2

No. modules wide <sup>1)</sup>	Cat. No. <sup>2)</sup>	Price \$
KWH meter DIN 4 module	CE4DT 14A2	560.00
KWH meter DIN 4 module (CUMMS)	CE4DT 14A6	640.00

**Notes:** <sup>1)</sup> 'DTSP' - 0.5 module width spacer available if required when DTPBS used.  
<sup>2)</sup> CE4DT Price Schedule 'Y8'.

## Busbar comb Din-T MCBS



### Current rating 100 A

#### Pin type busbars

No. of poles	1 Phase <sup>1)</sup> Cat. No.	Price \$	3 Phase Cat. No.	Price \$
8 Way	IBC108P	10.60	—	
12 Way	IBC112P	17.80	ICL123	49.00
15 Way	IBC115P	21.20	ICL153	61.00
18 Way	IBC118P	29.60	ICL183	72.50
21 Way	IBC121P	36.00	ICL213	94.50
55 Way	IBC155P	77.50	—	
57 Way	—		ICL573	225.00

#### Pin type busbar

Pin type busbar	Cat. No.	Price \$
1P+N 56 Way pin type busbar comb	ICL562	128.00
1P+N 6 Way pin type busbar comb	ICL62	18.20
1P+N 10 Way pin type busbar comb	ICL102	26.00
3P+Aux 56 Way pin type busbar comb	ICL563A <sup>2)</sup>	200.00
3P+N 56 Way pin type busbar comb	ICL564	255.00



#### Fork type busbar

Fork type busbar	Cat. No.	Price \$
56 Way 1 phase fork type busbar comb	ICL561F	78.00
57 Way 3 phase fork type busbar comb	ICL573F	230.00

#### End caps

End caps	Cat. No.	Price \$
1P end cap to suit IBC style buscomb	IBCEC1	2.00
2P and 3P end cap to suit ICL style buscomb	ICLEC23 <sup>3)</sup>	4.00
3P+N end cap to suit ICL style buscomb	ICLEC4 <sup>3)</sup>	4.00



ICL123

ICLTOC  
T-off cap (strip of 5)

ICL573F

**Notes:** <sup>1)</sup> IBC busbar combs come complete with endcaps.

<sup>2)</sup> 16 x 3 MCB connections and 16 x 9 mm spaces (AUXs).

<sup>3)</sup> ICL end caps do not suit IBC busbar combs.

## Din-T

### Modular changeover switch



- Standard IEC 60669 - 1
- Handle sealable and lockable in ON or OFF position
- Terminal protection IP 20
- Captive terminal screws with cross head

#### Without OFF I - II

In (A)	No. of Poles	No. of Modules	Connection	Cat. No.	Price \$
32	1	1		DTCS3212	47.50
32	2	1		DTCS3222	71.50

#### With OFF I - O - II

In (A)	No. of Poles	No. of Modules	Connection	Cat. No.	Price \$
32	1	1		DTCS3213	59.00
32	2	1		DTCS3223	83.00

## Din-T

### Pushbuttons and pilot lights

- Modular size
- DIN rail mounting
- Terminal protection IP 20
- Contacts, 16 A @ 250 V AC



Description	No. of Poles	No. of Modules	Contacts	Cat. No.	Price \$
Pushbutton	2	1	N/O + N/C	DTPB11	35.50
Pushbutton illuminated	1	1	N/O	DTPB10L <sup>1)</sup>	54.00
Pilot light base 1		1		DTPLB <sup>2)</sup>	25.40
Lamp 240 V neon	-	-		DTPLL240	3.60
Lamp 24 V (filament)	-	-		DTPLL24	3.60
Lens red	-	-		DTLLRD	3.30
Lens green	-	-		DTLLGR	3.30
Lens orange	-	-		DTLLOR	3.30
Lens clear	-	-		DTLLCL	3.30

**Notes:** <sup>1)</sup> Order lens separately. 240 V lamp built-in and cannot be changed.  
<sup>2)</sup> Order lens and lamp separately.

# MCB LOCKING SOLUTIONS

## - LockDIN™

The miniature circuit breaker locking solution for NHP DIN-T circuit breakers.



PP-LOCKDIN-MCB-CPB

The first comprehensive system for safe and secure locking of DIN miniature circuit breakers (MCBs)

- Designed specifically for the mining industry
- Easy to install and retrofit to existing Concept-Premier and Concept-TOUGH panelboards
- Can be used with DINsafe RCBOs
- Accepts 2.5 - 6.5 mm padlocks, hasps and scissor arrangements
- Can only be used with the NHP DIN-T range
- Can be used with 1, 2 and 3 pole DIN-T MCBs



## LOCK DIN™

Din-T lockdogs provide a captive locking attachment for Din-T MCBs and RCDs.

The system is designed to be used in conjunction with Concept Premier and Concept Tough Panelboards. If a switchboard is being specifically designed to accommodate the new LOCK DIN™, then extra depth is required between escutcheon and door to accommodate the padlocks being used on site.

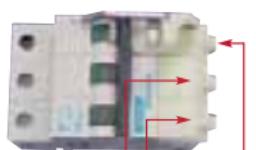
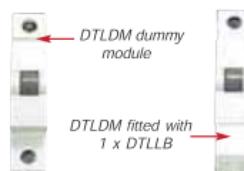
The LOCK DIN™ is designed to be clipped onto the line side of the MCB. This requires the line terminal screw to be tightened before installation. The escutcheon cut out needs to be increased by 16 mm over the line terminal to allow for the extended profile of the MCB with the LOCK DIN™ fitted.



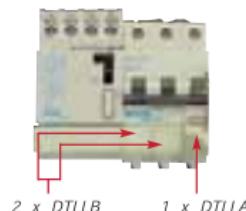
DTLLA



DTLLB

MCB in ON Position.  
Non lockable.2 x DTLLB for a 3 pole MCB  
The use of 1 x DTLLAMCB in OFF Position.  
Can be locked.DTLDM dummy module  
DTLDM fitted with 1 x DTLLB

1 x DTLCM



2 x DTLLB

1 x DTLLA

**LOCK DIN™**

1

Description	Cat. No.	Price \$
<b>Locking devices</b>		
LH locking assembly for MCBs and single pole RCBOs	<b>DTLLA</b>	<b>51.00</b>
RH locking assembly for MCBs and single pole RCBOs	<b>DTLLARH</b>	<b>51.00</b>
LH locking assembly for 2 pole RCBOs	<b>DTLLAB</b>	<b>51.00</b>
RH locking assembly for 2 pole RCBOs	<b>DTLLABRH</b>	<b>51.00</b>
Locking assembly for DINT-10H MCB	<b>DTLLA10H</b>	<b>61.00</b>
12 pack LH locking assembly for MCBs and single pole RCBOs	<b>DTLLABULK</b>	<b>570.00</b>
12 pack RH locking assembly for MCBs and single pole RCBOs	<b>DTLLARHBULK</b>	<b>570.00</b>
<b>Pole fillers and blanking devices</b>		
12 pack locking blank for MCBs and single pole RCBOs	<b>DTLLB</b>	<b>12.00</b>
Locking blank for DSRCM (add on RCCB), 3 pole MCBs	<b>DTLCM</b>	<b>4.70</b>
Dummy MCB (for total touch protection)	<b>DTLDM</b>	<b>12.00</b>
12 pack pole filler (extended length to suit 63 mm cutout)	<b>DTLPF</b>	<b>12.00</b>
<b>Escutcheons and labels</b>		
Concept premier escutcheon size 1 24 way to suit LockDIN	<b>CPPES100DTL</b>	<b>210.00</b>
Concept premier escutcheon size 2 48 way to suit LockDIN	<b>CPPES200DTL</b>	<b>250.00</b>
Concept premier escutcheon size 3 60 way to suit LockDIN	<b>CPPES300DTL</b>	<b>290.00</b>
Concept premier escutcheon size 4 84 way to suit LockDIN	<b>CPPES400DTL</b>	<b>330.00</b>
Concept premier escutcheon size 5 96 way to suit LockDIN	<b>CPPES500DTL</b>	<b>375.00</b>
Concept tough escutcheon size 2 48 way to suit LockDIN	<b>CTES248RDCOLD</b>	<b>570.00</b>
Concept tough escutcheon size 3 96 way to suit LockDIN	<b>CTES396RDCOLD</b>	<b>670.00</b>
Centre escutcheon label 1 - 48	<b>LABLE148DT</b>	<b>22.80</b>
Centre escutcheon label 49 - 96	<b>LABLE4996DT</b>	<b>22.80</b>



NHP LOCK DIN™



NHP LOCK DIN™

## Meter Isolator LOCK DIN™

The Lockable Meter Isolator from NHP utilises the captive locking system known as LOCK DIN™. LOCK DIN™ has been designed for safe and secure captive locking of Terasaki DIN-T MCBs. When you combine LOCK DIN™ with a sealable enclosure and Terasaki MCB you have a complete system suitable for meter isolation and supply capacity/ service protection. <sup>1)</sup>

### DTPC Complete kits include: enclosure, MCB and LOCK DIN™

No. of poles	Amps	kA	Curve	Cat. No.	Price \$
<b>Enclosure type - DTPC (2 pole)</b>					
1 pole	63 kA	6 A	C	DTPC2LDCB	109.00
			D	DTPC2LDCBV	109.00
<b>Enclosure type - DTPC (4 pole)</b>					
3 pole	63 kA	6 kA	C	DTPC4LDCB	250.00
		10 kA	D	DTPC4LDCBV	540.00

### ILC Complete kits include: enclosure, MCB and LOCK DIN™

No. of poles	Amps	kA	Curve	Cat. No.	Price \$
<b>Enclosure type - ILC (4 pole)</b>					
1 pole	63 kA	6 A	C	ILC4SLDCB1P	156.00
			D	ILC4SLDCB1PD	161.00
3 pole	80-125 A	10 kA	C	ILC4SLDCB_1P <sup>2)</sup>	365.00
			D	ILC4SLDCB_1PD <sup>2)</sup>	440.00
3 pole	63 A	6 kA	C	ILC4SLDCB3P	290.00
		10 kA	D	ILC4SLDCB3PD	300.00
3 pole	80-125 A	10 kA	C	ILC4SLDCB_3P <sup>2)</sup>	950.00
			D	ILC4SLDCB_3PD <sup>2)</sup>	1020.00



**Notes:** <sup>1)</sup> As the service and installations rules vary from region to region please consult these to check suitability.

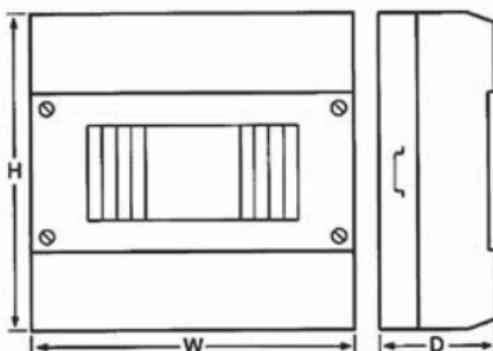
<sup>2)</sup> Insert 80, 100 or 125 for required amp rating.

## Meter Isolator LOCK DIN™

**Enclosures only, to suit meter isolator**

To suit	Enclosure type	Cat. No.	Price \$
1 P MCB <63 A	DTPC (2 pole)	<b>DTPC2LD</b>	<b>19.20</b>
1-3 P MCB <63 A	DTPC (4 pole)	<b>DTPC4LD</b>	<b>23.40</b>
1-3 P MCB <63 A	ILC (4 pole)	<b>ILC4SLD</b>	<b>71.50</b>
1-3 P MCB 80-125 A	ILC (4 pole)	<b>ILC4SLD10H</b>	<b>77.00</b>
2 P RCBO 6-40 A	DTPC (2 pole)	<b>DTPC2LDRCBO</b>	<b>19.80</b>

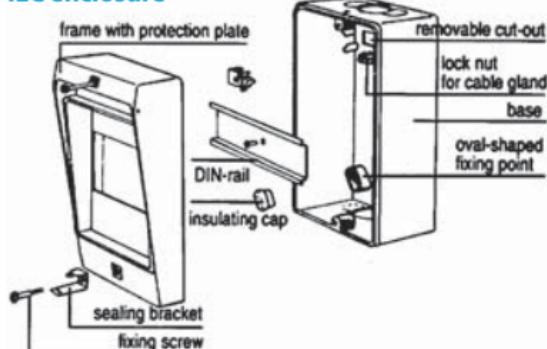
### DTPC enclosure



### Dimensions (mm)

No. of poles	Height	Width	Depth
2 pole	139	51	61
4 pole	139	88	61

### ILC enclosure



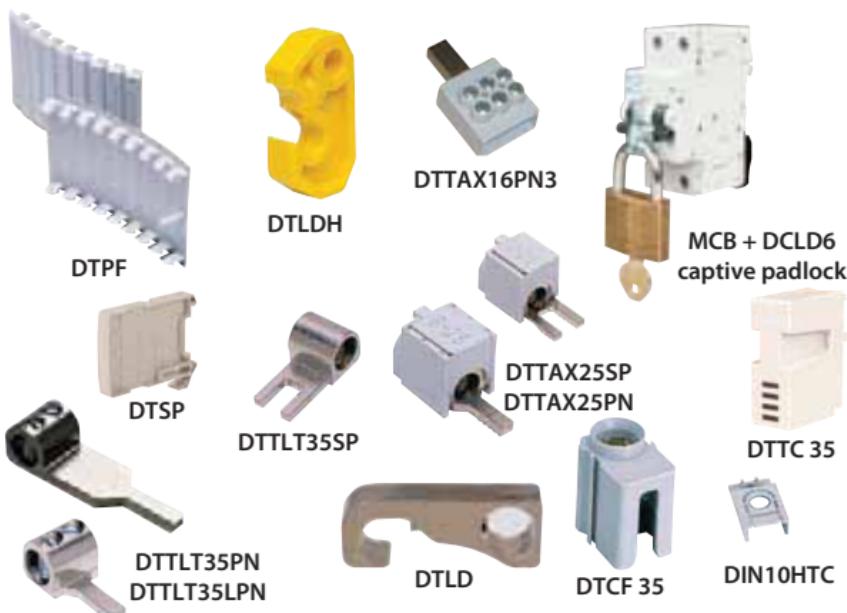
### Dimensions (mm)

No. of poles	Height	Width	Depth
4 pole	175	90	100

## Din-T series MCBs

### Accessories

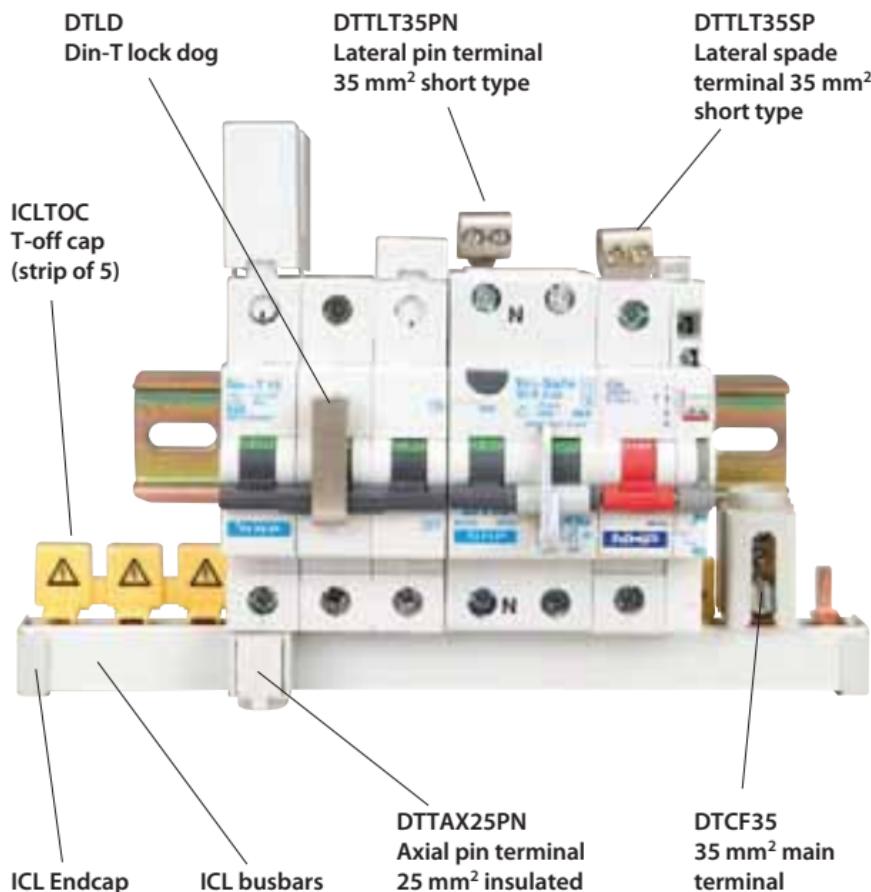
Description	Cat. No.	Price \$
Lateral pin terminal 35 mm <sup>2</sup> (short type)	DTTLT35PN	10.80
Lateral pin terminal 35 mm <sup>2</sup> (long type)	DTTLT35LPN	10.80
Din-T lock dog (Non-captive)	DTLD	23.00
Din-T lock dog captive (LOCK DIN) Refer page 1 - 46	-	
Din-T lock dog captive (1 - 4 pole) <sup>1)</sup>	DCLD6	57.00
Din-T lock dog to suit DINT10H	DTLDH	30.50
Lateral spade terminal 35 mm <sup>2</sup> (short type)	DTTLT35SP	10.80
Axial spade terminal 25 mm <sup>2</sup> (insulated)	DTTAX25SP	10.80
Axial pin terminal 25 mm <sup>2</sup> (insulated)	DTTAX25PN	10.80
Axial pin terminal 50 mm <sup>2</sup> (insulated)	DTTAX50PN	18.20
3 way neutral link suit RCCB	DTTAX16PN3	19.40
35 mm <sup>2</sup> main terminal	DTCF35	17.60
185 mm <sup>2</sup> main terminal	NEB185	88.00
Pole filler (1 strip of 4 poles, 8 x 9 mm segments)	DTPF	4.30
Busbar comb Refer page 1 - 43	-	
End cap (strip offs) (T-off cap)	ICLTOC	4.60
1/2 module spacer (9 mm wide)	DTSP	4.40
Din-T terminal cover 5 mm	DTTC5	4.70
Din-T terminal cover 35 mm	DTTC35	16.60
Din-T 10H terminal cover	DINT10HTC	5.40
Din-T 1P RCBO terminal cover	DSRCBHTC	7.50



**Notes:** 1) Suitable for padlock hasp size 4.5 to 6.5 mm.

## Din-T series MCBs

### Accessories



## Din-T Series contactors

- Standard AS/NZS 60947.4.1
- Voltage 240/415 V AC
- Silent operated magnetic drive
- Integrated surge suppression
- Switch position indicator
- DIN rail mount



### Application

Din-T contactors are electromagnetically controlled switches used to control single or multiphase high power loads while the control itself can be low power. Applications include switching and control of lighting equipment, heating, ventilation, pumps, heat pumps and other equipment.

### Features

Except for the 20 A version, all Din-T contactors have DC coils, resulting in noise-free silent operation. As all DC coil contactors have an internal diode rectifier bridge they can be operated by both DC and AC power supplies. The built-in varistor protects the coil against an overvoltage of up to 5 kV. The switch position of contacts is visible via a flag indicator on the front of the contactor.

Current I <sub>th</sub>	Contact config.	Coil volts	No. of Mods.	Cat. No.	Price \$
20 A	1 NO / 1 NC	240 V AC	1	DTC2011240	151.00
20 A	2 N/O	24 V AC	1	DTC202024	151.00
20 A	2 N/O	240 V AC	1	DTC2020240	151.00
20 A	2 N/C	240 V AC	1	DTC2002240	151.00
24 A	4 N/O	12 V AC/DC	2	DTC244012	175.00
24 A	4 N/O	240 V AC/DC	2	DTC2440240	175.00
24 A	4 N/C	240 V AC/DC	2	DTC2404240	175.00
24 A	4 N/O	24 V AC/DC	2	DTC244024	175.00
40 A	4 N/O	24 V AC/DC	3	DTC404024	310.00
40 A	4 N/O	240 V AC/DC	3	DTC4040240	310.00
63 A	4 N/O	24 V AC/DC	3	DTC634024	430.00
63 A	4 N/O	240 V AC/DC	3	DTC6340240	430.00

### Din-T hour run counter

- DIN rail mounting
- Synchronous motor drive
- 99,999.99 hours
- Permanent visual display non-resettable
- Protection IP 20



No. Modules	Voltage	Cat. No. <sup>1)</sup>	Price \$
2	230 V AC	DTHR	131.00

**Notes:** <sup>1)</sup> Cannot be reset.

## Din-T Series contactors

1

**Technical data**

Type	DTC20	DTC24	DTC40	DTC63
Rated continuous current $I_{th}$	20 A	24 A	40 A	63 A
<b>AC 1/AC 7a switching of heaters</b>				
Rated operational current $I_e$ <sup>1)</sup>	20 A	24 A	40 A	63 A
Rated output AC 1 240 V 1ø 415 V 3ø	4 kW	5.3 kW	8.7 kW	13.3 kW
	—	16.0 kW	26.0 kW	—
<b>AC 3/AC 7b switching of motors</b>				
Rated operational current $I_e$ <sup>1)</sup>	9 A	9 A	22 A	30 A
Rated output AC 3 240 V 1ø 415 V 3ø	1.3 kW	1.3 kW	3.7 kW	5.0 kW
	—	4.0 kW	11.0 kW	15.0 kW
<b>AC 5a switching of electric discharge lamp controls <sup>2)</sup> (uncompensated)</b>				
Rated operational current $I_e$ <sup>1)</sup>	8 A	10 A	30 A	44 A
<b>AC 5b switching of incandescent lamps <sup>2)</sup></b>				
Rated operational current $I_e$ <sup>1)</sup>	6 A	7 A	15 A	22 A
<b>Switching on capacity</b>				
$\cos\phi = 0.95$ at 220-230 V 1 phase	100 A	—	—	—
$\cos\phi = 0.65$ at 380-400 V 3 phase	—	90 A	220 A	300 A
Ohmic loss per contact $I_n$	1.0 W	1.5 W	3.0 W	6.0 W
<b>Endurance and mechanical switching</b>				
Max. switching frequency at AC 1/AC 7a	300 h	300 h	300 h	300 h
Max. switching frequency at AC 3/AC 7b	600 h	600 h	600 h	600 h
Mechanical service life	106	106	106	106
Electrical service life at AC 1/AC 7a	150,000	150,000	150,000	150,000
Electrical service life at AC 3/AC 7b	150,000	500,000	170,000	240,000
Terminal capacity max.	1x10 mm <sup>2</sup>	2x4 mm <sup>2</sup>	1x25 mm <sup>2</sup>	2x10 mm <sup>2</sup>
<b>Magnetic control system</b>				
Control voltage range	85...110 % x Un			
Rated operating frequency	50 / 60 Hz		DC, 40...450 Hz	
Operating temperature range	-22 °C to +55 °C <sup>3)</sup>			
Max. pull-in coil power loss	8 VA/5 W	4 VA/4 W	5 VA/5 W	65 VA/65 W
Max. holding coil power loss	3.2 VA/1.2 W	4 VA/4 W	5 VA/5 W	4.2 VA/4.2 W
Switching on delay	9...12 ms	<40 ms	<40 ms	<40 ms
Switching off delay	10...12 ms	<40 ms	<40 ms	<40 ms
Terminal capacity max.	1 x 4 mm <sup>2</sup> or 2 x 2.5 mm <sup>2</sup>			

**Notes:** <sup>1)</sup> When parallel switching 2 current paths the rated current  $I_e$  will be multiplied by 1.6.

<sup>2)</sup> For additional lamp switching data refer to NHP.

<sup>3)</sup> If several contactors are mounted side by side in a row fit a half-module spacer (Cat. No. DTSP) between every second contactor.

## Din Series contactors

- Standard AS/NZS 60947.4.1
- Voltage 240/415 V AC
- Switch position indicator
- DIN rail mount



### Application

Din contactors are electromagnetically controlled switches used to control single or multiphase high power loads while the control itself can be low power. Applications include switching and control of lighting equipment, heating, ventilation, pumps, heat pumps and other equipment.

Current I <sub>th</sub>	Contact config.	Coil volts	No. of Mods.	Cat. No.	Price \$
20 A	2 N/O	24 V AC	1	DTC202024L	78.00
20 A	2 N/O	240 V AC	1	DTC2020240L	78.00
25 A	4 N/O	12 V AC/DC	2	DTC254012L	98.50
25 A	4 N/O	240 V AC/DC	2	DTC2540240L	98.50
25 A	4 N/C	240 V AC/DC	2	DTC2504240L	98.50
40 A	4 N/O	240 V AC/DC	3	DTC4040240L	235.00
63 A	4 N/O	240 V AC/DC	3	DTC6340240L	260.00

### Technical data

Type	DTC20...L	DTC25...L	DTC40...L	DTC63...L
Rated continuous current I <sub>th</sub>	20 A	25 A	40 A	63 A
<b>AC 1/AC 7a switching of heaters</b>				
Rated operational current I <sub>e</sub>	20 A	25 A	40 A	63 A
Rated output kW	4	5.4	8.4	13
<b>AC 7b</b>				
Rated operational current I <sub>e</sub>	7 A	8.5 A	15 A	25 A
Rated output kW	1.2	1.5	2.4	3.8
<b>Switching on capacity (A)</b>				
AC 1/7a cos Ø 0.8 Ue 1.05	30	37.5	60	94.5
AC 7b cos Ø 0.45 Ue 1.05	160	200	320	504
<b>Performance</b>				
AC 1/7a cos Ø 0.8 Ue 1.05	20	25	40	63
AC 7b cos Ø 0.45 Ue 0.17	4	5.4	8.4	13
<b>General</b>				
Terminal capacity mm <sup>2</sup>	6	10	25	25
Control voltage range 85 - 110% x Un				
Frequency 50 Hz				
Rated insulation voltage 500 V				
Pick up time 50 mS				
Mechanical life >3x10 <sup>4</sup>				
Electrical life >1x10 <sup>5</sup>				

## Din-T Impulse switch



### Din-T impulse switch

- Standard IEC 60669-2-2
- Visual indication of contact position
- Manual or electrical operation
- Terminal protection IP 20
- 16 A 240 V AC contact rating

### Function

Impulse switches are electromechanical switches used to control medium power loads while the control itself remains low power. The device switches between 2 stable positions each time a brief pulse is required to switch positions. The device can also be switched manually.

Diagram	Coil Voltage	No. of poles	No. of mods.	In	Cat. No. <sup>1)</sup>	Price \$
	12 V AC	1	1	16 A	DTIS1012VAC	66.00
	24 V AC	1	1	16 A	DTIS1024VAC	66.00
	48 V AC	1	1	16 A	DTIS1048VAC	66.00
	240 V AC	1	1	16 A	DTIS10240VAC	66.00
	12 V DC	1	1	16 A	DTIS1012VDC	66.00
	24 V DC	1	1	16 A	DTIS1024VDC	66.00
	12 V AC	2	1	16 A	DTIS2012VAC	96.00
	24 V AC	2	1	16 A	DTIS2024VAC	96.00
	48 V AC	2	1	16 A	DTIS2048VAC	96.00
	240 V AC	2	1	16 A	DTIS20240VAC	96.00
	12 V DC	2	1	16 A	DTIS2012VDC	96.00
	24 V DC	2	1	16 A	DTIS2024VDC	96.00
	12 V AC	2	1	32 A	DTIS123212VDC	187.00
	12 V AC	2	1	16 A	DTIS1112VAC	96.00
	24 V AC	2	1	16 A	DTIS1124VAC	96.00
	48 V AC	2	1	16 A	DTIS1148VAC	96.00
	240 V AC	2	1	16 A	DTIS11240VAC	96.00
	12 V DC	2	1	16 A	DTIS1112VDC	96.00
	24 V DC	2	1	16 A	DTIS1124VDC	96.00
	12 V DC	2	1	32 A	DTIS113212VDC	187.00

### Add on power contact<sup>2)</sup>

Diagram	Coil Voltage	No. of poles	No. of mods.	In	Cat. No. <sup>1)</sup>	Price \$
		2	1	16 A	DTIS2NO	83.00
		2	1	16 A	DTIS2CO	83.00
		2	1	32 A	DTIS132PWR	187.00

- Notes:**
- 1) When stacking in rows ensure adequate ventilation, insert spacer (DTSP) every second device.
  - 2) Only suitable for 32 A DTIS. 32 A unit available - refer NHP.

## Sprecher + Schuh CA 8 contactors

1

### Features

- Ideally suited for heating, lighting, hot water and storage heating applications
- Small size (2.5 pole width), panel or DIN rail mounting
- Contactors can be mechanically interlocked
- Large range of snap-on accessories <sup>1)</sup>
- Conforms to AS/NZS 60947 with world-wide approvals



Contactor CA 8-5

### Maximum current ratings (amps) at 415 volts

Cat. No. <sup>1)</sup>	CA 8-5-10_AC <sup>2)</sup>			CA 8-9-10_AC <sup>2)</sup> [CA 8-12-10_AC <sup>2)</sup> ]			4-POLE CA 8-9-M40_AC	
Price \$ <sup>3)</sup>	99.50			113.00 [137.00]			143.00	
<b>Heating loads AC 1</b>		2 Pole Parallel	3 Pole Parallel		2 Pole Parallel	3 Pole Parallel		4 Pole Parallel
Amps per phase 40 °C (A)	20	34	50	20	34	50	20	64
Amps per phase 60 °C (A)	16	27	40	16	27	40	16	51
<b>Lighting loads</b>								
Tungsten per phase (A)	4	-	-	7	-	-	7	-
Fluorescent 40 °C (A)	18	30	45	18	30	45	18	57
Fluorescent 60 °C (A)	14.5	24	35	14.5	24	35	14.5	45
<b>Motor loads</b>								
Amps 415 volt AC 3		5.3			9.0 [12]			9.0
kW @ 60 °C		2.6			4.5 [6.1]			4.5

### Emergency lighting test unit

	Cat. No.	Price \$
Standard switch operated emergency lighting test unit	ELTS <sup>4)</sup>	235.00
Key operated emergency lighting test unit	ELTK <sup>4)</sup>	250.00



ELTS



ELTK

**Notes:** <sup>1)</sup> For further information refer to Part A Section 1 Price List Catalogue.

<sup>2)</sup> Supplied with 1 N/O auxiliary contact. For 1 N/C auxiliary contact specify 01 instead of 10 when ordering.

<sup>3)</sup> Price is for standard AC coil voltage. Specify voltage when ordering

<sup>4)</sup> Cat. No. ELTS and ELTK use Price Schedule 'A4'

## DIN rail mounted surge diverters - Electrical network

1

### Features:

- Compact size
- Status indication (via flag)
- DIN rail mounting
- Thermal disconnection
- Remote indication (via volt free contact)



PSC series



PSM series

### PSC Series

The PSC pluggable range consists of Class 1+2 (according to IEC 61643-11) surge protective devices (lightning arrestor) (10/350 µs) and surge protector (8/20 µs) with low Up (protection of downstream equipments) for single-phase and three-phase electrical power networks.

These units are ideal for protection of service entrances and distribution panels in areas exposed to lightning activity or externally generated heavy transients.

No. of phases	$I_{imp}$	$I_{max}$	Connection	$I_N$	$U_c$	$U_p$	Cat. No.
1P	12.5 kA	65 kA	L-N	20 kA	275 V	$\leq 1.3 \text{ kV}$	<b>CPTPSC1-12/230IR</b>
1P	25 kA	65 kA	N-PE	25 kA	255 V	$\leq 1.5 \text{ kV}$	<b>CPTPSC1-25N</b>
1P	25 kA	100 kA	L-N	25 kA	275 V	$\leq 1.3 \text{ kV}$	<b>CPTPSC1-25/230IR</b>
1P	50 kA	65 kA	N-PE	50 kA	255 V	$\leq 1.5 \text{ kV}$	<b>CPTPSC1-50N</b>
1P	100 kA	100 kA	N-PE	50 kA	255 V	$\leq 1.5 \text{ kV}$	<b>CPTPSC1-100N</b>
1P+N	12.5 kA	65 kA	L+N-PE	20 kA	275 V	$\leq 1.3 \text{ kV}$	<b>CPTPSC2-12/230IR</b> <sup>1))</sup>
1P+N	25 kA	100 kA	L+N-PE	25 kA	275 V	$\leq 1.3 \text{ kV}$	<b>CPTPSC2-25/230IR</b> <sup>1))</sup>
3P+N	12.5 kA	65 kA	L+L+L+N-PE	20 kA	440 V	$\leq 1.3 \text{ kV}$	<b>CPTPSC4-12/400IR</b> <sup>1))</sup>
3P+N	25 kA	100 kA	L+L+L+N-PE	25 kA	440 V	$\leq 1.3 \text{ kV}$	<b>CPTPSC4-25/400IR</b> <sup>1))</sup>

Accessories	For use with	Cat. No.
Replacement module - limp 12.5 kA	CPTPSC1-12/230IR, CPTPSC2-12/230IR & CPTPSC4-12/400IR	<b>CPTPSC-12-230MOD</b>
Replacement module - limp 25 kA	CPTPSC1-25/230IR, CPTPSC2-25/230IR & CPTPSC4-25/400IR	<b>CPTPSC-25-230MOD</b>

**Notes:** <sup>1)</sup>  $U_p$  listed above is between L-N. The  $U_p$  between N-PE is  $\leq 1.5 \text{ kV}$ .

<sup>2)</sup>  $U_c$  listed above is between L-N. The  $U_c$  between N-PE is 255 V.

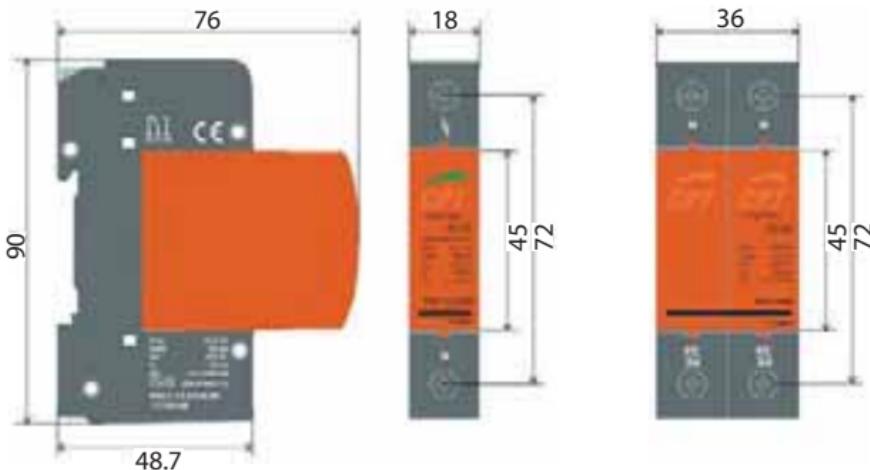
<sup>3)</sup>  $I_{imp}$  listed above is between L-N. The  $I_{imp}$  between N-PE is 25 kA.

<sup>4)</sup>  $I_{imp}$  listed above is between L-N. The  $I_{imp}$  between N-PE is 50 kA.

<sup>5)</sup>  $I_{imp}$  listed above is between L-N. The  $I_{imp}$  between N-PE is 100 kA.

## DIN rail mounted surge diverters - Electrical network

### Dimensions (mm)



All PSC series

CPTPSC112230IR

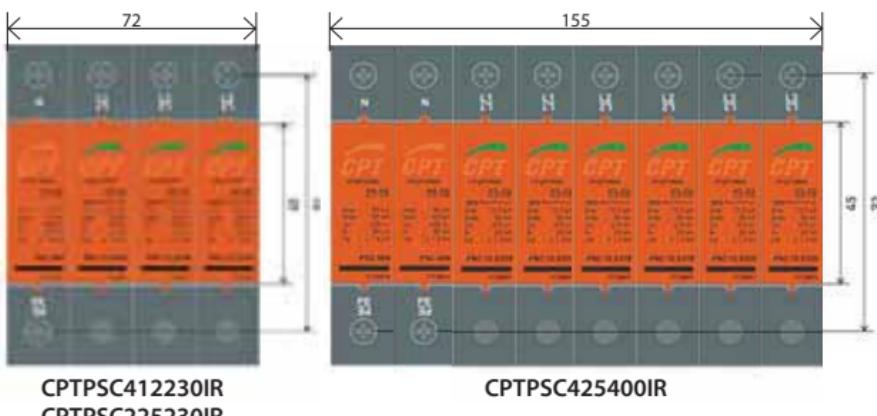
CPTPSC125N

CPTPSC150N

CPTPSC125230IR

CPTPSC1100N

CPTPSC212230IR

CPTPSC412230IR  
CPTPSC225230IR

CPTPSC425400IR

**Notes:** CPTPSC425400IR dimensions are H x W x D (mm): 90 x 155 x 76.

## DIN rail mounted surge diverters - Electrical network

1

### PSM Series

The PSM pluggable range consists of Class 2 (according to IEC) surge protective devices designed for protection against transient overvoltages in single-phase and three-phase electrical power networks.

These units are ideal for protection of distribution and branch panels, electronic equipment etc.

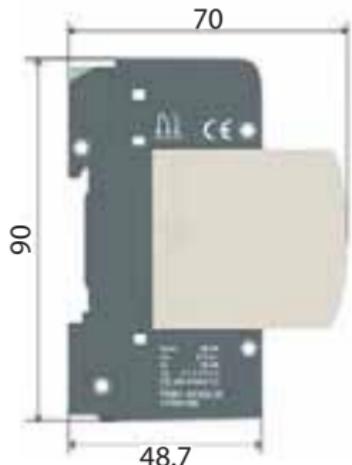
No. of phases	$I_{max}$	Connection	$I_N$	$U_c$	$U_p$	Cat. No.
1 P	20 kA	L-N	10 kA	275 V	< 1.4 kV	CPTPSM1- 20/230 IR
1 P	20 kA	N-PE	10 kA	255 V	< 1.5 kV	CPTPSM1- 20N
1 P	40 kA	L-N	20 kA	275 V	< 1.3 kV	CPTPSM1- 40/230 IR
1 P	40 kA	N-PE	20 kA	275 V	< 1.5 kV	CPTPSM1- 40N
1 P+N	20 kA	L+N-PE	10 kA	275 V	< 1.4 kV	CPTPSM2- 20/230 IR <sup>1)</sup> <sup>2)</sup>
1 P+N	40 kA	L+N-PE	20 kA	275 V	< 1.3 kV	CPTPSM2- 40/230 IR <sup>1)</sup> <sup>3)</sup>
3 P+N	20 kA	L+L+L+ N-PE	10 kA	440 V	< 1.4 kV	CPTPSM4- 20/400 IR <sup>1)</sup> <sup>2)</sup>
3 P+N	40 kA	L+L+L+ N-PE	20 kA	440 V	< 1.3 kV	CPTPSM4- 40/400 IR <sup>1)</sup> <sup>3)</sup>

Accessories	For use with	Cat. No.
Replacement module - $I_{max}$ 20 kA	CPTPSM1-20/230IR, CPTPSM2- 20/230IR & CPTPSM4-20/400IR	CPTPSM-20-230MOD
Replacement module - $I_{max}$ 40 kA	CPTPSM1-40/230IR, CPTPSM2- 40/230IR & CPTPSM4-40/400IR	CPTPSM-40-230MOD

**Notes:** <sup>1)</sup>  $U_p$  listed above is between L-N. The  $U_p$  between N-PE is  $\leq 1.5$  kV.  
<sup>2)</sup>  $U_c$  listed above is between L-N. The  $U_c$  between N-PE is 255 V.  
<sup>3)</sup>  $U_c$  listed above is between L-N. The  $U_c$  between N-PE is 265 V.

## DIN rail mounted surge diverters - Electrical network

### Dimensions (mm)



All PSM models



1P PSM models

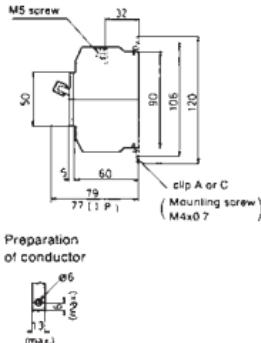
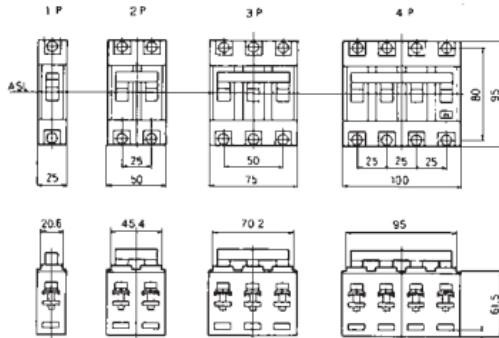


1P+N PSM models

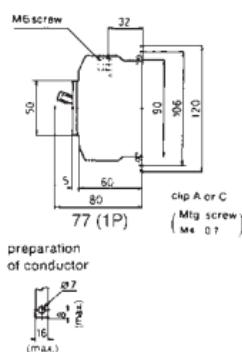
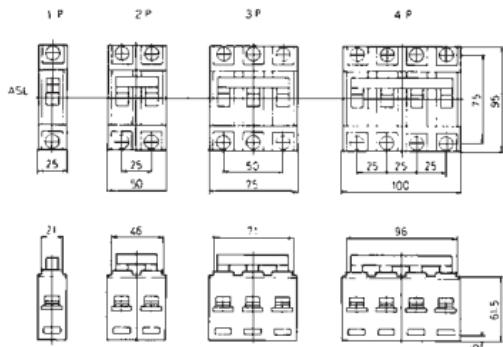


3P+N PSM models

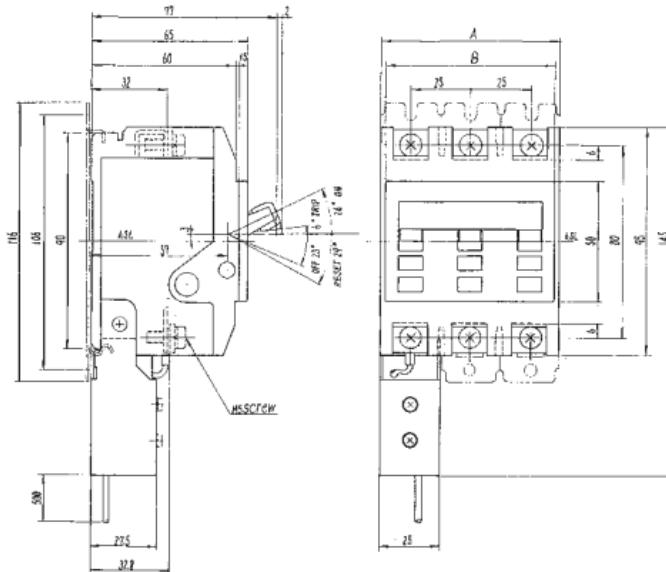
### Safe-T (6-63 A) MCBs



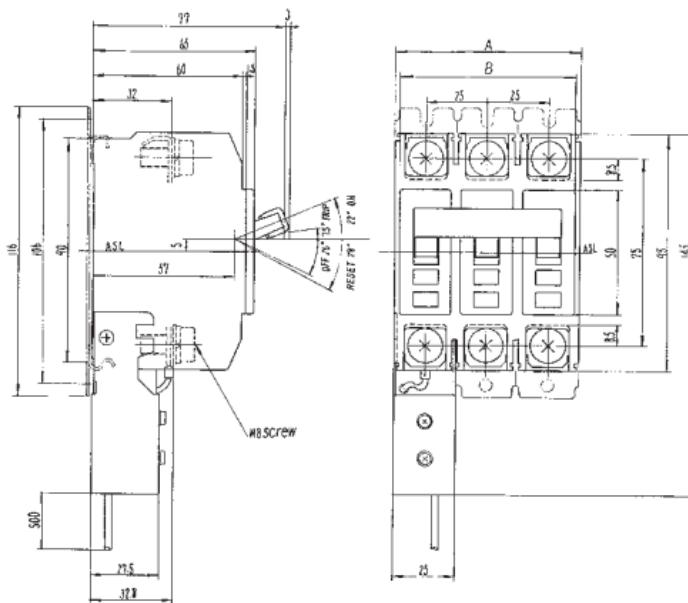
### Safe-T (80-100 A) MCBs



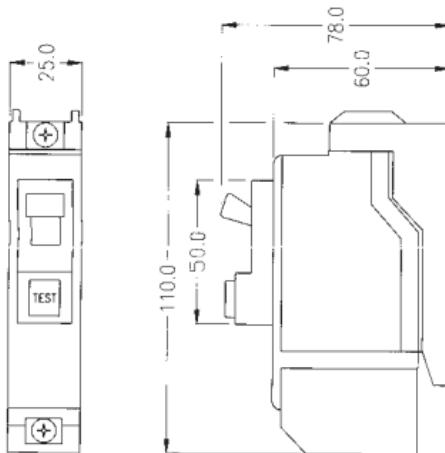
## Safe-T (6-63 A)



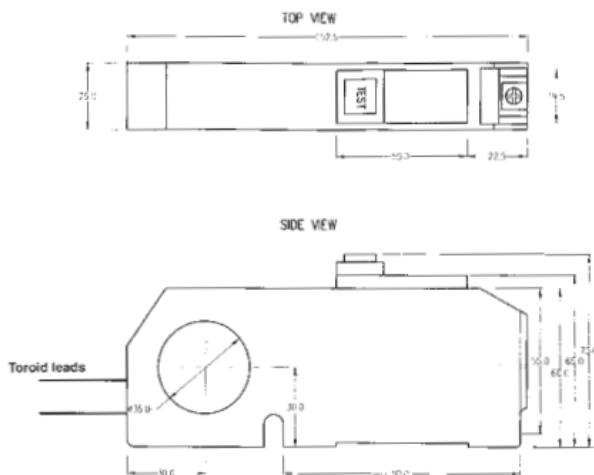
## Safe-T (80-100 A)



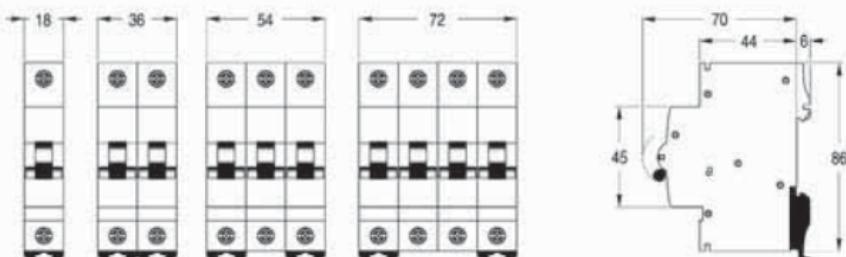
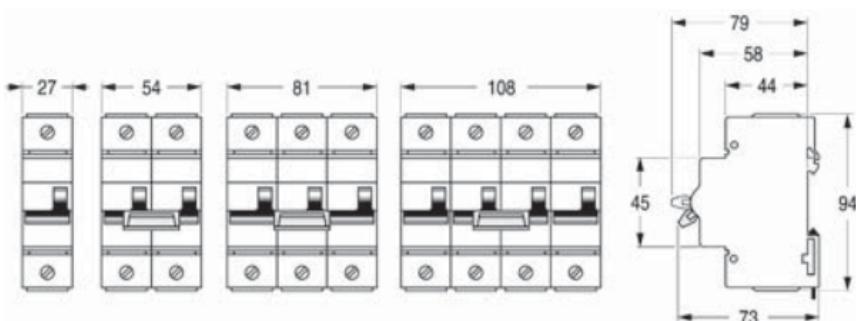
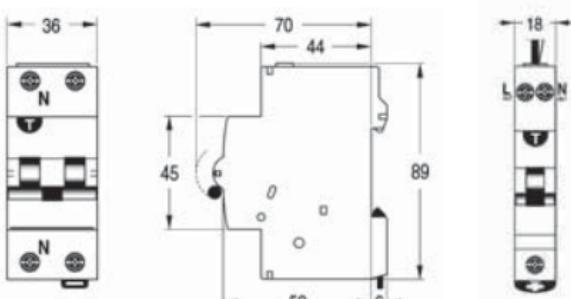
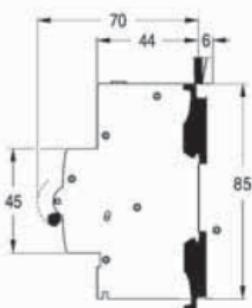
### Safe-T (SRCB) RCBO



### Safe-T (ELR) earth leakage relay

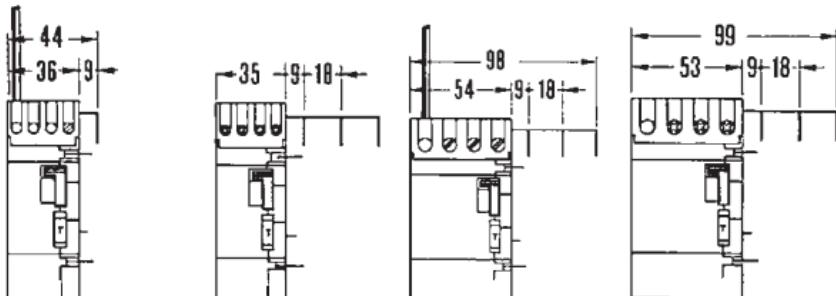


1

**Din-T 6, 10, 15 / Din-T DC - MCBs****Din-T 10H - MCBs****Din-Safe - 2 P RCBO****DSRCBS**

### Din-Safe – Add-on earth leakage module

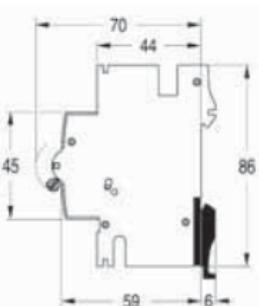
**1 P + N (32 & 63 A)    3 P + N (32 A)    3 P + N (63 A)    3 P (63 A)**



### Din-T shunt trip

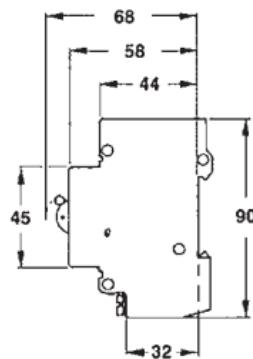
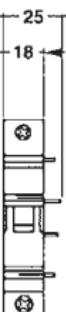
To suit:

Din-T 6, 10, 15, Din-T DC



To suit:

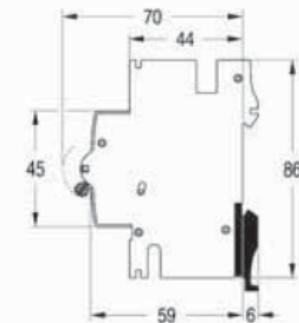
Din-T 10H

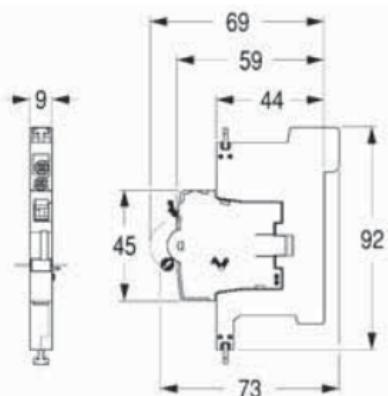
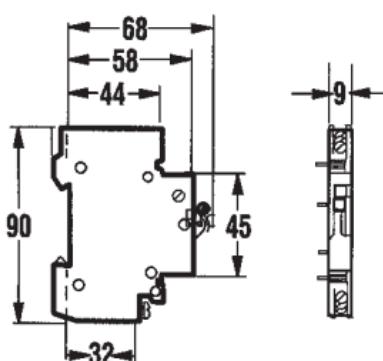
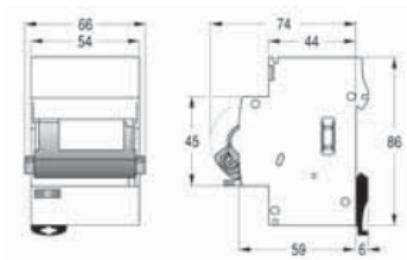
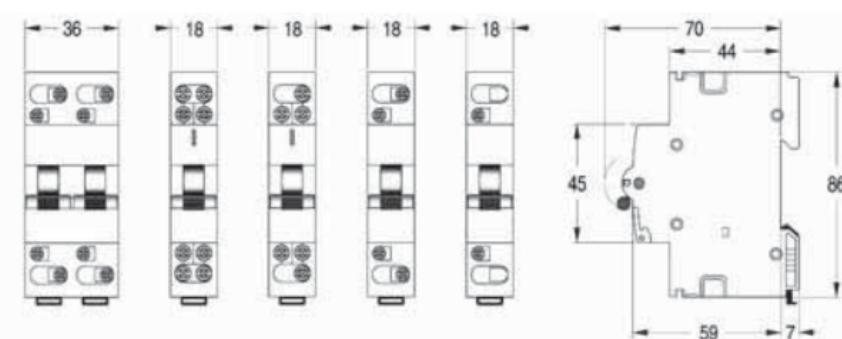


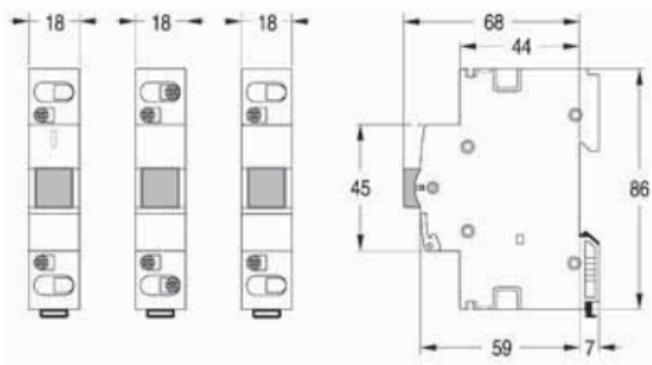
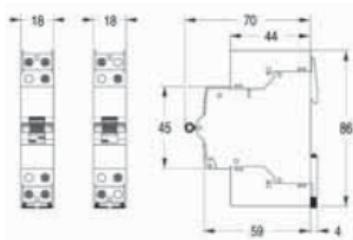
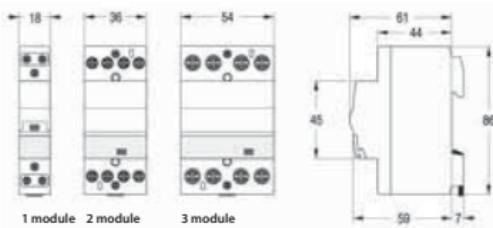
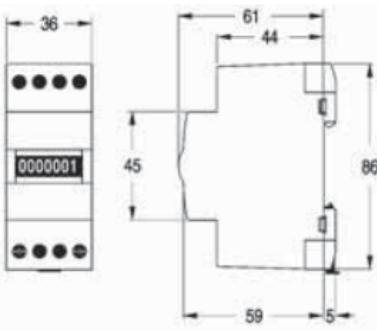
### Din-T undervoltage trip

To suit:

Din-T 6, 10, 15, Din-T DC (not Din-T10H)



**Auxiliary contacts for MCBs****Din-T 6, 10, 15, Din-T DC****Din-T 10H****Din-T - motor operator****Din-T - panelboard switch****Din-T - changeover switch**

**Din-T - pushbutton****Din-T - impulse switch****Din-T - contactor****Din-T - Pilot light****Din-T - hour run counter**

## Time switches Talento range

- Digital & Analogue
  - 24 hr, 7 day and yearly programming
  - 17.5 mm wide and standard DIN housing
  - 1, 2 and 4 channel flexibility
  - Economical synchronous operation and quartz precision with reserve
  - Manual overide
  - Pulse switching capability (TAL 471,472 P)
  - Energy saving ASTRO function (TAL 791 P)



TAL111MINI



TAL371  
MINI PLUS

## Specifications

Supply voltage: 220 - 240 V 50 Hz

Contact rating:  
(resistive load) 16 A / 240 V AC 1

\* Other voltages available, contact NHP.



TAL371 PRO

## Analogue 24 hr & 7 day - 16 A rating (resistive load)

<b>Pro- gramme</b>	<b>Reserve</b>	<b>Min. switch time</b>	<b>Contact</b>	<b>Cat. No.</b>	<b>Price \$</b>
24 hr	–	30 min	1 N/O	TAL111MINI	102.00
24 hr	–	30 min	1 C/O	TAL111	105.00
24 hr	50 hr	30 min	1 N/O	TAL211MINI	151.00
24 hr	150 hr	30 min	1 C/O	TAL211	200.00
7 day	–	3 hr	1 C/O	TAL171	148.00
7 day	150 hr	3 hr	1 C/O	TAL271	215.00

## Digital 24 hr, 7 day & yearly - 16 A rating (resistive load)

Programme	Reserve	Min. switch time	No. of memory locations	Contact	Cat. No.	Price \$
24hr/7 days	3 yrs	1 min	50	1 C/O	TAL371MP240VAC	145.00
24hr/7 days	3 yrs	1 min	70	1 C/O	TAL371PRO	210.00
24hr/7 days	3 yrs	1 min	70	2 C/O	TAL372PRO	330.00
24hr/7 days	3 yrs	1 min	100	1 C/O	TAL471PRO	270.00
24hr/7 days	3 yrs	1 min	100	2 C/O	TAL472PRO	390.00
Astro	3 yrs	Daylight Switch	1 C/O		TAL791PRO	430.00
Yearly	3 yrs	1 sec	800	2 C/O	TAL892PLUSTOP	760.00
Yearly	3 yrs	1 sec	800	4 C/O	TAL892PLUSTOP AND TALCEPLUSTOP	760.00 365.00

## Panelboards, Loadcentres and accessories

### Busbar chassis assemblies

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Pole Covers to suit Safe-T and Din-T series

**Loadcentres**

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Insulated – ILC series

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Insulated - Din-T surface mount

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Insulated - Din-T flush mount

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Insulated – Din-Modula 150 series

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Insulated - MCE weatherproof series

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Insulated – Din-Modula weatherproof series

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Metal – NLC for Din-T MCBs

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Metal – TLC for Safe-T MCBs

**CONCEPT**

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CONCEPT economical panelboards

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CONCEPT•PLUS multi-purpose panelboards

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CONCEPT•PLUS Grizz-Bar isolation

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CONCEPT•PLUS accessory modules

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CONCEPT•PLUS options and accessories

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**KATKO**

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Panelboard DIN switch-fuse &amp; fuse links

2 - 70

Modular panelboard features

2 - 1

## Pole covers

### Safe-T and Din-T

#### Safe-T pole covers

- Standard AS/NZS 3132
- Degree of protection IP 30
- Surface mounting
- Colour – Black
- Supplied complete with clip tray



Pole capacity	Cat. No.	Price \$
1	SAFE-TPC1	18.20
3	SAFE-TPC23	32.50

#### Dimensions (mm)

Pole capacity	H	W	D
1	160	30	64
3	160	80	64

#### Price schedule 'T1'

#### Din-T pole covers for Din-T series MCBs

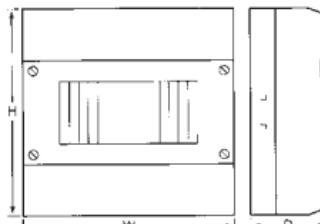
- Standard AS/NZS 3132
- Suits Din-T6, 10, 10H, 15 MCBs and associated DIN equipment
- Made from high impact resistant material
- Degree of protection IP 30
- Surface mounting
- Colour – Grey
- 2 and 4 way lead sealable



Capacity	Cat. No. <sup>1)</sup>	Price \$
1 Pole	CSPC1	7.30
2 Pole	DTPC2	13.00
4 Pole	DTPC4	16.80
6 Pole	DTPC6	31.50
8 Pole	DTPC8	41.00
1 Pole (Suits 1P MCB with LockDIN)	DTPC2LD	19.20
3 Pole (Suits 3P MCB with LockDIN)	DTPC4LD	23.40

#### Dimensions (mm)

Pole capacity	H	W	D
1	130	32	62
2	139	51	61
4	139	88	61
6	165	140	72
8	198	200	72



**Notes:** 1) Will not accept DSRCBH single pole RCDs.

## Insulated loadcentres

### ILC series

- Standard AS/NZS 3132
- Suits Din-T6, 10, 10H, 15 MCBs and associated DIN equipment
- Made from high impact resistance material
- Comprehensive cable entry facilities at top, bottom, sides and rear
- Modern consumer unit designed with an attractive styling for new buildings, replacing old units, or adding extensions



2

#### Ordering details

Pole capacity	Cat. No.	Price \$
4	ILC 4S	65.50
8	ILC 8S	79.00
1-3 (Suits ≤63 A Din-T MCB with Lockdin)	ILC4SLD	71.50
1-3 (Suits 80-125 A Din-T MCB with Lockdin)	ILC4SLD10H	77.00

#### Optional accessories

Description	Cat. No.	Price \$
Comb type busbars	REFER PAGE	1 - 43
Main switches	REFER PAGE	1 - 38
	ILC 4EN	27.00
Earth and neutral bar kit	ILC 8EN	31.00
Lead sealing bracket	ILCSB	3.60

#### Technical data

- Maximum load 120 amp
- Maximum operating voltage 415 V AC
- Degree of protection IP 43
- Material: self-extinguishing halogen-free polystyrene
- Colour: Base: Grey RAL 7035  
Door: Clear

#### Dimensions (mm)

Cat. No.	H	W	D
ILC 4S	175	90	100
ILC 8S	175	170	120

**Notes:** Earth and neutral kit ordered separately.

Bus comb ordered separately.

Will not accept DSRCBH single pole RCDs.

## Insulated loadcentres

### DIN-T – surface mount

2

- Standard AS/NZS 3439-3
- Suits NHP Din-T MCBs and associated DIN equipment
- Surface mount
- Degree of protection IP 40
- Split earth neutral bars
- Removable earth and neutral bar support
- Transparent or white door
- Door hinged at the top
- Supplied complete with Buscomb



#### Ordering details

Pole cap.	No. of rows	Neutral bar	Earth bar	Trans. door Cat. No.	White door Cat. No.	Price \$
8	1	4/4	8	CSB08ST	CSB08SW	67.50
12	1	5/3/3	12	CSB12ST	CSB12SW	78.00
18	1	9/3/3/3	18	CSB18ST	CSB18SW	119.00
24	2	10/3/3/3/3	24	CSB24ST	CSB24SW	156.00
36	3	12/12/12	36	CSB36ST	CSB36SW	197.00

#### Dimensions

Pole capacity	Width (mm)	Height (mm)	Depth (mm)
8	185	200	94
12	256	200	97
18	363	220	97
24	269	326	97
36	306	473	102

## Insulated loadcentres

### DIN-T – flush mount

- Standard AS/NZS 3439-3
- Suits NHP Din-T MCBs and associated DIN equipment
- Flush mount
- Degree of protection IP 40
- Split earth neutral bars
- Removable earth and neutral bar support
- Transparent or white door
- Door hinged at the top
- Supplied complete with Buscomb



2

#### Ordering details

Pole cap.	No. of rows	Neutral bar	Earth bar	Trans. door Cat. No.	White door Cat. No.	Price \$
12	1	5/3/3	12	CSB12FT	CSB12FW	78.00
18	1	9/3/3/3	18	CSB18FT	CSB18FW	119.00
24	2	10/3/3/3/3	24	CSB24FT	CSB24FW	156.00
36	3	12/12/12	36	CSB36FT	CSB36FW	197.00

#### Metal backing plate long

Pole capacity	Cat. No.	Price \$
12	CSB12FMPL	37.00
18	CSB18FMPL	37.00
24	CSB24FMPL	42.00
36	CSB36FMPL	42.00

#### Dimensions

Pole capacity	Description	Width (mm)	Height (mm)	Depth (mm)
12	Base	270	211	66
12	Cover	304	246	29
18	Base	380	232	76
18	Cover	412	267	29
24	Base	270	304	76
24	Cover	305	358	29
36	Base	308	470	76
36	Cover	342	503	29

#### Flush enclosure - cut out dimensions (mm)

Enclosure type	Width	Height
12 way	259	199
18 way	365	213
24 way	259	311
36 way	296	458

## Insulated loadcentres

### Din-Modula 150 series

2

- Standard AS/NZS 3439.3
- Suits Din-T6, 10, 10H & 15 MCBs and associated DIN equipment
- IP 40 protection rating
- Totally insulated
- Maximum 100 amp load
- 150 mm centre distance between DIN rails with 30 mm behind the mounting frame
- The range consists of 36, 54 and 72 pole enclosures
- Neutral and earth bars rated at 100 amps



These enclosures have generous 150 mm wiring space between and 30 mm behind equipment rails. The removable mounting frame serves to ease cabling and wiring greatly. Din-Modula 150 is designed for indoor use and to accept the Din-T 6, 10, 10H and 15 MCB range, time switches, contactors and main switches.

#### Technical data

- Material: Base: Grey impact resistant polystyrene  
Door: Clear polycarbonate
- Halogen free

#### Ordering details

No. of rows	Pole cap.	Neutral bar	Earth bar	Surface Cat. No. <sup>1)</sup>	Price \$
2	36	1 x 18	1 x 18	DM15036	305.00
3	54	2 x 18	1 x 24	DM15054	440.00
4	72	2 x 18	1 x 36	DM15072	580.00

#### Optional accessories

Description	Cat. No.	Price \$
Neutral 19-36	DM150NAA	39.50
Neutral 37-54	DM150NAB	72.50
Neutral 55-72	DM150NAC	72.50
Locking device	DM150LD	46.00
Coupling kit	DM150JK	23.40

#### Dimensions (mm)

Cat. No.	H	W	D
DM15036	450	355	142
DM15054	600	355	142
DM15072	750	355	142

**Notes:** 1) Will not accept DSRCBH single pole RCDs.  
Neutral bar extension kits must be ordered separately.  
When flush mount required order separately by description.

## Insulated loadcentres

### MCE weatherproof series

- Suits Din-T6, 10, 10H, 15 and DC MCBs
- Suits DSRCBS 1P and DSRCB 2P RCBOs
- IP 65 - IK 08
- Maximum 120 A load
- Totally insulated
- Base polycarbonate, RAL 7035
- Cover polycarbonate, transparent
- UV resistant UL508
- 5 and 9 pole
- Pre-punched knockouts



2

The MCE weatherproof enclosure was designed to meet the tough demands of Australia's environment. The MCE is ideal for roof mounted applications such as used in solar (photovoltaic) applications.

#### Ordering details

No. of rows	Pole capacity	Cat. No.	Price \$
1	5	MCEPCN5MFM	88.00
1	9	MCEPCN9MFM	140.00

No earth or neutral bars

#### Dimensions (mm)

Pole capacity	H	W	D
5	200	116	105
9	200	190	105

## **Insulated loadcentres**

- Standard AS/NZS 3439.3
  - Suits Din-T6, 10, 10H & 15 MCBs
  - IP 55-IK07 protection
  - Maximum 120 amp load
  - Padlocking possible
  - Door changeable left or right side
  - Totally insulated
  - Halogen free



The Din-Modula weatherproof was designed with maximum flexibility in mind.

Using the connection set, two or more enclosures can be joined together – maintaining the IP protection rating. A further feature of flexibility is that of the adjustable height DIN rail. Grey impact resistant polystyrene base and clear polycarbonate door.

Din-Modula weatherproof was designed for use with the Din-T 6, 10, 10H and 15 MCB range in wet area applications, out of direct sunlight. Split neutral and earth bars are provided. For accessories, **refer to page 1 - 43 & 1 - 50**.

## Accessories

- Circuit identification labels
  - Split neutral and earth bars
  - Weatherproof sealing caps for mounting screws
  - Pole fillers
  - Locking bracket to suit a padlock
  - Connection set-for joining enclosures together at extra cost
  - 125 mm DIN rail centres

## Ordering details

No. of rows	Pole cap.	Neutral bar	Earth bar	Cat. No.	Price \$
1	12	8/4	8	DMWP12	220.00
2	24	18/6	18	DMWP24	280.00
3	36	24/12	18	DMWP36	370.00

## Optional accessories

Description	Cat. No.	Price \$
Locking device	DMWPLD	28.00
connection set	DMWPCS	13.00

## Dimensions (mm)

<b>Pole capacity</b>	<b>H</b>	<b>W</b>	<b>D</b>
12	250	285	138
24	375	285	138
36	500	285	138

## Metal loadcentres

### NLC loadcentres for 'Din-T' MCBs

- Suits Din-T6, 10, 10H & 15 MCBs and associated DIN equipment
- 1 mm zinc annealed steel
- Polyester powder coated N42 grey
- Earth and neutral bars provided
- Circuit schedule labels provided
- DIN rail fitted
- IP 30 (IP 40 with door)
- Commercial and light industrial applications



2

#### Ordering details

Pole cap.	Surface mount enclosure <sup>4)</sup>	Price \$	Flush <sup>1)</sup> escutcheon	Price \$	Door <sup>1) 2)</sup>	Price \$
	Cat. No.		Cat. No.		Cat. No.	
8	NLC8S	141.00	NLC8FE	27.40	LD6/8	67.50
12	NLC12S	164.00	NLC12FE	35.50	LD9/12	67.50
15	NLC15S	187.00	NLC15FE	35.50	LD12/15	78.00
18	NLC18S	205.00	NLC18FE	41.50	LD15/18	78.00
21	NLC21S	215.00	NLC21FE	45.50	LD18/21	83.00
24	NLC24S	275.00	-		LD24	109.00

Load center supplied standard as base and escutcheon. Door and flush escutcheon supplied as optional extras.

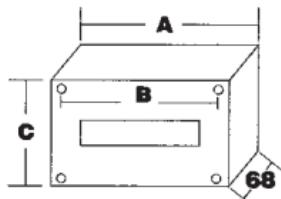
Earth and neutral bars – 2 x 25 mm<sup>2</sup>, remaining 16 mm<sup>2</sup>

#### Options and accessories

Description	Cat. No.	Price \$
Locking kit includes bracket and fasteners (CL001)	DSLK	30.50
Fitting of Din-T MCB single pole	ADD EACH	1.90
Fitting of Din-T MCBs two and three pole	ADD EACH	1.90
NSW Public Works Department E1 type lock	ADD	380.00

#### Dimensions (mm)

Pole cap.	A <sup>3)</sup>	B	C <sup>3)</sup>
8	268	192	245
12	343	267	245
15	418	342	245
18	493	417	245
21	568	492	245
24	693	549	245



**Notes:** <sup>1)</sup> Doors and flush escutcheons supplied loose.

<sup>2)</sup> Door has provision for lock. Lock kit ordered separately.

<sup>3)</sup> Dimensions 'A' and 'C' increased by 50 mm when flush mounted.  
With door depth = 98 mm.

<sup>4)</sup> Accepts DSRCBH single pole RCDs.

## Metal loadcentres

### TLC loadcentres for 'Safe-T' MCBs

2

- Suitable for Safe-T MCBs and Safe-T RCDs
- 1 mm zinc annealed steel
- Polyester powder coated N42 grey
- Earth and neutral bars provided
- Circuit schedule labels provided
- MCB clip tray fitted
- IP 30 (IP 40 with door)
- Australian made
- Commercial and light industrial applications



#### Ordering details

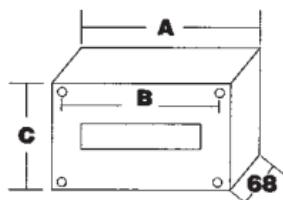
Pole cap.	Surface mount enclosure <sup>2)</sup> Cat. No.	Price \$	Door <sup>1)</sup> Cat. No.	Price \$
6	TLC6S	126.00	LD6/8	67.50
12	TLC12S	164.00	LD12/15	78.00
18	TLC18S	205.00	LD18/21	83.00

#### Options and accessories

Description	Cat. No.	Price \$
Safe-T pole fillers	SAFETPF	1.80
Locking kit includes bracket and fasteners (CL001)	DSLK	30.50
Fitting of Safe-T MCB 1, 2 and 3 pole	ADD	1.90
DIN mount adaptor for time clock and contactors	TLCDMA	33.00
NSW Public Works Department E1 type lock	ADD	380.00

#### Dimensions (mm)

Pole cap.	A	B	C
6	268	192	245
12	418	342	245
18	568	492	245



**Notes:** 1) Doors supplied loose.

2) Accepts DSRCBH single pole RCDs.

## NHP – The panelboard innovators

### CONCEPT

The NHP CONCEPT family range of panelboards keeps a common and attractive appearance throughout the range.



2

### CONCEPT

#### **The economical panelboard:**

The 'CONCEPT' panelboard is designed for those wanting a visually attractive, economical panelboard, but also offering a robust enclosure with an excellent range of standard features. This type of panelboard is designed to be stocked nationally as an 'off the shelf' panelboard.

### CONCEPT•PLUS

#### **The multipurpose panelboard:**

For those wanting an 'off the shelf' panelboard which offers a large range of features and options. The CONCEPT•PLUS is a multipurpose panelboard that offers among its many features: indoor rated panelboard with dust seal option, six modular sizes, and accessory boxes that can be added to extend the height or width of the panelboard. CONCEPT•PLUS panelboards are available for either DIN or NEMA (Safe-T) MCBs.

### CONCEPT•PREMIER

#### **The premium panelboard:**

The CONCEPT•PREMIER panelboard range has all the features of CONCEPT•PLUS, but also includes important additional features, such as a greater box depth, weatherproof rating, the option of stainless steel enclosures, a floor mounting plinth, plus others.

CONCEPT•PREMIER panelboards are available for Safe-T, Din-T, 125 A and 250 A MCCBs or combinations thereof.

### CONCEPT•TOUGH

#### **The heavy-duty panelboard:**

The CONCEPT•TOUGH panelboard range has all the features of CONCEPT•PREMIER plus more, the CONCEPT•TOUGH has an increase in depth, width and material thickness for extra strength. The increase in depth allows the use of a wider range of padlock/locking facilities on isolators and circuit breakers between the door and escutcheon. This extra depth also allows larger accessory items to be mounted below the escutcheon such as contactors and change-over switches. The CONCEPT•TOUGH has a vast amount of wiring space and very generously sized glandplate entry and exit points due to the extra width. This package is all put together in a rigid 2 mm fully welded construction for those extra tough applications.

## Quick reference table

2

Features and options	CONCEPT	CONCEPT+PLUS
Circuit Breaker Types	Din-T	Din-T / Safe-T
<b>Enclosure Details &amp; Accessory Spacing</b>		
Width	485 mm	585 mm
Depth	151 mm	185 mm
IP Rating	IP 40	IP 42 <sup>1)</sup>
Material	1 mm	1.6 mm
Pole capacity	24 - 60	18 - 96
Colours available (doors)	Grey & Orange	Grey & Orange
Spare DIN rail - rail mounting space	12 Poles	18 Poles
Largest contactor under PB escutcheon	CA 7-43	CA 7-85
Largest contactor in accessory module	-	CA 6-180
<b>Main Switches, Busbars, Earth &amp; Neutral Bars</b>		
STD Main switch rating	160 A or 250 A	160 or 250 A standard
Maximum main switch sizes available	250 A	400 A
Dual Earth & Neutral bars	-	-
Lock type on door (keylock)	Flush	Flush
Chassis type	Din chassis	NC - GB - CT
<b>Common Features</b>		
Horizontal DIN rail	✓	✓
Knockouts for MCBs & accessories	✓	✓
Door reversible RHS to LHS	✓	✓
Door hinged independent of escutcheon	✓	✓
<b>Optional Accessories &amp; Features</b>		
Emergency lighting kits - option	✓	✓
Split chassis - option	✓	✓
Special colours - option	✓	✓
Rain & dust hood	-	-
Custom 'modular' assemblies - option	-	✓
Accessory / header boxes - option	-	✓
Brass or aluminium gland plates - option	-	✓
Removable gland plates - standard	-	✓
Can fit MCCBs - option	-	✓
Fault current limiter DIN fuses - option	-	✓
Flush surround kits - option	✓	✓
Hinged escutcheon	-	optional
Dust seal	-	optional
Floor mounting plinth - option	-	✓
Wall mounting brackets - option	-	-
'3 point locking' door - on Lge encl. <sup>2)</sup>	-	-
Stainless steel enclosure - option	-	-

**Notes:** For a more complete listing of accessory details refer to accessory pages relating to individual panelboards.

<sup>1)</sup> Dust seal option - IP52B.

<sup>2)</sup> On large enclosures ≥ 1000 mm.

## Quick reference table

<b>Features and options</b>	<b>CONCEPT-PREMIER</b>	<b>CONCEPT-TOUGH</b>
<b>Circuit Breaker Types</b>	Din-T / Safe-T/ 125 & 250 A MCCBs	Din-T / Safe-T/ 125 & 250 A MCCBs
<b>Enclosure Details &amp; Accessory Spacing</b>		
Width	640 mm	800 mm
Depth	240 mm	300 mm
IP Rating	IP 66	IP 66
Material	1.6 mm	2.0 mm
Pole capacity	18 - 96	18 - 96
Colours available (doors)	Grey & Orange	Grey & Orange
Spare DIN rail rail mounting space	18 Poles	18 Poles
Largest contactor under PB escutcheon	CA 6-180	CA 6-180
Largest contactor in accessory module	CA 6-420	CA 6-420
<b>Main Switches, Busbars, Earth &amp; Neutral Bars</b>		
STD Main switch rating	160 or 250 A standard	-
Maximum main switch sizes available	< 800 A	< 800 A
Dual Earth & Neutral bars	✓	✓
Lock type on door (keylock)	T-handle, flush (series 2)	Chrome plated LHandle
Chassis type	CD-NC-GB-XA-XB	CD-NC-GB-XA-XB
<b>Common Features</b>		
Horizontal DIN rail	✓	✓
Knockouts for MCBs & accessories	✓	✓
Door reversible RHS to LHS	✓	-
Door hinged independent of escutcheon	✓	✓
<b>Optional Accessories &amp; Features</b>		
Emergency lighting kits – option	✓	✓
Split chassis – option	✓	✓
Special colours – option	✓	✓
Rain & dust hood	✓	✓
Custom 'modular' assemblies – option	✓	✓
Accessory / header boxes – option	✓	accessory only
Brass or aluminium gland plates – option	✓	✓
Removable gland plates – standard	✓	✓
Can fit MCCBs – option	✓	✓
Fault current limiter DIN fuses – option	✓	✓
Flush surround kits – option	✓	-
Hinged escutcheon	standard	standard
Dust seal	standard	standard
Floor mounting plinth – option	✓	✓
Wall mounting brackets – option	✓	standard
'3 point locking' door – on Lge encl. <sup>1)</sup>	✓	✓
Stainless steel enclosure – option	✓	✓

**Notes:** For a more complete listing of accessory details refer to accessory pages relating to individual panelboards.

<sup>1)</sup> On large enclosures ≥ 1000 mm.

## CONCEPT

### The economical panelboard for Din-T MCBs

2

- Standard AS/NZS 3439-3
- Type tested busbar system
- Compact 160 A or 250 A main switch
- Door fitted independent of escutcheon
- Left or right hand door hinging
- Lockable door
- Australian made
- Commercial and industrial applications



#### **Application**

The Concept range is an economical panelboard designed for the commercial and light industrial sectors. It will accept Din-T circuit breakers and associated accessory devices.

#### **Features**

- Two-tone colour scheme, make a colour change by simply changing the door colour.
- The door is field changeable from right to left hinged and is totally independent of the escutcheon.
- Gloss white escutcheon has been dished to allow a wide range of accessories to fit under the door.
- Knockouts provided in the escutcheon for up to 12 modules of extra standard DIN rail equipment.
- Compact main switch with a 160 A or 250 A rating.
- Earth and neutral bars, circuit identification and schedule cards supplied.

#### **Technical data**

**Material type:** 1 mm steel

**Finish:** Polyester powder coated

**Colour (AS 2700-1995):** Base – charcoal gloss

Door – N42 storm grey or X15 orange

Escutcheon – bright white gloss

**Protection degree:** IP 30 without door

IP 40 with door, IP42 with rain hood

**Busbar ratings:** 250 A

20 kA for 0.2 seconds

**Main Switch:** 160 A 3 pole 415 V AC top mount

250 A 3 pole 415 V AC top mount

## CONCEPT

**The economical panelboard for Din-T MCBs**



2

### **CONCEPT**

**Surface mount panelboard with grey door**

**Suits Din-T MCBs (DIN) refer to section one**

Main switch	Pole cap.	Box size	Height (mm)	Cat. No.	Price \$
160 A	24	1	700	CON 24 M160 G	1190.00
	36	2	800	CON 36 M160 G	1300.00
	48	3	900	CON 48 M160 G	1400.00
	60	4	1000	CON 60 M160 G	1540.00
250 A	24	1	700	CON 24 M250 G	1400.00
	36	2	800	CON 36 M250 G	1500.00
	48	3	900	CON 48 M250 G	1620.00
	60	4	1000	CON 60 M250 G	1740.00

Width = 485 mm, Depth = 151 mm includes door. (Door = 20 mm)

### **CONCEPT**

**Surface mount panelboard with orange door**

**Suits Din-T MCBs (DIN) refer to section one**

Main switch	Pole cap.	Box size	Height (mm)	Cat. No.	Price \$
160 A	24	1	700	CON 24 M160 O	1190.00
	36	2	800	CON 36 M160 O	1300.00
	48	3	900	CON 48 M160 O	1400.00
	60	4	1000	CON 60 M160 O	1540.00
250 A	24	1	700	CON 24 M250 O	1400.00
	36	2	800	CON 36 M250 O	1500.00
	48	3	900	CON 48 M250 O	1620.00
	60	4	1000	CON 60 M250 O	1740.00

Width = 485 mm, Depth = 151 mm includes door. (Door = 20 mm)

## CONCEPT

### The economical panelboard for Din-T MCBs

#### **Accessories**

2

Description	Cat. No.	Price \$	
Split chassis kit (supplied loose)	STKCD	119.00	
Emergency lighting kit <sup>1)</sup> (supplied loose)	Rotary control switch unwired prewired	<b>CPELK1</b> <b>CPELK1W</b>	430.00 445.00
	Key operated control switch unwired	<b>CPELK2</b>	495.00
Pole fillers (Din-T)	DTPF	4.30	
	SIZE 1 CON	<b>CONFK1</b>	285.00
Flush kit	SIZE 2 CON	<b>CONFK2</b>	285.00
	SIZE 3 CON	<b>CONFK3</b>	285.00
	SIZE 4 CON	<b>CONFK4</b>	285.00
Spare Key (set of 2) CL001 x 2	<b>KEYCL001</b>	7.80	
Spare Key (set of 2) 92268 x 2	<b>KEY92268</b>	7.80	
	CL001	<b>CPDHANDLECL001</b>	36.50
	92268	<b>CPDHANDLE92268</b>	36.50
Door lock	NSW PWD ELOCK	<b>CPDHANDLEELOCK</b>	290.00
	Padlockable	<b>CPDHANDLEPADLCK</b>	78.00
	Non-lockable	<b>CPDHANDLENOLOCK</b>	36.50

**Notes:** 1) Emergency lighting kits can be field fitted to Concept panelboards utilising horizontal DIN knockouts at top of board. Kits include control switch, timer, 24 A 4 Pole N/C contactor, labels and wiring diagram to complete control circuit which complies with AS 2293.1.

## CONCEPT•PLUS

### Multi-purpose panelboards for Din-T or Safe-T MCBs

- Standard AS/NZS 3439-3
- IP 42
- 6 modular sizes up to 96 poles
- Accessory module
- Type tested busbar chassis system
- Compact 250 A main switch
- Generous wiring room
- Removable gland plates
- Door fitted independent of escutcheon
- Flush door handle
- Left or right hand door hinging
- Commercial and industrial applications



2

#### **Application**

The Concept Plus range of panelboards provide a unique enclosure system for the NHP range of Din-T and Safe-T MCBs and associated accessory devices.

#### **Features**

- Two-tone colour scheme, make a colour change simply by changing the door colour
- The door is field changeable from right to left hinged and is totally independent of the escutcheon
- Gloss white escutcheon has been dished to allow a wide range of accessories to fit under the door
- Knockouts provided in the escutcheon for up to 18 modules of standard DIN rail equipment
- Removable gland plates aid on-site installation of cables
- New compact main switch with a fully enclosed rating of 160 A and 250 A
- Earth and neutral bars, circuit identification and schedule cards supplied standard

#### **Technical data**

**Material type:** 1.6 mm steel, polyester powder coated

**Colour (AS 2700-1995):** Base - Charcoal gloss  
Door - N42 Storm grey or X15 orange  
Escutcheon - bright white

**Protection degree:** IP 42 - with door (Dust seal option)

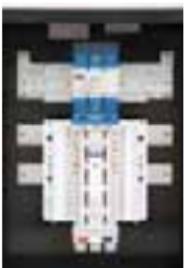
**Busbar ratings:** SafeT - 250 A CT (355 A option)  
Din-T - 250 A NC (400 A option)  
Din-T - 250 A Grizz-Bar

**Main switch (options):** Safe-T 100 A Non-auto (chassis mount CST)  
Din-T M/S 100 A (chassis mount CDT)  
160 A 3 pole 415 V AC (top mount)  
250 A 3 pole 415 V AC (top mount)  
200 A MCCB (top mount)

**Neutral and earth bars:** 2 x 8 mm studs; tunnel terminals with 2 screws  
10 kA 1 second.

## **CONCEPT•PLUS 2**

### **Multi-purpose panelboards for Din-T MCBs**



CONCEPT•PLUS 2

## Din-T – Surface mount with grey door

**Suits Din-T MCBs (DIN) refer to section one**

Main switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	18	1	700	CDT 18G2	1090.00
	24	1	700	CDT 24G2	1190.00
	36	2	900	CDT 36G2	1300.00
	48	2	900	CDT 48G2	1460.00
	60	3	1100	CDT 60G2	1630.00
	72	4	1300	CDT 72G2	1780.00
	84	4	1300	CDT 84G2	2060.00
	96	5	1500	CDT 96G2	2390.00
	18	1	700	CDT 18M160G2	1340.00
160 A	24	1	700	CDT 24M160G2	1440.00
	36	2	900	CDT 36M160G2	1550.00
	48	2	900	CDT 48M160G2	1710.00
	60	3	1100	CDT 60M160G2	1880.00
	18	1	700	CDT 18M250G2 <sup>1)</sup>	1460.00
250 A	24	1	700	CDT 24M250G2 <sup>1)</sup>	1570.00
	36	2	900	CDT 36M250G2	1670.00
	48	2	900	CDT 48M250G2	1840.00
	60	3	1100	CDT 60M250G2	2000.00
	72	4	1300	CDT 72M250G2	2160.00
	84	4	1300	CDT 84M250G2	2440.00
	96	5	1500	CDT 96M250G2	2760.00

Width = 585 mm. Depth = 185 mm includes door. (Door = 20 mm)

**Notes:** 1) Main switch supplied loose i.e. CDT18-M250-G2 = CDT18G2 + EVA3250H.

## CONCEPT•PLUS 2

### Multi-purpose panelboards for Din-T MCBs



2

**CONCEPT•PLUS 2****Din-T – Surface mount with orange door****Suits Din-T MCBs (DIN) refer to section one**

Main switch	Pole cap.	Box size	Height (mm)	Cat. No.	Price \$
	18	1	700	CDT 18O2	1090.00
	24	1	700	CDT 24O2 <sup>2)</sup>	1190.00
	36	2	900	CDT 36O2 <sup>2)</sup>	1300.00
-	48	2	900	CDT 48O2 <sup>2)</sup>	1460.00
	60	3	1100	CDT 60O2 <sup>2)</sup>	1630.00
	72	4	1300	CDT 72O2	1780.00
	84	4	1300	CDT 84O2	2060.00
	96	5	1500	CDT 96O2	2390.00
	18	1	700	CDT 18M160O2	1340.00
	24	1	700	CDT 24M160O2 <sup>2)</sup>	1440.00
160 A	36	2	900	CDT 36M160O2 <sup>2)</sup>	1550.00
	48	2	900	CDT 48M160O2	1710.00
	60	3	1100	CDT 60M160O2 <sup>1)</sup>	1880.00
	18	1	700	CDT 18M250O2 <sup>1)</sup>	1460.00
	24	1	700	CDT 24M250O2 <sup>1,2)</sup>	1570.00
	36	2	900	CDT 36M250O2 <sup>2)</sup>	1670.00
250 A	48	2	900	CDT 48M250O2 <sup>2)</sup>	1840.00
	60	3	1100	CDT 60M250O2 <sup>2)</sup>	2000.00
	72	4	1300	CDT 72M250O2 <sup>2)</sup>	2160.00
	84	4	1300	CDT 84M250O2 <sup>2)</sup>	2440.00
	96	5	1500	CDT 96M250O2 <sup>1,2)</sup>	2760.00

Width = 585 mm, Depth = 185 mm includes door. (Door = 20 mm)

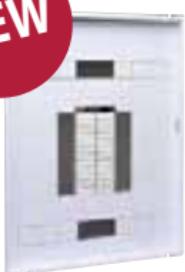
**Notes:** 1) Main switch supplied loose i.e. CDT18-M250-O2 = CDT18O2 + EVA3250H.

2) Enclosure with orange base replace "O" with "OO" e.g. CDT36OO2.

## **CONCEPT•PLUS 2**

### **Multi-purpose panelboards for Din-T MCBS**

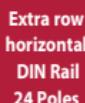
2



CONCEPT•PLUS 2

#### **Din-T – Surface mount with grey door**

**Suits Din-T MCBs (DIN) refer to section one**



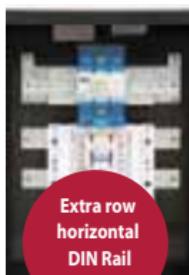
Main switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	18	1	700	CDTE18G2	1190.00
	36	2	900	CDTE36G2	1400.00
	48	3	1100	CDTE48G2	1660.00
	72	4	1300	CDTE72G2	1890.00
	96	5	1500	CDTE96G2	2490.00
	18	1	700	CDTE18M160G2	1440.00
160 A	36	2	900	CDTE36M160G2	1650.00
	48	3	1100	CDTE48M160G2	1910.00
	72	4	1300	CDTE72M160G2	2140.00
	96	5	1500	CDTE96M160G2	2740.00
	18	1	700	CDTE18M250G2	1560.00
	36	2	900	CDTE36M250G2	1770.00
250 A	48	3	1100	CDTE48M250G2	2040.00
	72	4	1300	CDTE72M250G2	2260.00
	96	5	1500	CDTE96M250G2	2860.00

Width = 585 mm. Depth = 185 mm includes door. (Door = 20 mm)

**Notes:** NC 250 topfeed chassis  
24P horizontal DIN rail cut-out below chassis  
Made to order

## CONCEPT•PLUS 2

### Multi-purpose panelboards for Din-T MCBs

**CONCEPT•PLUS 2****Din-T – Surface mount with orange door****Suits Din-T MCBs (DIN) refer to section one**

2

Main switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	18	1	700	CDTE18O2	1190.00
	36	2	900	CDTE36O2	1400.00
	48	3	1100	CDTE48O2	1660.00
	72	4	1300	CDTE72O2	1890.00
	96	5	1500	CDTE96O2	2490.00
160 A	18	1	700	CDTE18M160O2	1440.00
	36	2	900	CDTE36M160O2	1650.00
	48	3	1100	CDTE48M160O2	1910.00
	72	4	1300	CDTE72M160O2	2140.00
	96	5	1500	CDTE96M160O2	2740.00
250 A	18	1	700	CDTE18M250O2	1560.00
	36	2	900	CDTE36M250O2	1770.00
	48	3	1100	CDTE48M250O2	2040.00
	72	4	1300	CDTE72M250O2	2260.00
	96	5	1500	CDTE96M250O2	2860.00

Width = 585 mm, Depth = 185 mm includes door. (Door = 20 mm)

**Notes:** NC 250 topfeed chassis  
24P horizontal DIN rail cut-out below chassis  
Made to order

## CONCEPT•PLUS 2

### Multi-purpose panelboards for Din-T MCBs

2

**CONCEPT•PLUS 2****Din-T – Surface mount with grey door****Suits DIN-T-MCBs (DIN) refer to section one**

100 - 160 A main switch = S160NJ3160 MCCB



Main switch	Pole cap.	Box size	Height (mm)	Cat. No.	Price \$
100 - 160 A <sup>1)</sup>	24	1	700	CDT24MCCB160G2	1800.00
	42	2	900	CDT42MCCB160G2	1990.00
	60	3	1100	CDT60MCCB160G2	2200.00
	78	4	1300	CDT78MCCB160G2	2600.00
	96	5	1500	CDT96MCCB160G2	2990.00

160 - 200 A main switch = E250NJ3250 MCCB

Main switch	Pole cap.	Box size	Height (mm)	Cat. No.	Price \$
160 - 200 A <sup>2)</sup>	24	1	700	CDT24MCCB200G2	1950.00
	42	2	900	CDT42MCCB200G2	2150.00
	60	3	1100	CDT60MCCB200G2	2350.00
	78	4	1300	CDT78MCCB200G2	2750.00
	96	5	1500	CDT96MCCB200G2	3150.00

Width = 585 mm, Depth = 185 mm includes door. (Door = 20 mm)

**Notes:** <sup>1)</sup> Factory set 160 A. Adjustable down to 100 A.<sup>2)</sup> Factory set 200 A. Adjustable down to 160 A.

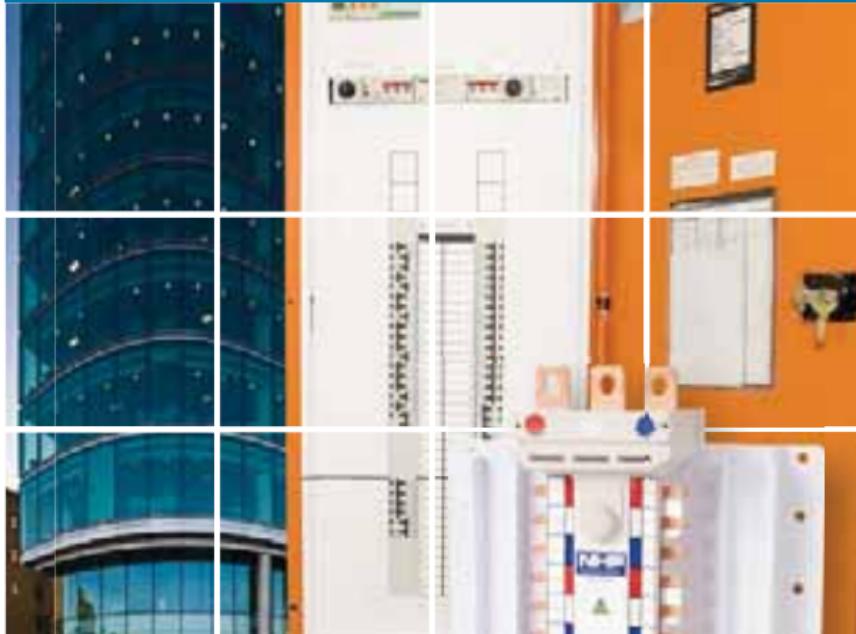
For 250 A refer NHP.

For orange door change "G" to "O" e.g. CDT24MCCB160O2 made to order.

# NC BUSBAR CHASSIS

Enclosed busbar distribution system for Din-T, MCBs and RCBOs.

POWER PROTECTION



PP-TERASAKI-CHASSIS-CFB

**The Concept range of busbar chassis assemblies have been specifically designed for incorporating into the Concept family of panelboards**

- Models from 6 to 108 poles
- Standard AS/NZS 3439.1
- 250 A and new 400 A rating
- Improved withstand ratings
- Retrofittable with CD chassis
- Improved form rating



**CONCEPT•PLUS CONCEPT•PREMIER**



**TERASAKI**  
Innovators in Protection Technology

## **CONCEPT•PLUS 2**

### **Multi-purpose panelboards for Din-T MCBs C/W isolation chassis**



2

**NEW**  
**Grizz-Bar**  
**Isolation**  
**chassis**

CONCEPT•PLUS 2

## Din-T – Surface mount with grey door

**Suits Din-T MCBs (DIN) refer to section one**

Main switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	24	1	700	CDG 24G2	1550.00
	36	2	900	CDG 36G2	1750.00
	48	2	900	CDG 48G2	2010.00
	60	3	1100	CDG 60G2	2320.00
	72	4	1300	CDG 72G2	2550.00
	84	4	1300	CDG 84G2	2990.00
	96	5	1500	CDG 96G2	3400.00
160 A	24	1	700	CDG 24M160G2 <sup>1)</sup>	1750.00
	36	2	900	CDG 36M160G2 <sup>1)</sup>	1950.00
	48	2	900	CDG 48M160G2 <sup>1)</sup>	2150.00
	60	3	1100	CDG 60M160G2 <sup>1)</sup>	2480.00
250 A	24	1	700	CDG 24M250G2 <sup>1)</sup>	1910.00
	36	2	900	CDG 36M250G2 <sup>1)</sup>	2110.00
	48	2	900	CDG 48M250G2 <sup>1)</sup>	2370.00
	60	3	1100	CDG 60M250G2 <sup>1)</sup>	2680.00
	72	4	1300	CDG 72M250G2 <sup>1)</sup>	2850.00
	84	4	1300	CDG 84M250G2 <sup>1)</sup>	3350.00
	96	5	1500	CDG 96M250G2 <sup>1)</sup>	3750.00

Width = 585 mm. Depth = 185 mm includes door. (Door = 20 mm)

**Notes:** <sup>1)</sup> Main switch supplied loose i.e. CDG18-M250-G2 = CDG18G2+EVA3250H

**CONCEPT•PLUS 2**

**Multi-purpose panelboards  
for Din-T MCBs C/W isolation chassis**



2

**CONCEPT•PLUS 2****Din-T – Surface mount with orange door****Suits Din-T MCBs (DIN) refer to section one**

Main switch	Pole capacity	Box size	Height (mm)	Cat. No. <sup>2)</sup>	Price \$
-	24	1	700	<b>CDG 24O2</b>	<b>1550.00</b>
	36	2	900	<b>CDG 36O2</b>	<b>1750.00</b>
	48	2	900	<b>CDG 48O2</b>	<b>2010.00</b>
	60	3	1100	<b>CDG 60O2</b>	<b>2320.00</b>
	72	4	1300	<b>CDG 72O2</b>	<b>2550.00</b>
	84	4	1300	<b>CDG 84O2</b>	<b>2990.00</b>
	96	5	1500	<b>CDG 96O2</b>	<b>3400.00</b>
160 A	24	1	700	<b>CDG 24M160O2 <sup>1)</sup></b>	<b>1750.00</b>
	36	2	900	<b>CDG 36M160O2 <sup>1)</sup></b>	<b>1950.00</b>
	48	2	900	<b>CDG 48M160O2 <sup>1)</sup></b>	<b>2150.00</b>
	60	3	1100	<b>CDG 60M160O2 <sup>1)</sup></b>	<b>2480.00</b>
250 A	24	1	700	<b>CDG 24M250O2 <sup>1)</sup></b>	<b>1910.00</b>
	36	2	900	<b>CDG 36M250O2 <sup>1)</sup></b>	<b>2110.00</b>
	48	2	900	<b>CDG 48M250O2 <sup>1)</sup></b>	<b>2370.00</b>
	60	3	1100	<b>CDG 60M250O2 <sup>1)</sup></b>	<b>2680.00</b>
	72	4	1300	<b>CDG 72M250O2 <sup>1)</sup></b>	<b>2850.00</b>
	84	4	1300	<b>CDG 84M250O2 <sup>1)</sup></b>	<b>3350.00</b>
	96	5	1500	<b>CDG 96M250O2 <sup>1)</sup></b>	<b>3750.00</b>

Width = 585 mm, Depth = 185 mm includes door. (Door = 20 mm)

**Notes:** <sup>1)</sup> Main switch supplied loose i.e. CDG18-M250-O2 = CDG18O2+EVA3250H<sup>2)</sup> Enclosure with orange base replace "O" with "OO" e.g. CDG36OO2.

## CONCEPT•PLUS 2

### Energy metering panelboards for Din-T MCBS

2

- Standard AS/NZS 3439-3
- Dual metering, separate light and power (Greenstar V3.0)
- kWh, kvarh
- RS 485 Comms or pulsed output
- Active energy class 1.0 or better
- Options - V, A, W, var, Hz, PF, THD, Admd
- Options - gas and water inputs
- Retro fit kits available
- IP 42
- Commercial and industrial applications



Improve your  
NABERS,  
GREENSTAR  
rating

#### **Application**

The Concept•Plus energy metering range of panelboards have been designed to meet the energy metering requirements of today's market.

#### **CONCEPT•PLUS**

##### **160 A Energy metering panelboards with grey door**

CT connect meters rated 75 A for light circuits and 120 A for power circuits

Pole capacity size	Box size	Light poles	Power poles	Main switch	Cat. No.	Price \$
36	1100 mm	12	24	160 A	CDM36M160G	3370.00
48	1300 mm	18	30	160 A	CDM48M160G	3530.00
60	1300 mm	18	42	160 A	CDM60M160G	3790.00

#### **CONCEPT•PLUS**

##### **250 A Energy metering panelboards with grey door**

CT connect meters rated 120 A for light circuits and 200 A for power circuits

Pole capacity size	Box size	Light poles	Power poles	Main switch	Cat. No.	Price \$
60	1300 mm	18	42	250 A	CDM60M250G	3890.00
72	1500 mm	24	48	250 A	CDM72M250G	4100.00
84	1500 mm	30	54	250 A	CDM84M250G	4410.00
96	1700 mm	36	60	250 A	CDM96M250G	4510.00

#### **CONCEPT•PLUS**

##### **Retro fit energy metering kits with grey door**

Main switch	Box size	Light	Power poles	Cat. No. 1)	Price \$
-	400 mm	-	250 A	CDMRFG	1610.00
250 A	600 mm	-	250 A	CDMRFSM250AG6	2020.00
250 A	600 mm	125 A	250 A	CDMRFDM250AG6	2750.00

Width = 585 mm, depth = 185 mm, includes (door = 20 mm)

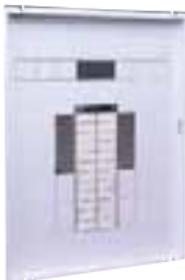
**Notes:** 1) Delete M160 and M250 if no main switch is required. Replace G with O for Orange door.

For other combinations or options refer to NHP.

**Metering boards are not suitable for utility metering.**

## CONCEPT•PLUS

### Multi-purpose panelboards for Safe-T MCBs



2

**CONCEPT•PLUS****Safe-T – Surface mount with grey door****Suits Safe-T-MCBs (NEMA) refer section one**

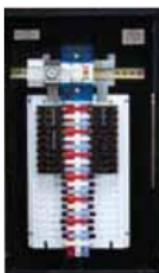
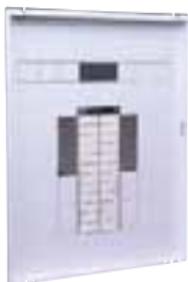
Main switch	Pole cap.	Box size	Height (mm)	Cat. No.	No M/S Price \$
-	24	1	700	CST 24G	1300.00
	36	2	900	CST 36G	1410.00
	48	3	1100	CST 48G	1550.00
	60	4	1300	CST 60G	1710.00
	72	5	1500	CST 72G	1860.00
	96	6	1700	CST 96G	2490.00
160 A	24	1	700	CST 24M160G <sup>1)</sup>	1550.00
	36	2	900	CST 36M160G <sup>1)</sup>	1660.00
	48	3	1100	CST 48M160G <sup>1)</sup>	1790.00
	60	4	1300	CST 60M160G <sup>1)</sup>	1960.00
250 A	24	1	700	CST 24M250G <sup>1)</sup>	1670.00
	36	2	900	CST 36M250G <sup>1)</sup>	1780.00
	48	3	1100	CST 48M250G <sup>1)</sup>	1920.00
	60	4	1300	CST 60M250G <sup>1)</sup>	2090.00
	72	5	1500	CST 72M250G <sup>1)</sup>	2230.00
	96	6	1700	CST 96M250G <sup>1)</sup>	2860.00

Width = 585 mm, Depth = 185 mm includes door. (Door = 20 mm)

**Notes:** 1) Main switch supplied loose i.e. CST24M250G = CST24G + CST250MS.

## **CONCEPT•PLUS**

### Multi-purpose panelboards for Safe-T MCBs



**CONCEPT•PLUS**

## **Safe-T – Surface mount with orange door**

**Suits Safe-T-MCBs (NEMA) refer section one**

Main switch	Pole cap.	Box size	Height (mm)	Cat. No.	No M/S Price \$
-	24	1	700	CST 240	1300.00
	36	2	900	CST 360	1410.00
	60	4	1300	CST 600	1710.00
	72	5	1500	CST 720	1860.00
	96	6	1700	CST 960	2490.00
160 A	24	1	700	CST 24M1600 <sup>1)</sup>	1550.00
	36	2	900	CST 36M1600 <sup>1)</sup>	1660.00
	60	4	1300	CST 60M1600 <sup>1)</sup>	1960.00
250 A	24	1	700	CST 24M2500 <sup>1)</sup>	1670.00
	36	2	900	CST 36M2500 <sup>1)</sup>	1780.00
	60	4	1300	CST 60M2500 <sup>1)</sup>	2090.00
	72	5	1500	CST 72M2500 <sup>1)</sup>	2230.00
	96	6	1700	CST 96M2500 <sup>1)</sup>	2860.00

Width = 585 mm. Depth = 185 mm includes door. (Door = 20 mm)

**Notes:** 1) Main switch supplied loose i.e. CST24M2500 = CST24O + CST250MS.

**CONCEPT•PLUS 2****Multi-purpose panelboards accessory modules****CONCEPT•PLUS 2 (Series 2)****Accessory modules with grey door<sup>1)</sup>**

Box size	Height (mm)	Pole cap	Cat. No. with escutcheon	Price \$
0	400	24 (1 row 24 way)	CPACC24G2	790.00
0	400	48 (2 row 24 way)	CPACC48G2	810.00
H	600	72 (3 row 24 way)	CPACC72G2	880.00

Box size	Height (mm)	Cat. No. without escutcheon	Price \$
0	400	CPACCSOG2	740.00
H	600	CPACCSHG2	870.00

Box size	Height (mm)	Cat. No. with blank escutcheon	Price \$
0	400	CPACCSOGE2	740.00
H	600	CPACCSHGE2	870.00
1	700	CPACCS1GE2	900.00
2	900	CPACCS2GE2	1020.00
3	1100	CPACCS3GE2	1130.00
4	1300	CPACCS4GE2	1320.00
5	1500	CPACCS5GE2	1430.00
6	1700	CPACCS6GE2	1610.00

Width = 585 mm, Depth = 185 mm includes door. (Door = 20 mm)

Height (mm)	Cat. No.	Price \$
94 mm	CPBGT51	46.50
194 mm	CPBGT52	67.50
294 mm	CPBGT53	88.00
494 mm	CPBGT5H	114.00
594 mm	CPBGT54	145.00
994 mm	CPBGT56	230.00

Gear trays for Concept Plus must be 100 mm shorter than enclosure size.

**Earth and neutral bar kit to suit accessory module**

No. of ways	Cat. No.	Price \$
24	CEN24	88.00
36	CEN36	95.00
48	CEN48	118.00
60	CEN60	144.00
72	CEN72	158.00
84	CEN84	193.00
96	CEN96	215.00

Includes 2 bars mounting supports and fasteners.

**Notes:** 1) For orange enclosure replace G with O e.g. CPACC24G2 with CPACC24O2

## CONCEPT•PLUS

### Multi-purpose panelboards options and accessories

2

Description			Cat. No.	Price \$
<b>Top mount main switch kits (supplied loose)</b>	160 A	3 pole	CDT, CDG	<b>EVA3160H</b> 305.00
			CST	<b>CST160MS</b> 305.00
	250 A	3 pole	CDT, CDG	<b>EVA3250H</b> 435.00
			CST	<b>CST250MS</b> 435.00
IP 52B sealing kit (Charcoal Base)			<b>CPIP52G</b>	210.00
<b>Chassis mount</b>	80 A	3 pole	CDT	<b>DINTMS803</b> 102.00
	100 A	3 pole	CDT	<b>DINTMS1003</b> 115.00
	100 A	3 pole	CST	<b>SAFET63100NA</b> 285.00
			Size 1	<b>CPBFK1</b> 300.00
<b>Flush surround kit (supplied loose) (45 mm width)</b>			Size 2	<b>CPBFK2</b> 300.00
			Size 3	<b>CPBFK3</b> 300.00
			Size 4	<b>CPBFK4</b> 300.00
			Size 5	<b>CPBFK5</b> 300.00
			Size 6	<b>CPBFK6</b> 300.00
Dust door seal fits all box sizes			<b>CPDRUBBER</b>	197.00
Blue cover to suit 160 A and 250 A isolator			<b>1LS2VS</b>	12.00
Floor mount plinth (100 mm height) <sup>3)</sup>			<b>CPPLINTH</b>	365.00
<b>Gland plate options</b>				
Open end-cap (cut-out for cable entry)			<b>CPECS</b>	104.00
Steel gland plate (suits open end-cap)			<b>CPGPS</b>	54.00
Brass gland plate (suits open end-cap) (3 mm)			<b>CPGPB</b>	220.00
Aluminium gland plate (suits open end-cap) (3 mm)			<b>CPGPA</b>	67.50
<b>Emergency lighting kit (supplied loose)</b>				
Rotary control switch (unwired)			<b>CPELK1<sup>1)</sup></b>	430.00
Rotary control switch (complete wired loom)			<b>CPELK1W<sup>1)</sup></b>	445.00
Key operated control switch (unwired)			<b>CPELK2<sup>1)</sup></b>	495.00
Door locks (suit Series 2)	CL001		<b>CPDHANDLECL001</b>	36.50
	92268		<b>CPDHANDLE92268</b>	36.50
	NSW PWD E LOCK		<b>CPDHANDLEELOCK</b>	290.00
	Pad lockable		<b>CPDHANDLEPADLCK</b>	78.00
Spare key (set of 2)	Non lockable		<b>CPDHANDLENOLOCK</b>	36.50
	CL001 x 2		<b>KEYCL001</b>	7.80
	92268 x 2		<b>KEY92268</b>	7.80
Escutcheon Hinge Kit <sup>2)</sup>			<b>CPESC</b>	50.00
White liner <sup>5)</sup>			<b>CPWIL_</b> <sup>4)</sup>	83.00

**Notes:** <sup>1)</sup> Emergency lighting kits can be field fitted utilising horizontal DIN knock-outs at top of board. Kits include control switch, timer, 24 A 4 P N/C contactor, labels and wiring diagram to AS 2293.1.

<sup>2)</sup> Qty 1 required for size 1-4 enclosure, Qty 2 required for size 5-6 enclosure.

<sup>3)</sup> Plinth is designed for bottom cable entry; if panelboard is freestanding additional support is required.

<sup>4)</sup> Insert enclosure size, e.g. size 5 CPWIL5.

<sup>5)</sup> White insert to transform interior of DB white without having to respray, 2 required per DB.

## CONCEPT•PLUS

### Multi-purpose panelboards options and accessories

#### Accessories

Description		Cat. No.	Price \$
External lighting kits (Time clock, contactor, bypass switch)	1 channel mini timer, 2 N/O 20 A contactor	CPEXTLK1	300.00
	1 channel, 2 N/O 20 A contactor	CPEXTLK1	395.00
	2 channel, 2 N/O 20 A contactor	CPEXTLK2	710.00
Split chassis kit (supplied loose)	CT250 A CST	STK250ND/TH	119.00
	CT355 A CST	STK300TH	119.00
Pole fillers	Din-T CDT	DTPF	4.30
	Safe-T CST	SAFE-TPF	1.80

#### Factory fitted options

Description	Cat. No.	Price \$
<b>Connection kits</b>		
250 A MCCB to CD chassis	CD250CKT2	280.00
200 A MCCB to NC chassis (Direct)	NCCK200CP <sup>1)</sup>	182.00
250 A MCCB to NC chassis (TAG)	NCCK250CP <sup>1)</sup>	490.00
Support bracket to mount 250 MCCB	CPBS250	83.00
<b>Optional main switches</b>		
- 160 A DIN switch fuse	ISO3160SFH	500.00
- 250 A MCCB non-auto	S250NN3	500.00
- 250 A MCCB	S250NJ	1480.00
- 315 A S+S load-break	LE 73151753	1090.00
- 400 A MCCB non-auto	S400NN3	1650.00
<b>Feeder MCCB</b>		
- 125 A 3 pole	DINT10H3125C	590.00
- 160 A 3 pole	S160NJ3160	1080.00
<b>Fault current limiters</b>		
- 160 A DIN size 00	Refer NHP	-
- 200 A DIN size 1	Refer NHP	-
Load shedding / emergency power contactor	Refer NHP	-
kWh metering IME energy meters	Refer Page	1 - 42
<b>Cable duct (fitted)</b>		
- CDT ... max. 100 x 100 mm	Refer NHP	-
- CST ... max. 60 x 100 mm	Refer NHP	-
<b>Special colours (doors)</b>		
- Standard powder coat (per Interpon chart)	Refer NHP	-

**Notes:** 1) Connection kit includes, connection tags, terminal covers and bracket.

## CONCEPT•PREMIER

**Suits Din-T and Safe-T MCBs, E125, S125 and S160,  
S250 MCCBs**

2

- Standard AS/NZS 3439-3
- IP 66 rated enclosure
- 1.6 mm fully welded construction
- 316 Stainless steel option
- 7 modular sizes 600 mm to 2000 mm
- Very generous amount of wiring room
- Accessory module
- Type tested busbar/chassis system
- Removable gland plates (with gaskets)
- 3 point door locking on sizes 1000 mm and above
- T handle door lock
- Flush handle door lock (series 2)
- Australian made
- Commercial, industrial and heavy industrial applications

IP 66



### Application

The CONCEPT•PREMIER range of Panelboards provides a unique enclosure system for NHP Din-T and Safe-T MCBs and E125, S125 and S160, S250 MCCBs.

### Features

- Two-tone colour scheme, make a colour change by simply changing the door colour
- The door is field changeable from right to left hinged and is totally independent of the escutcheon
- Gloss white hinged escutcheon has been dished to allow a wide range of accessories to fit under the door
- D handles fitted to the lift-off escutcheon to allow easy fitting and removal
- Knockouts provided in the escutcheon for up to 18 modules of standard DIN rail equipment (Din-T & Safe-T Panelboards only)
- Removable gland plates aid on-site installation of cable and trunking systems
- Compact main switch with a fully enclosed rating of 160 A and 250 A (Din-T and Safe-T Panelboards only)
- Mount up to a CA 6-170 contactor behind the escutcheon or a CA 6-420 in an accessory module without an escutcheon
- Dual earth and neutral bars, circuit identification and schedule cards supplied standard
- 30 % Larger gland plate opening in series 2



## CONCEPT•PREMIER

**Suits Din-T and Safe-T MCBs, E125, S125 and S160,  
S250 MCCBs**

### **Technical data**

<b>Material type:</b>	1.6 mm steel, polyester powder coated 1.6 mm 316 Stainless steel option
<b>Colour</b>	Base – Charcoal gloss
<b>(AS 2700-1995):</b>	Door – N42 Storm Grey or X15 Orange (other colours refer NHP) Escutcheon – Bright white gloss
<b>Protection degree:</b>	IP 30 – without door IP 66 – with door
<b>Busbar ratings:</b>	SafeT - 250 A CT (355 A option) Din-T - 250 A CD (355 A option) Din-T - 250 A NC (400 A option) Din-T - 250 A GB S125 MCCB - 630 A XA (800 A option)
<b>Main Switch (options):</b>	Safe-T 100 A non-auto (chassis mount Safe-T) Din-T M/S 80/100 A (chassis mount Din-T) 160 A, 250 A, 400 A, 630 A, & 800 A 3 pole 415 V AC (top mount)
<b>Neutral and earth bars:</b>	Din-T & Safe-T Panelboards - (dual bars) 2 x 8 mm studs & 2 screw tunnel terminals (16 mm) MCCBs Panelboards - 2 x 10 mm studs, 8 x 8 mm studs & 1 screw tunnel terminals (35 mm)

# CONCEPT•PREMIER

**The premium panelboard suits Din-T MCBs**



## **CONCEPT•PREMIER**

#### **Din-T – Surface mount with grey door**

**Suits Din-T MCBs (DIN) refer to section one**

Main Switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	18	1	800	CPD 18G	1870.00
	24	1	800	CPD 24G	1970.00
	36	2	1000	CPD 36G	2180.00
	48	2	1000	CPD 48G	2310.00
	60	3	1200	CPD 60G	2540.00
	72	4	1400	CPD 72G	3100.00
	84	4	1400	CPD 84G	3620.00
	96	5	1600	CPD 96G	4250.00
	18	1	800	CPD 18M160G <sup>1)</sup>	2120.00
160 A	24	1	800	CPD 24M160G	2220.00
	36	2	1000	CPD 36M160G <sup>1)</sup>	2430.00
	48	2	1000	CPD 48M160G <sup>1)</sup>	2560.00
	60	3	1200	CPD 60M160G <sup>1)</sup>	2790.00
	18	1	800	CPD 18M250G <sup>1)</sup>	2240.00
250 A	24	1	800	CPD 24M250G <sup>1)</sup>	2340.00
	36	2	1000	CPD 36M250G <sup>1)</sup>	2550.00
	48	2	1000	CPD 48M250G	2690.00
	60	3	1200	CPD 60M250G <sup>1)</sup>	2920.00
	72	4	1400	CPD 72M250G <sup>1)</sup>	3480.00
	84	4	1400	CPD 84M250G <sup>1)</sup>	3990.00
	96	5	1600	CPD 96M250G <sup>1)</sup>	4630.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** <sup>1)</sup> Main switches are supplied loose. i.e. CPD 24 M250 G = CPD 24G + CDT250MS

- Larger main switches and other options and accessories available.
  - Refer NHP for delivery confirmation regarding types with main switches.

## CONCEPT•PREMIER

The premium panelboard suits Din-T MCBs



2

### CONCEPT•PREMIER

Din-T – Surface mount with orange door

Suits Din-T MCBs (DIN) refer to section one

Main Switch	Pole capacity	Box size	Height (mm)	Cat. No. <sup>2)</sup>	Price \$
-	18	1	800	CPD 18O	1870.00
	24	1	800	CPD 24O	1970.00
	36	2	1000	CPD 36O	2180.00
	48	2	1000	CPD 48O	2310.00
	60	3	1200	CPD 60O	2540.00
	72	4	1400	CPD 72O	3100.00
	84	4	1400	CPD 84O	3620.00
	96	5	1600	CPD 96O	4250.00
	18	1	800	CPD 18M1600 <sup>1)</sup>	2120.00
160 A	24	1	800	CPD 24M1600 <sup>1)</sup>	2220.00
	36	2	1000	CPD 36M1600 <sup>1)</sup>	2430.00
	48	2	1000	CPD 48M1600 <sup>1)</sup>	2560.00
	60	3	1200	CPD 60M1600 <sup>1)</sup>	2790.00
	18	1	800	CPD 18M2500 <sup>1)</sup>	2240.00
250 A	24	1	800	CPD 24M2500 <sup>1)</sup>	2340.00
	36	2	1000	CPD 36M2500 <sup>1)</sup>	2550.00
	48	2	1000	CPD 48M2500 <sup>1)</sup>	2690.00
	60	3	1200	CPD 60M2500 <sup>1)</sup>	2920.00
	72	4	1400	CPD 72M2500 <sup>1)</sup>	3480.00
	84	4	1400	CPD 84M2500 <sup>1)</sup>	3990.00
	96	5	1600	CPD 96M2500 <sup>1)</sup>	4630.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** <sup>1)</sup> Main switches are supplied loose. i.e. CPD 24 M250 O = CPD 24O + CDT250MS.

<sup>2)</sup> Enclosures with orange base replace "O" with "OO" e.g. CPD36OO.

- Larger main switches and other options and accessories available.

- Refer NHP for delivery confirmation regarding types with main switches.

## CONCEPT•PREMIER SS

The premium panelboard suits Din-T MCBs

2



### CONCEPT•PREMIER

**Din-T – Surface mount with stainless steel door**

Suits Din-T MCBs (DIN) refer to section one

Main Switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	18	1	800	CPD 18SS	6850.00
	24	1	800	CPD 24SS	6950.00
	36	2	1000	CPD 36SS	7890.00
	48	2	1000	CPD 48SS	7980.00
	60	3	1200	CPD 60SS <sup>2)</sup>	9050.00
	72	4	1400	CPD 72SS <sup>2)</sup>	10150.00
	84	4	1400	CPD 84SS <sup>2)</sup>	10320.00
	96	5	1600	CPD 96SS <sup>2)</sup>	11100.00
	18	1	800	CPD 18M160SS <sup>1)</sup>	7160.00
160 A	24	1	800	CPD 24M160SS <sup>1)</sup>	7240.00
	36	2	1000	CPD 36M160SS <sup>1)</sup>	8140.00
	48	2	1000	CPD 48M160SS <sup>1)</sup>	8290.00
	60	3	1200	CPD 60M160SS <sup>1)</sup>	9330.00
	18	1	800	CPD 18M250SS <sup>1)</sup>	7310.00
250 A	24	1	800	CPD 24M250SS <sup>1)</sup>	7420.00
	36	2	1000	CPD 36M250SS <sup>1)</sup>	8290.00
	48	2	1000	CPD 48M250SS <sup>1)</sup>	8460.00
	60	3	1200	CPD 60M250SS <sup>1)</sup>	9490.00
	72	4	1400	CPD 72M250SS <sup>1)</sup>	10480.00
	84	4	1400	CPD 84M250SS <sup>1)</sup>	10690.00
	96	5	1600	CPD 96M250SS <sup>1)</sup>	11400.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** <sup>1)</sup> Main switches are supplied loose. i.e. CPD 24 M250 SS = CPD 24SS + CDT250MS.

<sup>2)</sup> Made to order.

- Stainless steel panelboards are fully assembled from stocked components.
- Larger main switches and other options and accessories available.
- Refer NHP for delivery confirmation regarding types with main switches.

## CONCEPT•PREMIER

The premium panelboard suits Din-T MCBs  
C/W isolation chassis

**NEW**  
Grizz-Bar  
Isolation  
chassis



2

### CONCEPT•PREMIER

Din-T – Surface mount with grey door

Suits Din-T MCBs (DIN) refer to section one

Main Switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	24	1	800	CPG 24G <sup>2)</sup>	2300.00
	36	2	1000	CPG 36G <sup>2)</sup>	2600.00
	48	2	1000	CPG 48G <sup>2)</sup>	2850.00
	60	3	1200	CPG 60G <sup>2)</sup>	3200.00
	72	4	1400	CPG 72G <sup>2)</sup>	3850.00
	84	4	1400	CPG 84G <sup>2)</sup>	4550.00
	96	5	1600	CPG 96G <sup>2)</sup>	5250.00
160 A	24	1	800	CPG 24M160G <sup>1)</sup>	2550.00
	36	2	1000	CPG 36M160G <sup>1)</sup>	2850.00
	48	2	1000	CPG 48M160G <sup>1)</sup>	3050.00
	60	3	1200	CPG 60M160G <sup>1)</sup>	3450.00
250 A	24	1	800	CPG 24M250G <sup>1)</sup>	2650.00
	36	2	1000	CPG 36M250G <sup>1)</sup>	2950.00
	48	2	1000	CPG 48M250G <sup>1)</sup>	3200.00
	60	3	1200	CPG 60M250G <sup>1)</sup>	3550.00
	72	4	1400	CPG 72M250G <sup>1)</sup>	4200.00
	84	4	1400	CPG 84M250G <sup>1)</sup>	4900.00
	96	5	1600	CPG 96M250G <sup>1)</sup>	5600.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** <sup>1)</sup> Main switches are supplied loose. i.e. CPG 24 M250 G = CPG 24G + EVA3250H.

<sup>2)</sup> Made to order.

- Larger main switches and other options and accessories available.
- Refer NHP for delivery confirmation regarding types with main switches.

## **CONCEPT•PREMIER**

**The premium panelboard suits Din-T MCBs  
C/W isolation chassis**



CONCEPT•PREMIER

## Din-T – Surface mount with orange door

**Suits Din-T MCBs (DIN) refer to section one**

Main Switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	24	1	800	CPG 24O <sup>2)</sup>	2300.00
	36	2	1000	CPG 36O <sup>2)</sup>	2600.00
	48	2	1000	CPG 48O <sup>2)</sup>	2850.00
	60	3	1200	CPG 60O <sup>2)</sup>	3200.00
	72	4	1400	CPG 72O <sup>2)</sup>	3850.00
	84	4	1400	CPG 84O <sup>2)</sup>	4550.00
	96	5	1600	CPG 96O <sup>2)</sup>	5250.00
160 A	24	1	800	CPG 24M160O <sup>1)</sup>	2550.00
	36	2	1000	CPG 36M160O <sup>1)</sup>	2850.00
	48	2	1000	CPG 48M160O <sup>1)</sup>	3050.00
	60	3	1200	CPG 60M160O <sup>1)</sup>	3450.00
250 A	24	1	800	CPG 24M250O <sup>1)</sup>	2650.00
	36	2	1000	CPG 36M250O <sup>1)</sup>	2950.00
	48	2	1000	CPG 48M250O <sup>1)</sup>	3200.00
	60	3	1200	CPG 60M250O <sup>1)</sup>	3550.00
	72	4	1400	CPG 72M250O <sup>1)</sup>	4200.00
	84	4	1400	CPG 84M250O <sup>1)</sup>	4900.00
	96	5	1600	CPG 96M250O <sup>1)</sup>	5600.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** 1) Main switches are supplied loose. i.e. CPG 24 M250 O = CPG 24O + EVA3250H

<sup>2)</sup> Made to order.

- Made to order.
  - Larger main switches and other options and accessories available.
  - Refer NHP for delivery confirmation regarding types with main switches.

**CONCEPT•PREMIER****The premium panelboard suits Din-T MCBs****400 A  
Chassis****Made  
to  
order****2****CONCEPT•PREMIER****Din-T – Surface mount with grey door****Suits Din-T MCBs (DIN) refer to section one**

Main Switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
400 A Isolator Socomec SLB400	48	4	1400	CPD 48M400G	3300.00
	60	5	1600	CPD 60M400G	3600.00
	72	5	1600	CPD 72M400G	4200.00
	84	6	1800	CPD 84M400G	4700.00
	96	6	1800	CPD 96M400G	5300.00
300 A Isolator Terasaki S400NN	48	4	1400	CPD 48M300G	3300.00
	60	5	1600	CPD 60M300G	3600.00
	72	5	1600	CPD 72M300G	4200.00
	84	6	1800	CPD 84M300G	4700.00
	96	6	1800	CPD 96M300G	5300.00
300 A MCCB Terasaki S400CJ	48	4	1400	CPD 48MCCB300G	3800.00
	60	5	1600	CPD 60MCCB300G	4100.00
	72	5	1600	CPD 72MCCB300G	4700.00
	84	6	1800	CPD 84MCCB300G	5200.00
	96	6	1800	CPD 96MCCB300G	5800.00

**Notes:** 400 NC chassis universal feed.

## CONCEPT•PREMIER 2

The premium panelboard suits Din-T MCBs

2

Series 2  
NC chassis  
flush handle



Available  
mid 2013

### CONCEPT•PREMIER

Din-T – Surface mount with grey door

Suits Din-T MCBs (DIN) refer to section one

Main Switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
	18	1	800	CPD 18G2	1870.00
	24	1	800	CPD 24G2	1970.00
	36	2	1000	CPD 36G2	2180.00
-	48	2	1000	CPD 48G2	2310.00
	60	3	1200	CPD 60G2	2540.00
	72	4	1400	CPD 72G2	3100.00
	84	4	1400	CPD 84G2	3620.00
	96	5	1600	CPD 96G2	4250.00
	18	1	800	CPD 18M160G2 <sup>1)</sup>	2120.00
	24	1	800	CPD 24M160G2 <sup>1)</sup>	2220.00
160 A	36	2	1000	CPD 36M160G2 <sup>1)</sup>	2430.00
	48	2	1000	CPD 48M160G2 <sup>1)</sup>	2560.00
	60	3	1200	CPD 60M160G2 <sup>1)</sup>	2790.00
	18	1	800	CPD 18M250G2 <sup>1)</sup>	2240.00
	24	1	800	CPD 24M250G2 <sup>1)</sup>	2340.00
	36	2	1000	CPD 36M250G2 <sup>1)</sup>	2550.00
250 A	48	2	1000	CPD 48M250G2 <sup>1)</sup>	2690.00
	60	3	1200	CPD 60M250G2 <sup>1)</sup>	2920.00
	72	4	1400	CPD 72M250G2 <sup>1)</sup>	3480.00
	84	4	1400	CPD 84M250G2 <sup>1)</sup>	3990.00
	96	5	1600	CPD 96M250G2 <sup>1)</sup>	4630.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** 1) Main switches are supplied loose. i.e. CPD 24 M250 G = CPD 24G + EVA3250H.

- Larger main switches and other options and accessories available.
- Refer NHP for delivery confirmation regarding types with main switches.

## CONCEPT•PREMIER 2

The premium panelboard suits Din-T MCBs

Series 2  
NC chassis  
flush handle



Available  
mid 2013

2

### CONCEPT•PREMIER

Din-T – Surface mount with orange door

Suits Din-T MCBs (DIN) refer to section one

Main Switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
	18	1	800	CPD 18O2	1870.00
	24	1	800	CPD 24O2	1970.00
	36	2	1000	CPD 36O2	2180.00
	48	2	1000	CPD 48O2	2310.00
	60	3	1200	CPD 60O2	2540.00
	72	4	1400	CPD 72O2	3100.00
	84	4	1400	CPD 84O2	3620.00
	96	5	1600	CPD 96O2	4250.00
160 A	18	1	800	CPD 18M160O2 <sup>1)</sup>	2120.00
	24	1	800	CPD 24M160O2 <sup>1)</sup>	2220.00
	36	2	1000	CPD 36M160O2 <sup>1)</sup>	2430.00
	48	2	1000	CPD 48M160O2 <sup>1)</sup>	2560.00
	60	3	1200	CPD 60M160O2 <sup>1)</sup>	2790.00
250 A	18	1	800	CPD 18M250O2 <sup>1)</sup>	2240.00
	24	1	800	CPD 24M250O2 <sup>1)</sup>	2340.00
	36	2	1000	CPD 36M250O2 <sup>1)</sup>	2550.00
	48	2	1000	CPD 48M250O2 <sup>1)</sup>	2690.00
	60	3	1200	CPD 60M250O2 <sup>1)</sup>	2920.00
	72	4	1400	CPD 72M250O2 <sup>1)</sup>	3480.00
	84	4	1400	CPD 84M250O2 <sup>1)</sup>	3990.00
	96	5	1600	CPD 96M250O2 <sup>1)</sup>	4630.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** 1) Main switches are supplied loose. i.e. CPD 24 M250 O = CPD 24O + EVA3250H.

- Enclosures with orange base replace "O" with "OO" e.g. CPD36OO.
- Larger main switches and other options and accessories available.
- Refer NHP for delivery confirmation regarding types with main switches.

**CONCEPT•PREMIER 2 SS**

The premium panelboard suits Din-T MCBs

2

  
Series 2  
NC chassis  
flush handle

  
Available  
mid 2013
**CONCEPT•PREMIER****Din-T – Surface mount with stainless steel door**

Suits Din-T MCBs (DIN) refer to section one

Main Switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
	18	1	800	CPD 18SS2	6850.00
	24	1	800	CPD 24SS2	6950.00
	36	2	1000	CPD 36SS2	7890.00
	48	2	1000	CPD 48SS2	7980.00
	60	3	1200	CPD 60SS2 <sup>2)</sup>	9050.00
	72	4	1400	CPD 72SS2 <sup>2)</sup>	10150.00
	84	4	1400	CPD 84SS2 <sup>2)</sup>	10320.00
	96	5	1600	CPD 96SS2 <sup>2)</sup>	11100.00
160 A	18	1	800	CPD 18M160SS2 <sup>1)</sup>	7160.00
	24	1	800	CPD 24M160SS2 <sup>1)</sup>	7240.00
	36	2	1000	CPD 36M160SS2 <sup>1)</sup>	8140.00
	48	2	1000	CPD 48M160SS2 <sup>1)</sup>	8290.00
	60	3	1200	CPD 60M160SS2 <sup>1)</sup>	9330.00
250 A	18	1	800	CPD 18M250SS2 <sup>1)</sup>	7310.00
	24	1	800	CPD 24M250SS2 <sup>1)</sup>	7420.00
	36	2	1000	CPD 36M250SS2 <sup>1)</sup>	8290.00
	48	2	1000	CPD 48M250SS2 <sup>1)</sup>	8460.00
	60	3	1200	CPD 60M250SS2 <sup>1)</sup>	9490.00
	72	4	1400	CPD 72M250SS2 <sup>1)</sup>	10480.00
	84	4	1400	CPD 84M250SS2 <sup>1)</sup>	10690.00
	96	5	1600	CPD 96M250SS2 <sup>1)</sup>	11400.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** <sup>1)</sup> Main switches are supplied loose. i.e. CPD 24 M250 SS2 = CPD 24SS2 + EVA3250H.

<sup>2)</sup> Made to order.

- Larger main switches and other options and accessories available.
- Refer NHP for delivery confirmation regarding types with main switches.

## CONCEPT•PREMIER 2

The premium panelboard suits Din-T MCBs  
C/W isolation chassis

Series 2  
NC chassis  
flush handle



Available  
mid 2013

2

### CONCEPT•PREMIER

#### Din-T – Surface mount with grey door

Suits Din-T MCBs (DIN) refer to section one

Main Switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
	24	1	800	CPG 24G2 <sup>2)</sup>	2300.00
	36	2	1000	CPG 36G2 <sup>2)</sup>	2600.00
	48	2	1000	CPG 48G2 <sup>2)</sup>	2850.00
-	60	3	1200	CPG 60G2 <sup>2)</sup>	3200.00
	72	4	1400	CPG 72G2 <sup>2)</sup>	3850.00
	84	4	1400	CPG 84G2 <sup>2)</sup>	4550.00
	96	5	1600	CPG 96G2 <sup>2)</sup>	5250.00
160 A	24	1	800	CPG 24M160G2 <sup>1)</sup>	2550.00
	36	2	1000	CPG 36M160G2 <sup>1)</sup>	2850.00
	48	2	1000	CPG 48M160G2 <sup>1)</sup>	3050.00
	60	3	1200	CPG 60M160G2 <sup>1)</sup>	3450.00
250 A	24	1	800	CPG 24M250G2 <sup>1)</sup>	2650.00
	36	2	1000	CPG 36M250G2 <sup>1)</sup>	2950.00
	48	2	1000	CPG 48M250G2 <sup>1)</sup>	3200.00
	60	3	1200	CPG 60M250G2 <sup>1)</sup>	3550.00
	72	4	1400	CPG 72M250G2 <sup>1)</sup>	4200.00
	84	4	1400	CPG 84M250G2 <sup>1)</sup>	4900.00
	96	5	1600	CPG 96M250G2 <sup>1)</sup>	5600.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** <sup>1)</sup> Main switches are supplied loose. i.e. CPG 24 M250 G2 = CPG 24G2 + EVA3250H.

<sup>2)</sup> Made to order.

- Larger main switches and other options and accessories available.
- Refer NHP for delivery confirmation regarding types with main switches.

## **CONCEPT•PREMIER 2**

**The premium panelboard suits Din-T MCBs  
C/W isolation chassis**



**Series 2  
NC chassis  
flush handle**



**Available  
mid 2013**

**CONCEPT•PREMIER**

#### **Pin-T - Surface mount with orange door**

**Suits Din-T MCBs (DIN) refer to section one**

Buits DIN - MCCBs (DIN), refer to Section ONE					
Main Switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	24	1	800	CPG 24O2 <sup>2)</sup>	2300.00
	36	2	1000	CPG 36O2 <sup>2)</sup>	2600.00
	48	2	1000	CPG 48O2 <sup>2)</sup>	2850.00
	60	3	1200	CPG 60O2 <sup>2)</sup>	3200.00
	72	4	1400	CPG 72O2 <sup>2)</sup>	3850.00
	84	4	1400	CPG 84O2 <sup>2)</sup>	4550.00
	96	5	1600	CPG 96O2 <sup>2)</sup>	5250.00
160 A	24	1	800	CPG 24M160O2 <sup>1)</sup>	2550.00
	36	2	1000	CPG 36M160O2 <sup>1)</sup>	2850.00
	48	2	1000	CPG 48M160O2 <sup>1)</sup>	3050.00
	60	3	1200	CPG 60M160O2 <sup>1)</sup>	3450.00
250 A	24	1	800	CPG 24M250O2 <sup>1)</sup>	2650.00
	36	2	1000	CPG 36M250O2 <sup>1)</sup>	2950.00
	48	2	1000	CPG 48M250O2 <sup>1)</sup>	3200.00
	60	3	1200	CPG 60M250O2 <sup>1)</sup>	3550.00
	72	4	1400	CPG 72M250O2 <sup>1)</sup>	4200.00
	84	4	1400	CPG 84M250O2 <sup>1)</sup>	4900.00
	96	5	1600	CPG 96M250O2 <sup>1)</sup>	5600.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** 1) Main switches are supplied loose. i.e. CPG 24 M250 O2 = CPG 24O2 + EVA3250H

<sup>2)</sup> Made to order

- Larger main switches and other options and accessories available.
  - Refer NHP for delivery confirmation regarding types with main switches.

## CONCEPT•PREMIER

**The premium panelboard suits Safe-T MCBs**



2

### **CONCEPT•PREMIER**

#### **Safe-T – Surface mount with grey door**

**Suits Safe-T MCBs (NEMA) refer to section one**

Main Switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	24	1	800	CPS 24G <sup>2)</sup>	2060.00
	36	2	1000	CPS 36G	2260.00
	48	3	1200	CPS 48G	2410.00
	60	4	1400	CPS 60G	2580.00
	72	5	1600	CPS 72G <sup>2)</sup>	3220.00
	84	6	1800	CPS 84G <sup>2)</sup>	3720.00
	96	6	1800	CPS 96G <sup>2)</sup>	4360.00
160 A	24	1	800	CPS 24M160G <sup>1)</sup>	2310.00
	36	2	1000	CPS 36M160G <sup>1)</sup>	2510.00
	48	3	1200	CPS 48M160G <sup>1)</sup>	2660.00
	60	4	1400	CPS 60M160G <sup>1)</sup>	2830.00
250 A	24	1	800	CPS 24M250G <sup>1)</sup>	2440.00
	36	2	1000	CPS 36M250G <sup>1)</sup>	2640.00
	48	3	1200	CPS 48M250G <sup>1)</sup>	2780.00
	60	4	1400	CPS 60M250G <sup>1)</sup>	2960.00
	72	5	1600	CPS 72M250G <sup>1)</sup>	3590.00
	84	6	1800	CPS 84M250G <sup>1)</sup>	4100.00
	96	6	1800	CPS 96M250G <sup>1)</sup>	4730.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** <sup>1)</sup> Main switches are supplied loose. i.e. CPS 24 M250 G = CPS 24G + EVA3250H.

<sup>2)</sup> Made to order.

- Larger main switches and other options and accessories available.
- Refer NHP for delivery confirmation regarding types with main switches.

## CONCEPT•PREMIER

**The premium panelboard suits Safe-T MCBs**



2

### **CONCEPT•PREMIER**

#### **Safe-T – Surface mount with orange door**

**Suits Safe-T MCBs (NEMA) refer to section one**

Main Switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	24	1	800	CPS 24O <sup>2)</sup>	2060.00
	36	2	1000	CPS 36O <sup>2)</sup>	2260.00
	48	3	1200	CPS 48O <sup>2)</sup>	2410.00
	60	4	1400	CPS 60O <sup>2)</sup>	2580.00
	72	5	1600	CPS 72O <sup>2)</sup>	3220.00
	96	6	1800	CPS 96O <sup>2)</sup>	4360.00
160 A	24	1	800	CPS 24M160O <sup>1)</sup>	2310.00
	36	2	1000	CPS 36M160O <sup>1)</sup>	2510.00
	48	3	1200	CPS 48M160O <sup>1)</sup>	2660.00
	60	4	1400	CPS 60M160O <sup>1)</sup>	2830.00
250 A	24	1	800	CPS 24M250O <sup>1)</sup>	2440.00
	36	2	1000	CPS 36M250O <sup>1)</sup>	2640.00
	48	3	1200	CPS 48M250O <sup>1)</sup>	2780.00
	60	4	1400	CPS 60M250O <sup>1)</sup>	2960.00
	72	5	1600	CPS 72M250O <sup>1)</sup>	3590.00
	96	6	1800	CPS 96M250O <sup>1)</sup>	4730.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** <sup>1)</sup> Main switches are supplied loose. i.e. CPS 24 M250 O = CPS 24O + EVA3250H.

<sup>2)</sup> Made to order.

- Larger main switches and other options and accessories available.
- Refer NHP for delivery confirmation regarding types with main switches.

**CONCEPT•PREMIER CPX****The premium panelboard****Suits E125, S125 MCCBs**

2

**CONCEPT•PREMIER CPX****MCCB - Surface mount with grey door**

Pole cap.	Box size	Height (mm)	Cat. No.	Price \$
18	2	1000	CPX18G <sup>1)</sup>	3680.00
24	2	1000	CPX24G <sup>1)</sup>	4100.00
36	3	1200	CPX36G <sup>1)</sup>	4460.00
42	4	1400	CPX42G	4880.00
48	4	1400	CPX48G	4930.00
60	5	1600	CPX60G	5290.00
72	6	1800	CPX72G	5710.00

**CONCEPT•PREMIER CPX****MCCB - Surface mount with orange door**

Pole cap.	Box size	Height (mm)	Cat. No.	Price \$
18	2	1000	CPX18O <sup>1)</sup>	3680.00
24	2	1000	CPX24O <sup>1)</sup>	4100.00
36	3	1200	CPX36O	4460.00
42	4	1400	CPX42O	4880.00
48	4	1400	CPX48O	4930.00
60	5	1600	CPX60O	5290.00
72	6	1800	CPX72O	5710.00

**CONCEPT•PREMIER CPX****MCCB - Surface mount stainless steel**

Pole cap.	Box size	Height (mm)	Cat. No.	Price \$
18	2	1000	CPX18SS	8560.00
24	2	1000	CPX24SS	8770.00
36	3	1200	CPX36SS	10220.00
42	4	1400	CPX42SS	11460.00
48	4	1400	CPX48SS	11670.00
60	5	1600	CPX60SS	13120.00
72	6	1800	CPX72SS	14270.00

Width = 640 mm, Depth = 240 mm includes door. (Door = 20 mm)

**Notes:** CPX panelboards are fully assembled from stocked components.

Cat. No. refers to panelboard suitable for E125, S125 MCCBs.

Refer to NHP for panelboard suitable for S160, S250 MCCBs.

<sup>1)</sup> Units stocked.

## CONCEPT•PREMIER

### The premium panelboard options and accessories

#### **Accessory modules**

2

Box size	Height (mm)	Pole cap.	With escutcheon Cat. No. ')	Price \$
H	600	24	CPPACC24G	1030.00
H	600	48	CPPACC48G	1060.00
<b>Without escutcheon Cat. No. ')</b>			<b>Price \$</b>	
Box size	Height (mm)		CPPACCG	950.00
H	600			
Box size	Height (mm)		With blank escutcheon Cat. No. ')	Price \$
H	600		CPPACCGE	1020.00
1	800		CPPACCS1GE	1250.00
2	1000		CPPACCS2GE	1450.00
3	1200		CPPACCS3GE	1660.00
4	1400		CPPACCS4GE	1970.00
5	1600		CPPACCS5GE	2280.00
6	1800		CPPACCS6GE	2590.00
7	2000		CPPACCS7GE	2910.00

Width = 640 mm Depth = 240 mm includes door (Door = 20 mm)

#### **Gear trays to suit Accessory Module**

##### **White mounting plate**

Height (mm)	Cat. No.	Price \$
94	CPBGT51	46.50
194	CPBGT52	67.50
294	CPBGT53	88.00
494	CPBGTSH	114.00
594	CPBGT54	145.00
994	CPBGT56	230.00

Gear trays for Concept Premier must be 200 mm shorter than enclosure size.

#### **Earth and neutral bar kit to suit Accessory Module**

No Ways	Cat. No.	Price \$
24	CEN24	88.00
36	CEN36	95.00
48	CEN48	118.00
60	CEN60	144.00
72	CEN72	158.00
84	CEN84	193.00
96	CEN96	215.00

Includes 2 bars, mounting supports and fasteners.

**Notes:** 1) Replace "G" with "O" for orange door, replace "G" with "SS" for stainless steel.

## CONCEPT•PREMIER 2

### The premium panelboard options and accessories

Series 2  
available  
mid 2013

#### Accessory modules

Box size	Height (mm)	Pole cap.	With escutcheon Cat. No. <sup>1)</sup>	Price \$
H	600	24	CPPACC24G2	1030.00
H	600	48	CPPACC48G2	1060.00

Box size	Height (mm)	Without escutcheon Cat. No. <sup>1)</sup>	Price \$
H	600	CPPACCG2	1030.00

Box size	Height (mm)	With blank escutcheon Cat. No. <sup>1)</sup>	Price \$
H	600	CPPACCGE2	1060.00
1	800	CPPACCS1GE2	1250.00
2	1000	CPPACCS2GE2	1450.00
3	1200	CPPACCS3GE2	1660.00
4	1400	CPPACCS4GE2	1970.00
5	1600	CPPACCS5GE2	2280.00
6	1800	CPPACCS6GE2	2590.00
7	2000	CPPACCS7GE2	2910.00

Width = 640 mm Depth = 240 mm includes door (Door = 20 mm)

**Notes:** <sup>1)</sup> Replace "G" with "O" for orange door, replace "G" with "SS" for stainless steel.

## **CONCEPT•PREMIER**

#### **The premium panelboard options and accessories**

## Options and accessories

Description	Cat. No.	Price \$
Emergency lighting kits	rotary control switch (unwired)	CPELK1 430.00
	rotary control switch (wired loom)	CPELK1W 445.00
	Key switch (unwired)	CPELK2 495.00
Flush kits (supplied loose) 45 mm width	Size H	CPPFKH 300.00
	Size 1	CPPFK1 300.00
	Size 2	CPPFK2 300.00
	Size 3	CPPFK3 300.00
	Size 4	CPPFK4 300.00
	Size 5	CPPFK5 300.00
	Size 6	CPPFK6 300.00
	Size 7	CPPFK7 300.00
Weather-proof cover	Mild steel	Single width CPPWC 255.00 Double width CPPWCD 415.00
	Stainless steel	Single width CPPWCSS 650.00
		Double width CPPWCDS 2390.00
	Mild steel	Single width CPPPLINTHS 360.00 Double width CPPPLINTHD 930.00
Floor mounting plinth <sup>2)</sup> (100 mm)	Stainless steel	Single width CPPPLINTHSS 1220.00 Double width CPPPLINTHDSS 2650.00
Wall mounting brackets	Mild steel	CPPWBMS 290.00
	Stainless steel	CPPWB 325.00
Gland plates	Brass 3 mm	CPPGPB 200.00
	Brass 5 mm	CPPGPB5 375.00
	Aluminium 3 mm	CPPGPA 67.50
	Aluminium 6 mm	CPPGPA6 72.50
	White liners <sup>1)</sup> 2 required per board	Size H CPPWILH 150.00
		Size 1 CPPWIL1 150.00
		Size 2 CPPWIL2 150.00
		Size 3 CPPWIL3 150.00
		Size 4 CPPWIL4 150.00
		Size 5 CPPWIL5 150.00
		Size 6 CPPWIL6 150.00
		Size 7 CPPWIL7 150.00
Gland plate gasket	Series 1	305.00001 6.20
	Series 2	TBA POA

**Notes:** 1) Transforms interior of board white without respray.

- ✓) transforms interior of board white without respray.
- ✓) Plinth is designed for bottom cable entry, if panelboard is freestanding additional support is required.

**CONCEPT•PREMIER**
**The premium panelboard**  
**Options and accessories**
**Accessories**

Description	Cat. No.	Price \$
Top mount main switch kit (supplied loose)	160 A 3 pole CPD	<b>CDT160MS</b> 305.00
	CPG, CPS	<b>EVA3160H</b> 305.00
	250 A 3 pole CPD	<b>CDT250MS</b> 435.00
	CPG, CPS	<b>EVA3250H</b> 435.00
Blue cover to suit 160 A and 250 A isolator	<b>1LS2VS</b>	12.00
Split chassis kits	CPD CD chassis	<b>STKCD</b> 119.00
	CPS CT chassis 250 A	<b>STK250NDTH</b> 119.00
	CPS CT chassis 355 A	<b>STK300TH</b> 119.00
Connection kits	250 A MCCB to CD chassis	<b>CD250CKT2</b> 280.00
	200 A MCCB to NC chassis (Direct)	<b>NCCK200CPP</b> 187.00
	250 A MCCB to NC chassis (TAG)	<b>NCCK250CPP</b> 500.00
	400 A MCCB to NC chassis (TAG)	<b>NCCK400CPP</b> 590.00
	400 A SLB to NC chassis (TAG)	<b>NCCK4002CPP</b> 820.00
Support bracket to mount S250	<b>CPPBS250</b>	83.00
Pole Fillers	Din-T	<b>DTPF</b> 4.30
	Safe-T	<b>SAFETPF</b> 1.80
	S 125	<b>XAB2</b> 3.80
	S 250	<b>XAB3</b> 3.80
Door handles (T handle)	CL001	<b>CPPDCL001</b> 67.50
	92268	<b>CPPD92268</b> 78.00
Tee-off plastic caps	CD-Din-T	<b>CD250TOPC</b> 0.60
	NC-Din-T	<b>NC250TOPC</b> 0.80
	GB-Din-T	<b>GBTOC</b>
	Safe-T	<b>TH250TOPC</b> 0.60
Spare Key (set of 2)	CL001	<b>KEYCL001</b> 7.80
	92268	<b>KEY92268</b> 7.80
NSW PWD E lock (series 1)		<b>CPPPWDNSW</b> 295.00
Traffolite labelling available		<b>REFER NHP</b> -
Special paint colour		<b>REFER NHP</b> -
PVC wiring duct		<b>REFER NHP</b> -
kWh meter		<b>REFER PAGE</b> -
		<b>1 - 42</b>

## CONCEPT•TOUGH

### The heavy-duty panelboard

**Suits Din-T MCBs, E125, S125 and S160, S250 MCCBs**

2

- Standard AS/NZS 3439.3
- IP 66 rated enclosure
- 2.0 mm fully welded construction
- 316 Stainless steel option
- 6mm Aluminium gland plates
- 4 modular sizes 500 mm to 2000 mm
- Very generous amounts of wiring room
- Type tested busbar/chassis system
- Removable gland plates (with gaskets)
- Lift-off hinged escutcheon
- Chrome hinges and door handle
- 3 point door locking
- Australian made
- Padlockable door handle
- Commercial, industrial and heavy industrial applications



### Application

The CONCEPT•TOUGH range of Panelboards provides a unique enclosure system for NHP Din-T MCBs, E125, S125 and S160, S250 MCCBs.

### Features

- The lift-off hinged door is totally independent of the escutcheon.
- Generous space between door and escutcheon to allow a wide range of accessories/locking facilities to fit behind the door.
- D handles fitted to the lift-off escutcheon to allow easy fitting and removal.
- Knockouts provided in the escutcheon for up to 18 modules of standard DIN rail equipment (Din-T Panelboards only)
- Removable gland plates aid on-site installation of cable and trunking systems.
- Compact main switch with a fully enclosed rating of 160 A and 250 A (Din-T Panelboards only).
- Large gland plates to allow for incoming/outgoing cables.
- Dual earth and neutral bars, circuit identification and two schedule cards supplied standard.
- 6 mm aluminum gland plate

## CONCEPT•TOUGH

### The heavy-duty panelboard

**Suits Din-T MCBs, E125, S125 and S160, S250 MCCBs**

#### Technical data

<b>Material type:</b>	2.0 mm steel, polyester powder coated 6 mm Aluminium gland plates 2.0 mm 316 Stainless steel option	2
<b>Colour (AS 2700-1995):</b>	Base – Orange gloss / Charcoal gloss Door – X15 Orange or N42 Storm Grey (other colours refer NHP) Escutcheon – Bright white gloss	
<b>Protection degree:</b>	IP 40 – without door IP 66 – with door	
<b>Busbar ratings:</b>	Din-T Panelboards - 250 A CD chassis (355 A option) - 250 A NC chassis (400 A option)	
	S 125 MCCBs Panelboard - 630 A (std), 36 kA for 1 second - 800 A (optional)	
<b>Main switch (options):</b>	Din-T M/S 80/100 A (chassis mount Din-T) 160 A, 250 A, 400 A, 630 A & 800 A 3 pole 415 V AC (top mount)	
<b>Neutral and Earth bars:</b>	Din-T Panelboards - (dual bars) 2 x 8 mm studs & 2 screw tunnel terminals (16 mm) S 125 MCCBs Panrlboard 2 x 10 mm studs, 8 x 8 mm studs & 1 screw tunnel terminals (35 mm) 400 A	

## **CONCEPT•TOUGH**

### The heavy-duty panelboard Suits Din-T MCBs



**CONCEPT•TOUGH**  
**Din-T - Surface mount orange**

Pole capacity	Box size	Height (mm)	Cat. No. <sup>1)</sup>	Price \$
18	2	1000	CTD180	5910.00
24	2	1000	CTD240	6230.00
36	2	1000	CTD360	6540.00
48	2	1000	CTD480	6740.00
60	3	1500	CTD600	8090.00
72	3	1500	CTD720	8510.00
84	3	1500	CTD840	8920.00
96	3	1500	CTD960	9230.00

**CONCEPT•TOUGH**  
**Din-T - Surface mount stainless steel-orange**

Pole capacity	Box size	Height (mm)	Cat. No. <sup>1)</sup>	Price \$
18	2	1000	CTD18SSO	20020.00
24	2	1000	CTD24SSO	20230.00
36	2	1000	CTD36SSO	20270.00
48	2	1000	CTD48SSO	20580.00
60	3	1500	CTD60SSO	24010.00
72	3	1500	CTD72SSO	24320.00
84	3	1500	CTD84SSO	24530.00
96	3	1500	CTD96SSO	24730.00

Delete "O" for raw stainless enclosure e.g. CTD18SS.

## **CONCEPT•TOUGH**

### **Accessory modules with orange doors**

Pole capacity	Box size	Height (mm)	Cat. No. <sup>1)</sup>	Price \$
0	1	500	CTACCO	3990.00
24	1	500	CTACC24HO <sup>2)</sup>	4250.00
24	1	500	CTACC240	4250.00

Width = 800 mm, Depth = 300 mm includes door. (Door = 20 mm)

**Notes:**

- <sup>1)</sup> CTD panelboard are fully assembled from stocked components.  
Correct box size when fitting 160 A or 250 A isolator.  
Made to order.
- <sup>2)</sup> 24 pole horizontal on DIN Rail (18P suit lock DIN, 3P suit STD DIN)

## CONCEPT•TOUGH

**The heavy-duty panelboard**  
**Suits E125, S125 MCCBs**



2

### **CONCEPT•TOUGH**

#### **MCCB - Surface mount with orange door**

Main switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	18	2	1000	CTX18O	7420.00
	24	2	1000	CTX24O	7680.00
	36	3	1500	CTX36O	8140.00
	48	3	1500	CTX48O	8660.00
	60	3	1500	CTX60O	11050.00
	72	4	2000	CTX72O	11620.00
	18	3	1500	CTX18M4000	POA
400 A S400CJ	24	3	1500	CTX24M4000	POA
	36	3	1500	CTX36M4000	POA
	48	4	2000	CTX48M4000	POA
	60	4	2000	CTX60M4000	POA
	72	4	2000	CTX72M4000	POA

### **CONCEPT•TOUGH**

#### **MCCB - Surface mount stainless steel-orange**

Main switch	Pole capacity	Box size	Height (mm)	Cat. No.	Price \$
-	18	2	1000	CTX18SSO	23290.00
	24	2	1000	CTX24SSO	23600.00
	36	3	1500	CTX36SSO	24120.00
	48	3	1500	CTX48SSO	24590.00
	60	3	1500	CTX60SSO	29620.00
	72	4	2000	CTX72SSO	30190.00

Width = 800 mm, Depth = 300 mm includes door. (Door = 20 mm)

Delete "O" for raw stainless steel enclosure e.g. CTX18SS.

**Notes:** Made to order.

CTX panelboards are fully assembled from stocked components.

Cat. No. refers to Panelboard suitable for E125, S125 MCCB.

Refer to NHP for Panelboard suitable for S160, S250 MCCB.

## **Panelboard hardware to suit the CONCEPT family of panelboards with Din-T or Safe-T MCBs**

**Earth and neutral bars - 165 A**

No. tunnels	Numbering	Single screw Cat. No.	Price \$	Double screw Cat. No.	Price \$
18	1-18	TGPEN181S	55.00	TGPEN182S	57.00
24	1-24	TGPEN241S	65.50	TGPEN242S	67.50
30	1-30	-	-	TGPEN302S	83.00
36	1-36	-	-	TGPEN362S	93.50
42	1-42	-	-	TGPEN422S	93.50
48	1-48	-	-	TGPEN482S	98.50
60	1-60	-	-	TGPEN602S	135.00
72	1-72	-	-	TGPEN722S	161.00
84	1-84	-	-	TGPEN842S	197.00
96	1-96	-	-	TGPEN962S	235.00

Numbering Pole cap.(odd/even)	Double screw odd numbers Cat. No.	Price \$	Double screw even numbers Cat. No.	Price \$
9      1-17 & 2-18	TGPEN92SODD	41.50	TGPEN92SEVE	41.50
18     1-35 & 2-36	TGPEN182SODD	62.50	TGPEN182SEVE	62.50
24     1-47 & 2-48	TGPEN242SODD	72.50	TGPEN242SEVE	72.50
30     1-59 & 2-60	TGPEN302SODD	88.00	TGPEN302SEVE	88.00
36     1-71 & 2-72	TGPEN362SODD	104.00	TGPEN362SEVE	104.00
42     1-83 & 2-84	TGPEN422SODD	114.00	TGPEN422SEVE	114.00
48     1-95 & 2-96	TGPEN482SODD	125.00	TGPEN482SEVE	125.00

165 A bars - 2 x M8 studs & 2 x 25 mm tunnel terminals, remainder 2 screw 16 mm terminals

## **Earth and neutral bars - 300 A**

No. tunnels	Numbering	Single screw Cat. No.	Price \$
18	1-18	CPEN18	88.00
24	1-24	CPEN24	101.00
36	1-36	CPEN36	130.00
48	1-48	CPEN48	140.00
60	1-60	CPEN60	171.00
72	1-72	CPEN72	192.00
84	1-84	CPEN84	225.00
96	1-96	CPEN96	265.00



## Panelboard hardware

**to suit the CONCEPT family of panelboards**  
**with Din-T or Safe-T MCBs**



Pole capacity	Numbering (odd/even)	Double screw odd numbers Cat. No.	Price \$	Double screw even numbers Cat. No.	Price \$
9	1-17 & 2-18	CPEN9ODD	78.00	CPEN9EVE	78.00
18	1-35 & 2-36	CPEN18ODD	98.50	CPEN18EVE	98.50
24	1-47 & 2-48	CPEN24ODD	111.00	CPEN24EVE	111.00
30	1-59 & 2-60	CPEN30ODD	130.00	CPEN30EVE	130.00
36	1-71 & 2-72	CPEN36ODD	140.00	CPEN36EVE	140.00
48	1-95 & 2-96	CPEN48ODD	150.00	CPEN48EVE	150.00

300 A bars- 2 x M10 & 2 x M8 studs and 6 x 25 mm tunnel terminals, remainder 2 screw 16 mm terminals.

(Studs suitable for 2 x 185 mm lugs and 50 mm and 70 mm lugs)



### Earth and neutral bars - 400 A rated

Ways	(Hex head screws)	Tunnel terminals	Double screw even numbers Cat. No.	Price \$
8 way	2 x M10 & 8 x M8 studs	-	CPXEN8	109.00
12 way	2 x M10 & 8 x M8 studs	4 x 35 mm <sup>2</sup> tunnel term.	CPXEN12	140.00
18 way	2 x M10 & 8 x M8 studs	10 x 35 mm <sup>2</sup> tunnel term.	CPXEN18	250.00
36 way	3 x M10 & 8 x M8 studs	28 x 35 mm <sup>2</sup> tunnel term.	CPXEN36	320.00

### Extras

Description	Cat. No.	Price \$
Neutral bar extension - suits 165 A E/N bars - connection 2 x 185 mm lugs	NEB185	88.00
Neutral bar extension - 300 A - suits 165 A E/N	NEB33S	88.00
Neutral bar mounting insulators (pair)	TGPINS	8.90
Neutral bar insulated support (each)	CPBMN	4.20
A4 Schedule card	CPSCHEDULECARD	3.00
Schedule card holder (plastic)	CPSCHEDULEHOLD	13.00
Touch-up paint <b>charcoal</b> spray can 150 g	392.00001	46.50
Touch-up paint <b>grey</b> spray can 150 g	392.35554	46.50
Touch-up paint <b>orange</b> spray can 150 g	392.35555	46.50
Touch-up paint <b>bright white</b> spray can 150 g	392.00002	46.50

NC Chassis

## Concept Panelboard busbar chassis assemblies for Din-T MCBs

- Standard AS/NZS 3439-1
  - Current rating 250 A and 400 A
  - Encapsulated busbar (no insulation coating required)
  - Withstand rating 250 A / 25 kA 0.1s (20 kA 0.3s)
  - Withstand rating 400 A / 30 kA 0.1s (25 kA 0.3s)
  - Busbar direct connect to 160 A & 250 A switch
  - Top and bottom feed standard (top feed only pictured)
  - Tee-offs 50 % capped
  - IP 20 (maintained when fitted with 160 A & 250 A switch)
  - IP 20 Connection kits to 250 A MCCB
  - Interchangeable with CD chassis



New  
Enclosed  
Busbar  
System

## Application

The Concept range of busbar chassis assemblies have been specifically designed for incorporation into the Concept family of panelboards, providing a secure mounting platform and connection system for the NHP Din-T range of MCBs. The busbars are fully enclosed therefore not requiring an insulated coating for electrical isolation. The new NC chassis are type tested and are mounted on a box section steel pan, powdercoated white.

## **CONCEPT Pin-T - 250 chassis**

**Suits Din-T MCBs (18 mm pole pitch)**

Pole capacity	Cut-out length (mm)	Pan height (mm) ²)	Cat. No.¹)	250 A Price \$
12	111	134	NC212/183U	200.00
18	165	188	NC218/183U	225.00
24	219	242	NC224/183U	280.00
30	273	296	NC230/183U	310.00
36	327	350	NC236/183U	350.00
42	381	404	NC242/183U	380.00
48	435	458	NC248/183U	425.00
54	489	512	NC254/183U	475.00
60	543	566	NC260/183U	495.00
72	651	674	NC272/183U	660.00
78	705	728	NC278/183U	780.00
84	759	782	NC284/183U	850.00
96	867	890	NC296/183U	990.00

**Notes:** 1) For top fed chassis delete "U" and replace with "TF" e.g. NCTE212183TF

<sup>2)</sup> Add 40 mm for flared busbar at top and 56 mm for bottom of chassis.

7) Add 40 mm for hared busbar at top and 50 mm for bottom of chassis.  
For split chassis, order special chassis or order two top fed chassis and  
mount bottom chassis upside down and fit new label. See accessories for  
Cat. No.

OFF (line) side of MCB connects to chassis tee-off.

Combinations other than those listed above can be special ordered refer to NHP.

## NC Chassis

### Concept Panelboard busbar chassis assemblies for Din-T MCBs

#### **CONCEPT Din-T - 400 A chassis**

**Suits Din-T MCBs (18 mm pole pitch)**

Pole capacity	Cut-out length (mm)	Pan height (mm) <sup>2)</sup>	Cat. No. <sup>1)</sup>	400 A Price \$
12	111	134	NC412/183U	375.00
18	165	188	NC418/183U	425.00
24	219	242	NC424/183U	480.00
30	273	296	NC430/183U	540.00
36	327	350	NC436/183U	580.00
42	381	404	NC442/183U	620.00
48	435	458	NC448/183U	710.00
54	489	512	NC454/183U	750.00
60	543	566	NC460/183U	790.00
72	651	674	NC472/183U	930.00
78	705	728	NC478/183U	1000.00
84	759	782	NC484/183U	1090.00
96	867	890	NC496/183U	1250.00
108	975	998	NC4108/183TF	1380.00

#### **CONCEPT Din-T - 250 A chassis 4P**

**Suits Din-T 2P RCBOs (18 mm pole pitch)**

Pole capacity	Cut-out 'C' length (mm)	Pan height (mm) <sup>2)</sup>	Cat. No. <sup>1)</sup>	250 A Price \$
24	219	242	NC224/184U	430.00
36	327	350	NC236/184U	520.00
48	435	458	NC248/184U	630.00
60	543	566	NC260/184U	750.00
72	651	674	NC272/184U	980.00

Chassis colours - Red, Black, White, Black, Blue, Black

#### **CONCEPT Din-T - 250 A chassis 3P+N**

**Suits Din-T 4P MCBS (18 mm pole pitch)**

Pole capacity	Cut-out 'C' length (mm)	Pan height (mm) <sup>2)</sup>	Cat. No. <sup>1)</sup>	250 A Price \$
24	219	242	NC224183PNU	430.00
48	435	458	NC248183PNU	630.00
72	651	674	NC272183PNU	980.00
96	887	890	NC296183PNU	1330.00

**Notes:** <sup>1)</sup> For top fed chassis delete "U" and replace with "TF" e.g. NCTF212183TF

<sup>2)</sup> Add 40 mm for flared busbar at top and 56 mm for bottom of chassis.

For split chassis, order special chassis or order two top fed chassis and mount bottom chassis upside down and fit new label. See accessories for Cat. No.

OFF (line) side of MCB connects to chassis tee-off.

Combinations other than those listed above can be special ordered refer to NHP.

## NC Chassis

# Concept Panelboard busbar chassis assemblies for Din-T MCBs

## **CONCEPT Din-T - 400 A chassis**

**Suits Din-T10H MCBs (27 mm pole pitch)**

Pole capacity	Cut-out 'C' length (mm)	Pan height (mm) <sup>2)</sup>	Cat. No. <sup>1)</sup>	400 A Price \$
6	84	107	NCH46/273U	385.00
12	165	188	NCH412/273U	560.00
18	244	267	NCH418/273U	760.00
24	327	350	NCH424/273U	920.00

## **CONCEPT Din-T - 400 A chassis**

**Suits Din-T MCBs and Din-T10H MCBs (27/18 mm pole pitch)**

Pole capacity 27 mm	Pole capacity 18 mm	Cut-out 'C' length (mm)	Pan height (mm) <sup>2)</sup>	Cat. No. <sup>1)</sup>	400 A Price \$
6	12	192	215	NCH46/1227/183U	500.00
6	24	300	323	NCH46/2427/183U	560.00
6	36	408	431	NCH46/3627/183U	590.00
6	48	516	539	NCH46/4827/183U	630.00
12	30	435	458	NCH412/3027/183U	660.00
12	42	543	566	NCH412/4227/183U	790.00
12	60	705	728	NCH412/6027/183U	980.00

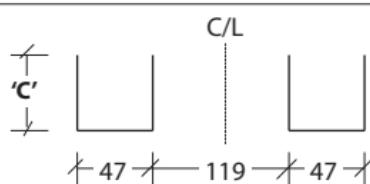
## **CONCEPT Pin-T 250 A chassis 1P + N (DC)**

Suits 2P Din-T DC MCBs (18 mm pitch)

Pole capacity	Cut-out 'C' length (mm)	Pan height (mm)	Cat. No.	Price \$
24	219	242	NC224182U	280.00
36	327	350	NC236182U	350.00
48	435	458	NC248182U	425.00
60	543	566	NC260182U	495.00

#### Chassis colours - Bed and black

## Escutcheon critical cut-out dimensions



**Notes:** 1) For top fed chassis delete "U" and replace with "TF" e.g. NC224184TF.

<sup>2)</sup> Add 55 mm for flared busbar at top and bottom of chassis.

4 pole and other special configurations available to special order refer NHP.

OFF (line) side of MCB connects to chassis tee-off.

Combinations other than those listed above can be special ordered refer to NHP.

## NC Chassis

### Concept Panelboard busbar chassis assemblies for Din-T MCBs

#### Accessories for NC chassis

Description	Cat. No.	250 A Price \$
Tee-off cap (18 mm tee-off)	NC250TOPC	0.80
Tee-off cap (27 mm tee-off)	NC250HTOPC	0.75
Busbar cap (each)	NCBBC	5.70
3P back cover	NCBC	10.80
4P back cover	NCBC4	16.00
Label 24 pole (Red, White, Blue)	NCL243	16.60
Label 24 pole (Custom-field modifiable)	NCL24C	16.60
Label 18 pole (Red, White, Blue) 27 mm pitch	NCH123	15.00

2

#### Connection kits

S160, E/S 250 MCCB direct connect to NC Chassis	NCCK200	135.00
S160, E/S 250 MCCB TAG connect to NC chassis	NCCK250	355.00
E/S 400 MCCB TAG connect to NC chassis	NCCK400	510.00
SLB 400 TAG connect to NC chassis	NCCK4002	720.00
Support bracket to mount S250	NCS250GT	78.00
Support bracket 400 A chassis NCCK400	CPPBNC400GT	41.50

## GB Isolation Chassis

### Concept Panelboard busbar chassis assemblies for Din-T MCBs

2

- Standard AS/NZS 3439.1
- Current rating 250 A 3P & 4P
- Tee-Off isolator (AC20)
- Integrated and switchable 4<sup>th</sup> pole
- Padlocking option
- Enclosed busbar
- 1, 2, 3 & 4 pole toggle conversion kit
- Withstand rating 250 A lcw 25 kA 0.1S and 10 kA 1.0S
- Withstand rating 250 A lcc 63 kA- S250PE
- Busbar direct connect 160 A & 250 A switch
- IP 20 direct connect switch and MCCB connection kits
- Interchangeable with NC or CD chassis

**NEW  
Isolation  
chassis**



The Concept range of busbar chassis assemblies have been specifically designed for incorporation into the Concept family of panelboards, providing a secure mounting platform and connection system for the NHP Din-T range of MCBs. The busbars are fully enclosed therefore not requiring an insulated coating for electrical isolation. The new GB chassis has an isolation switch for each individual TEE-OFF, are type tested and are mounted on a box section steel pan, powdercoated white.

#### **CONCEPT Din-T - 250 A chassis** **Suits Din-T MCBs (18 mm pole pitch)**

Connection capacity	Pole	Cut-out length (mm)	Bar Height (mm) <sup>2)</sup>	Cat. No.	Price \$
Top Feed <sup>1)</sup>	12	110	140	GB212183TF	450.00
	24	218	248	GB224183TF	610.00
	36	326	356	GB236183TF	790.00
	48	434	464	GB248183TF	960.00
	60	542	572	GB260183TF	1150.00
	72	650	680	GB272183TF	1350.00
	84	758	788	GB284183TF	1610.00
	96	866	896	GB296183TF	1810.00
Universal Feed	18	110	140	GB212183U	560.00
	24	218	248	GB224183U	720.00
	36	326	356	GB236183U	910.00
	48	434	464	GB248183U	1080.00
	60	542	572	GB260183U	1270.00
	72	650	680	GB272183U	1470.00
	84	758	788	GB284183U	1730.00
	96	866	896	GB296183U	1930.00

**Notes:** <sup>1)</sup> For bottom feed replace TF with BF.

<sup>2)</sup> Add 41 mm for busbar tags at top or bottom as applicable.

Chassis cannot be split, use a top feed and bottom feed in lieu.

## GB Isolation Chassis

### Concept Panelboard busbar chassis assemblies for Din-T MCBs

**CONCEPT Din-T - 250 A chassis 4 pole**  
**Suits Din-T 2P RCBOs (18 mm pole pitch)**

Connection	Pole capacity	Cut-out 'C' length (mm)	Pan Height (mm) <sup>2)</sup>	Cat. No. <sup>1)</sup>	Price \$
Top Feed <sup>1)</sup>	24	218	248	GB224184TF	610.00
	48	434	464	GB248184TF	960.00
	72	650	680	GB272184TF	1350.00
	96	866	896	GB296184TF	1810.00
Universal Feed	24	218	248	GB224184U	980.00
	48	434	464	GB248184U	1440.00
	72	650	680	GB272184U	1900.00
	96	866	896	GB296184U	2450.00

Chassis colours - Red, Black, White, Black, Blue

**CONCEPT Din-T - 250 A chassis 3PN**  
**Suits Din-T 4P MCBs (18 mm pole pitch)**

Connection	Pole capacity	Cut-out 'C' length (mm)	Pan Height (mm) <sup>2)</sup>	Cat. No. <sup>1)</sup>	Price \$
Top Feed <sup>1)</sup>	24	218	248	GB224183PNTF	790.00
	48	434	464	GB248183PNTF	1220.00
	72	650	680	GB272183PNTF	1700.00
	96	866	896	GB296183PNTF	2250.00
Universal Feed	24	218	248	GB224183PNU	980.00
	48	434	464	GB248183PNU	1440.00
	72	650	680	GB272183PNU	1900.00
	96	866	896	GB296183PNU	2450.00

Chassis colours - Red, White, Blue, Black

**CONCEPT Din-T - 250 A chassis 1P + N (DC)**  
**Suits 2P Din-T DC MCBs (18 mm pole pitch)**

Connection	Pole capacity	Cut-out 'C' length mm	Pan Height (mm) <sup>2)</sup>	Cat. No.	Price \$
Top Feed <sup>1)</sup>	24	218	248	GB224182TF	610.00
	48	434	464	GB248182TF	960.00
	72	650	680	GB272182TF	1350.00
	96	866	896	GB296182TF	1810.00

Chassis colours - Red and Black

**Notes:** <sup>1)</sup> For bottom feed replace TF with BF.

<sup>2)</sup> Add 41 mm for busbar tags at top or bottom as applicable.

Chassis cannot be split, use a top feed and bottom feed in lieu.

## GB Isolation Chassis

### Concept Panelboard busbar chassis assemblies for Din-T MCBs

2

**CONCEPT Din-T - 250 A chassis****Suits 1P Din-T MCBs (18 mm pole pitch)**

<b>Connection</b>	<b>Pole capacity</b>	<b>Cut-out 'C' length</b>	<b>Pan Height (mm)<sup>2)</sup></b>	<b>Cat. No.</b>	<b>Price \$</b>
	24	218	248	GB224181TF	610.00
Top Feed <sup>1)</sup>	48	434	464	GB248181TF	960.00
	72	650	680	GB272181TF	1350.00
	96	866	896	GB296181TF	1810.00

Chassis colours - Red

**Accessories for GB chassis**

<b>Description</b>	<b>Cat. No.</b>	<b>Price \$</b>
Tee-off cap	GBTOC	1.50
Busbar cap	GBBBC	4.00
Padlock mechanism (factory fit)	GBLM	50.00
Togglebar 1P	GBTB1	2.00
Togglebar 2P	GBTB2	2.00
Togglebar 3P	GBTB3	2.00
Togglebar 4P	GBTB4	2.00
Back cover 3P - Katko switch	GBSPP3P	5.00
Back cover 4P - Katko switch	GBSPP4P	6.00
Interpole barrier	GBIB	5.00
Through terminal 100 A	DINTT100	10.00
Label escutcheon 1-47 LH	GBL148L	10.00
Label escutcheon 2-48 RH	GBL148R	10.00
Label escutcheon 49-95 LH	GBL4996L	10.00
Label escutcheon 50-96 RH	GBL4996R	10.00
Label - R,W,B main bars 3P	GBPL3P	2.00
Label - R, W, B, N main bar 4P	GBPL4P	2.00
Label - blank pole label	GBUSL	2.00

**Notes:** <sup>1)</sup> For bottom feed replace TF with BF.<sup>2)</sup> Add 41 mm for busbar tags at top or bottom as applicable.

Chassis cannot be split, use a top feed and bottom feed in lieu.

## CD Chassis

### Concept•Plus and Concept•Premier busbar chassis assemblies for Din-T MCBs

- Standard AS/NZS 3439.1
- Current rating 250 A and 355 A
- Withstand rating 250 A / 20 kA for 0.2 sec (9 kA for 1 sec)
- Withstand rating 355 A / 25 kA for 0.3 sec (20 kA for 1 sec)
- Splayed busbar to suit 160 A & 250 A switch
- Top and bottom feed
- Tee-offs stripped and 50 % capped
- Top power feed stripped and capped
- Full 35 mm DIN rail, improved MCB mounting security
- Improved insulation coating



2

#### Application

The Concept range of busbar chassis assemblies have been specifically designed for incorporation into the Concept•Plus and Concept•Premier range of multipurpose panelboards, providing a secure mounting platform and connection system for the NHP Din-T range of MCBs. The busbars are fully dipped and type tested and are mounted on a box section steel pan, powder coated white.

#### CONCEPT Din-T - 250 A chassis

**Suits Din-T MCBs (18 mm pole pitch)**

Pole capacity	Cut-out 'C' length (mm)	Pan height (mm) <sup>1)</sup>	Cat. No.	250 A Price \$
12	110	152	CD212/183U	200.00
18	164	206	CD218/183U	225.00
24	218	260	CD224/183U	265.00
30	272	314	CD230/183U	310.00
36	326	368	CD236/183U	350.00
42	380	422	CD242/183U	380.00
48	434	476	CD248/183U	425.00
54	488	530	CD254/183U	475.00
60	542	584	CD260/183U	495.00
72	650	692	CD272/183U	660.00
78	704	746	CD278/183U	780.00
84	758	800	CD284/183U	850.00
96	866	908	CD296/183U	990.00

**Notes:** 1) Add 32.5 mm for flared busbar at top and bottom of chassis.  
 4 pole and other special configurations available to special order refer NHP.  
 'OFF' (line) side of MCB connects to chassis tee-off.  
 Use insulated tool provided to disengage DIN clip when removing MCB from chassis. DIN clip can be removed and discarded when mounting MCB on CD chassis.

## CD Chassis

### Concept•Plus and Concept•Premier busbar chassis assemblies for Din-T MCBs

#### **CONCEPT Din-T - 400 A chassis**

Suits Din-T MCBs (18 mm pole pitch)

2

Pole capacity	Cut-out 'C' length (mm)	Pan height (mm) <sup>1)</sup>	Cat. No.	355 A Price \$
12	110	152	CD312/183U	340.00
18	164	206	CD318/183U	385.00
24	218	260	CD324/183U	440.00
30	272	314	CD330/183U	495.00
36	326	368	CD336/183U	530.00
42	380	422	CD342/183U	570.00
48	434	476	CD348/183U	650.00
54	488	530	CD354/183U	680.00
60	542	584	CD360/183U	720.00
72	650	692	CD372/183U	850.00
78	704	746	CD378/183U	910.00
84	758	800	CD384/183U	1000.00
96	866	908	CD396/183U	1130.00

#### **CONCEPT Din-T 355 A chassis**

Suits Din-T and Din-T10H MCBs (27/18 mm pole pitch)

Pole cap. 27 mm	Pole cap. 18 mm	Cut-out length 'C' (mm)	Pan Height (mm)	Cat. No. <sup>1)</sup>	Price \$
6	12	191	228	CDH36/1227/183U	490.00
6	24	299	380	CDH36/2427/183U	550.00
6	36	407	488	CDH36/3627/183U	580.00
12	30	434	471	CDH312/3027/183U	640.00
12	42	542	579	CDH312/4227/183U	770.00
12	60	704	741	CDH312/6027/183U	950.00

#### **Accessories CD chassis**

Description	Cat. No.	Price \$
Split tariff kit 250/355 A (supplied loose)	STKCD	119.00
Split tariff kit (supplied & fitted)	REFER NHP	-
Plastic tee-off cap 250/355 A	CD250TOPC	0.60

**Notes:** <sup>1)</sup> Add 32.5 mm for flared busbar at top and bottom of chassis.

4 pole and other special configurations available to special order refer NHP.

'OFF' (line) side of MCB connects to chassis tee-off.

Use insulated tool provided to disengage DIN clip when removing MCB from chassis. DIN clip can be removed and discarded when mounting MCB on CD chassis.

## CT Chassis

### Concept•Plus and Concept•Premier busbar chassis assemblies for Safe-T MCBs

- Standard AS/NZS 3439.1
- Current rating 250 A and 355 A
- Withstand rating 250 A / 20 kA for 0.2 sec
- Withstand rating 355 A / 20 kA for 1 sec
- Splayed busbar to suit 160 A & 250 A switch
- Top and bottom feed
- Tee-offs stripped and 50 % capped
- Top power feed stripped and capped
- 25 mm pole pitch, Safe-T MCBs
- Improved insulation coating



2

#### CONCEPT Safe-T - 250 & 355 A chassis

#### Suits Safe-T MCBs

Pole capacity	Cut-out 'C' length (mm)	Pan height (mm) <sup>1)</sup> <sup>2)</sup>	Cat. No.	250 A Price \$
12	147	221	CT 212/253	225.00
18	222	296	CT 218/253	255.00
24	297	371	CT 224/253	280.00
30	372	446	CT 230/253	295.00
36	447	521	CT 236/253	370.00
42	522	596	CT 242/253	395.00
48	597	671	CT 248/253	440.00
60	747	821	CT 260/253	540.00
72	897	971	CT 272/253	740.00
84	1047	1121	CT 284/253	830.00
96	1197	1271	CT 296/253	1020.00

**Notes:** <sup>1)</sup> Add 25 mm for flared busbar at top of chassis.

<sup>2)</sup> Add 22 mm for straight busbar at bottom of chassis.

4 pole and other special configurations available to special order refer NHP.

## CT Chassis

### Concept•Plus and Concept•Premier busbar chassis assemblies for Safe-T MCBs

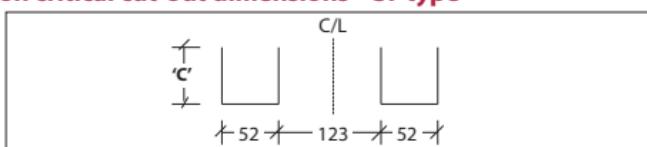
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Pole capacity	Cut-out 'C' length (mm)	Pan height (mm) <small>1) 2)</small>	Cat. No.	355 A Price \$
12	147	221	CT 312/253	370.00
18	222	296	CT 318/253	425.00
24	297	371	CT 324/253	495.00
30	372	446	CT 330/253	540.00
36	447	521	CT 336/253	590.00
42	522	596	CT 342/253	680.00
48	597	671	CT 348/253	750.00
60	747	821	CT 360/253	860.00
72	897	971	CT 372/253	1030.00
84	1047	1121	CT 384/253	1120.00
96	1197	1271	CT 396/253	1220.00

#### Accessories CT chassis

Description	Cat. No.	Price \$
Split tariff kit 250 A (supplied loose)	STK250ND/TH	119.00
Split tariff kit (supplied and fitted)	REFER NHP	-
Plastic tee-off cap 250/355 A	TH250TOPC	0.60

#### Escutcheon critical cut-out dimensions - CT type



**Notes:** 1) Add 25 mm for flared busbar at top of chassis.

2) Add 22 mm for straight busbar at bottom of chassis.

4 pole and other special configurations available to special order refer NHP.

## Panelboard DIN switch-fuse



2

### Features

- Compact size suited for panelboard use
- Fuse covers are supplied standard
- Non-captive escutcheon mounting handle supplied standard

### Ordering details

Description	Cat. No.	Price \$
160 A fuse switch 3 P	ISO 3160SFH	500.00
200 mm extension shaft <sup>1)</sup>	L2000KT	29.60

### Technical data

#### Fuse switch ratings

	ISO 3160 SFH
Rated insulation voltage, Ui (V)	1000
Rated impulse withstand voltage, Uimp (kV)	12
Rated thermal current, Ith (A)	160
Rated operational voltage, Ue (V)	690

#### Rated operational current, Ie (A)

AC 21/22	415 V	160
AC 23	415 V	125

#### Rated fused short circuit current

Back-up fuse (A)	160
RMS value (kA)	50
Peak value (kA)	11
Rated short circuit making capacity (kA)	11
Rated breaking capacity (A)	1000

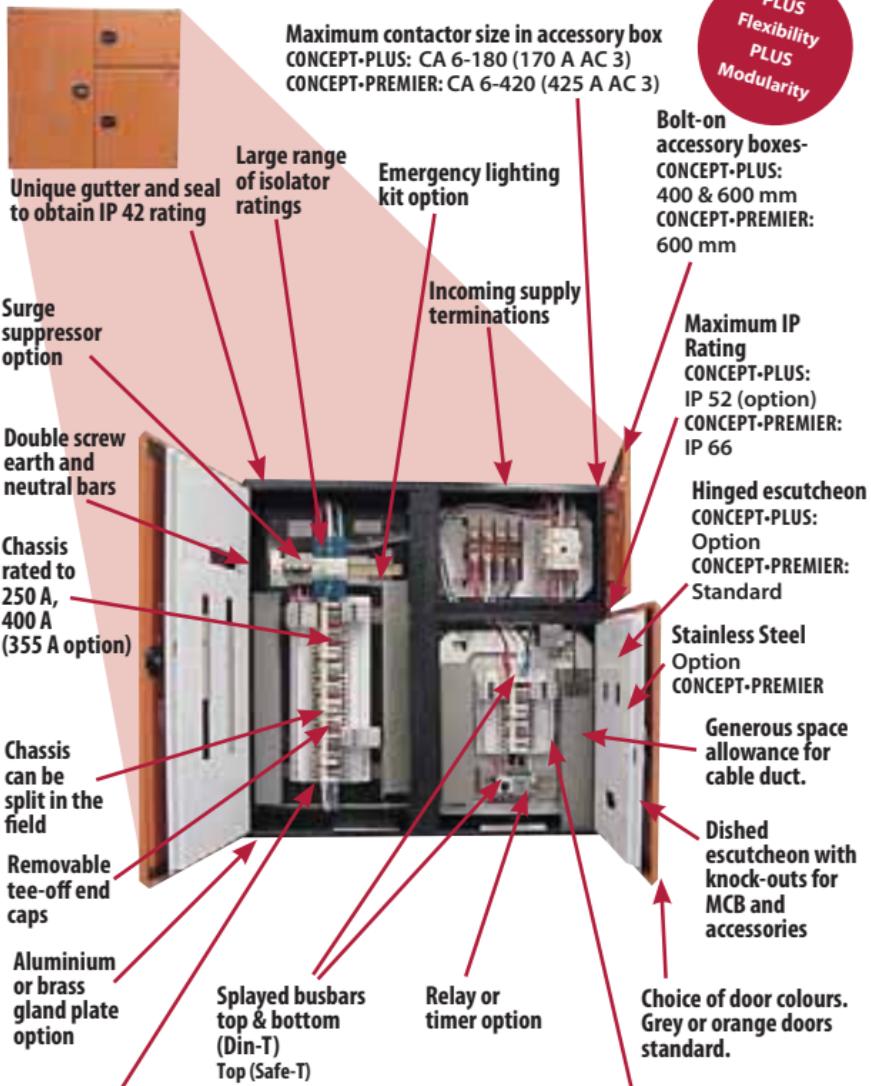
#### Mechanical data

Electrical endurance (no. of ops)	2000
Mechanical endurance (no. of ops)	20000
Terminals/bolt size Cu (mm <sup>2</sup> )	6-70
Maximum terminal torque (Nm)	4.5
Fuse type	DIN size 00
Weight, less fuses (kg)	1.5

**Notes:** 1) Extension shaft required for CONCEPT•PREMIER panelboards.

## **Modular panelboards**

**2** Concept•Plus and Concept•Premier form a highly featured innovative range of panelboards for commercial and industrial applications. The widely accepted Concept•Plus can be used for a variety of indoor applications, while the Concept•Premier is suited to indoor or outdoor use. Application versatility is also increased because panelboards can be combined with accessory modules or simply bolted together to form custom modular constructions combining power distribution and control equipment.



#### **Maximum contactor size in panelboard**

**CONCEPT•PLUS: CA 7-85 (85 A AC 3)**

#### **CONCEPT•PLUS: Din-T or Safe-T**

## **CONCEPT•PREMIER: Din-T, Safe-T 125 A or 250 A MCCBs**

\*The above modular panelboard represents one possible combination of enclosures and equipment.

**TemBreak 1 and 2 MCCBs**

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160 A - 250 A	3 - 59
400 A / 630 A	3 - 92
630 A / 800 A	3 - 115
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## The TemBreak 1 & 2 product lines

### TemBreak 2

#### Moulded Case Circuit Breakers

Rated current ( $I_n$ ) from 12 A to 1600 A.

Breaking Capacity ( $I_{cu}$ ) from 25 kA to 200 kA at 400/415 V AC.

3



Earth Leakage MCCB



250 A



1600 A

### TemBreak 1

#### Moulded Case Circuit Breakers

Rated current ( $I_n$ ) from 630 A to 3200 A.

Breaking Capacity ( $I_{cu}$ ) from 50 kA to 125 kA at 400/415 V AC.



800 A



3200 A

## TemBreak 2

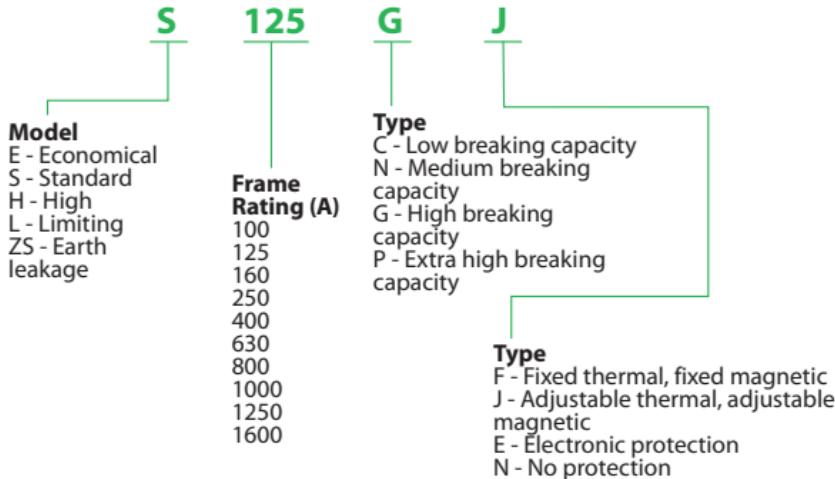
### Easy selection guide – TemBreak 2 MCCBs

The TemBreak 2 range of products includes:

- Moulded Case Circuit Breakers (MCCBs)
- Earth Leakage MCCBs
- Switch-Disconnectors in the same compact moulded case frame sizes as MCCBs
- A comprehensive range of accessories which are common to MCCBs and Switch-Disconnectors. All internal accessories are common to all frame sizes.

### Catalogue Number construction

3



## About TemBreak 2

### 1. Field installable accessories

3



- Accessories can be fitted by the switchboard builder or added by the end-user. All internal accessories are common for TemBreak 2 MCCBs.
- Handles and motor operators can be rapidly fitted using the locking pegs. It takes less than 10 seconds to secure a handle or motor to the MCCB.
- All accessories are endurance tested to the same level as the host MCCB.

### 2. Higher kA ratings in Small Frame sizes

125 A Frame models now feature versions to 65 kA, while 250 A Frame models go to 200 kA.



### 3. Modular and Common sizes



- All current ratings up to 1600 A can be supplied in 9 frame sizes.
- 400 A and 630 A MCCB are a common size. (400 AF)
- The compact 125 A size offers the same features and performance but with reduced dimensions.
- 800/ 1000 are a common size
- 1250/ 1600 A common height and width
- 160/ 250 A common size

## About TemBreak 2

### 4. IP 65 or IP 55 variable depth handles

IP 55 or IP 65 on MCCBs  
125 A to 1600 A.



3

### 5. Increased Thermal-Magnetic flexibility



Overload protection is adjustable between 63 % and 100 % of the rating.

Short-circuit protection is adjustable on all thermal magnetic models.

Short-circuit protection settings are suitable for motor starting on all models, including the compact 125 A and 250 A frames.

### 6. Electronic protection in a 250 A Frame

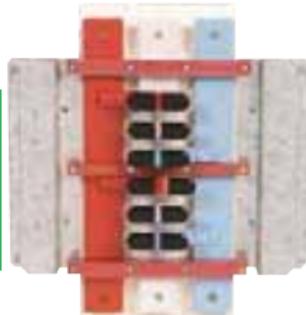


The adjustability of an electronic MCCB in a 250 A Frame MCCB. OCR Ratings range from 16 A to 250 A.

## About TemBreak 2

### 7. 250 A Frame MCCBs:

#### 12 A - 250 A on a common chassis



3

### 8. Compact Transfer Switches



Changeover pair with link interlock and motor operators



Viewed from side (250 A frame)

### 9. Transfer Switch Controller options



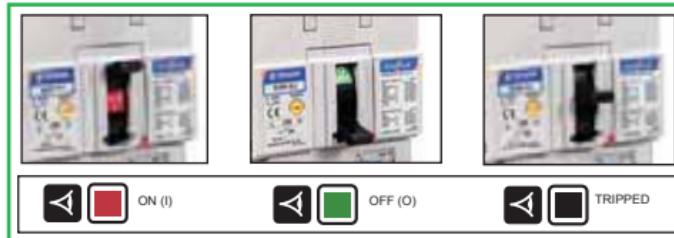
250 AF MCCBs are available ranging from:

- 12 A - 250 A @ 25, 30 kA (E/S 160-250)
- 32 A - 250 A @ 36, 65 kA (S160-250)
- 16 A - 250 A @ 70 kA (S250PE)

A mechanical interlock is used with two MCCBs, and is compatible with motor operators and handles. An automatic changeover system can be assembled by a switchboard builder or end-user, from components. Alternatively, pre-assembled transfer switches are available.

## About TemBreak 2

### 10. Visual safety



3

Coloured indicators display the ON or OFF status. The indicators are fully covered if the breaker trips, so that black is the only visible colour.

### 11. Direct opening



Under the heading "Measures to minimise the risk in the event of failure", IEC 60204-1 Safety of Machinery-Electrical Equipment of Machinery includes the following recommendation:

- "-the use of switching devices having positive (or direct) opening operation."
- MCCBs, motors, auxiliaries, alarms (heavy duty) are all direct opening

### 12. ZS Integral Earth Leakage MCCB

The Terasaki earth leakage MCCB is contained within a standard 125/160/250/ 400/ 630/ 800 A frame size.



### 13. Metering MCCBs



- TemBreak 2 metering & Modbus comms MCCBs 100 A to 1000 A
- 250 AF (16 A to 250 A) MCCB with Modbus energy metering output
- External meter display option for all metering MCCBs
- Choice of Ammeter only or multifunction energy metering display
- All new TemBreak 2 MCCB range extension to 800 A to 1600 A

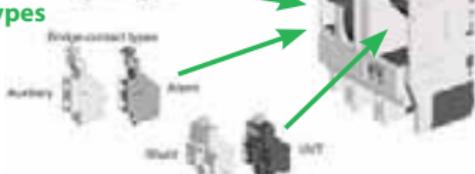
## Accessories to suit TemBreak 2, 125 - 1600 AF

### Accessory fitting combinations

#### General purpose types



#### Heavy duty types



3

Standard TemBreak 2 MCCBs 125 A - 1600 A

Permissible combinations and locations

## Accessories to suit TemBreak 2, 125 - 1600 AF

### Accessory fitting combinations

Frame size (A)	125	160 and 250	400 and 630	800 and 1000	1250 and 1600
E	E125	E250	E400 E630		
S	S125 ZS125 <sup>1)</sup>	S160 S250 ZS250 <sup>1)</sup>	S400 S630 ZS630 <sup>1)</sup>	S800 S1000 ZS800 <sup>1)</sup>	S1250 S1600
H		H125 H160 H250	H400	H800	
L		L125 L160 L250	L400	L800	
AUX					
ALA					
SHT					
AUX					
ALA					
UVT					
AUX					
ALA					
SHT					
AUX					
ALA					
UVT					

Auxilliary Switch = ALA

Alarm Switch = ALA

Shunt Trip = SHT

Undervoltage Trip = UVT

**Notes:** <sup>1)</sup> Shunts and UVTs cannot be installed in ZS ELCBs.

General purpose and heavy duty status indication switches cannot be mixed in the same MCCB.

It is not possible to install a shunt trip and an undervoltage trip in an MCCB as they occupy the same location. Undervoltage trips can provide remote tripping if necessary by wiring a normally closed contact or pushbutton in series with the protected supply.

Undervoltage trips with time delays require an external time delay controller which clips to the side of the MCCB.

## Special 'EA' TemBreak 2 MCCBs 125 A - 250 A

### Permissible combinations EA (extra auxiliary)

#### version and locations

- 3
- Auxiliary contact blocks: Depending on the auxiliary type and MCCB size, up to 4 auxiliary switches can be fitted in the LEFT and RIGHT pockets.
  - Alarm contact blocks: a maximum of 2 can be installed in an MCCB. One LEFT, one RIGHT.
  - One Shunt Trip or one Under-Voltage Trip can be installed in the RIGHT side. Both cannot be mounted in an MCCB together as they occupy the same position. When auxiliaries or alarms are fitted in the RIGHT side, shunts and UVT's cannot be fitted.



For more specific information on internal accessory combinations and maximum allowable, refer to the table below.

#### Permissible combinations of EA MCCBs<sup>1)</sup>

MCCB type 3 - 4 pole	MCCB left side				MCCB right side			
	General purpose type		Heavy duty type		General purpose type		Heavy duty type	
	Auxiliary	Alarm	Auxiliary	Alarm	Auxiliary	Alarm	Auxiliary	Alarm
125 A	2		1		2		1	
160 / 250 A	2	1	2	1	2	1	2	1
125 / 250 A					1 Shunt or 1 Under Voltage Trip			

#### ZS Integral Earth leakage MCCB - internal accessory fitting.

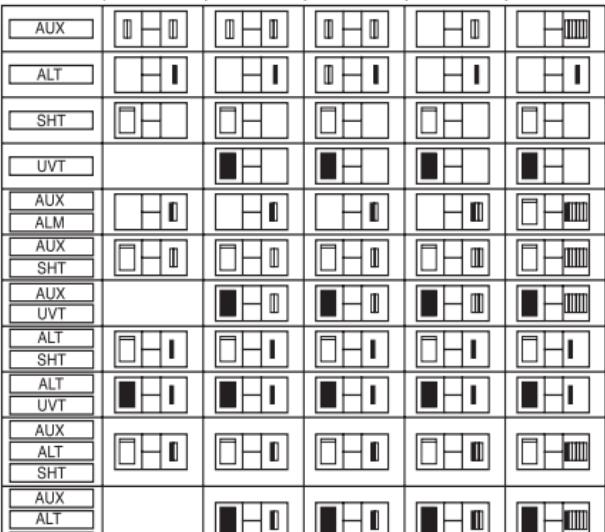
MCCB type 3 - 4 pole	MCCB left side				MCCB right side			
	General purpose type		Heavy duty type		Right side pocket area occupied by earth leakage circuitry. Shunts and UVT's cannot be installed.			
	Auxiliary	Alarm	Auxiliary	Alarm				
125 A	2		1					
160 / 250 A	2	1	2	1				

**Notes:** 1) Certain MCCB models will be stocked with the extra auxiliary option. They are S125GJ, S160NJ (20 / 32 A) S160GJ, S250GJ. Other MCCB "EA" types are available on indent.

ZS integral Earth leakage MCCBs only accept auxiliaries and alarms.  
See table above for auxiliary and alarm options.

## TemBreak 1 standard combinations of internally mounted accessories

3

AUX		Auxiliary switch			
ALT		Alarm switch			
SHT		Shunt trip			
UVT		Undervoltage trip			
		Left pole			
		Right pole			
<b>UVT rating</b>					
A. Inst type					
AC 100 ~ 120 V					XS400
AC 200 ~ 240 V					XH/XS400
AC 380 ~ 450 V					XS630
DC 24 V					XH/XS630
DC 48 V					XS800
DC 60 V					XH/XS800
DC 100 ~ 115 V					XS2000
DC 200 ~ 230 V					XS2500
	XM30PB	XS 125PJ XS-125CJ XS-125NU XH-125NU	XS 160PJ XS-250NU XH-250NU	XS 1250 XS1250 XS1600	XS3200
B. Time delay type					
AC 100 ~ 120 V					
AC 200 ~ 240 V					
AC 380 ~ 450 V					
SHT rating					
AC 100 ~ 115 V					
AC 200 ~ 480 V					
AC 24 V					
AC 48 V					
DC 12 V					
DC 24 V					
DC 30 V					
DC 48 V					
DC 60 V					
DC 100 ~ 115 V					
DC 125					
DC 200 ~ 230 V					
					

**Notes:** 2 pole type is the same as the 3 pole type with the centre pole omitted.  
If provided with UVT for AC, use the UVT controller.

## TemBreak 2 MCCB kA ratings 20 A - 630 A

Ampere Range	400/415 V Icu kA rating								
	25	30	36	50	65	70	85	125	200
12.5 - 125	25								
16 - 125	25								
15 - 100	65				65				
12.5 - 125		36	1)						
12.5 - 125				65					
12.5 - 125							125		
12.5 - 125								200	
12.5 - 160	25								
12.5 - 160		36							
32 - 160				65					
100 - 160							125		
100 - 160								200	
12.5 - 250	25								
160 - 250		36							
160 - 250				65					
16 - 250					70				
160 - 250							125		
16 - 250								125	
160 - 250								200	
252 - 400	25								
160 - 400		36							
160 - 400			50						
100 - 400			50						
160 - 400				70					
100 - 400					70				
100 - 400						85			
100 - 400								125	
252 - 400									200
252 - 630		36							
252 - 630			50						
252 - 630				70					

**Isolator switches****Short time rating for 0.3 seconds Icw (kA)**

125	2
160	3
250	3
400	5
630	5

**Colour Key**

MCCB labels are similarly colour coded via a coloured rectangle around the catalogue number on the breaker.

 Motor Circuit Range - XM	 High kA range - H
 Economy Range - E	 Limitor Range - L
 Standard range - S	 Isolators/ Non-auto - N

Thermal Magnetic OCR	Electronic OCR	Catalogue Number
Yes	-	E125NJ
Yes	-	S125NF
Yes	-	S100GF
Yes	-	S125NJ
Yes	-	S125GJ/Z5125GJ
Yes	-	H125NJ
Yes	-	L125NJ
Yes	-	S160NF
Yes	-	S160NJ
Yes	-	S160GJ/ZS250GJ
Yes	-	H160NJ
Yes	-	L160NJ
Yes	-	E250NJ
Yes	-	S250NJ
Yes	-	S250GJ/Z5250GJ
-	Yes	S250PE
Yes	-	H250NJ
-	Yes	H250NE
Yes	-	L250NJ
Yes	-	E400NJ
Yes	-	S400CJ
Yes	-	S400NJ
-	Yes	S400NE
Yes	-	S400GJ/ZS400GF
-	Yes	S400GE
-	Yes	S400PE
-	Yes	H400NE
-	Yes	L400NE
-	Yes	E630NE
-	Yes	S630CE
-	Yes	S630GE
		S125NN
		S160NN
		S250NN
		S400NN
		S630NN

**Notes:** 1) 20-32 A trip unit versions rated 30 kA.

A TemBreak 1 to TemBreak 2 cross reference can be found at the rear of this section.

See page 3 - 12 for colour key.

## TemBreak 1 XM Motor Circuit MCCBs to 12 A, & 630 A – 3000 A MCCBs

### TemBreak 2 MCCB 400A to 1600A kA Ratings / XM30PB

Ampere Range	400/415 V I <sub>cu</sub> kA rating								
	25	30	36	50	65	70	85	125	200
0.7 - 12							85		
500 - 630			50						
396 - 800		36							
700 - 800			50						
396 - 800			50						
396 - 800	65				70				
252 - 800				70					
250 - 800						125			
250 - 800							200		
400 - 1000					70				
500 - 1250						85			
640- 1600						85			

### Isolator switches

Short time rating for 0.3 seconds I<sub>CW</sub> (kA)

800	10	
1000	10	
1250		15
1600		20

### TemBreak 1 MCCBs 2000A to 3200A

Ampere Range	400/415 V I <sub>cu</sub> kA rating								
	25	30	36	50	65	70	85	125	200
1000-2000							85		
1250-2500							85		
1600-3200							85		

- Motor Circuit Range - XM      ■ High kA range - H
- Economy Range - E      ■ Limitor Range - L
- Standard range - S      ■ Isolators/ Non-auto - N

Thermal Magnetic	Electronic OCR	Catalogue Number
Hydraulic - mag	-	XM30PB
Yes	-	ZS630NF
Yes	-	S800CJ
Yes	-	ZS800NF
Yes	-	S800NJ
Yes	-	S800RJ
-	Yes	S800RE
-	Yes	H800NE
-	Yes	L800NE
-	Yes	S1000NE
-	Yes	S1250GE
-	Yes	S1600NE

3

S800NN  
S1000NN  
S1250NN  
S1600NN

Thermal Magnetic	Electronic OCR	Catalogue Number
-	Yes	XS2000NE
-	Yes	XS2500NE
-	Yes	XS3200NE



630/800 AF MCCB



1250/1600 AF MCCB

## MCCB types and setting ranges

MCCBs with a common colour have the same physical dimensions

<b>Ampere Range</b>	<b>415 V kA</b>		<b>Thermal Magnetic Trip Unit Adjustment</b>	
	<i>I<sub>cu</sub></i>	<i>I<sub>cs</sub></i>	Thermal <i>I<sub>R</sub></i>	Magnetic <i>I<sub>M</sub></i>
12.5 – 125	25	19	0.63 – 100%	6 – 10 or 12M
16 – 125	25	13	Fixed	Fixed
15 – 100	65	33	Fixed	Fixed
12.5 – 125	36	36	0.63 – 100%	6 – 10 or 12M
12.5 – 125	65	36	0.63 – 100%	6 – 10 or 12M
12.5 – 125	125	85	0.63 – 100%	6 – 10 or 12M
12.5 – 125	200	150	0.63 – 100%	6 – 10 or 12M
16 – 160	25	19	Fixed	Fixed
12.5 – 160 <sup>3)</sup>	36	36	0.63 – 100%	6 – 12M
32 – 160	65	36	0.63 – 100%	6 – 12M
100 – 160	125	85	0.63 – 100%	6 – 12M
100 – 160	200	150	0.63 – 100%	6 – 12M
12.5 – 250	25	19	0.63 – 100%	6 – 10 or 12M
160 – 250	36	36	0.63 – 100%	6 – 10M
160 – 250	65	36	0.63 – 100%	6 – 10M
16 – 250	70	70	–	–
160 – 250	125	85	0.63 – 100%	6 – 10M
16 – 250	125	85	–	–
160 – 250	200	150	0.63 – 100%	6 – 10M
252 – 400	25	25	0.63 – 100%	6 – 12M
160 – 400	36	36	0.63 – 100%	6 – 12M
160 – 400	50	50	0.63 – 100%	6 – 12M
100 – 400	50	50	–	6 – 12M
160 – 400	70	50	0.63 – 100%	6 – 12M
100 – 400	70	50	–	–
160 – 400	85	85	–	–
100 – 400	125	85	–	–
100 – 400	200	150	–	–
252 – 630	36	36	–	–
252 – 630	50	50	–	–
252 – 630	70	50	–	–
<b>Isolator switches</b>	<b>Short time rating for 0.3 seconds <i>I<sub>sw</sub></i>(kA)</b>			<b>Rated short-circuit making capacity <i>I<sub>cm</sub></i> (kA)</b>
125	2			3.6
160	3			6
250	3			6
400	5			9
630	5			9

**Notes:** 1) The STD settings are not adjustable, however by selecting different curve types, the STD setting will vary between 2.5 – 10 x *I<sub>R</sub>* : for 250/400 A MCCBs and 2.5 – 8 x *I<sub>R</sub>* : for 630 A MCCBs.

3) 20-32 A trip unit versions rated 30 kA.

Range $I_R$	Electronic OCR Adjustment STD x $I_R$ / INST x $I_R^{1/2}$ )	Catalogue Number	Dimensions (mm)		
			H	W	D
-	-	E125NJ	155	90	68
-	-	S125NF	155	30	68
-	-	S100GF	155	60	68
-	-	S125NJ	155	90	68
-	-	S125GJ	155	90	68
-	-	H125NJ	165	105	103
-	-	L125NJ	165	105	103
-	-	S160NF	165	35	68
-	-	S160NJ	165	105	68
-	-	S160GJ	165	105	68
-	-	H160NJ	165	105	103
-	-	L160NJ	165	105	103
-	-	E250NJ	165	105	68
-	-	S250NJ	165	105	68
-	-	S250GJ	165	105	68
40 - 100%	2.5, 5, 10 / 13 or 14	S250PE	165	105	103
-	-	H250NJ	165	105	103
40 - 100%	2.5, 5, 10 / 13 or 14	H250NE	165	105	103
-	-	L250NJ	165	105	103
-	-	E400NJ	260	140	103
-	-	S400CJ	260	140	103
-	-	S400NJ	260	140	103
40 - 100%	2.5, 5, 10 / 13 or 14	S400NE	260	140	103
-	-	S400GJ	260	140	103
40 - 100%	2.5, 5, 10 / 13 or 14	S400GE	260	140	103
40 - 100%	2.5, 5, 10 / 13 or 14	S400PE	260	140	103
40 - 100%	2.5, 5, 10 / 13 or 14	H400NE	260	140	140
40 - 100%	2.5, 5, 10 / 13 or 14	L400NE	260	140	140
40 - 100%	2.5, 5, 8 / 10 or 14	E630NE	260	140	103
40 - 100%	2.5, 5, 8 / 10 or 14	S630CE	260	140	103
40 - 100%	2.5, 5, 8 / 10 or 14		260	140	103

S125NN	155	90	68
S160NN	165	105	68
S250NN	165	105	68
S400NN	260	140	103
S630NN	260	140	103

**Notes:** <sup>2)</sup> The Instantaneous settings are not adjustable, however by selecting different curve types, the INST instantaneous setting will vary from 13 or  $14 \times I_R$ : for 400 A MCCBs and 10 or  $14 \times I_R$  for 630 A MCCBs. Refer curve examples & setting data in Section 9.

## ZS ELCB / XM30PB / 800 A to 3200 A

### MCCB types and setting ranges

MCCBs with a common colour have the same physical dimensions

Ampere Range	415 V kA		Thermal Magnetic Trip Unit Adjustment		Electronic OCR Adjustment	
	I <sub>CU</sub>	I <sub>CS</sub>	Thermal I <sub>R</sub>	Magnetic I <sub>M</sub>	Range I <sub>R</sub>	
0.7 - 12	85	85	-	-	-	
12.5 - 125	65	36	0.63 – 100%	-	-	
100 - 250	65	36	0.63 – 100%	-	-	
250 - 400	70	-	-	6 - 12M	-	
500 - 630	50	-	-	6 - 10M	-	
396 - 800	36	36	0.63 – 100%	5 - 10M	-	
396 - 800	50	50	0.63 – 100%	5 - 10M	-	
700 - 800	50	-	-	6 - 10M	-	
396 - 800	70	50	0.63 – 100%	5 - 10M	-	
252 - 800	70	50	-	-	40 - 100%	
250 - 800	125	94	-	-	40 - 100%	
250 - 800	200	150	-	-	40 - 100%	
400 - 1000	70	50	-	-	40 - 100%	
500 - 1250	85	65	-	-	40 - 100%	
640- 1600	85	65	-	-	40 - 100%	
1000-2000	85	64	-	-	50 - 100%	
1250-2500	85	64	-	-	50 - 100%	
1600-3200	85	64	-	-	50 - 100%	

#### Isolator switches

	Short time rating for 0.3 seconds ICW (kA)	Rated short-circuit Making capacity ICM (kA)
800	10	17
1000	10	17
1250	15	32
1600	20	45

STD x I <sub>R</sub> / INST x I <sub>R</sub> (1)	Catalogue Number	Dimensions 3P (mm)		
		H	W	D
-	XM30PB	148	78	97
-	ZS125GJ	155	90	68
-	ZS250GJ	165	105	68
-	ZS400GF	260	140	103
-	ZS630NF	273	210	103
-	S800CJ	273	210	103
-	S800NJ	273	210	103
-	ZS800NF	273	210	103
-	S800RJ	273	210	103
2.5, 5, 10 / 12 or 14	S800RE	273	210	103
2.5, 5, 10 / 12 or 14	H800NE	273	210	140
2.5, 5, 10 / 12 or 14	L800NE	273	210	140
2.5, 5, 10 / 10 or 14	S1000NE	273	210	103
2.5, 5, 10 / 12 or 14	S1250GE	370	210	120
2.5, 5, 10 / 12 or 14	S1600NE	370	210	140
LSI Adjustable	XS2000NE	450	320	185
LSI Adjustable	XS2500NE	450	320	185
LSI Adjustable	XS3200NE	450	320	185

	S800NN	273	210	103
	S1000NN	273	210	103
	S1250NN	370	210	120
	S1600NN	370	210	140

**TemBreak**  
**T2SW Add-on current and voltage  
metering blocks**

**Block dimensions (mm) excluding MCCB**

	125 AF 3P	4P	250 AF 3P	4P	400/ 630 AF 3P	4P
Height <sup>2)</sup>	85	85	85	85	86	86
Width	90	120	105	140	140	185
Depth <sup>3)</sup>	66	66	66	66	88	88

3

**Ordering details**

Suit MCCB type	Pri- mary	T2SW block Cat. No.	Price \$	Optional load side terminal cover Cat. No.	Price \$	
E125, S125	3	125 A	T2SW3P1251255K	900.00	T2SW3P125TC	55.00
E125, S125	4	125 A	T2SW4P1251255K	1190.00	T2SW4P125TC	66.50
H125, E/S/ H16/25	3	150 A	T2SW3P2501505K	940.00	T2SW3P250TC	110.00
H125, E/S/ H16/25	3	250 A	T2SW3P2502505K	940.00	T2SW3P250TC	110.00
H125, E/S/ H16/25	4	150 A	T2SW4P2501505K	1230.00	T2SW4P250TC	148.00
H125, E/S/ H16/25	4	250 A	T2SW4P2502505K	1230.00	T2SW4P250TC	148.00
E/S/H400, E/S630	3	400 A	T2SW3P6304005K	1230.00	T2SW3P630TC	110.00
E/S/H400, E/S630	3	600 A	T2SW3P6306005K	1230.00	T2SW3P630TC	110.00
E/S/H400, E/S630	4	400 A	T2SW4P6304005K	1630.00	T2SW4P630TC	160.00
E/S/H400, E/S630	4	600 A	T2SW4P6306005K	1630.00	T2SW4P630TC	160.00

Suit MCCB type	Frame size	Voltage Poles	Total Amp & voltage termin- inal quantity	T2SW block Cat. No.
E125, S125	125	3	0 <sup>1)</sup>	6
E125, S125	125	4	4 (3+N)	10
H125, E/S/H/L	16/25	160, 2503	3	9
H125, E/S/H/L	16/25	160, 2503	3	9
H125, E/S/H/L	16/25	160, 2504	4 (3+N)	10
H125, E/S/H/L	16/25	160, 2504	4 (3+N)	10
E/S/H400, E/S630	400, 6303	3	9	T2SW3P6304005K
E/S/H400, E/S630	400, 6303	3	9	T2SW3P6306005K
E/S/H400, E/S630	400, 6304	4 (3+N)	10	T2SW4P6304005K
E/S/H400, E/S630	400, 6304	4 (3+N)	10	T2SW4P6306005K

**Notes:** <sup>1)</sup> Voltage lugs supplied for mounting on external bars for 125 A 3 pole block.

<sup>2)</sup> Height excludes connection bars

<sup>3)</sup> Refer NHP for additional dimension data

## TemBreak co-ordination motor protection

### Circuit breakers - XM30PB

**85 kA**

**Current rating:** 0.7 – 12 A

**Approvals and tests:** Standards: AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)

**Trip unit:** Fixed hydraulic-magnetic



3

Voltage	Icu kA	Ics kA
AC use	400/415	85

#### Dimensions (mm)

Poles	3
H	148
W	78
D (less toggle)	97
Weight (kg)	1.3

Amp rating NRC	Cat. No.	Price \$
0.7	XM30PB0.7 3P	500.00
1.4	XM30PB1.4 3P	500.00
2.0	XM30PB2.0 3P	500.00
2.6	XM30PB2.6 3P	500.00
4	XM30PB4 3P	500.00
5	XM30PB5 3P	500.00
8	XM30PB8 3P	500.00
10	XM30PB10 3P	500.00
12	XM30PB12 3P	500.00

**Notes:** NRC: Nominal rated current.

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 GST not included NHP Sales 1500 NHP NHP  
 Price schedule 'T2'

## Accessories to suit XM30PB

### Internal accessories - factory fit

		Cat. No.	Price \$
Shunt trip	110 V AC SHT (100 – 115 V)	<b>2H1931BAA</b>	<b>131.00</b>
	240 V AC SHT (200 – 480 V)	<b>2H1931BBA</b>	<b>131.00</b>
	24 V DC SHT	<b>2H1931BCA</b>	<b>131.00</b>
	48 V DC SHT	<b>2H1931BDA</b>	<b>131.00</b>
	110 V DC SHT (100 – 115 V)	<b>2H1931BEA</b>	<b>131.00</b>
	24 V AC SHT	<b>2H1932BAD</b>	<b>131.00</b>
	48 V AC SHT	<b>2H1932BBA</b>	<b>131.00</b>
	12V DC SHT	<b>2H1932BDA</b>	<b>131.00</b>
	125 V DC SHT	<b>2H1932BGA</b>	<b>131.00</b>
	200 V DC SHT (200 – 230 V)	<b>2H1932BHA</b>	<b>131.00</b>
Auxiliary switches	AUX SW right/left hand 1C	<b>UXXB0001D</b>	<b>86.50</b>
	AUX SW right/left hand 2C	<b>UXXB0003C</b>	<b>127.00</b>
Alarm switches	Alarm SW right/left hand	<b>UXLB0006C</b>	<b>84.00</b>
Alarm & auxiliary switches	Alarm/AUX SW right/left hand 1C	<b>UXLB0008C</b>	<b>120.00</b>

### External accessories - user fit

		Cat. No.	Price \$
Handle operators	3 P solderless terminals (6)	<b>TXBD0009A</b>	<b>36.50</b>
	IP55 Grey variable depth handle + 357 mm shaft	<b>T1HS03R5GM</b>	<b>240.00</b>
	T1HS escutcheon plate option: 100 mm <sup>2</sup>	<b>T2HSESC100</b>	<b>18.20</b>
	90 mm T pin shaft for T2HS - no flexi coupling	<b>T2HS250SHAFT</b>	<b>47.00</b>
	IP65 Grey variable depth handle + 420 mm shaft	<b>T1HP03R6BNA4</b>	<b>141.00</b>
	Padlock attachment for T2HP/HS mechanism	<b>T1HP30PALK</b>	<b>44.50</b>
	IP55 direct mount fixed depth handle	<b>TFJ21PB</b>	<b>235.00</b>
Trapped Key interlock	Prosafe shot bolt lock HS handles xx code	<b>TKNHPXX</b>	<b>520.00</b>
	Prosafe standard key xx code for above	<b>TKNNHPKEYXX</b>	<b>130.00</b>
	Cam for T2HS handle shafts Key codes A to Z are available. Specify by changing the key code above.	<b>14997702</b>	<b>235.00</b>
TemPlug	3 P Templug	<b>UPX330PB<sup>1)</sup></b>	<b>270.00</b>
Terminal Cover	Line side terminal screw cover	<b>XM30TSC</b>	<b>21.80</b>

**Notes:** <sup>1)</sup> Price schedule 'T3' applies for this item.

NHP

# CAPTIVE LOCK ATTACHMENTS

Securely locks off Terasaki Tembreak2 circuit breakers.



PP-TERASAKI-LCAP-LOCK-CPB

- Three types: T2HL12CAP, T2HL25CAP, T2HL40CAP
- Also available for 1 Pole MCCBs
- Consists of a fully moulded front cover with built-in padlockable flap
- Off position padlockable as standard
- Knockout provided for ON position padlocking
- Internal accessory fitting not affected
- Locking not padlock size dependant
- Suits one lock up to 8 mm
- Accepts multiple padlock hasps
- XKA captive locks for MCCBs to 800 A also available
- Can be field fitted
- Suits MCCBs up to 630 A
- Suits ZS earth leakage MCCBs
- Accepts a compression seal


**TERASAKI**  
Innovators in Protection Technology

## TemBreak 2 Thermal magnetic type E125NJ

**25 kA****Current rating:** 12.5 – 125 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:****3**

	Voltage	Icu	Ics
AC use	380/415	25	19
DC use	250	25	19

**Trip unit:** Adjustable thermal (0.63 Ir to 100 % Ir) and adjustable magnetic**Dimensions (mm)**

Poles	3
H	155
W	90
D (less toggle)	68
Toggle cut-out	104

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	3 pole Price \$
20	12.5 – 20	120 – 240	E125 NJ 3 20	440.00
32	20 – 32	192 – 384	E125 NJ 3 32	440.00
50	32 – 50	300 – 600	E125 NJ 3 50	440.00
63	40 – 63	378 – 756	E125 NJ 3 63	440.00
100	63 – 100	600 – 1200	E125 NJ 3 100	630.00
125	80 – 125	750 – 1250	E125 NJ 3 125	780.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting  
Adj. Im: Adjustable magnetic setting

NRC: Nominal rated current

Magnetic only MCCBs are available on request.

For 4 pole MCCBs refer S125GJ type.

## TemBreak 2 Thermal magnetic type S125NF

**25 kA****Current rating:** 16 – 125 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**

Voltage	Icu	Ics
AC use	230	25

**Trip unit:** Fixed thermal magnetic**Dimensions (mm)**

Poles	1
H	155
W	30
D (less toggle)	68
Toggle cut-out	104

Ampere Rating NRC	Ir	Im	Cat. No.	1 pole Price \$
16	16	208	S125 NF 1 16	165.00
20	20	260	S125 NF 1 20	165.00
25	25	325	S125 NF 1 25	165.00
32	32	420	S125 NF 1 32	165.00
40	40	520	S125 NF 1 40	165.00
50	50	650	S125 NF 1 50	165.00
63	63	820	S125 NF 1 63	165.00
80	80	1040	S125 NF 1 80	235.00
100	100	1300	S125 NF 1 100	310.00
125	125	1550	S125 NF 1 125	310.00



Optional terminal covers



Optional captive lock attachment

**Notes:** For Interpole Barriers, Terminal Covers and Padlock attachments refer to accessories pages.

Ir: thermal rating

Im: magnetic rating

NRC: Nominal rated current

S125NF will not accept rear connection studs. (S160NF types do)

## TemBreak 2 Thermal magnetic type S100GF

**65 kA****Current rating:** 15 – 100 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:****3**

	Voltage	Icu	Ics
AC use	230	85	85
	380/415	65	33
DC use		40	40

**Black TemBreak 2  
MCCB****Trip unit:** Fixed thermal magnetic**Dimensions (mm)**

<b>Poles</b>	<b>2</b>
H	155
W	60
D (less toggle)	68
Toggle cut-out required	52 <sup>1)</sup> or 104

**Accessories**

Has mounting provision for any 1 (one) of the following: TemBreak 2 accessories UVT or Shunt or a combination of up to 2 Auxiliaries plus 1 Alarm.

Will accept standard TemBreak 2 external accessories such as: interpole barriers, terminal connection options, toggle locks, and 2 pole terminal covers.

Refer accessories pages. Will not accept motors or handles due to the 60 mm width of the MCCB.

Ampere Rating NRC	Ir	Im	Cat. No.	2 pole Price \$
15	15	180	S100 GF 2 15	315.00
20	20	240	S100 GF 2 20	315.00
30	30	360	S100 GF 2 30	315.00
40	40	480	S100 GF 2 40	315.00
50	50	600	S100 GF 2 50	315.00
60	60	720	S100 GF 2 60	315.00
75	75	900	S100 GF 2 75	355.00
100	100	1200	S100 GF 2 100	430.00

**Notes:** 1) S100GF 2 Pole MCCBs require a 52 mm cut-out as the toggle area is 50 mm high.

Ir: thermal rating

Im: magnetic rating

NRC: Nominal rated current

Magnetic only MCCBs are available on request.

## TemBreak 2 Thermal magnetic type S125NJ

**36 kA****Current rating:** 12.5 – 125 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**

Voltage	Icu	Ics
AC use	380/400	36
DC use	250	19



3

**Trip unit:** Adjustable thermal (0.63 Ir to 100 % Ir) and adjustable magnetic**Dimensions (mm)**

Poles	3
H	155
W	90
D (less toggle)	68
Toggle cut-out	104

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	3 pole Price \$
20	12.5 – 20	120 – 240	S125 NJ 3 20	480.00
32	20 – 32	192 – 384	S125 NJ 3 32	480.00
50	32 – 50	300 – 600	S125 NJ 3 50	480.00
63	40 – 63	378 – 756	S125 NJ 3 63	480.00
100	63 – 100	600 – 1200	S125 NJ 3 100	680.00
125	80 – 125	750 – 1250	S125 NJ 3 125	810.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting  
Adj. Im: Adjustable magnetic setting

NRC: Nominal rated current

Magnetic only MCCBs are available on request.

For 4 pole MCCBs refer S125GT types.

## TemBreak 2 Thermal magnetic type S125GJ

**65 kA****Current rating:** 12.5 – 125 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:****3**

	Voltage	Icu	Ics
AC use	380/400	65	36
DC use	250	40	40

**Trip unit:** Adjustable thermal (0.63 Ir to 100 % Ir) and adjustable magnetic

Poles	3	4
H	155	155
W	90	120
D (less toggle)	68	68
Toggle cut-out	104	104

**3 Pole**

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	3 pole Price \$
20	12.5 – 20	120 – 240	S125 GJ 3 20 <sup>2)</sup>	750.00
32	20 – 32	192 – 384	S125 GJ 3 32 <sup>2)</sup>	750.00
50	32 – 50	300 – 600	S125 GJ 3 50 <sup>2)</sup>	750.00
63	40 – 63	378 – 756	S125 GJ 3 63 <sup>2)</sup>	750.00
100	63 – 100	600 – 1200	S125 GJ 3 100 <sup>2)</sup>	900.00
125	80 – 125	750 – 1250	S125 GJ 3 125 <sup>2)</sup>	1000.00

**4 Pole**

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	4 pole Price \$
20	12.5 – 20	120 – 240	S125 GJ 4 20 <sup>2)</sup>	990.00
32	20 – 32	192 – 384	S125 GJ 4 32 <sup>2)</sup>	990.00
50	32 – 50	300 – 600	S125 GJ 4 50 <sup>2)</sup>	990.00
63	40 – 63	378 – 756	S125 GJ 4 63 <sup>2)</sup>	990.00
100	63 – 100	600 – 1200	S125 GJ 4 100 <sup>2)</sup>	1210.00
125	80 – 125	750 – 1250	S125 GJ 4 125 <sup>2)</sup>	1330.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

2) To obtain MCCBs that accept additional internal auxiliary circuits add "EA" to the above Cat. No's. E.g.: S125GJ3125EA. Otherwise leave blank. Refer NHP for availability. Refer page 3 - 9 for details.

NRC: Nominal rated current

Magnetic only MCCBs are available on request.

## TemBreak 2 690V AC High Fault Interruption MCCB L125PJ

**70 kA****Current rating:** 12.5 – 125 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	690 V	70	33



3

**Trip unit:** Adjustable thermal (0.63 Ir to 100 % Ir) and adjustable magnetic  
 Adjustable magnetic 6 Im to 12 Im, trip unit: 20 A to 100 A  
 6 Im to 10 Im, trip unit: 125 A

Poles	3
H	165
W	105
D (less toggle)	103
Toggle cut-out	48
	105 on chassis <sup>1)</sup>

Ampere Rating NRC	Adj. Ir Min. – Max.	Adj. Im Min. – Max.	Cat. No.	Price \$
20	12.5 – 20	120 – 240	L125 PJ 3 20	730.00
32	20 – 32	192 – 384	L125 PJ 3 32	730.00
50	32 – 50	300 – 600	L125 PJ 3 50	730.00
63	40 – 63	378 – 756	L125 PJ 3 63	730.00
100	63 – 100	600 – 1200	L125 PJ 3 100	830.00
125	80 – 125	750 – 1250	L125 PJ 3 125	830.00

**Notes:** 1) Not suitable for reverse connection either individually or on chassis.

Suitable for general motor starting and power distribution applications.

Refer to NHP for availability of 4 pole version.

Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

NRC: Nominal rated current

## TemBreak 2 Thermal magnetic type H125NJ

**125 kA**

**Current rating:** 12.5 – 125 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

**3**

	<b>Voltage</b>	<b>Icu</b>	<b>Ics</b>
AC use	380/415	125	85
DC use	250	40	40



**Trip unit:** Adjustable thermal (0.63 Ir to 100 % Ir) and adjustable magnetic

**Dimensions (mm)**

<b>Poles</b>	<b>3</b>	<b>4</b>
H	165	155
W	105	140
D (less toggle)	105	103
Toggle cut-out	104	104

\*H125NJ is a 250 AF MCCB

### 3 Pole

<b>Ampere Rating NRC</b>	<b>Adj. Ir<sup>-1</sup>) Min. – Max.</b>	<b>Adj. Im<sup>-1</sup>) Min. – Max.</b>	<b>Cat. No.</b>	<b>3 pole Price \$</b>
20	12.5 – 20	120 – 240	<b>H125 NJ 3 20</b>	<b>960.00</b>
32	20 – 32	192 – 384	<b>H125 NJ 3 32</b>	<b>960.00</b>
50	32 – 50	300 – 600	<b>H125 NJ 3 50</b>	<b>960.00</b>
63	40 – 63	378 – 756	<b>H125 NJ 3 63</b>	<b>960.00</b>
100	63 – 100	600 – 1200	<b>H125 NJ 3 100</b>	<b>1110.00</b>
125	80 – 125	750 – 1250	<b>H125 NJ 3 125</b>	<b>1110.00</b>

### 4 Pole

<b>Ampere Rating NRC</b>	<b>Adj. Ir<sup>-1</sup>) Min. – Max.</b>	<b>Adj. Im<sup>-1</sup>) Min. – Max.</b>	<b>Cat. No.</b>	<b>4 pole Price \$</b>
20	12.5 – 20	120 – 240	<b>H125 NJ 4 20</b>	<b>1290.00</b>
32	20 – 32	192 – 384	<b>H125 NJ 4 32</b>	<b>1290.00</b>
50	32 – 50	300 – 600	<b>H125 NJ 4 50</b>	<b>1290.00</b>
63	40 – 63	378 – 756	<b>H125 NJ 4 63</b>	<b>1290.00</b>
100	63 – 100	600 – 1200	<b>H125 NJ 4 100</b>	<b>1470.00</b>
125	80 – 125	750 – 1250	<b>H125 NJ 4 125</b>	<b>1470.00</b>

**Notes:** 1) Adj. Ir: Adjustable thermal setting  
Adj. Im: Adjustable magnetic setting  
NRC: Nominal rated current

## TemBreak 2 Thermal magnetic type L125NJ

**200 kA**

**Current rating:** 12.5 – 125 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	380/415	200	150
DC use	250	40	40



3

**Trip unit:** Adjustable thermal (0.63 Ir to 100 % Ir) and adjustable magnetic

**Dimensions (mm)**

Poles	3	4
H	165	165
W	105	140
D (less toggle)	103	103
Toggle cut-out	104	104

\*L125NJ is a 250 AF MCCB

### 3 Pole

Ampere Rating NRC	Adj. Ir <sup>-1</sup> ) Min. – Max.	Adj. Im <sup>-1</sup> ) Min. – Max.	Cat. No.	3 pole Price \$
20	12.5 – 20	120 – 240	L125 NJ 3 20	1090.00
32	20 – 32	192 – 384	L125 NJ 3 32	1090.00
50	32 – 50	300 – 600	L125 NJ 3 50	1090.00
63	40 – 63	378 – 756	L125 NJ 3 63	1090.00
100	63 – 100	600 – 1200	L125 NJ 3 100	1170.00
125	80 – 125	750 – 1250	L125 NJ 3 125	1170.00

### 4 Pole

Ampere Rating NRC	Adj. Ir <sup>-1</sup> ) Min. – Max.	Adj. Im <sup>-1</sup> ) Min. – Max.	Cat. No.	4 pole Price \$
20	12.5 – 20	120 – 240	L125 NJ 4 20	1440.00
32	20 – 32	192 – 384	L125 NJ 4 32	1440.00
50	32 – 50	300 – 600	L125 NJ 4 50	1440.00
63	40 – 63	378 – 756	L125 NJ 4 63	1440.00
100	63 – 100	600 – 1200	L125 NJ 4 100	1570.00
125	80 – 125	750 – 1250	L125 NJ 4 125	1570.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting  
Adj. Im: Adjustable magnetic setting  
NRC: Nominal rated current

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GST not included NHP Sales 1500 NHP NHP  
Price schedule 'T2'

## Accessories to suit 125 A TemBreak 2



3

	<b>Internal accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
SH	Shunt trips Internal accessories are common for MCCBs 125 A to 630 A. All have screw terminals except those indicated below with wire leads.		
<b>For 2, 3 and 4 pole MCCBs</b>			
	110 V AC	T2SH00A10TA <sup>1)</sup>	255.00
	230 – 240 V AC	T2SH00A20TA <sup>1)</sup>	255.00
	400 – 415 V AC	T2SH00A40TA <sup>1)</sup>	255.00
	24 V DC (Suits 24 V AC)	T2SH00D02TA <sup>1)</sup>	255.00
	48 V DC	T2SH00D04TA <sup>1)</sup>	255.00
	110 V DC	T2SH00D10TA <sup>1)</sup>	255.00
	230 V DC	T2SH00D20TA <sup>1)</sup>	255.00
UV	Undervoltage trips <b>Instantaneous operation</b>		
	110 V AC	T2UV00A10NTA	270.00
	200 – 240 V AC	T2UV00A20NTA	270.00
	380 – 450 V AC	T2UV00A40NTA	270.00
	24 V DC	T2UV00D02NTA	270.00
	110 V DC	T2UV00D10NTA	270.00
	230 V DC	T2UV00D20NTA	270.00
<b>Time delayed operation (500 ms) – refer NHP</b>			
AX AL	Auxiliary & Alarm switches <b>General type (2 A @ 240 V Inductive)</b>		
	1 C/O Auxiliary	T2AX00M3STA	134.00
	1 C/O Auxiliary – with 0.7 m wire leads	T2AX00M3SWA	146.00
	1 C/O Alarm	T2AL00M3STA	134.00
	1 C/O Alarm – with 0.7 m wire leads	T2AL00M3SWA	146.00
<b>Heavy-duty type (4 A @ 240 V Inductive)</b>			
	1 N/O Auxiliary	T2AX00B1STA	146.00
	1 N/C Auxiliary	T2AX00B2STA	146.00
	1 N/O Alarm	T2AL00B1STA	146.00
	1 N/C Alarm	T2AL00B2STA	146.00
<b>Micro switching type (very low voltages)</b>			
	1 C/O Auxiliary	T2AX00M3RTA	187.00
	1 C/O Alarm	T2AL00M3RTA	187.00

**Notes:** 1) Wire lead types available.

## Accessories to suit 125 A TemBreak 2

<b>External accessories</b>		<b>Cat. No.</b>	<b>Price \$</b>
<b>MC</b>	<b>Suits MCCB types</b>		
	<b>E125, S125</b>		
	110 V AC	T2MC12A10NB	1200.00
	230 – 240 V AC	T2MC12A24NB	1200.00
	24 V DC	T2MC12D02NB	1200.00
	48 V DC	T2MC12D04NB	1190.00
	110 V DC	T2MC12D10NB	1200.00
	<b>H125, L125</b>		
	110 V AC	T2MC25A10NB	1620.00
	230 – 240 V AC	T2MC25A24NB	1630.00
<b>Motor Accessories</b>	24 V DC	T2MC25D02NB	1630.00
	48 V DC	T2MC25D04NB	1620.00
	110 V DC	T2MC25D10NB	1620.00
	<b>Motor connection cable loom for electrical interlocking for transfer switches</b>		
	T2MC12 cable 500 mm 125/250AF	T2MM25L05A	60.50
T2MC12 cable 1500 mm 125/250AF		T2MM25L15A	73.00
Motor options: Contact NHP for key locking and auto-reset.			
MCCB identification labels		T12CAPLAB	3.50



## Accessories to suit 125 A TemBreak 2

		Cat. No.	Price \$
	<b>External accessories</b>		
	<b>Suits MCCB types</b>		
	<b>E125, S125</b>		
	Operating handles		
	Direct mounting, fixed depth, IP 54		
	<b>HB</b>		
	Grey/black	T2HB12UR5BN	175.00
	Red/yellow	T2HB12UR5RN	199.00
	<b>H125, L125</b>		
	Grey/black	T2HB25UR5BN	189.00
	Red/yellow	T2HB25UR5RN	210.00
	Optional MCCB identification labels	T12CAPLAB	3.50
	<b>HS</b>		
	<b>E125, S125</b>		
	Grey IP 55 handle + 357 mm shaft	T2HS12R5GM	280.00
	Red/ yellow IP 55 handle 357 mm shaft	T2HS12R5RM	290.00
	Escutcheon plate option: 100 mm <sup>2</sup>	T2HSESC100	18.20
	90 mm T pin shaft for T2HS - no flexi coupling	T2HS250SHAFT	47.00
	<b>HP</b>		
	Grey/ black IP65 handle + 420 mm shaft	T2HP12R6BN	290.00
	Red/ yellow IP65 handle + 420 mm shaft	T2HP12R6RN	300.00
	Padlock attachment for T2HP/HS mechanism	T2HP25PALK	49.50
	Optional MCCB identification labels	T12CAPLAB	3.50
	<b>H125, L125</b>		
	IP 55 handle + 357 mm shaft	T2HS25R5GM	280.00
	Red/ yellow IP 55 handle + 357 mm shaft	T2HS25R5RM	290.00
	Large escutcheon plate option: 100 mm <sup>2</sup>	T2HSESC100	18.20
	90 mm T pin shaft for T2HS - no flexi coupling	T2HS250SHAFT	47.00
	Grey/ black IP 65 handle + 420 mm shaft	T2HP25R6BN	290.00
	Red/ yellow IP 65 handle + 420 mm shaft	T2HP25R6RN	300.00
	Padlock attachment for T2HP/ HS mechanism	T2HP25PALK	49.50
	Optional MCCB identification labels	T12CAPLAB	3.50



T2HS handle mechanism with  
T2HP25PALK mechanism lock



T2HS handle with  
T2HSESC100 escutcheon  
plate

## Accessories to suit 125 A TemBreak 2

<b>External accessories</b>		<b>Cat. No.</b>	<b>Price \$</b>
Mechanical Interlocks	Link Interlock – suitable for manual or motorised operation. Will accept handles. Suitable for front or rear connect type MCCBs.		
Link type	<b>Suits MCCB types E125, S125</b>		
ML	Common 3 or 4 pole right side section	T2ML12RA	113.00
	3 pole left side section	T2ML12L3A	127.00
	4 pole left side section	T2ML12L4A	127.00
	MCCB identification labels	T12CAPLAB	3.50
	<b>H125, L125</b>		
	Common 3 or 4 pole right side section	T2ML25RA	113.00
	3 pole left side section	T2ML25L3A	127.00
	4 pole left side section	T2ML25L4A	127.00
	MCCB identification labels	T12CAPLAB	3.50

3

Left section 3 or 4 pole  
(T2ML12L4A shown)



Common right section  
(T2ML12RA shown)

Link interlock on MCCBs, T2ML



Link interlock on MCCBs with motors and electrical interlocking cable T2MM

**Notes:** Handles supplied with shaft  
Refer to Section 5 if MCCB labels are required or refer to NHP.

Q-Pulse Id ADTMS 1307210012511 of 1633

Price schedule 'T2'

GST not included

NHP Sales 1300 NHP NHP

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## Accessories to suit 125 A TemBreak 2

	<b>External accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
Slide type interlock	Manual operation, padlockable. Does not allow motors, handles or other front mounted accessories to be fitted.  <b>Suitable for front or rear connection</b> <b>E125, S125 MCCB types</b>		
<b>MS</b>	3 pole	T2MS123SFA	120.00
	4 pole	T2MS124SFA	134.00
	<b>H125, L125</b>		
	3 pole	T2MS253LFA	120.00
	4 pole	T2MS254LFA	134.00
Cable interlock	Allows an MCCB to be mounted horizontally, vertically or diagonally. Accepts Motors and handles.  <b>Suitable for 3 or 4 pole MCCBs</b> <b>E125, S125 MCCB types</b>		
<b>MW</b>	Interlock kit less wire	T2MW12CA <sup>1)</sup>	265.00
	MCCB identification labels	T12CAPLAB	3.50
	<b>H125, L125</b>		
	Interlock kit less wire	T2MW25CA	275.00
	MCCB identification labels	T12CAPLAB	3.50
	Wire for above interlocks Wire 1.0 M	T2MW00SA <sup>2)</sup>	63.00
	Wire 1.5 M	T2MW00LA <sup>2)</sup>	73.00



Slide interlock on  
MCCBs, T2MS



Cable interlock on MCCBs, T2MW

**Notes:** <sup>1)</sup> Order one interlock kit for each MCCB.

<sup>2)</sup> One wire length will cover two MCCBs.

## Accessories to suit 125 A TemBreak 2

<b>External accessories</b>		<b>Cat. No.</b>	<b>Price \$</b>
Terminal Covers	Flush IP 20	Front connected MCCBs	
		<b>Suits MCCB types</b>	
		<b>E125, S125</b>	
<b>CS</b>	1 pole cover set of 2	<b>T2CS121SG</b>	<b>10.60</b>
	3 pole cover set of 2	<b>T2CS123SG</b>	<b>44.00</b>
	4 pole cover set of 2	<b>T2CS124SG</b>	<b>55.00</b>
	<b>H125, L125</b>		
	3 pole cover set of 2	<b>T2CS253SG</b>	<b>54.00</b>
<b>CF</b>	4 pole cover set of 2	<b>T2CS254SG</b>	<b>60.50</b>
	<b>Short terminal covers</b>	<b>E125, S125</b>	
	3 pole cover set of 2, 22 mm long	<b>T2CF123SSNBA</b>	<b>60.50</b>
	4 pole cover set of 2, 22 mm long	<b>T2CF124SSNBA</b>	<b>71.00</b>
	<b>Standard terminal covers</b>	<b>E125, S125</b>	
<b>CF</b>	1 pole cover set of 2, 40 mm long	<b>T2CF121SLNG</b>	<b>35.00</b>
	2 pole cover set of 2, 40 mm long	<b>T2CF122SLNG</b>	<b>49.50</b>
	3 pole cover set of 2, 40 mm long	<b>T2CF123SLNG</b>	<b>64.50</b>
	4 pole cover set of 2, 40 mm long	<b>T2CF124SLNG</b>	<b>73.00</b>
	<b>H125, L125</b>		
	3 pole cover set of 2, 40 mm long	<b>T2CF253LLNG</b>	<b>71.00</b>
	4 pole cover set of 2, 40 mm long	<b>T2CF254LLNG</b>	<b>77.50</b>



T2CS Flush IP20 Cover



T2CF Short terminal



Single pole terminal cover



T2CF Standard terminal covers



T2RC Rear connect terminal cover

3

## Accessories to suit 125 A TemBreak 2

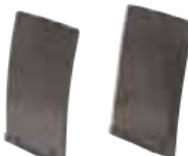
		Cat. No.	Price \$
	<b>External accessories</b>		
Terminal covers rear connect	<b>Suits MCCB types E125, S125</b>		
	3 pole cover set of 2	T2CR123SG	44.00
	4 pole cover set of 2	T2CR124SG	55.00
	<b>H125, L125</b>		
	3 pole cover set of 2	T2CR253SG	54.00
	4 pole cover set of 2	T2CR254SG	60.50
<b>CR</b>			
Terminal and cover locking clip	A clip that provides additional terminal cover position locking also allows a sealing device to be fitted.		
	All sizes 125, 250, 400, 630 AF	T2CF00L	9.10
	<b>Interpole Barriers<sup>1)</sup> <sup>2)</sup></b>		
	<b>Suits MCCB types E125, S125</b>		
	Interpole barrier (Qty 2)	T2BA123SHA	17.40
<b>BA</b>	<b>H125, L125</b>		
	Interpole barrier (Qty 2)	T2BA253LHA	20.00
Toggle locks	Non Captive: Fits up to 3 padlocks or a multiple lock device		
	2, 3 and 4 pole E/S125 lock	T2HL25B	31.50
	1 pole S125NF lock	UXKB0013A	61.00
	Captive: Allows a single padlock or multiple padlock device		
	<b>E125, S125</b>		
<b>HL</b>	For 3/4 pole MCCBs 1 x 8 mm hole	T2HL12CAP	33.50
	For 1 pole MCCBs, 1 x 8 mm hole	T2HLS125NFCAP	92.00
	<b>H125, L125</b>		
	Lock with one 8 mm hole	T2HL25CAP	33.50



T2CF locking clip



Non captive lock attachment



Inter pole barriers



Captive lock attachment

**Notes:** <sup>1)</sup> Line side interpole barriers or terminal covers must be installed with MCCBs.

<sup>2)</sup> Interpole Barriers are supplied with MCCBs as standard; 2 barriers with 3 pole MCCBs, and 3 barriers with 4 pole MCCBs.

## Accessories to suit 125 A TemBreak 2

	<b>External accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
ProSafe lock option <sup>1)</sup>	Allen-Bradley ProSafe locks can be used with T2HS variable depth handles. Refer NHP for direct mounting handle options.		
	<b>Suits MCCB types E/S/H/L 125</b>		
	Prosafe shot bolt lock HS handles xx code	<b>TKNHPXX</b>	<b>520.00</b>
<b>TKN</b>	Prosafe standard key xx code for above	<b>TKNNHPKEYXX</b>	<b>130.00</b>
	Cam for T2HS handle shafts Key codes A to Z are available. Specify by changing the key code above.	<b>14997702</b>	<b>235.00</b>
Extention Busbars	<b>E125, S125</b>		
	1 set of 2 of straight bars	<b>T2FB251BA</b>	<b>26.80</b>
	3 pole set of 6 straight bars	<b>T2FB123BA</b>	<b>77.50</b>
	4 pole set of 8 straight bars	<b>T2FB124BA</b>	<b>103.00</b>
<b>FB</b>	<b>H125, L125</b>		
	1 set of straight terminal bars	<b>T2FB251BA</b>	<b>26.80</b>
	3 pole, set of 6, flanged bars	<b>T2FB253BA</b>	<b>77.50</b>
	4 pole, set of 8, straight bars	<b>T2FB254BA</b>	<b>103.00</b>
Tunnel clamp terminals	<b>E125, S125</b>		
	3 pole set of 6 terminals 50 mm <sup>2</sup>	<b>T2FW12S3A</b>	<b>107.00</b>
	4 pole set of 8 terminals 50 mm <sup>2</sup>	<b>T2FW12S4A</b>	<b>141.00</b>
<b>FW</b>	<b>H125, L125</b>		
	3 pole set of 6 terminals 35 - 120 mm <sup>2</sup>	<b>T2FW25L3B</b>	<b>173.00</b>
	4 pole set of 8 terminals 35 - 120 mm <sup>2</sup>	<b>T2FW25L4B</b>	<b>240.00</b>



T2FW Tunnel clamp terminals and optional T2CS terminal cover



T2FB Attached busbar



ProSafe key Interlock and cam

**Notes:** 1) Contact NHP for lock options.

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Price schedule 'T2'

GST not included

NHP Sales

1300 NHP

NHP

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## Accessories to suit 125 A TemBreak 2

3

		Cat. No.	Price \$
	<b>External accessories</b>		
Rear connect terminal studs	<b>Suits MCCB types E125, S125<sup>1)</sup></b>		
	3 pole kit, set of 6 studs	T2RP123SA	200.00
	4 pole kit, set of 8 studs	T2RP124SA	270.00
<b>RP</b>	<b>H125, L125</b>		
	3 pole kit, set of 6 studs	T2RP253LA	390.00
	4 pole kit, set of 8 studs	T2RP254LA	540.00
TemPlug	<b>Suits MCCB types TemPlug MCCB line-side plug-in attachment E125, S125</b>		
<b>UP</b>	3 pole TemPlug	T2UPX3125	305.00
	<b>H125, L125</b>		
	3 pole TemPlug (65 kA limit)	T2UPXE3250	350.00
	Templugs suit 6.3 mm busbar as standard, 10 mm types indent		
OCR sealing cover SF	125/250 A thermal magnetic	T2SF25NTA	26.80
<b>PM</b>	Plug-in MCCBs (refer rear of section 3)		
<b>DR</b>	Draw-out MCCBs (refer NHP)		



T2RP Rear connect studs



T2UPX Templug



T2SF OCR Seal kit. Suitable for a compression seal device.



T2CR Rear connect term cover

**Notes:** 1) 125 A rear connect studs will not fit to S125NF single pole MCCBs. S160NF single pole MCCBs will accept rear studs.

## Accessories to suit 125 A TemBreak 2

<b>External accessories</b>		<b>Cat. No.</b>	<b>Price \$</b>
Pole fillers	<b>Suits MCCB types</b> <b>E/S/H/L125</b>		
<b>PF</b>	Pole filler 1 strip for a 46 mm high cut-out <sup>1)</sup>	<b>DTPF</b>	<b>4.30</b>
	Pole filler, 30 mm wide for a 104 mm cut-out	<b>XAB2</b>	<b>3.80</b>
DIN Rail Adaptor	Allows a 125 AF MCCB to be mounted on standard 35 mm DIN rail <b>E125, S125</b>		
<b>DA</b>	Metal DIN rail adaptor	<b>T2DA12A</b>	<b>63.00</b>
Door flange	Provides an attractive panel cut-out surround for MCCBs or motors <b>Suits MCCB types</b> <b>E/S/H/L125</b>		
<b>DF</b>	MCCB IP 30 gland and gasket	<b>T2DF25A</b>	<b>127.00</b>
	MOTOR IP 30 gland and gasket	<b>T2DM25A</b>	<b>215.00</b>
Door mounting flush plate	A kit that allows an MCCB to be mounted directly onto a door		
<b>FP</b>	3 pole kit E125, S125	<b>T2FP12S3B</b>	<b>82.50</b>
	4 pole kit E125, S125	<b>T2FP12S4A</b>	<b>POA</b>
Wire lead terminal block	125/250 AF left side	<b>T2TF25LGA</b>	<b>189.00</b>
<b>TF</b>	125/250 AF right side	<b>T2TF25RGA</b>	<b>189.00</b>

3

T2PF



Pole fillers

T2DF/DM

Door flange



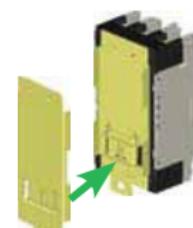
T2TF



Wire lead terminal block

T2DA

DIN rail adapter



**Notes:** <sup>1)</sup> 1 strip is 8 off, 9 mm segments. Order 2 strips for each 125 A MCCB.

Q-Pulse Id ADMS 130721001517 of 1633

Price schedule 'T2'

GST not included

NHP Sales 1300 NHP NHP

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## TemBreak 2 Thermal magnetic type S160NF

**25 kA**

**Current rating:** 16 – 160 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

**3**

	<b>Voltage</b>	<b>Icu</b>	<b>Ics</b>
AC use	230	25	19
	125	15	8
DC use	125	15	–



**Trip unit:** Fixed thermal and magnetic

**Dimensions (mm)**

<b>Poles</b>	<b>1</b>
H	165
W	35
D (less toggle)	68
Toggle cut-out	104

<b>Ampere Rating NRC</b>	<b>Ir</b>	<b>Im</b>	<b>Cat. No.</b>	<b>1 pole Price \$</b>
16	16	160	<b>S160 NF 1 16</b>	<b>165.00</b>
20	20	200	<b>S160 NF 1 20</b>	<b>165.00</b>
25	25	250	<b>S160 NF 1 25</b>	<b>165.00</b>
32	32	320	<b>S160 NF 1 32</b>	<b>165.00</b>
40	40	400	<b>S160 NF 1 40</b>	<b>165.00</b>
50	50	500	<b>S160 NF 1 50</b>	<b>165.00</b>
63	63	630	<b>S160 NF 1 63</b>	<b>165.00</b>
80	80	800	<b>S160 NF 1 80</b>	<b>220.00</b>
100	100	1000	<b>S160 NF 1 100</b>	<b>310.00</b>
125	125	1250	<b>S160 NF 1 125</b>	<b>310.00</b>
160	160	1600	<b>S160 NF 1 160</b>	<b>340.00</b>



Optional  
terminal  
covers



Optional  
captive lock  
attachment

**Notes:** For Shunt Trips, Interpole Barriers and Terminal Covers refer to accessories pages.

Ir: thermal rating

Im: magnetic rating

NRC: Nominal rated current

S160NF will accept rear terminal studs.

## TemBreak 2 Thermal magnetic type S160NJ

**30 / 36 kA**

**Current rating:** 12.5 – 160 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

**20 – 32 A:**

	<b>Voltage</b>	<b>Icu</b>	<b>Ics</b>
AC use	380/415	30	25
DC use	250	40	40

**50 – 250 A:**

	<b>Voltage</b>	<b>Icu</b>	<b>Ics</b>
AC use	380/415	36	36
DC use	250	40	40

**Trip unit:** Adj thermal (0.63  $I_r$  to 100 %  $I_r$ ) and adj magnetic

**Dimensions (mm)**

<b>Poles</b>	<b>3</b>	<b>4</b>
H	165	165
W	105	140
D (less toggle)	68	68
Toggle cut-out	104	104

**3 Pole**

<b>Ampere Rating NRC</b>	$I_r$ <sup>(1)</sup> Min. – Max.	$I_m$ <sup>(1)</sup> Min. – Max.	<b>Cat. No.</b>	<b>3 pole Price \$</b>
20	12.5 – 20	120 – 240	<b>S160 NJ 3 20 <sup>(2)</sup></b>	<b>480.00</b>
32	20 – 32	192 – 384	<b>S160 NJ 3 32 <sup>(2)</sup></b>	<b>480.00</b>
50	32 – 50	300 – 600	<b>S160 NJ 3 50</b>	<b>480.00</b>
63	40 – 63	378 – 756	<b>S160 NJ 3 63</b>	<b>480.00</b>
100	63 – 100	600 – 1200	<b>S160 NJ 3 100</b>	<b>680.00</b>
125	80 – 125	750 – 1500	<b>S160 NJ 3 125</b>	<b>810.00</b>
160	100 – 160	960 – 2080	<b>S160 NJ 3 160</b>	<b>1080.00</b>

**4 Pole**

<b>Ampere Rating NRC</b>	$I_r$ <sup>(1)</sup> Min. – Max.	$I_m$ <sup>(1)</sup> Min. – Max.	<b>Cat. No.</b>	<b>4 pole Price \$</b>
20	12.5 – 20	120 – 240	<b>S160 NJ 4 20</b>	<b>630.00</b>
32	20 – 32	192 – 384	<b>S160 NJ 4 32</b>	<b>630.00</b>
50	32 – 50	300 – 600	<b>S160 NJ 4 50</b>	<b>630.00</b>
63	40 – 63	378 – 756	<b>S160 NJ 4 63</b>	<b>630.00</b>
100	63 – 100	600 – 1200	<b>S160 NJ 4 100</b>	<b>900.00</b>
125	80 – 125	750 – 1500	<b>S160 NJ 4 125</b>	<b>1090.00</b>
160	100 – 160	960 – 2080	<b>S160 NJ 4 160</b>	<b>1425.00</b>

**Notes:** <sup>1)</sup> Adj. Ir: Adjustable thermal setting - Adj. Im: Adjustable magnetic setting

<sup>2)</sup> To obtain MCCBs that accept additional internal auxiliary circuits add "EA" to the above Cat. No.'s. E.g.: S125GJ3125EA.

Some types are stocked. Refer to NHP for availability. Refer page 3 - 9 for details.

NRC: Nominal rated current

Magnetic only MCCBs are available on request.



3

## TemBreak 2 Thermal magnetic type S160GJ

**65 kA**

**Current rating:** 32 – 160 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**



**3**

	Voltage	Icu	Ics
AC use	380/415	65	36
DC use	250	40	40

**Trip unit:** Adjustable thermal (0.63 I<sub>r</sub> to 100 % I<sub>r</sub>) and adjustable magnetic

### Dimensions (mm)

Poles	3	4
H	165	165
W	105	140
D (less toggle)	68	68
Toggle cut-out	104	104

### 3 Pole

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No. <sup>2)</sup>	3 pole Price \$
50	32 – 50	300 – 600	S160 GJ 3 50	750.00
63	40 – 63	378 – 756	S160 GJ 3 63	750.00
100	63 – 100	600 – 1200	S160 GJ 3 100	900.00
125	80 – 125	750 – 1500	S160 GJ 3 125	1000.00
160	100 – 160	960 – 2080	S160 GJ 3 160 <sup>2)</sup>	1210.00

### 4 Pole

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No. <sup>2)</sup>	4 pole Price \$
50	32 – 50	300 – 600	S160 GJ 4 50	990.00
63	40 – 63	378 – 756	S160 GJ 4 63	990.00
100	63 – 100	600 – 1200	S160 GJ 4 100	1210.00
125	80 – 125	750 – 1500	S160 GJ 4 125	1330.00
160	100 – 160	960 – 2080	S160 GJ 4 160 <sup>2)</sup>	1620.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

2) To obtain MCCBs that accept additional internal auxiliary circuits add "EA" to the above Cat. No.'s. E.g.: S160GJ3160EA. Otherwise leave blank.

NRC: Nominal rated current

Magnetic only MCCBs are available on request.

## TemBreak 2 Thermal magnetic type H160NJ

**125 kA****Current rating:** 100 – 160 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	380/415	125	85
DC use	250	40	40



3

**Trip unit:** Adjustable thermal (0.63 I<sub>r</sub> to 100 % I<sub>r</sub>) and adjustable magnetic (6 I<sub>m</sub> to 13 I<sub>m</sub>)

**Dimensions (mm)**

Poles	3	4
H	165	165
W	105	140
D (less toggle)	103	103
Toggle cut-out	104	104

**3 Pole**

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	3 pole Price \$
160	100 – 160	960 – 2080	H160 NJ 3 160	1650.00

**4 Pole**

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	4 pole Price \$
160	100 – 160	960 – 2080	H160 NJ 4 160	2210.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting  
Adj. Im: Adjustable magnetic setting  
NRC: Nominal rated current

## TemBreak 2 Thermal magnetic type L160NJ

**200 kA**

**Current rating:** 100 – 160 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**



**3**

	<b>Voltage</b>	<b>Icu</b>	<b>Ics</b>
AC use	380/415	200	150
DC use	250	40	40

**Trip unit:** Adjustable thermal ( $0.63 I_r$  to 100 %  $I_r$ ) and adjustable magnetic ( $6 I_m$  to 13  $I_m$ )

**Dimensions (mm)**

<b>Poles</b>	<b>3</b>	<b>4</b>
H	165	165
W	105	140
D (less toggle)	103	103
Toggle cut-out	104	104

### 3 Pole

<b>Ampere Rating NRC</b>	<b>Adj. Ir<sup>1)</sup> Min. – Max.</b>	<b>Adj. Im<sup>1)</sup> Min. – Max.</b>	<b>Cat. No.</b>	<b>3 pole Price \$</b>
160	100 – 160	960 – 2080	L160 NJ 3 160	2030.00

### 4 Pole

<b>Ampere Rating NRC</b>	<b>Adj. Ir<sup>1)</sup> Min. – Max.</b>	<b>Adj. Im<sup>1)</sup> Min. – Max.</b>	<b>Cat. No.</b>	<b>4 pole Price \$</b>
160	100 – 160	960 – 2080	L160 NJ 4 160	2710.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting  
Adj. Im: Adjustable magnetic setting  
NRC: Nominal rated current

## TemBreak 2 Thermal magnetic type E250NJ

**25 kA**

**Current rating:** 12.5 – 250 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

Voltage	Icu	Ics
AC use	230	25
DC use	250	25



3

**Trip unit:** Adjustable thermal (0.63 I<sub>r</sub> to 100 % I<sub>r</sub>) and adjustable magnetic

**Dimensions (mm)**

Poles	3
H	165
W	105
D (less toggle)	68
Toggle cut-out	104

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	3 pole Price \$
20	12.5 – 20	120 – 240	E250 NJ 3 20	440.00
32	20 – 32	192 – 384	E250 NJ 3 32	440.00
50	32 – 50	300 – 600	E250 NJ 3 50	440.00
63	40 – 63	378 – 756	E250 NJ 3 63	440.00
100	63 – 100	600 – 1200	E250 NJ 3 100	630.00
125	80 – 125	750 – 1500	E250 NJ 3 125	780.00
160	100 – 160	960 – 2080	E250 NJ 3 160	1030.00
250	160 – 250	1500 – 2500	E250 NJ 3 250	1400.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting  
Adj. Im: Adjustable magnetic setting

NRC: Nominal rated current

Magnetic only MCCBs are available on request.

## TemBreak 2 Thermal magnetic type S250NJ

**36 kA****Current rating:** 160 – 250 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:****3**

	Voltage	Icu	Ics
AC use	380/415	36	36
DC use	250	40	40

**Trip unit:** Adjustable thermal (0.63 I<sub>r</sub> to 100 % I<sub>r</sub>) and adjustable magnetic (6 I<sub>m</sub> to 10 I<sub>m</sub>)

**Dimensions (mm)**

Poles	3	4
H	165	165
W	105	140
D (less toggle)	68	68
Toggle cut-out	104	104

**3 Pole**

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	3 pole Price \$
250	160 – 250	1500 – 2500	S250 NJ 3 250	1480.00

**4 Pole**

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	4 pole Price \$
250	160 – 250	1500 – 2500	S250 NJ 4 250	1860.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting  
Adj. Im: Adjustable magnetic setting

NRC: Nominal rated current

Magnetic only MCCBs are available on request.

For smaller amp trip units in the same 36 kA frame size, refer S160NJ MCCBs.

## TemBreak 2 Thermal magnetic type S250GJ

**65 kA**

**Current rating:** 160 – 250 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

Voltage	Icu	Ics
AC use	380/415	65
DC use	250	40



3

**Trip unit:** Adjustable thermal (0.63 I<sub>r</sub> to 100 % I<sub>r</sub>) and adjustable magnetic (6 I<sub>m</sub> to 10 I<sub>m</sub>)

### Dimensions (mm)

Poles	3	4
H	165	165
W	105	140
D (less toggle)	68	68
Toggle cut-out	104	104

### 3 Pole

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No. <sup>2)</sup>	3 pole Price \$
250	160 – 250	1500 – 2500	S250 GJ 3 250	1680.00

### 4 Pole

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No. <sup>2)</sup>	4 pole Price \$
250	160 – 250	1500 – 2500	S250 GJ 4 250	2240.00

### Fixed low magnetic and standard magnetic only types

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Fixed magnetic	Cat. No. <sup>2)</sup>	3 pole Price \$
250	160 – 250	750 A	S250 GJ 3 SO23160	1780.00
250	160 – 250	1000 A	S250 GJ 3 250M1000	1870.00
250	Magnetic trip only	2500 A	S250 GJ3 250MAG	1910.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

2) To obtain MCCBs that accept additional internal auxiliary circuits add 'EA' to the above Cat. Nos. E.g.: S250GJ3250EA. Otherwise leave blank.

NRC: Nominal rated current

For smaller amp trip units in the same 65 kA frame size, refer S160GJ MCCBs.

## MCCBs with Electronic Overcurrent Relays

TemBreak 2 Molded Case Circuit Breakers to 1600 A are available with electronic overcurrent relays 250 A to 1600 A. Current ratings range from 16 A to 1600 A. The overcurrent relays are easy to adjust – simply select the current rating via a dial adjustment, and depending on the application, a dial selectable pre-set characteristic curve can also be selected.

### STANDARD Overcurrent Relay

#### Features:

3

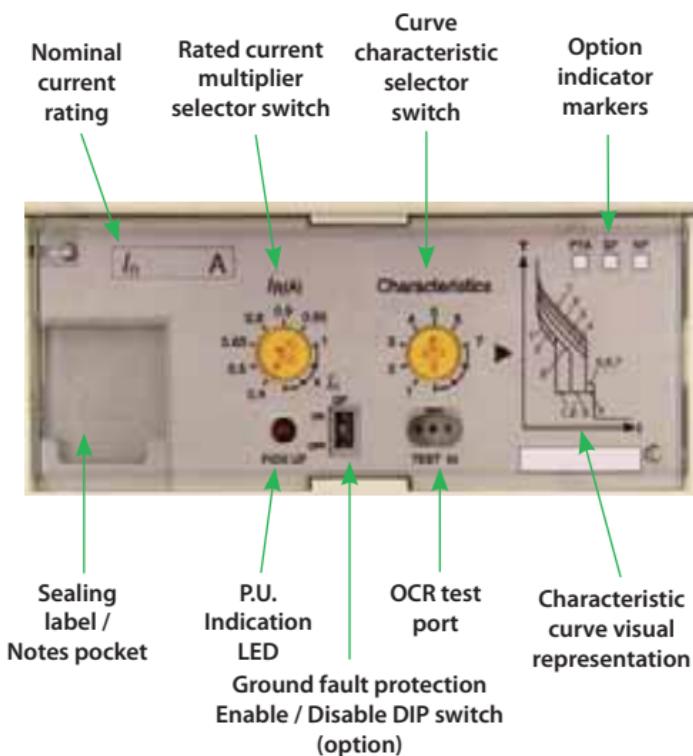
- Electronic overcurrent protection, for general and selectivity applications
- 250 A and 1600 A: 7 characteristic curves, (630 A: 6 characteristic curves)
- Long Time, Short Time & Instantaneous trip times vary depending on the characteristic curve selected
- Base current  $I_r$  is adjustable from 40 % – 100 % of the nominal rated current  $I_n$ .  
(dial settings are via incremental steps)

#### OCR Options:

- Ground fault trip on 400-1600 A models
- Neutral pole protection for 4 pole MCCBs
- Pre-trip alarm
- Special curve characteristics are available

#### Right:

Typical OCR adjustment and setting detail shown on electronic MCCBs  
(400/630 A shown)



**Notes:** Additional ELECTRONIC MCCB setting information can be found in Section 9.

## TemBreak 2 Electronic type S250PE

**70 kA**

**Current rating:** 16 – 250 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	380/415	70	70



3

**Overcurrent relay:**

- Electronic, for general and selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_r$  is adjustable from 40 % – 100 % of the nominal rated current  $I_n$ .

**OCR Options:**

- Neutral pole protection for 4 pole MCCBs only
- Pre-trip alarm

**Dimensions (mm)**

Poles	3	4
H	165	165
W	105	140
D (less toggle)	103	103
Toggle cut-out	104	104

## TemBreak 2 Electronic type S250PE

**3 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No. <sup>1)</sup>	Price \$
40	16 – 40	S250 PE 3 40	1610.00
125	50 – 125	S250 PE 3 125	1730.00
250	100 – 250	S250 PE 3 250	2100.00

**4 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No. <sup>1)</sup>	Price \$
40	16 – 40	S250 PE 4 40	1932.00
125	50 – 125	S250 PE 4 125	2430.00
250	100 – 250	S250 PE 4 250	2790.00

**Price Adder – For OCR options.**

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Cat. No. <sup>1)</sup>	Price \$
3 P OCR options:	PTA <sup>2)</sup>	S250 PE 3 AP 3	187.00
	PTA <sup>2)</sup>	S250 PE 4 AP 4	187.00
4 P OCR options:	NP <sup>2)</sup>	S250 PE 4 AN 4	187.00
	PTA + NP <sup>2)</sup>	S250 PE 4 APN 4	365.00

- Notes:**
- 1) The STD and Instantaneous pickup current ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_r$  settings the values will vary. Curve 1 & 2  $I_{sd} = 2.5 \times I_R$ , curve 3  $I_{sd} = 5 \times I_R$ , curve 4 – 7  $I_{sd} = 10 \times I_R$ .  $I_R$  dial setting 0.4 – 0.9  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.95 – 1.0  $I_i = 10 \times I_R$ . Refer curve examples and setting data in Section 9. NRC = Nominal rated current,  $I_R$  = Current adjustment dial setting, STD = Short Time Delay, INST = instantaneous
  - 2) To order a MCCB with the above options insert the required option after the pole to make up the Cat. No. E.g.: S250PE 4 APN 250 is a S250PE 4 Pole 250 A MCCB c/w Pre-trip Alarm and Neutral Protection.

## TemBreak 2 Thermal magnetic type H250NJ

**125 kA**

**Current rating:** 100 – 250 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	380/415	125	85
DC use	250	40	40



3

**Trip unit:** Adjustable thermal (0.63 I<sub>r</sub> to 100 % I<sub>r</sub>) and adjustable magnetic (6 I<sub>m</sub> to 10 I<sub>m</sub>)

### Dimensions (mm)

Poles	3	4
H	165	165
W	105	140
D (less toggle)	103	103
Toggle cut-out	104	104

### 3 Pole

Ampere Rating NRC	Adj. Ir Min. – Max.	Adj. Im Min. – Max.	Cat. No.	3 pole Price \$
250	160 – 250	1500 – 2500	H250 NJ 3 250	2020.00

### 4 Pole

Ampere Rating NRC	Adj. Ir Min. – Max.	Adj. Im Min. – Max.	Cat. No.	4 pole Price \$
250	160 – 250	1500 – 2500	H250 NJ 4 250	2700.00

## TemBreak 2 Electronic MCCB with Energy Metering Output S250PE\_AC

**70 kA****Current rating:** 16 – 250 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**

Voltage	Icu	Ics
AC use	415	70

**3****MCCB Standard features:**

- Electronic, for metering, selectivity, motor starting or general use
- 7 dial selectable characteristic suited to different applications
- Base current  $I_R$  adjustable from 40% - 100% of current  $I_n$ .
- STD setting  $2.5 - 10 (x I_R)^2$
- INST setting  $14 (\text{Max } 13 \times I_n)^2$
- Energy (multifunction) metering output, A, V, P, kW, kWh, E, Pf, F
- Trip event log, Alarm event log
- Modbus RTU 485 communications output
- External door mounting meter option (T2ED not incl. in below pricing)
- Neutral Pole protection option for 4 pole MCCBs only (AN)
- Pre-Trip Alarm (AP) option

**Dimensions (mm)**

Poles	3
H	165
W	105
D (less toggle)	103
Toggle cut-out	48
	105 on chassis



Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No. <sup>1)</sup>	T2ED	3 pole Price \$	4 pole Price \$
40	16 - 40	S250 PE 3 40 AC		3260.00	
		S250 PE 4 40 AC			4100.00
125	50 - 125	S250 PE 3 125 AC		3760.00	
		S250 PE 4 125 AC			4500.00
250	100 - 250	S250 PE 3 250 AC		3970.00	
		S250 PE 4 250 AC			4760.00

**Notes:** 1) The STD and Instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_R$  settings the values will vary. Curve 1 & 2  $I_{sd} = 2.5 \times I_R$ , curve 3  $I_{sd} = 5 \times I_R$ , curve 4 - 7  $I_{sd} = 10 \times I_R$ .  $I_R$  dial setting 0.4 – 0.9  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.95 – 1.0  $I_i = 13 \times I_R$ . Refer curve examples & setting data in section 9.

2) To order a MCCB with the above options add the required amp rating to the end of the catalogue number to complete it. Eg: S250PE 4 AN 250 is a S250PE 4 Pole 250 A MCCB c/w Neutral Protection.

NRC = Nominal rated current, IR = Current adjustment dial setting,

STD = Short Time Delay, INST = instantaneous

For additional information on installation, options and applications refer Section 9, Part C

## TemBreak 2 Electronic type H250NE

**125 kA**

**Current rating:** 16 – 250 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

Voltage	Icu	Ics
AC use	380/415	125



3

**Overcurrent relay:**

- Electronic, for general and selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_r$  is adjustable from 40 % – 100 % of the nominal rated current  $I_n$ .

**OCR Options:**

- Neutral pole protection for 4 pole MCCBs only
- Pre-trip alarm

**Dimensions (mm)**

Poles	3	4
H	165	165
W	105	140
D (less toggle)	103	103
Toggle cut-out	104	104

## TemBreak 2 Electronic type H250NE

**3 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No. <sup>1)</sup>	3 pole Price \$
40	16 - 40	H250 NE 3 40	1670.00
125	50 - 125	H250 NE 3 125	2050.00
250	100 - 250	H250 NE 3 250	2560.00

**3****4 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No. <sup>1)</sup>	4 pole Price \$
40	16 - 40	H250 NE 4 40	3580.00
125	50 - 125	H250 NE 4 125	3220.00
250	100 - 250	H250 NE 4 250	3410.00

**Price Adder – For OCR options.**

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Cat. No. <sup>1)</sup>	3 pole Price \$	4 pole Price \$
3 P OCR options:	PTA <sup>2)</sup>	H250 NE 3 AP 3	187.00	
4 P OCR options:	PTA <sup>2)</sup>	H250 NE 4 AP 3		187.00
	NP <sup>2)</sup>	H250 NE 4 AN 3		187.00
	PTA + NP <sup>2)</sup>	H250 NE 4 APN 3		365.00

**Notes: (for pages 3 - 56 and 3 - 57)**

- 1) The STD and Instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different IR settings the values will vary. Curve 1 & 2  $I_{sd} = 2.5 \times I_R$ , curve 3  $I_{sd} = 5 \times I_R$ , curve 4 - 7  $I_{sd} = 10 \times I_R$ .  $I_R$  dial setting 0.4 – 0.9  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.95 – 1.0  $I_i = 13 \times I_R$ . Refer curve examples & setting data in section 9.
- 2) To order a MCCB with the above options add the required amp rating to the end of the catalogue number to complete it. Eg: H250NE 4 AN 250 is a H250NE 4 Pole 250 A MCCB c/w Neutral Protection.

NRC = Nominal rated current, IR = Current adjustment dial setting,

STD = Short Time Delay, INST = instantaneous

For additional information on installation, options and applications refer Section 9, Part C catalogue or NHP.

## TemBreak 2 Electronic MCCB with Energy Metering Output H250NE\_AC

**125 kA**

**Current rating:** 16 – 250 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

### Interrupting capacity:

	Voltage	Icu	Ics
AC use	415	125	85

### MCCB Standard features:

- Electronic, for metering, selectivity, motor starting or general use
- 7 dial selectable characteristic suited to different applications
- Base current Ir adjustable from 40% - 100% of current In
- STD setting 2.5 – 10 ( $x IR^2$ )
- INST setting 14 (Max 13  $x In^2$ )
- Energy (multifunction) metering output, A, V, P, kW, kWh, E, Pf, F
- Trip event log, Alarm event log
- Modbus RTU 485 communications output
- External door mounting meter option (T2ED not incl. in below pricing)
- Neutral Pole protection options for 4 pole MCCBs only (AN)
- Pre-Trip Alarm (AP) option



3

### Dimensions (mm)

Poles	3
H	165
W	105
D (less toggle)	103
Toggle cut-out	48
	105 on chassis



T2ED

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No. <sup>1)</sup>	3 pole Price \$	4 pole Price \$
40	16 - 40	H250 NE 3 40 AC	3550.00	
		H250 NE 4 40 AC		4400.00
125	50 - 125	H250 NE 3 125 AC	4150.00	
		H250 NE 4 125 AC		4800.00
250	100 - 250	H250 NE 3 250 AC	4350.00	
		H250 NE 4 250 AC		4990.00

**Notes:** See page 3 - 56 for notes.

Q-Pulse Id ATMS 130721001253 of 1633  
GST not included NHP Sales 1300 NHP NHP  
Price schedule 'T2'

## TemBreak 2 Thermal magnetic type L250NJ

**200 kA**

**Current rating:** 100 – 250 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**



**3**

	Voltage	Icu	Ics
AC use	380/415	200	150
DC use	250	40	40

**Trip unit:** Adjustable thermal (0.63  $I_r$  to 100 %  $I_r$ ) and adjustable magnetic (6  $I_m$  to 10  $I_m$ )

**Dimensions (mm)**

Poles	3	4
H	165	165
W	105	140
D (less toggle)	103	103
Toggle cut-out	104	104

**3 Pole**

Ampere Rating NRC	Adj. $I_r$ <sup>1)</sup> Min. – Max.	Adj. $I_m$ <sup>1)</sup> Min. – Max.	Cat. No.	3 pole Price \$
250	160 – 250	1500 – 2500	L250 NJ 3 250	2340.00

**4 Pole**

Ampere Rating NRC	Adj. $I_r$ <sup>1)</sup> Min. – Max.	Adj. $I_m$ <sup>1)</sup> Min. – Max.	Cat. No.	4 pole Price \$
250	160 – 250	1500 – 2500	L250 NJ 4 250	3120.00

**Notes:** 1) Adj.  $I_r$ : Adjustable thermal setting  
Adj.  $I_m$ : Adjustable magnetic setting  
NRC: Nominal rated current

## Accessories to suit 160 – 250 AF TemBreak 2

3

	<b>External accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
SH	Shunt trips Internal accessories are common for MCCBs 125 A to 630 A. All have screw terminals except those indicated below with wire leads as standard <b>For 2, 3 and 4 pole MCCBs</b>		
	110 V AC	T2SH00A10TA <sup>1)</sup>	255.00
	230 – 240 V AC	T2SH00A20TA <sup>1)</sup>	255.00
	400 – 415 V AC	T2SH00A40TA <sup>1)</sup>	255.00
	24 V DC (Suits 24 V AC)	T2SH00D02TA <sup>1)</sup>	255.00
	48 V DC	T2SH00D04TA <sup>1)</sup>	255.00
	110 V DC	T2SH00D10TA <sup>1)</sup>	255.00
	230 V DC	T2SH00D20TA <sup>1)</sup>	255.00
UV	<b>For 1 pole S160NF MCCBs</b>		
	110 V AC	T2SH16A10WA	255.00
	230 – 240 V AC	T2SH16A20WA	255.00
	24 V DC	T2SH16D02WA	255.00
	110 V DC	T2SH16D10WA	250.00
	230 V DC	T2SH16D20WA	250.00
AX	Undervoltage trips <b>Instantaneous operation</b>		
	110 V AC	T2UV00A10NTA	270.00
	200 – 240 V AC	T2UV00A20NTA	270.00
	380 – 450 V AC	T2UV00A40NTA	270.00
	24 V DC	T2UV00D02NTA	270.00
	110 V DC	T2UV00D10NTA	270.00
	230 V DC	T2UV00D20NTA	270.00
AL	<b>Time delayed operation (500 ms) - refer NHP</b>		
	Auxiliary & alarm switches <b>General type (2 A @ 240 V Inductive)</b>		
	1 C/O Auxiliary	T2AX00M3STA	134.00
	1 C/O Auxiliary – with 0.7 m wire leads	T2AX00M3SWA	146.00
	1 C/O Alarm	T2AL00M3STA	134.00
	1 C/O Alarm – with 0.7 m wire leads	T2AL00M3SWA	146.00
	<b>Heavy-duty type (4 A @ 240 V Inductive)</b>		
	1 N/O Auxiliary	T2AX00B1STA	146.00
	1 N/C Auxiliary	T2AX00B2STA	146.00
	1 N/O Alarm	T2AL00B1STA	146.00
	1 N/C Alarm	T2AL00B2STA	146.00
	<b>Micro switching type (very low voltages)</b>		
	1 C/O Auxiliary	T2AX00M3RTA	187.00
	1 C/O Alarm	T2AL00M3RTA	187.00

**Notes:** 1) Wire lead types available.

## Accessories to suit 160 – 250 AF TemBreak 2

		Cat. No.	Price \$
<b>MC</b>	<b>Motor operators</b>	<b>Suits MCCB types S/H/L160, E/S/H/L250</b>	
	110 V AC	T2MC25A10NB	1620.00
	230 – 240 V AC	T2MC25A24NB	1630.00
	24 V DC	T2MC25D02NB	1630.00
	48 V DC	T2MC25D04NB	1620.00
	110 V DC	T2MC25D10NB	1620.00
<b>Motor Accessories</b>	Motor connection cable loom for electrical interlocking		
	T2MC 25 cable 500 mm, 250AF only	T2MM25L05A	60.50
	T2MC 25 cable 1500 mm, 250AF only	T2MM25L15A	73.00
	Motor options: Contact NHP for key locking and auto-reset.		
MCCB identification labels		T25CAPLAB	3.50

**T2SH**  
Shunt trip



**T2AX**  
**T2AL**  
Auxiliary &  
Alarm switches



**T2UV**  
Undervoltage trip



**T2MC**  
Motor operators  
250 A motor  
fitted to MCCB

## Accessories to suit 160 – 250 AF TemBreak 2

### External accessories

### Cat. No.

### Price \$

Operating handles Direct mounting, fixed depth, IP 54	<b>Suits MCCB types</b>		
	<b>S/H/L160, E/S/H/L250</b>		
	Grey/black	<b>T2HB25UR5BN</b>	<b>189.00</b>
	Red/yellow	<b>T2HB25UR5RN</b>	<b>210.00</b>

MCCB identification labels

**T25CPLAB****3.50****HB**

3

Door interlocking variable depth handle	<b>S/H/L160, E/S/H/L250</b>		
	Grey IP 55 handle + 357 mm shaft	<b>T2HS25R5GM</b>	<b>280.00</b>
	Red/ yellow IP 55 handle + 357 mm shaft	<b>T2HS25R5RM</b>	<b>290.00</b>
	Large escutcheon plate option: 100 mm <sup>2</sup>	<b>T2HSESC100</b>	<b>18.20</b>
	90 mm T pin shaft for T2HS - no flexi coupling	<b>T2HS250SHAFT</b>	<b>47.00</b>
	Grey/ black IP 65 handle + 420 mm shaft	<b>T2HP25R6BN</b>	<b>290.00</b>
	Red/ yellow IP 65 handle + 420 mm shaft	<b>T2HP25R6RN</b>	<b>300.00</b>
	Padlock attachment for T2HP/HS mechanism	<b>T2HP25PALK</b>	<b>49.50</b>

MCCB identification labels

**T25CPLAB****3.50**

T2HS variable depth handle IP 55



T2HP Variable depth handle IP 65

Operating handles  
Direct mounting, fixed depth, IP 54

Mechanism Padlock attachment

## Accessories to suit 160 – 250 AF TemBreak 2

External accessories	Cat. No.	Price \$
Mechanical Interlocks Link type	Link Interlock – suitable for manual or motorised operation. Will accept handles. Suitable for front or rear connect type MCCBs <b>S/H/L160, E/S/H/ L250</b>	
ML	Common 3 or 4 pole right side section	<b>T2ML25RA</b> 113.00
	3 pole left side section	<b>T2ML25L3A</b> 127.00
	4 pole left side section	<b>T2ML25L4A</b> 127.00
	MCCB identification labels	<b>T25CAPLAB</b> 3.50

3

Left section 3 or 4 pole  
(T2ML25L4A shown)

Common right section  
(T2ML25RA shown)



Link interlocked 250 A MCCBs



T2HS handle with optional T2HSESC100 escutcheon plate

## Accessories to suit 160 – 250 AF TemBreak 2

	<b>External accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
MS	Slide type interlock Manual operation, padlockable. Does not allow motors, handles or other front mounted accessories to be fitted.  <b>Suitable for front or rear connection</b> <b>S160, E250, S250</b>		
	3 pole	T2MS253SFA	120.00
	4 pole	T2MS254SFA	134.00
	<b>H160, L160, H250, L250</b>		
	3 pole	T2MS253LFA	120.00
	4 pole	T2MS254LFA	134.00
MW	Cable interlock Allows an MCCB to be mounted horizontally, vertically or diagonally. Accepts Motors and handles.  <b>Suitable for 3 or 4 pole MCCBs</b> <b>S/H/L160, E/S/H/L250</b>		
	Interlock kit less wire	T2MW25CA <sup>1)</sup>	275.00
	Wire for above interlocks Wire 1.0 M	T2MW00SA <sup>2)</sup>	63.00
	Wire 1.5 M	T2MW00LA <sup>2)</sup>	73.00
	MCCB identification labels	T25CAPLAB	3.50

T2MW

Cable interlock



T2MS

Slide type



**Notes:** <sup>1)</sup> Order one interlock kit for each MCCB.

<sup>2)</sup> Order one wire length for each pair of interlocked MCCBs.

## Accessories to suit 160 – 250 AF TemBreak 2

### External accessories

### Cat. No.

### Price \$

<b>CS</b>	<b>Suits MCCB types</b> <b>S/H/L160, E/S/H/L250</b>		
	1 pole cover set of 2	<b>T2CS251SG</b>	<b>10.00</b>
	3 pole cover set of 2	<b>T2CS253SG</b>	<b>54.00</b>
	4 pole cover set of 2	<b>T2CS254SG</b>	<b>60.50</b>
<b>CF</b>	<b>S160, E250, S250 – except S250-PE</b>		
	3 pole cover set of 2, 30 mm long	<b>T2CF253SSNBA</b>	<b>67.00</b>
	4 pole cover set of 2, 30 mm long	<b>T2CF254SSNBA</b>	<b>77.50</b>
<b>CF</b>	<b>S160, E250, S250 – except S250-PE</b>		
	1 pole cover set of 2, 55 mm long	<b>T2CF161SLNG</b>	<b>40.00</b>
	3 pole cover set of 2, 55 mm long	<b>T2CF253SLNG</b>	<b>67.00</b>
	4 pole cover set of 2	<b>T2CF254SLNG</b>	<b>77.50</b>
	<b>H/L160, S250-PE, H/L250</b>		
	3 pole cover set of 2, 55 mm long	<b>T2CF253LLNG</b>	<b>71.00</b>
	4 pole cover set of 2, 55 mm long	<b>T2CF254LLNG</b>	<b>77.50</b>



T2CF Standard term covers



Single pole terminal cover



T2CF Short terminal covers



T2CS Flush IP 20 Cover



T2RC Rear connect term cover

## Accessories to suit 160 – 250 AF TemBreak 2

<b>External accessories</b>		<b>Cat. No.</b>	<b>Price \$</b>
Terminal covers	<b>Rear Connect MCCBs S/H/L160, E/S/H/L250</b>		
<b>CR</b>	3 pole cover set of 2	T2CR253SG	54.00
	4 pole cover set of 2	T2CR254SG	60.50
Terminal locking clip	<b>A clip that provides additional terminal cover position locking, and cover also allows a lead seal to be fitted</b>		
	All sizes 125, 250, 400, 630 AF	T2CF00L	9.10
Interpole Barriers <sup>1)</sup> <sup>2)</sup>	<b>Suits MCCB types S160, E250, S250 – except S250-PE H/L160, S250-PE, H/L250</b>		
<b>BA</b>	Interpole barrier (Qty 2)	T2BA253SHA	20.00
	Interpole barrier (Qty 2)	T2BA253LHA	20.00
Toggle locks	<b>Non Captive: Fits up to 3 padlocks or a multiple lock device All 250 AF MCCBs (1 - 4 pole)</b>		
	Lock with 5 mm x 16.5 mm slot	T2HL25B	31.50
<b>HL</b>	<b>Captive: Allows a single padlock or multiple padlock device Suits 3/4 pole 250 AF MCCBs</b>		
	Lock with one 8 mm holes	T2HL25CAP	33.50
	For 1 pole MCCBs, 1 x 8 mm hole	T2HLS160NFCAP	92.00



T2CF locking clip

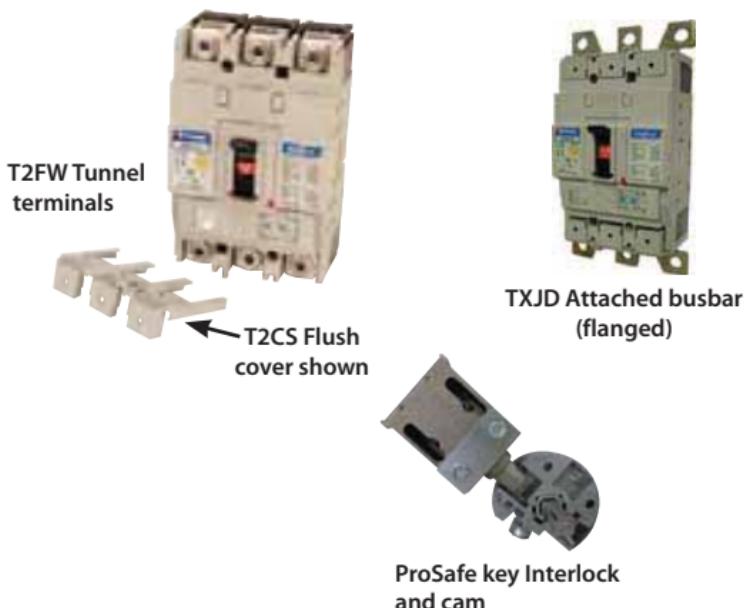
Non captive lock attachment  
T2HL25BInter pole barriers  
T2BAT2HL25CAP Captive lock  
attachment

**Notes:** <sup>1)</sup> Line side interpole barriers or terminal covers must be installed with MCCBs.

<sup>2)</sup> Interpole Barriers are supplied with MCCBs as standard; 2 barriers with 3 pole MCCBs, and 3 barriers with 4 pole MCCBs.

## Accessories to suit 160 – 250 AF TemBreak 2

	<b>External accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
ProSafe handle lock option <sup>1)</sup>	Allen-Bradley ProSafe locks can be used with T2HS variable depth handles. Refer NHP for direct mounting handle options.		
<b>Suits MCCB types E/S/H/L 160 - 250</b>			
<b>TKN</b>	Prosafe shot bolt lock HS handles xx code	<b>TKNHP_</b>	<b>520.00</b>
	Prosafe standard key xx code for above	<b>TKNNHPKEY_</b>	<b>130.00</b>
	Cam for T2HS handle shafts Key codes A to Z are available. Specify by changing the key code above.	<b>14997702</b>	<b>235.00</b>
<b>Attached Busbar</b>	<b>S/H/L160, E/S/H/L250</b>		
<b>FB</b>	2 straight terminal bars	<b>T2FB251BA</b>	<b>26.80</b>
	3 Pole, set of 6, flanged bar set	<b>T2FB253BA</b>	<b>77.50</b>
	3 Pole, set of 6, flanged bar set <sup>2)</sup>	<b>TXJD0050B</b>	<b>75.50</b>
	4 Pole, set of 8, straight bar set	<b>T2FB254BA</b>	<b>103.00</b>
<b>Tunnel clamp terminals</b>	<b>S/H/L160, E/S/H/L250</b>		
<b>FW</b>	3 Pole, set of 6 clamps 35 -120 mm <sup>2</sup> )	<b>T2FW25L3B</b>	<b>173.00</b>
	4 Pole, set of 8 clamps 35 -120 mm <sup>2</sup> )	<b>T2FW25L4B</b>	<b>240.00</b>



**Notes:** <sup>1)</sup> Contact NHP for lock options.  
<sup>2)</sup> TemBreak 1 version will fit TemBreak 2.

## Accessories to suit 160 – 250 AF TemBreak 2

		Cat. No.	Price \$
Rear connect terminal studs	<b>Suits MCCB types S160, E250, S250<sup>1)</sup> Not S250PE</b>		
	3 pole kit, set of 6 studs	T2RP253SB	375.00
	4 pole kit, set of 8 studs	T2RP254SB	480.00
<b>RP</b>	<b>H160, L160, H250, L250, S250PE</b>		
	3 pole kit, set of 6 studs	T2RP253LA	390.00
	4 pole kit, set of 8 studs	T2RP254LA	540.00
TemPlug	<b>Suits MCCB types TemPlug MCCB line-side plug-in attachment S160, E/S/250 S250PE</b>		
	3 pole TemPlug	T2UPX3250	330.00
<b>UP</b>	<b>Templugs suit 6.3 mm busbar (10 mm bar option)</b>		
OCR sealing cover	250 A thermal magnetic	T2SF25NTA	26.80
<b>SF</b>	250 A electronic	T2SF25NEA	26.80
Electronic OCR checker	230 V AC	TNS2	6590.00
<b>PM</b>	Plug-in MCCBs (refer rear of section 3)		
<b>DR</b>	Draw-out MCCBs		

Now available - Refer NHP



**T2RP**  
T2RP rear connect studs



**T2UP**  
T2UP TemPlug



**T2SF**  
OCR sealing kit.  
Suitable for a  
compression sealing  
device.

**Notes:** 1) S160NF single pole MCCBs will accept T2RP25 rear connect studs.

Q-Pulse Id ATMS 1307210012543 of 1633

Price schedule 'T2'

GST not included

NHP Sales 1300 NHPNHP

www.nhp.com.au

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## Accessories to suit 160 – 250 AF TemBreak 2

		Cat. No.	Price \$
Pole fillers	<b>Suits MCCB types S/H/L160, E/S/H/L250</b>		
<b>PF</b>	Pole filler 1 strip for a 46 mm high cut-out <sup>1)</sup>	<b>DTPF</b>	<b>4.30</b>
	Pole filler 35 mm wide for a 104 mm cut-out	<b>XAB3</b>	<b>3.80</b>
Door flange	Provides an attractive panel cut-out surround for MCCBs or motors		
<b>DF</b>	<b>Suits MCCB sizes S/H/L160, E/S/H/L250</b>		
	MCCB IP 30 gland and gasket	<b>T2DF25A</b>	<b>127.00</b>
	MOTOR IP 30 gland and gasket	<b>T2DM25A</b>	<b>215.00</b>
Door mounting flush plate	A kit that allows an MCCB to be mounted directly onto a door		
<b>FP</b>	<b>S160, E250, S250 – except for S250PE</b>		
	3 pole kit	<b>T2FP25S3B</b>	<b>82.50</b>
	4 pole kit	<b>T2FP25S4A</b>	<b>POA</b>
Wire lead terminal block	250 AF left side	<b>T2TF25LGA</b>	<b>189.00</b>
<b>TF</b>	250 AF right sideblock	<b>T2TF25RGA</b>	<b>189.00</b>



**T2PF**  
Pole fillers



**T2TF**  
Wire lead terminal block



**T2DF/DM**  
Door flange

**Notes:** 1) Order 2 strips per MCCB.

## TemBreak 2 Thermal magnetic type E400NJ

**25 kA**

**Current rating:** 252 – 400 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	380/415	25	25
DC use	250	25	19



3

**Trip unit:** Adjustable thermal (0.63 I<sub>r</sub> to 100 % I<sub>r</sub>) and adjustable magnetic (6 I<sub>m</sub> to 13 I<sub>m</sub>)

**Dimensions (mm)**

Poles	3
H	260
W	140
D (less toggle)	103

**3 Pole**

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	3 pole Price \$
400	250 – 400	2400 – 4800	E400 NJ 3 400	1930.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting  
Adj. Im: Adjustable magnetic setting  
NRC: Nominal rated current  
Magnetic only MCCBs are available on request.

## TemBreak 2 Thermal magnetic type S400CJ

**36 kA****Current rating:** 160 – 400 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:****3**

	Voltage	Icu	Ics
AC use	380/415	36	36
DC use	250	40	40

**Trip unit:** Adjustable thermal (0.63  $I_r$  to 100 %  $I_r$ ) and adjustable magnetic (6  $I_m$  to 12  $I_m$ )

**Dimensions (mm)**

Poles	3
H	260
W	140
D (less toggle)	103

**3 Pole**

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	3 pole Price \$
250	160 – 250	1500 – 3000	S400 CJ 3 250	1930.00
400	250 – 400	2400 – 4800	S400 CJ 3 400	1970.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting  
Adj. Im: Adjustable magnetic setting  
NRC: Nominal rated current  
Magnetic only MCCBs are available on request.

## TemBreak 2 Thermal magnetic type S400NJ

**50 kA**

**Current rating:** 160 – 400 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

Voltage	Icu	Ics
AC use	380/415	50
DC use	250	40



3

**Trip unit:** Adjustable thermal (0.63 I<sub>r</sub> to 100 % I<sub>r</sub>) and adjustable magnetic (6 I<sub>m</sub> to 12 I<sub>m</sub>)

**Dimensions (mm)**

Poles	3	4
H	260	260
W	140	185
D (less toggle)	103	103

### 3 Pole

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	3 pole Price \$
250	160 – 250	1500 – 3000	S400 NJ 3 250	2020.00
400	250 – 400	2400 – 4800	S400 NJ 3 400	2020.00

### 4 Pole

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	4 pole Price \$
250	160 – 250	1500 – 3000	S400 NJ 4 250	2700.00
400	250 – 400	2400 – 4800	S400 NJ 4 400	2700.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting  
Adj. Im: Adjustable magnetic setting

NRC: Nominal rated current

Magnetic only MCCBs are available on request.

## TemBreak 2 Electronic type S400NE

**50 kA**

**Current rating:** 100 – 400 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	380/415	50	50



**3**

**Overcurrent relay:**

- Electronic, for general and selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_r$  is adjustable from 40 % – 100 % of the nominal rated current  $I_n$ .
- STD setting 2.5 – 10 ( $\times I_r$ ) <sup>1)</sup>
- INST setting 13 – 14 ( $\times I_r$ ) <sup>1)</sup>

**OCR Options:**

- Refer S400GE

**Dimensions (mm)**

Poles	3	4
H	260	260
W	140	185
D (less toggle)	103	103

**3 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$
250	100 – 250	S400 NE 3 250	2180.00
400	160 – 400	S400 NE 3 400	2180.00

**4 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	4 pole Price \$
250	100 – 250	S400 NE 4 250	2180.00
400	160 – 400	S400 NE 4 400	2890.00

**Notes:** 1) For additional information on OCR setting and options refer section 9 or Part C catalogue.

## TemBreak 2 Thermal magnetic type S400GJ

**70 kA**

**Current rating:** 250 – 400 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**



Voltage	Icu	Ics
AC use	380/415	70
DC use	250	TBA

3

**Trip unit:** Adjustable thermal (0.63 I<sub>r</sub> to 100 % I<sub>r</sub>) and adjustable magnetic (6 I<sub>m</sub> to 12 I<sub>m</sub>)

**Dimensions (mm)**

Poles	3	4
H	260	260
W	140	185
D (less toggle)	103	103

### 3 Pole

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	3 pole Price \$
250	160 – 250	1500 – 3000	S400 GJ 3 250	2310.00
400	250 – 400	2400 – 4800	S400 GJ 3 400	2310.00

### 4 Pole

Ampere Rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Adj. Im <sup>1)</sup> Min. – Max.	Cat. No.	4 pole Price \$
250	160 – 250	1500 – 3000	S400 GJ 4 250	3080.00
400	250 – 400	2400 – 4800	S400 GJ 4 400	3080.00

**Notes:** 1) Adj. Ir: Adjustable thermal setting  
Adj. Im: Adjustable magnetic setting

NRC: Nominal rated current

Magnetic only MCCBs are available on request.

## TemBreak 2 Electronic type S400GE



**70 kA**

**Current rating:** 100 – 400 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

**3**

	Voltage	Icu	Ics
AC use	380/415	70	50

**Overcurrent relay:**

- Electronic, for general and selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_r$  is adjustable from 40 % – 100 % of the nominal rated current  $I_n$ .
- STD setting 2.5 – 10 ( $\times I_r$ ) <sup>1)</sup>
- INST setting 13 – 14 ( $\times I_r$ ) <sup>1)</sup>

**OCR Options:**

- Ground fault trip (400 A OCR only)
- Neutral pole protection for 4 pole MCCBs ONLY
- Pre-trip alarm

**Dimensions (mm)**

Poles	3	4
H	260	260
W	140	185
D (less toggle)	103	103

**Notes:** 1) Add overcurrent relay sensor AMP rating where "+" is shown.

## TemBreak 2 Electronic type S400GE

**3 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$
250	100 – 250	S400 GE 3 250	2550.00
		S400 GE 3 400	2550.00

**4 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	4 pole Price \$
250	100 – 250	S400 GE 4 250	3380.00
		S400 GE 4 400	3400.00

3

**S400GE with additional protection options**

Description		Cat. No.	Price \$
3 P OCR options:	PTA <sup>1)</sup>	S400 GE 3 AP 400	2750.00
	GF <sup>1,2)</sup>	S400 GE 3 AG 400	2720.00
	PTA + GF <sup>1,2)</sup>	S400 GE 3 APG 400	2925.00
4 P OCR options:	PTA <sup>1)</sup>	S400 GE 4 AP 400	3590.00
	NP <sup>1)</sup>	S400 GE 4 AN 400	3590.00
	PTA + NP <sup>1)</sup>	S400 GE 4 APN 400	3780.00
	GF + NP <sup>1)</sup>	S400 GE 4 AGN 400	3780.00

- Notes:**
- 1) For additional information on OCR setting and options refer section 9 or Part C catalogue.
  - 2) Where a neutral is present, a 4th Neutral pole CT is required for 3 pole GF MCCBs, and must be ordered separately using Cat. No.: T2GB40N04A. Refer page 3 - 100.

## TemBreak 2 Electronic XOW Metering MCCBs

### S400GE\_X1L / X1S

**70 kA****Current rating:** 100 – 400 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	415	70	50



3

**XOW Over Current Relay:**

- Ammeter or Energy Metering types
- Adjustable LSI setting for grading applications
- Base current adjustable from 40% - 100% of  $I_n$

**MCCB Standard features:****S400GE\_X1L**

- Ammeter, Adjustable LSI
- Trip event log, Alarm event log, Test function

**S400GE\_X1S**

- Energy (multifunction) meter: A, V, P, kW, kWh, E, Pf, F, H
- Adjustable LSI
- Backlit LCD display
- Ground fault, Pre trip alarm, Phase rotation & Neutral pole protection
- Trip and Alarm event log, Test function, Trip indication contact output
- Modbus RTU 485 communications
- External door mounting meter option (T2ED not incl. in below pricing)



New  
metering  
MCCB

**Dimensions (mm)**

Poles	3	4
H (less attached busbar)	260	260
W	140	185
D (less toggle)	103	103



T2ED

	Ampere Rating	Ir Adj. Min.	Max.	Cat. No. <sup>1)</sup>	3 pole Price \$	4 pole Price \$
MCCB with ammeter	250	100	250	<b>S400 GE 3 250 X1L</b>	<b>4650.00</b>	
	400	160	400	<b>S400 GE 4 250 X1L</b>		<b>5690.00</b>
	250	100	250	<b>S400 GE 3 400 X1L</b>	<b>4900.00</b>	
	400	160	400	<b>S400 GE 4 400 X1L</b>		<b>5880.00</b>
MCCB with energy meter	250	100	250	<b>S400 GE 3 250 X1S</b>	<b>6550.00</b>	
	400	160	400	<b>S400 GE 4 250 X1S</b>		<b>7750.00</b>
	250	100	250	<b>S400 GE 3 400 X1S</b>	<b>6800.00</b>	
	400	160	400	<b>S400 GE 4 400 X1S</b>		<b>8160.00</b>

**Notes:** NRC: Nominal rated current, Ir: Current adjustment dial setting,

STD= Short Time Delay, INST = instantaneous

For additional information on installation, options and applications refer Section 9, Part C catalogue or NHP.

## TemBreak 2 690 V AC High Fault Interruption MCCB L400PE

**70 kA**

**Current rating:** 100 – 400 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	690	70	50



3

**Over Current Relay:**

- Electronic, for general & selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_R$  is adjustable from 40% - 100% of the nominal rated current  $I_n$
- STD setting  $2.5 - 10 (x I_R)^{-1}$
- INST setting  $14 (\text{Max } 13 \times I_n)^{-1}$

**Dimensions (mm)**

Poles	3
H (less attached busbar)	260
W	140
D (less toggle)	140

**3 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$
250	100 – 250	L400 PE 3 250	3240.00
400	252 – 400	L400 PE 3 400	3240.00

**Notes:** NRC = Nominal rated current, IR = Current adjustment dial setting, STD = Short Time Delay, INST = instantaneous

<sup>1)</sup> The STD and Instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_R$  settings the values will vary. Curves 1 & 2  $I_{sd} = 2.5 \times I_R$ , curve 3  $I_{sd} = 5 \times I_R$ , curves 4 - 7  $I_{sd} = 10 \times I_R$ .

IR dial setting 0.4 – 0.9  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.95 – 1.0  $I_i = 13 \times I_R$ . Not suitable for reverse connection either individually or on a chassis.

Suitable for general motor starting and power distribution applications. Refer NHP for 4 pole version availability.

Refer NHP for additional information.

## TemBreak 2 Electronic type S400PE

**85 kA**

**Current rating:** 100 – 400 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	380/415	85	85



**3**

**Overcurrent relay:**

- Electronic, for general and selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_r$  is adjustable from 40 % – 100 % of the nominal rated current  $I_n$ .
- STD setting 2.5 – 10 ( $\times I_r$ )<sup>1)</sup>
- INST setting 13 – 14 ( $\times I_r$ )<sup>1)</sup>

**OCR Options:**

- Ground fault trip (400 A OCR only)
- Neutral pole protection for 4 pole MCCBs ONLY
- Pre-trip alarm

**Notes:** 1) Add overcurrent relay sensor AMP rating where "+" is shown.

## TemBreak 2 Electronic type S400PE

### Dimensions (mm)

Poles	3	4
H	260	260
W	140	185
D (less toggle)	103	103

### 3 Pole

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$
250	100 – 250	S400 PE 3 250	2780.00
400	160 – 400	S400 PE 3 400	2780.00

### 4 Pole

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	4 pole Price \$
250	100 – 250	S400 PE 4 250	3480.00
400	160 – 400	S400 PE 4 400	3480.00

### Price Adder – For OCR options

Description	Cat. No.	Price \$
PTA <sup>1)</sup>	S400 PE 3 AP +	187.00
3 P OCR options: GF <sup>1)2)</sup>	S400 PE 3 AG 400	187.00
PTA + GF <sup>1)2)</sup>	S400 PE 3 APG 400	375.00
PTA <sup>1)</sup>	S400 PE 4 AP +	187.00
NP <sup>1)</sup>	S400 PE 4 AN +	187.00
4 P OCR options:		
PTA + NP <sup>1)</sup>	S400 PE 4 APN +	375.00
GF + NP <sup>1)</sup>	S400 PE 4 AGN 400	375.00

- Notes:**
- 1) For additional information on OCR setting and options refer section 9 or Part C catalogue.
  - 2) Where a neutral is present, a 4th Neutral pole CT is required for 3 pole GF MCCBs, and must be ordered separately using Cat. No.: T2GB40N04A. Refer to page 3 - 100.

## TemBreak 2 Electronic type H400NE

**125 kA**

**Current rating:** 100 – 400 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	380/415	125	85



**3**

**Overcurrent relay:**

- Electronic, for general and selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_r$  is adjustable from 40 % – 100 % of the nominal rated current  $I_n$ .
- STD setting 2.5 – 10 ( $\times I_r$ )<sup>1)</sup>
- INST setting 13 – 14 ( $\times I_r$ )<sup>1)</sup>

**OCR Options:**

- Ground fault trip (400 A OCR only)
- Neutral pole protection for 4 pole MCCBs
- Pre-trip alarm

**Notes:** 1) Add overcurrent relay sensor AMP rating where “+” is shown.

## TemBreak 2 Electronic type H400NE

### Dimensions (mm)

Poles	3	4
H	260	260
W	140	185
D (less toggle)	140	140

### 3 Pole

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$
250	100 – 250	H400 NE 3 250	3240.00
400	160 – 400	H400 NE 3 400	3240.00

3

### 4 Pole

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	4 pole Price \$
250	100 – 250	H400 NE 4 250	4320.00
400	160 – 400	H400 NE 4 400	4320.00

### Price Adder – For OCR options

Description		Cat. No.	Price \$
3 P OCR options:	PTA <sup>1)</sup>	H400 NE 3 AP +	187.00
	GF <sup>1)2)</sup>	H400 NE 3 AG 400	187.00
	PTA + GF <sup>1)2)</sup>	H400 NE 3 APG 400	375.00
4 P OCR options:	PTA <sup>1)</sup>	H400 NE 4 AP +	187.00
	NP <sup>1)</sup>	H400 NE 4 AN +	187.00
	PTA + NP <sup>1)</sup>	H400 NE 4 APN +	375.00
	GF + NP <sup>1)</sup>	H400 NE 4 AGN 400	375.00

- Notes:**
- 1) For additional information on OCR setting and options refer section 9 or Part C catalogue.
  - 2) Where a neutral is present, a 4th Neutral pole CT is required for 3 pole GF MCCBs, and must be ordered separately using Cat. No.: T2GB40N04A. Refer to page 3 - 100.

## TemBreak 2 Electronic XOW Metering MCCBs

### H400NE\_X1L / X1S

**125 kA****Current rating:** 100 – 400 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**

Voltage	Icu	Ics
AC use	415	125

**3****XOW Over Current Relay:**

- Ammeter or Energy Metering types
- Adjustable LSI setting for grading applications
- Base current adjustable from 40% - 100% of  $I_n$

**MCCB Standard features:****H400NE\_X1L**

- Ammeter, Adjustable LSI
- Trip event log, Alarm event log, Test function

**H400NE\_X1S**

- Energy (multifunction) meter: A, V, P, kW, kWh, E, Pf, F, H
- Adjustable LSI
- Backlit LCD display
- Ground fault, Pre trip alarm, Phase rotation & Neutral pole protection
- Trip and Alarm event log, Test function, Trip indication contact output
- Modbus RTU 485 communications
- External door mounting meter option (T2ED not incl. in below pricing)

New  
metering  
MCCB

**Dimensions (mm)**

Poles	3	4
H (less attached busbar)	260	260
W	140	185
D (less toggle)	103	103



	Ampere Rating	Ir Adj. NRC Min. Max.	Cat. No.	3 pole Price \$	4 pole Price \$
MCCB with ammeter	250	100 250	<b>H400 NE 3 250 X1L</b>	<b>5350.00</b>	
	400	160 400	<b>H400 NE 4 250 X1L</b>		<b>6540.00</b>
MCCB with energy meter	250	100 250	<b>H400 NE 3 400 X1L</b>	<b>5350.00</b>	
			<b>H400 NE 4 400 X1L</b>		<b>6540.00</b>
	400	160 400	<b>H400 NE 3 250 X1S</b>	<b>7150.00</b>	
			<b>H400 NE 4 250 X1S</b>		<b>8250.00</b>
			<b>H400 NE 3 400 X1S</b>	<b>7150.00</b>	
			<b>H400 NE 4 400 X1S</b>		<b>8250.00</b>

**Notes:** NRC: Nominal rated current, Ir: Current adjustment dial setting,

STD= Short Time Delay, INST = instantaneous

For additional information on installation, options and applications refer Section 9, Part C catalogue or NHP.

## TemBreak 2 Electronic type L400NE

**200 kA**

**Current rating:** 100 – 400 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

Voltage	Icu	Ics
AC use	380/415	200



3

**Overcurrent relay:**

- Electronic, for general and selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_r$  is adjustable from 40 % – 100 % of the nominal rated current  $I_n$ .
- STD setting 2.5 – 10 ( $\times I_r$ )<sup>1)</sup>
- INST setting 13 – 14 ( $\times I_r$ )<sup>1)</sup>

**OCR Options:**

- Ground fault trip (400 A OCR only)
- Neutral pole protection for 4 pole MCCBs
- Pre-trip alarm

**Notes:** 1) Add Over Current Relay sensor AMP rating where "+" is shown.

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 GST not included NHP Sales 1300 NHP NHP  
**Price schedule 'T2'**

## TemBreak 2 Electronic type L400NE

### Dimensions (mm)

Poles	3	4
H	260	260
W	140	185
D (less toggle)	140	140

3

### 3 Pole

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No. <sup>1)</sup>	3 pole Price \$
250	100 – 250	L400 NE 3 250	3370.00
400	160 – 400	L400 NE 3 400	3370.00

### 4 Pole

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No. <sup>1)</sup>	4 pole Price \$
250	100 – 250	L400 NE 4 250	4380.00
400	160 – 400	L400 NE 4 400	4380.00

### Price Adder – For OCR options.

Description	Cat. No.	3 pole Price \$	
PTA <sup>2)</sup>	L400 NE 3 AP +	187.00	
3 P OCR options:	GF <sup>2)</sup> <sup>3)</sup>	L400 NE 3 AG 400	187.00
	PTA + GF <sup>2)</sup> <sup>3)</sup>	L400 NE 3 APG 400	375.00
4 P OCR options:	PTA <sup>2)</sup>	L400 NE 4 AP +	187.00
	NP <sup>2)</sup>	L400 NE 4 AN +	187.00
	PTA + NP <sup>2)</sup>	L400 NE 4 APN +	375.00
	GF + NP <sup>2)</sup>	L400 NE 4 AGN 400	375.00

- Notes:**
- 1) Add Over Current Relay sensor AMP rating where "+" is shown.
  - 2) For additional information on OCR setting and options refer section 9 or Part C catalogue.
  - 3) Where a neutral is present, a 4th Neutral pole CT is required for 3 pole GF MCCBs, and must be ordered separately using Cat. No.: T2GB40N04A. Refer to page 3 - 100.



CORP PRODUCTS ADS CPB

## THINK PRODUCTS AND SOLUTIONS. THINK NHP.

NHP's Products Team is backed by years of experience from dedicated engineers and specialists, focused on providing Australasia's most comprehensive product range and project solutions.

### Products Team

As well as extensive application, technical and product knowledge, our high quality Products Teams are determined to provide customised motor starters and controllers to specification, by listening to you and your needs.

Together with NHP's Service Team, NHP is able to offer assistance with commissioning and site maintenance work.

Think Products and Solutions. Think NHP.

## TemBreak 2 Electronic type E630NE

**36 kA**

**Current rating:** 252 – 630 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**



**3**

Voltage	Icu	Ics
AC use	380/415	36

**Overcurrent relay:**

- Electronic, for general and selectivity applications
- 6 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_r$  is adjustable from 40 % – 100 % of the nominal rated current  $I_n$ .
- STD setting 2.5 – 8 ( $\times I_r$ )<sup>1)</sup>
- INST setting 10 – 14 ( $\times I_r$ )<sup>1)</sup>

**OCR Options:**

- Ground fault trip

**Dimensions (mm)**

Poles	3
H	260
W	140
D (less toggle)	103

**3 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$
630	252 – 630	E630 NE 3 630	2700.00

**Notes:** 1) The STD and instantaneous pickup current ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_r$  settings the values will vary. Curve 1 & 2  $I_{sd} = 2.5 \times I_r$ , curve 3  $I_{sd} = 5 \times I_r$ , curve 4 - 6  $I_{sd} = 8 \times I_r$ .  $I_r$  dial setting 0.4 – 0.63  $I_i = 14 \times I_r$  and  $I_r$  dial setting 0.8 – 1.0  $I_i = 10 \times I_r$ . Refer curve examples and setting data in Section 9.

NRC = Nominal rated current,  $I_r$  = Current adjustment dial setting, STD = Short Time Delay, INST = instantaneous

## TemBreak 2 Electronic type S630CE

**50 kA**

**Current rating:** 252 – 630 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

Voltage	Icu	Ics
AC use	380/415	50



3

**Overcurrent relay:**

- Electronic, for general and selectivity applications
- 6 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_R$  is adjustable from 40 % – 100 % of the nominal rated current  $I_N$ .
- STD setting 2.5 – 8 ( $\times I_R$ )<sup>1)</sup>
- INST setting 10 – 14 ( $\times I_R$ )<sup>1)</sup>

**OCR Options:**

- Refer S630GE

### Dimensions (mm)

Refer page 3 - 86

#### 3 Pole

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$
630	252 – 630	S630 CE 3 630	2920.00

#### 4 Pole

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	4 pole Price \$
630	252 – 630	S630 CE 4 630	3880.00

**Notes:** 1) The STD and instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_R$  settings the values will vary. Curve 1 & 2  $I_{sd} = 2.5 \times I_R$ , curve 3  $I_{sd} = 5 \times I_R$ , curve 4 - 6  $I_{sd} = 8 \times I_R$ .  $I_R$  dial setting 0.4 – 0.63  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.8 – 1.0  $I_i = 10 \times I_R$ . Refer curve examples and setting data in Section 9.

NRC = Nominal rated current,  $I_R$  = Current adjustment dial setting,  
STD = Short Time Delay, INST = instantaneous

# T1HS / T2HS HANDLES

For Terasaki moulded case circuit breakers up to 1600 A.

POWER PROTECTION

PP-TERASAKI/THS HANDLE -CP8



- IP55 rated plastic handle
- Long variable depth shaft supplied standard
- Heavy duty metal locking lever standard
- Internal door interlocking components are all metal
- All handles mount in a 31-37 mm hole
- Short lever handles on MCCBs to 250 A, longer types 400 - 1600 A
- 105 mm<sup>2</sup> or 130 mm<sup>2</sup> escutcheon plates are optional
- Handles are padlockable in the OFF position as standard
- ON padlocking optional via on site handle modification
- Accepts up to three 4 - 8 mm locks or multi lock devices
- Door opens when handle is switched to OFF position
- Door will not open when handle is padlocked OFF
- Door defeat function standard
- Padlock option for handle mechanism mounted on MCCB
- Door defeat non functional when padlocked OFF
- All handle mechanisms allow MCCB dial setting viewing and access
- For IP 65 applications T1HP/T2HP handles are available
- ON indication flag on handle mechanism
- Prosafe trapped key interlock options

**TERASAKI**  
Innovators in Protection Technology

## TemBreak 2 Electronic type S630GE

**70 kA**

**Current rating:** 252 – 630 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

Voltage	Icu	Ics
AC use	380/415	70



3

**Overcurrent relay:**

- Electronic, for general and selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_r$  is adjustable from 40 % – 100 % of the nominal rated current  $I_n$ .
- STD setting 2.5 – 8 ( $\times I_r$ )<sup>1)</sup>
- INST setting 10 – 14 ( $\times I_r$ )<sup>1)</sup>

**OCR Options:**

- Ground fault trip
- Neutral pole protection for 4 pole MCCBs ONLY
- Pre-trip alarm

**Notes:** 1) The STD and instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_R$  settings the values will vary. Curve 1 & 2  $I_{sd} = 2.5 \times I_R$ , curve 3  $I_{sd} = 5 \times I_R$ , curve 4 - 6  $I_{sd} = 8 \times I_R$ .  $I_R$  dial setting 0.4 – 0.63  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.8 – 1.0  $I_i = 10 \times I_R$ . Refer curve examples and setting data in Section 9. NRC = Nominal rated current,  $I_R$  = Current adjustment dial setting, STD = Short Time Delay, INST = instantaneous

## TemBreak 2 Electronic type

### S630GE

**Dimensions (mm)**

Refer page 3 - 86

**3 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$
630	252 – 630	S630 GE 3 630	3130.00

3

**4 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	4 pole Price \$
630	252 – 630	S630 GE 4 630	4180.00

**MCCB price with OCR option fitted.**

Description	Cat. No.	Price \$
PTA <sup>1)</sup>	S630 GE 3 AP 630	3330.00
3 P OCR options:GF <sup>1)</sup> <sup>2)</sup>	S630 GE 3 AG 630	3330.00
PTA + GF <sup>1)</sup> <sup>2)</sup>	S630 GE 3 APG 630	3530.00
PTA <sup>1)</sup>	S630 GE 4 AP 630	4370.00
NP <sup>1)</sup>	S630 GE 4 AN 630	4370.00
4 P OCR options:		
PTA + NP <sup>1)</sup>	S630 GE 4 APN 630	4570.00
GF + NP <sup>1)</sup>	S630 GE 4 AGN 630	4570.00

- Notes:**
- 1) To order a MCCB with the above options insert the required option after the pole to make up the Cat. No. E.g.: S630GE 3 AG 630 is a S630GE 3 Pole 630 A MCCB c/w Ground Fault protection.
  - 2) Where a neutral is present, a 4th Neutral pole CT is required for 3 pole GF MCCBs and must be ordered separately using Cat. No.: T2GB40N06A. Refer to page 3 - 100.

## TemBreak Electronic XOW Metering MCCBs

### S630GE\_X1L / X1S

**70 kA****Current rating:** 252 – 630 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**

Voltage	Icu	Ics
AC use	415	70



3

**XOW Over Current Relay:**

- Ammeter or Energy Metering types
- Adjustable LSI setting for grading applications
- Base current adjustable from 40% - 100% of  $I_n$

**MCCB Standard features:****S630PE\_X1L**

- Ammeter, Adjustable LSI
- Trip event log, Alarm event log, Test function

**S630PE\_X1S**

- Energy (multifunction) meter: A, V, P, kW, kWh, E, Pf, F, H
- Adjustable LSI
- Backlit LCD display
- Ground fault, Pre trip alarm, Phase rotation & Neutral pole protection
- Trip and Alarm event log, Test function, Trip indication contact output
- Modbus RTU 485 communications
- External door mounting meter option (T2ED not incl. in below pricing)

New  
metering  
MCCB

**Dimensions (mm)**

Poles	3	4
H (less attached busbar)	260	260
W	140	185
D (less toggle)	103	103



T2ED

Ampere Rating NRC	Ir Adj. Min. Max.	Cat. No.	3 pole Price \$	4 pole Price \$
MCCB with ammeter	630 252 630	<b>S630 GE 3 630 X1L</b>	<b>5500.00</b>	
		<b>S630 GE 4 630 X1L</b>		<b>6600.00</b>
MCCB with energy meter	630 252 630	<b>S630 GE 3 630 X1S</b>	<b>7340.00</b>	
		<b>S630 GE 4 630 X1S</b>		<b>8800.00</b>

**Notes:** NRC: Nominal rated current,  $I_n$ ; Current adjustment dial setting,

STD= Short Time Delay, INST = instantaneous

For additional information on installation, options and applications refer Section 9, Part C catalogue or NHP.

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**Price schedule 'T2'** www.nhp.com.au

## Accessories to suit 400 / 630 AF TemBreak 2



3

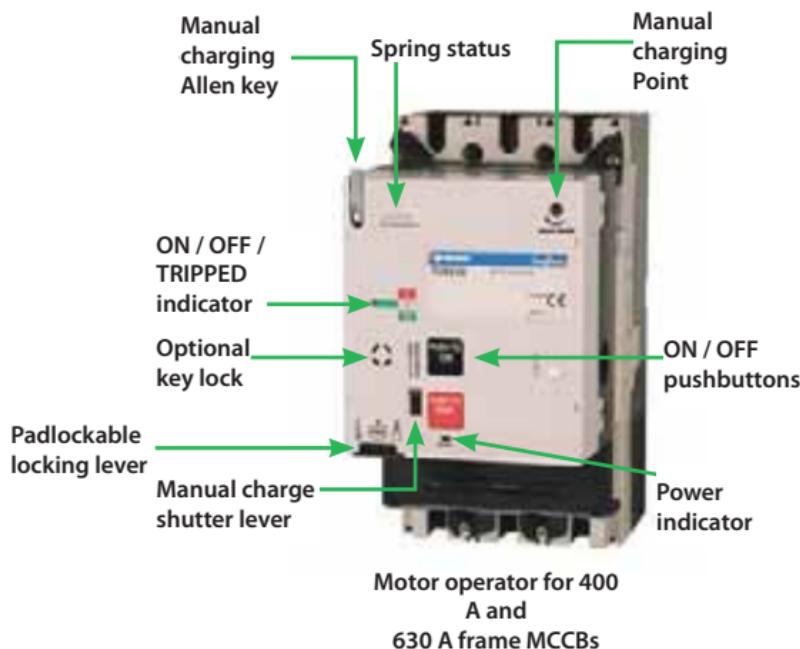
	<b>External accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
SH	Shunt trips Internal accessories are common for MCCBs 125 A to 630 A. All have screw terminals except those indicated below with wire leads as standard		
<b>For 3 and 4 pole MCCBs</b>			
	110 V AC	T2SH00A10TA <sup>1)</sup>	255.00
	230 – 240 V AC	T2SH00A20TA <sup>1)</sup>	255.00
	400 – 415 V AC	T2SH00A40TA <sup>1)</sup>	255.00
	24 V DC (Suits 24 V AC)	T2SH00D02TA <sup>1)</sup>	255.00
	48 V DC	T2SH00D04TA <sup>1)</sup>	255.00
	110 V DC	T2SH00D10TA <sup>1)</sup>	255.00
	230 V DC	T2SH00D20TA <sup>1)</sup>	255.00
UV	Undervoltage trips <b>Instantaneous operation</b>		
	110 V AC	T2UV00A10NTA	270.00
	200 – 240 V AC	T2UV00A20NTA	270.00
	380 – 450 V AC	T2UV00A40NTA	270.00
	24 V DC	T2UV00D02NTA	270.00
	110 V DC	T2UV00D10NTA	270.00
	230 V DC	T2UV00D20NTA	270.00
<b>Time delayed operation (500 ms) – refer NHP</b>			
AX	Auxiliary & Alarm switches <b>General type (2 A @ 240 V Inductive)</b>		
	1 C/O Auxiliary	T2AX00M3STA	134.00
	1 C/O Auxiliary – with 0.7 m wire leads	T2AX00M3SWA	146.00
	1 C/O Alarm	T2AL00M3STA	134.00
	1 C/O Alarm – with 0.7 m wire leads	T2AL00M3SWA	146.00
AL	<b>Heavy-duty type (4 A @ 240 V Inductive)</b>		
	1 N/O Auxiliary	T2AX00B1STA	146.00
	1 N/C Auxiliary	T2AX00B2STA	146.00
	1 N/O Alarm	T2AL00B1STA	146.00
<b>Micro switching type (very low voltages)</b>			
	1 C/O Auxiliary	T2AX00M3RTA	187.00
	1 C/O Alarm	T2AL00M3RTA	187.00

**Notes:** 1) Wire lead types available.

## Accessories to suit 400 / 630 AF TemBreak 2

External accessories	Cat. No.	Price \$
<b>Motor operators</b>	<b>Suits MCCB types E400, S400, H400, L400, E630, S630</b>	
110 – 240 V AC	T2MC40A10NB	2420.00
24 – 48 V DC	T2MC40D02NB	2420.00
110 V DC	T2MC40D10NB	2420.00
<b>MC</b>	<b>Motor connection cable loom for Electrical interlocking</b>	
T2MC40 cable 600 mm. 400AF only	T2MM40L06A	60.50
T2MC40 cable 2100 mm. 400AF only	T2MM40L21A	80.00
Motor options: Contact NHP for key locking and auto-reset.		
MCCB identification labels	T40CAPLAB	3.50

3



## Accessories to suit 400 / 630 AF TemBreak 2

	<b>External accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
	<b>Suits MCCB types</b> <b>E400, S400, H400, L400, E630, S630</b>		
Operating-handles			
Direct mounting, fixed depth, IP 54	Grey/black	T2HB40UR5BN	240.00
	Red/yellow	T2HB40UR5RN	265.00
	MCCB identification labels	T40CAPLAB	3.50
	<b>HB</b>		
Door interlocking variable depth handles	<b>E400, S400, H400, L400, E630, S630</b>		
	Grey IP55 handle + 320 mm shaft	T2HS40R5GM	370.00
	Red/yellow IP55 handle + 320 mm shaft	T2HS40R5RM	315.00
	Large escutcheon plate option: 100 mm <sup>2</sup>	T2HSESC100	18.20
	<b>HS</b>		
	390mm T pin shaft for T2HS - no flexi coupling	T2HS400SHAFT	47.00
	Grey/black IP65 handle + 445 mm shaft	T2HP40R6BN	315.00
	Red/yellow IP65 handle + 445 mm shaft	T2HP40R6RN	330.00
	<b>HP</b>		
	Padlock attachment for T2HP/HS mechanism	T2HP40PALK	49.50
	MCCB identification labels	T40CAPLAB	3.50



T2HP40 Variable depth handle



T2HP40PALK Mechanism padlock attachment



T2HS handle with optional escutcheon plate, type T2HSESC100



T2HB fixed depth "direct mount" handle

**Notes:** Handles supplied with key locks available on request for T2HP handles.

## Accessories to suit 400 / 630 AF TemBreak 2

<b>External accessories</b>		<b>Cat. No.</b>	<b>Price \$</b>
Mechanical Interlocks	Link Interlock – suitable for motorised operation. Suitable for front or rear contact MCCBs		
Link type	<b>E400, S400, H400, L400, E630, S630<sup>1)</sup></b>		
<b>ML</b>	Common 3 or 4 pole right side section	<b>T2ML40RB</b>	<b>350.00</b>
	3 pole left side section	<b>T2ML40L3B</b>	<b>133.00</b>
	4 pole left side section	<b>T2ML40L4B</b>	<b>133.00</b>
	MCCB identification labels	<b>T40CAPLAB</b>	<b>3.50</b>
<b>MH</b>	Link Interlock – suitable for manual handle operation only. Suitable for front or rear contact MCCBs		
	<b>E400, S400, H400, L400, E630, S630</b>		
	Common 3 or 4 pole right side section	<b>T2MLH40RB</b>	<b>350.00</b>
	3 pole left side section	<b>T2MLH40L3B</b>	<b>133.00</b>
	4 pole left side section	<b>T2MLH40L4B</b>	<b>133.00</b>
	MCCB identification	<b>T40CAPLAB</b>	<b>3.50</b>

3

Left section 3 or 4 pole  
(T2ML40L3B shown)

Common right side  
section T2ML40RB



T2ML Interlock for motorised operation

**Notes:** Refer to Section 5 if MCCB labels are required or refer to NHP.

<sup>1)</sup> A handle or motor must be fitted in addition to the interlock.

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Price schedule 'T2'

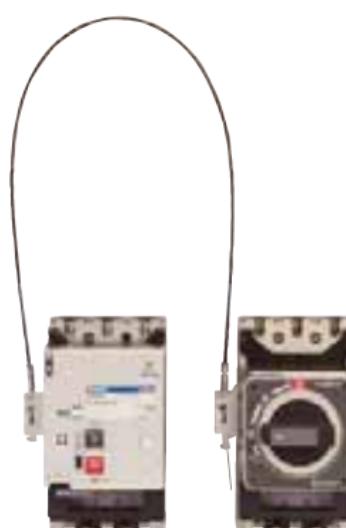
GST not included

NHP Sales 1300 NHP NHP

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## Accessories to suit 400 / 630 AF TemBreak 2

	<b>External accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
Slide type interlock	Manual operation, padlockable. Does not allow motors, handles or other front mounted accessories to be fitted.  <b>Suitable for front or rear connection E400, S400, E630, S630</b>		
<b>MS</b>	3 pole	T2MS403SFA	220.00
	4 pole	T2MS404SFA	210.00
Cable interlock	Allows an MCCB to be mounted horizontally, vertically or diagonally.  <b>Suitable for 3 or 4 pole MCCBs E400, S400, H400, L400, E630, S630<sup>1)</sup></b>		
<b>MW</b>	Interlock kit less wire for motorised operation	T2MW40CB	330.00
	Interlock kit less wire for manual handle operation	T2MWH40CB	330.00
	Wire for above interlocks Wire 1.0 M	T2MW00SA <sup>2)</sup>	63.00
	Wire 1.5 M	T2MW00LA <sup>2)</sup>	73.00
	MCCB identification labels	T40CAPLAB	3.50



T2MW40 wire interlocked MCCBs,  
showing either a motor or handle installed

**Notes:** <sup>1)</sup> A handle or motor must be fitted in addition to the interlock.  
<sup>2)</sup> Use one wire length for each MCCB pair.

## Accessories to suit 400 / 630 AF TemBreak 2

External accessories	Cat. No.	Price \$
Standard terminal covers FC	<b>E400, S400, H400, L400, E630, S630<sup>2)</sup></b>	
	3 pole cover set of 2, 180 mm wide	T2CF403SWNG <sup>1)</sup> <b>190.00</b>
	3 pole cover set of 2, 140 mm wide	T2CF403SLNG <sup>1)</sup> <b>190.00</b>
<b>CF</b>	4 pole cover set of 2, 185 mm wide	T2CF404SLNG <b>205.00</b>
	4 pole cover set of 2, 238 mm wide	T2CF404SWNG <b>205.00</b>



T2CF Wide cover  
shown at top of  
MCCB



T2CF Narrow cover



T2CF403SWNG Wide cover  
suitable for flanged bar  
connection.



T2CF403SLNG Narrow cover,  
which is the same width as  
the MCCB.

### TSCF403SLNG

Narrow covers include as  
standard:

- Locking clip for seal device
- IP 20 inserts with knock outs

**Notes:** <sup>1)</sup> For 400/630 A MCCBs, 'Flush' and 'rear' covers are the same item.  
<sup>2)</sup> Locking clip T2FOOL tool supplied standard.

## Accessories to suit 400 / 630 AF TemBreak 2

<b>External accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
Terminal covers <sup>3)</sup>	Rear Connect/ or flush front connect cover. <b>E400, S400, H400, L400, E630, S630</b>	
<b>CS/CR</b>	3 pole cover set of 2 4 pole cover set of 2	<b>T2CR403SG</b> <b>93.50</b> <b>T2CR404SG</b> <b>111.00</b>
Terminal cover locking clip	A clip that provides additional terminal cover position locking, and also allows a lead seal to be fitted	
Interpole Barriers <sup>1) 2)</sup>	All sizes 125, 250, 400, 630 AF <b>E400, S400, E630, S630</b> Interpole barrier (Qty 2) <b>H400, L400</b>	<b>T2CF00L</b> <b>9.10</b> <b>T2BA403SHA</b> <b>21.60</b> <b>T2BA403LHA</b> <b>POA</b>
<b>BA</b>	Interpole barrier (Qty 2)	

3



**T2CR / T2CS**  
Flush cover with 'knock-outs' for optional rear connect use.



**T2CF00L**  
Locking clip

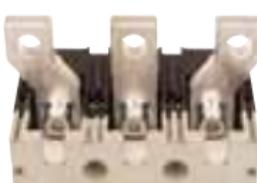


**T2BA**  
Interpole barriers

- Notes:**
- Line side interpole barriers or terminal covers must be installed with MCCBs.
  - Interpole Barriers are supplied with MCCBs as standard; 2 barriers with 3 pole MCCBs, and 3 barriers with 4 pole MCCBs.
  - For 400/630 A MCCBs, "flush" and "rear" covers are the same item.

## Accessories to suit 400 / 630 AF TemBreak 2

		<b>Cat. No.</b>	<b>Price \$</b>
<b>External accessories</b>			
ProSafe lock option	ProSafe locks can be mounted with T2HS variable depth handle operation. Refer NHP for direct mounting handle options.		
	<b>Suits MCCB types E/S/H/L 400 - 630</b>		
<b>TKN</b>	Prosafe shot bolt lock HS handles xx code	TKNHP_	520.00
	Prosafe standard key xx code for above	TKNNHPKEY_	130.00
	Cam for T2HS handle shafts Key codes A to Z are available. Specify by changing the key code above.	14997702	235.00
Toggle locks	Non Captive: Fits up to 3 padlocks or a multiple lock device <b>E400, S400, H400, L400, E630, S630</b>		
<b>HL</b>	Lock with three 8 mm holes	T2HL40A	73.00
	Captive: Allows a single padlock or multiple padlock device <b>E400, S400, H400, L400, E630, S630</b>		
	Lock with two 8 mm holes	T2HL40CAP	73.00
Attached Busbar	<b>E400, S400, H400, L400, E630, S630</b>		
	3 Pole, set of 6, wide bar, 400 A	2H1384DAA	225.00
<b>FB</b>	3 Pole, set of 6, wide bar set, 630 A	T2FB463BA	240.00
	4 Pole, set of 8, wide bar set, 630 A	T2FB464BA	305.00
Tunnel clamp terminals	<b>E400, S400, H400, L400, E630, S630</b>		
<b>FW</b>	3 Pole, set of 6 clamps 240 mm <sup>2</sup>	T2FW40L3A	415.00
	4 Pole, set of 8 clamps 240 mm <sup>2</sup>	T2FW40L4A	560.00



T2FB Attached flat bar



T2FW Tunnel clamp terminals

T2HL Toggle lock  
(captive)T2HL Toggle lock  
(non-captive)

## Accessories to suit 400 / 630 AF TemBreak 2

3

**RP****UP****GB****PM****DR**

<b>External accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
Rear connect terminal studs	<b>Suits MCCB types</b> <b>E400, S400</b>	
	3 pole kit, set of 6 studs	<b>T2RP403SA</b>
	4 pole kit, set of 8 studs	<b>T2RP404SA</b>
	<b>H400, L400</b>	
	3 pole kit, set of 6 studs	<b>T2RP403LA</b>
	4 pole kit, set of 8 studs	<b>T2RP404LA</b>
	<b>E630, S630</b>	
	3 pole kit, set of 6 studs	<b>T2RP463SA</b>
	4 pole kit, set of 8 studs	<b>T2RP464SA</b>
TemPlug	<b>Suits MCCB types</b> <b>TemPlug MCCB line-side plug-in attachment</b>	
	<b>E400, S400</b>	
	3 pole TemPlug	<b>T2UPX3400</b>
	<b>E630, S630</b>	
	3 pole TemPlug	<b>T2UPX3630</b>
	Templugs suit 6.3 mm busbar (10 mm optional)	
External neutral CT	400 A CT	<b>T2GB40N04A</b>
	630 A CT	<b>T2GB40N06A</b>
Electronic OCR checker	110 V AC	<b>TNS2110V</b>
	230 V AC	<b>TNS2240V</b>
PM	Plug-in MCCB (refer rear of section 3)	
DR	Draw-out MCCB	

Now  
available -  
Refer NHP


T2RP rear connect studs

T2UPX3400  
400 A TemplugT2UPX3630  
630 A Templug

## Accessories to suit 400 / 630 AF TemBreak 2

		Cat. No.	Price \$
Door flange	Provides an attractive panel cut-out surround for MCCBs or motors  <b>Suits MCCB sizes</b> <b>E400, S400, H400, L400, E630, S630</b>		
<b>DF</b>	MCCB IP 30 gland and gasket	<b>T2DF40A</b>	<b>132.00</b>
	MOTOR IP 30 gland and gasket	<b>T2DM40A</b>	<b>260.00</b>
Door mounting flush plate	A kit that allows an MCCB to be mounted directly onto a door  <b>E400, S400, E630, S630</b>		
<b>FP</b>	3 pole kit	<b>T2FP40S3A</b>	<b>280.00</b>
	4 pole kit	<b>T2FP40S4A</b>	<b>POA</b>
Wire lead terminal block	left side	<b>T2TF40LGA</b>	<b>189.00</b>
	right side	<b>T2TF40RGA</b>	<b>189.00</b>
<b>TF</b>			

3

**TNS**  
Electronic OCR checker



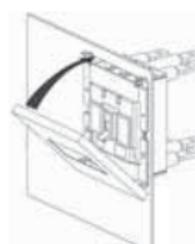
**T2DF/DM**  
Door flange



**T2TF**  
Wire lead terminal block



**T2FP**  
Door mounting flush plate



# MOULDED CASE CIRCUIT BREAKERS

NHP

2000 A to 3200 A

POWER PROTECTION



- Current limiting
- True RMS monitoring
- I<sub>2</sub>t switch to assist in obtaining selectivity
- Powerful interrupting capacities
- Icw for 0.5 sec of 38 kA
- Limitation of system damage
- Electronic trip unit with long, short and instantaneous adjustments
- Adjustment range 50 - 100 % of nominal current rating
- Standards AS/NZS 3947-2

 **TERASAKI**  
Innovators in Protection Technology

## TemBreak 2 Thermal magnetic type S800CJ

**36 kA**

**Current rating:** 630 – 800 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

Voltage	Icu	Ics
AC use	415	36
DC use	250	50



3

**Trip unit:**

- Adjustable thermal: 63% Ir to 100% Ir
- Adjustable magnetic: 5 to 10 x Im

**Dimensions (mm)**

Poles	3
H	273
W	210
D (less toggle)	103



**3 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Adj. Im Min. – Max.	Cat. No.	3 pole Price \$
630	396 - 630	3150 - 6300	S800 CJ 3 630	2500.00
800	504 - 800	4000 - 8000	S800 CJ 3 800	2550.00

**Notes:** Magnetic only available on application.

For additional information on applications refer section 9 or Part C catalogue.

NRC: Nominal rated current

Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

Replaces: XS630CJ and XS800NJ for applications up to 36 kA. Note: check exact ratings or dimensions to suit your application requirement .

## TemBreak 2 Thermal magnetic type S800NJ

**50 kA**

**Current rating:** 630 – 800 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

**3**

	Voltage	Icu	Ics
AC use	415	50	50
DC use	250	50	50



**Trip unit:**

- Adjustable thermal: 63% Ir to 100% Ir
- Adjustable magnetic: 5 to 10 x Im

**Dimensions (mm)**

Poles	3
H	273
W	210
D (less toggle)	103



**3 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Adj. Im Min. – Max.	Cat. No.	3 pole Price \$
630	396 - 630	3150 - 6300	S800 NJ 3 630	2900.00
800	504 - 800	4000 - 8000	S800 NJ 3 800	3150.00

**Notes:** Magnetic only available on application.

For additional information on applications refer section 9 or Part C catalogue.

NRC: Nominal rated current

Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

**Replaces:** XS630NJ and XS800NJ. Note: check exact ratings or dimensions to suit your application requirement.

## TemBreak 2 Thermal magnetic type S800RJ

### 70 kA

**Current rating:** 630 – 800 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	415	70	50
DC use	250	50	50



3

#### Trip unit:

- Adjustable thermal: 63% Ir to 100% Ir
- Adjustable magnetic: 5 to 10 x Im

#### Dimensions (mm)

Poles	3	4
H	273	273
W	210	280
D (less toggle)	103	103



#### Ampere

Rating NRC	Adj. Ir Min. – Max.	Adj. Ir Min. – Max.	Cat. No. <sup>1)</sup>	3 pole Price \$	4 pole Price \$
630	396 - 630	3150 - 6300	<b>S800 RJ 3 630</b>	<b>3910.00</b>	
			<b>S800 RJ 4 630</b>		<b>4350.00</b>
800	504 - 800	4000 - 8000	<b>S800 RJ 3 800</b>	<b>4500.00</b>	
			<b>S800 RJ 4 800</b>		<b>4950.00</b>

**Notes:** Magnetic only available on application.

For additional information on applications refer section 9 or Part C catalogue.

NRC: Nominal rated current

Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

Replaces: XH630SE and XH800SE. Note: check exact ratings or dimensions to suit your application requirement.

## TemBreak 2 Electronic type S800NE

**50 kA**

**Current rating:** 252 – 800 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**



**3**

Voltage	Icu	Ics
AC use	415	50

**Over Current Relay:**

- Electronic, for general & selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_R$  is adjustable from 40% - 100% of the nominal rated current  $I_N$
- STD setting 2.5 – 10 ( $x I_R$ ) <sup>1)</sup>
- INST setting 14 (Max 12  $x I_n$ ) <sup>1)</sup>

**Dimensions (mm)**

Poles	3	4
H	273	273
W	210	280
D (less toggle)	103	103

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$	4 pole Price \$
630	252 - 630	<b>S800 NE 3 630</b>	<b>3250.00</b>	
		<b>S800 NE 4 630</b>		<b>3740.00</b>
800	320 - 800	<b>S800 NE 3 800</b>	<b>3990.00</b>	
		<b>S800 NE 4 800</b>		<b>4560.00</b>

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2013  
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**Notes:** <sup>1)</sup> The STD and Instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_R$  settings the values will vary. Curves 1 & 2  $I_{sd} = 2.5 \times I_R$ , curve 3  $I_{sd} = 5 \times I_R$ , curves 4 - 7  $I_{sd} = 10 \times I_R$ .  $I_R$  dial setting 0.4 – 0.8  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.9 – 1.0  $I_i = 12 \times I_R$ .

NRC: Nominal rated current

Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

Replaces: XS630SE and XS800SE. Note: check exact ratings or dimensions to suit your application requirement.

## TemBreak 2 Electronic type S800RE

**70 kA**

**Current rating:** 252 – 800 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

Voltage	Icu	Ics
AC use	415	70

**Over Current Relay:**

- Electronic, for general & selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_R$  is adjustable from 40% - 100% of the nominal rated current  $I_N$
- STD setting  $2.5 - 10 (x I_R)^2$
- INST setting 14 (Max  $12 \times I_n$ ) $^2$

**OCR options:**

- Ground Fault Trip
- Neutral Pole protection
- Pre-Trip Alarm

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3

**Dimensions (mm)**

Poles	3	4
H	273	273
W	210	280
D (less toggle)	103	103

**Ampere Rating NRC**      **Adj. Ir Min. – Max.**

		Cat. No. <sup>1)</sup>	3 pole Price \$	4 pole Price \$
630	252 - 630	<b>S800 RE 3 630</b>	<b>3150.00</b>	
		<b>S800 RE 4 630</b>		<b>3810.00</b>
800	320 - 800	<b>S800 RE 3 800</b>	<b>4200.00</b>	
		<b>S800 RE 4 800</b>		<b>4850.00</b>

**Price Adder for OCR options.**  
Add to above MCCB price

		MCCB Cat. No. with option	3 pole Price \$	4 pole Price \$
3 P OCR options:	PTA <sup>3)</sup>	<b>S800 RE 3 AP #</b>	<b>180.00</b>	
	GF <sup>3)</sup>	<b>S800 RE 3 AG #</b>	<b>180.00</b>	
	PTA + GF <sup>3)</sup>	<b>S800 RE 3 APG #</b>	<b>360.00</b>	
4 P OCR options:	PTA <sup>3)</sup>	<b>S800 RE 4 AP #</b>		<b>180.00</b>
	AP <sup>3)</sup>	<b>S800 RE 4 AN #</b>		<b>180.00</b>
	PTA + NP <sup>3)</sup>	<b>S800 RE 4 APN #</b>		<b>360.00</b>
	GF + NP <sup>3)</sup>	<b>S800 RE 4 AGN #</b>		<b>360.00</b>

**Notes:** 1) "#" add OCR trip unit rating where shown with OCR options.

2) The STD and Instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_R$  settings the values will vary. Curve 1 & 2  $I_{sd} = 2.5 \times I_R$ , curve 3  $I_{sd} = 5 \times I_R$ , curve 4 - 7  $I_{sd} = 10 \times I_R$ .

$I_R$  dial setting 0.4 - 0.8  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.9 - 1.0  $I_i = 12 \times I_R$ .

3) To order a MCCB with the above options insert the required amp rating after the option to make up the Cat. No. Eg: S800RE 4 AGN 800 is an S800RE 4 Pole 800 A MCCB c/w Neutral Protection and Ground Fault protection.

For additional information on OCR settings, options and applications refer section 9 or part C catalogue.

**Replaces:** XH630SE and XH800SE. Note: check exact ratings or dimensions to suit your application requirement.

## TemBreak 2 Electronic XOW Metering MCCBs

### S800RE\_X1L/X1S

**70 kA****Current rating:** 320 – 800 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**

3

Voltage	Icu	Ics
AC use	415	70

**XOW Over Current Relay:**

- Ammeter or Energy Metering types
- Adjustable LSI setting for grading applications
- Base current adjustable from 40% - 100% of  $I_n$

**MCCB Standard features:****S800RE\_X1L**

- Ammeter, Adjustable LSI
- Trip event log, Alarm event log, Test function

**S800RE\_X1S**

- Energy (multifunction) meter: A, V, P, kW, kWh, E, Pf, F, H
- Adjustable LSI
- Backlit LCD display
- Ground fault, Pre trip alarm, Phase rotation & Neutral pole protection
- Trip and Alarm event log, Test function, Trip indication contact output
- Modbus RTU 485 communications
- External door mounting meter option (T2ED not incl. in below pricing)

**Dimensions (mm)**

Poles	3	4
H	273	273
W	210	280
D (less toggle)	103	103



T2ED

Ampere Rating NRC	Ir Adj. Min.-Max.	Cat. No. 1)	3 pole Price \$	4 pole Price \$
MCCB with ammeter 800	320 - 800	<b>S800 RE 3 800 X1L</b>	<b>6450.00</b>	
		<b>S800 RE 4 800 X1L</b>		<b>7740.00</b>
MCCB with energy meter 800	320 - 800	<b>S800 RE 3 800 X1S</b>	<b>7900.00</b>	
		<b>S800 RE 4 800 X1S</b>		<b>9480.00</b>

**Notes:** NRC: Nominal rated current

Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

For additional information on OCR settings, options and applications refer section 9 or part C catalogue.

## TemBreak 2 Electronic type H800NE

**125 kA**

**Current rating:** 252 – 800 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2



**Interrupting capacity:**

Voltage	Icu	Ics
AC use	415	125

**Over Current Relay:**

- Electronic, for general & selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_R$  is adjustable from 40% - 100% of the nominal rated current  $I_N$
- STD setting  $2.5 - 10 (x I_R)^2$
- INST setting 14 (Max  $12 \times I_n$ )<sup>2</sup>

**OCR Options:**

- Ground Fault Trip
- Neutral Pole protection
- Pre-Trip Alarm

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No. <sup>1)</sup>	3 pole Price \$	4 pole Price \$
630	252 - 630	H800 NE 3 630	4230.00	
		H800 NE 4 630		4810.00
800	320 - 800	H800 NE 3 800	4590.00	
		H800 NE 4 800		5220.00

Price Adder for OCR options. Add to above MCCB price	MCCB Cat. No. with option	3 pole Price \$	4 pole Price \$
3 P OCR options:	PTA <sup>3)</sup>	H800 NE 3 AP #	180.00
	GF <sup>3)</sup>	H800 NE 3 AG #	180.00
	PTA + GF <sup>3)</sup>	H800 NE 3 APG #	180.00
4 P OCR options:	PTA <sup>3)</sup>	H800 NE 4 AP #	180.00
	AP <sup>3)</sup>	H800 NE 4 AN #	180.00
	PTA + NP <sup>3)</sup>	H800 NE 4 APN #	360.00
	GF + NP <sup>3)</sup>	H800 NE 4 AGN #	360.00

**Notes:** <sup>1)</sup> "#" add OCR trip unit rating where shown with OCR options.

<sup>2)</sup> The STD and Instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_R$  settings the values will vary. Curve 1 & 2  $I_{sd} = 2.5 \times I_R$ , curve 3  $I_{sd} = 5 \times I_R$ , curve 4 - 7  $I_{sd} = 10 \times I_R$ .

<sup>3)</sup> To order a MCCB with the above options insert the required amp rating after the option to make up the Cat. No. Eg: H800NE 4 AGN 800 is an H800NE 4 Pole 800 A MCCB c/w Neutral Protection and Ground Fault protection.

For additional information on OCR settings, options and applications refer section 9 or part C catalogue.

Replaces: TL630NE and TL800NE. Note: check exact ratings or dimensions to suit your application requirement.

## TemBreak 2 Electronic XOW Metering MCCBs

### H800NE\_X1L/X1S

**125 kA****Current rating:** 320 – 800 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**

3

Voltage	Icu	Ics
AC use	415	125

**XOW Over Current Relay:**

- Ammeter or Energy Metering types
- Adjustable LSI setting for grading applications
- Base current adjustable from 40% - 100% of  $I_n$

**MCCB Standard features:****H800NE\_X1L**

- Ammeter, Adjustable LSI
- Trip event log, Alarm event log, Test function

**H800NE\_X1S**

- Energy (multifunction) meter: A, V, P, kW, kWh, E, Pf, F, H
- Adjustable LSI
- Backlit LCD display
- Ground fault, Pre trip alarm, Phase rotation & Neutral pole protection
- Trip and Alarm event log, Test function, Trip indication contact output
- Modbus RTU 485 communications
- External door mounting meter option ((T2ED not incl. in below pricing)

**Dimensions (mm)**

Poles	3	4
H	273	273
W	210	280
D (less toggle)	140	140



Ampere Rating NRC	Ir Adj. Min.-Max.	Cat. No.	3 pole Price \$	4 pole Price \$
MCCB with ammeter 800	320 - 800	H800 NE 3 800 X1L	7150.00	
		H800 NE 4 800 X1L		8500.00
MCCB with energy meter 800	320 - 800	H800 NE 3 800 X1S	8650.00	
		H800 NE 4 800 X1S		10300.00

**Notes:** NRC: Nominal rated current

Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

For additional information on OCR settings, options and applications refer section 9 or part C catalogue.

## TemBreak 2 Electronic type L800NE

**200 kA**

**Current rating:** 252 – 800 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

Voltage	Icu	Ics
AC use	415	200

**Over Current Relay:**

- Electronic, for general & selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_R$  is adjustable from 40% - 100% of the nominal rated current  $I_n$
- STD setting  $2.5 - 10 (x I_R)^2$
- INST setting 14 (Max  $12 \times I_n$ )<sup>2</sup>

**OCR options:**

- Ground Fault Trip
- Neutral Pole protection
- Pre-Trip Alarm

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3

**Dimensions (mm)**

Poles	3	4
H	273	273
W	210	280
D (less toggle)	140	140

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No. <sup>1)</sup>	3 pole Price \$	4 pole Price \$
630	252 - 630	L800 NE 3 630	4520.00	
		L800 NE 4 630		5350.00
800	320 - 800	L800 NE 3 800	4960.00	
		L800 NE 4 800		5960.00

**Price Adder for OCR options.**  
Add to above MCCB price

	MCCB Cat. No. with option	3 pole Price \$	4 pole Price \$
3 P OCR options:	PTA <sup>3)</sup> L800 NE 3 AP #	180.00	
	GF <sup>3)</sup> L800 NE 3 AG #	180.00	
	PTA + GF <sup>3)</sup> L800 NE 3 APG #	180.00	
4 P OCR options:	PTA <sup>3)</sup> L800 NE 4 AP #		180.00
	AP <sup>3)</sup> L800 NE 4 AN #		180.00
	PTA + NP <sup>3)</sup> L800 NE 4 APN #		360.00
	GF + NP <sup>3)</sup> L800 NE 4 AGN #		360.00

**Notes:** 1) "#" add OCR trip unit rating where shown with OCR options.

2) The STD and Instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_R$  settings the values will vary. Curve 1 & 2  $I_{sd} = 2.5 \times I_R$ , curve 3  $I_{sd} = 5 \times I_R$ , curve 4 - 7  $I_{sd} = 10 \times I_R$ .

$I_R$  dial setting 0.4 – 0.8  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.9 – 1.0  $I_i = 12 \times I_R$ .

3) To order a MCCB with the above options insert the required amp rating after the option to make up the Cat. No. Eg: L800NE 4 AGN 800 is an L800NE 4 Pole 800 A MCCB c/w Neutral Protection and Ground Fault protection.

For additional information on OCR settings, options and applications refer section 9 or part C catalogue.

## TemBreak 2 690V AC High Fault Interruption MCCB L800PE

**70 kA****Current rating:** 252 – 800 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**
Early  
2013  
Release
**3**

Voltage	Icu	Ics
AC use	690	70

**Over Current Relay:**

- Electronic, for general & selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_R$  is adjustable from 40% - 100% of the nominal rated current  $I_N$
- STD setting 2.5 – 10 ( $\times I_R^{-1}$ )
- INST setting 14 (Max  $12 \times I_n^{-1}$ )

**Dimensions (mm)**

Poles	3
H	273
W	210
D (less toggle)	140

**3 Pole**

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$
630	252 - 630	L800 PE 3 630	5340.00
800	320 - 800	L800 PE 3 800	5460.00

**Notes:** 1) The STD and Instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_R$  settings the values will vary. Curves 1 & 2  $I_{sd} = 2.5 \times I_R$ , curve 3  $I_{sd} = 5 \times I_R$ , curves 4 - 7  $I_{sd} = 10 \times I_R$ .

$I_R$  dial setting 0.4 – 0.9  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.95 – 1.0  $I_i = 13 \times I_R$ .

Not suitable for reverse connection either individually or on a chassis.

Suitable for general motor starting and power distribution applications

Refer NHP for 4 pole version availability.

Refer NHP for additional information.

NRC: Nominal rated current

Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

## TemBreak 2 Electronic type S1000NE

**70 kA****Current rating:** 400 – 1000 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**

Voltage	Icu	Ics
AC use	415	70

**Over Current Relay:**

- Electronic, for general & selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_R$  is adjustable from 40% - 100% of the nominal rated current  $I_N$
- STD setting 2.5 – 10 ( $x I_R$ )<sup>1)</sup>
- INST setting 14 (Max 12  $x I_R$ )<sup>1)</sup>

**OCR Options:**

- Ground Fault Trip
- Neutral Pole protection
- Pre-Trip Alarm

Early  
2013 release  
Reduced  
frame size



3

**Dimensions (mm)**

Poles	3	4
H	273	273
W	210	280
D (less toggle)	103	103

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$	4 pole Price \$
1000	400 - 1000	S1000 NE 3 1000	3850.00	
		S1000 NE 4 1000		4812.00

Price Adder for OCR options. Add to above MCCB price	MCCB Cat. No. with option	3 pole Price \$	4 pole Price \$
3 P OCR options:	PTA <sup>2)</sup>	S1000 NE 3 AP #	180.00
	GF <sup>2)</sup>	S1000 NE 3 AG #	180.00
	PTA + GF <sup>2)</sup>	S1000 NE 3 APG #	360.00
4 P OCR options:	PTA <sup>2)</sup>	S1000 NE 4 AP #	180.00
	AP <sup>2)</sup>	S1000 NE 4 AN #	180.00
	PTA + NP <sup>2)</sup>	S1000 NE 4 APN #	360.00
	GF + NP <sup>2)</sup>	S1000 NE 4 AGN #	360.00

**Notes:** <sup>1)</sup> 1. The STD and Instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_R$  settings the values will vary. Curve 1 & 2  $I_{sd} = 2.5 \times I_R$ , curve 3  $I_{sd} = 5 \times I_R$ , curve 4 - 6  $I_{sd} = 8 \times I_R$ .  $I_R$  dial setting 0.4 – 0.63  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.8 – 1.0  $I_i = 10 \times I_R$ .

<sup>2)</sup> To order a MCCB with the above options insert the required amp rating after the option to make up the Cat. No. Eg: S1000NE 4 AGN 800 is an S1000NE 4 Pole 800 A MCCB c/w Neutral Protection and Ground Fault protection.

For additional information on OCR settings, options and applications refer section 9 or part C catalogue.

Replaces: XH800SE and XS1250SE 1000A. Note: check exact ratings or dimensions to suit your application requirement.

## TemBreak 2 Electronic XOW Metering MCCBs

### S1000NE\_X1L/X1S

**70 kA****Current rating:** 400 - 1000 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:**

3

Voltage	Icu	Ics
AC use	415	70

**XOW Over Current Relay:**

- Ammeter or Energy Metering types
- Adjustable LSI setting for grading applications
- Base current adjustable from 40% - 100% of  $I_n$



New  
metering  
MCCB

**MCCB Standard features:****S1000NE\_X1L**

- Ammeter, Adjustable LSI
- Trip event log, Alarm event log, Test function

**S1000NE\_X1S**

- Energy (multifunction) meter: A, V, P, kW, kWh, E, Pf, F, H
- Adjustable LSI
- Backlit LCD display
- Ground fault, Pre trip alarm, Phase rotation & Neutral pole protection
- Trip and Alarm event log, Test function, Trip indication contact output
- Modbus RTU 485 communications
- External door mounting meter option (T2ED not incl. in below pricing)

**Dimensions (mm)**

Poles	3	4
H	273	273
W	210	280
D (less toggle)	103	103



Ampere Rating NRC	Ir Adj. Min.-Max.	Cat. No.	3 pole Price \$	4 pole Price \$
MCCB with ammeter 1000	400 - 1000	<b>S1000 NE 3 1000 X1L</b>	<b>7750.00</b>	
		<b>S1000 NE 4 1000 X1L</b>		<b>9300.00</b>
MCCB with energy meter 1000	400 - 1000	<b>S1000 NE 3 1000 X1S</b>	<b>9450.00</b>	
		<b>S1000 NE 4 1000 X1S</b>		<b>11340.00</b>

**Notes:** NRC: Nominal rated current

Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

For additional information on OCR settings, options and applications refer section 9 or part C catalogue.

## Accessories for 800 - 1000 A MCCBs



<b>Internal accessories</b>		<b>Cat. No.</b>	<b>Price \$</b>
Shunt trips	Internal accessories are common for MCCBs 800 A to 1600 A. All have screw terminals except those indicated below with wire leads as indicated.		
<b>For 3 and 4 pole MCCBs</b>			
SH	110 V AC	T2SH00A10TA	255.00
	230 - 240 V AC	T2SH00A20TA	255.00
	400 - 415 V AC	T2SH00A40TA	255.00
	12 V DC	T2SH00D01TA	255.00
	24 V DC (suits 24 V AC)	T2SH00D02TA	255.00
	48 V DC	T2SH00D04TA	255.00
	110 V DC	T2SH00D10TA	255.00
	230 V DC	T2SH00D20TA	255.00
Undervoltage trips	<b>Instantaneous operation</b>		
UV	110 V AC	T2UV80A10NTA	270.00
	200 - 240 V AC	T2UV80A20NTA	270.00
	380 - 450 V AC	T2UV80A40NTA	270.00
	24 V DC	T2UV80D02NTA	270.00
	110 V DC	T2UV80D10NTA	270.00
	230 V DC	T2UV80D20NTA	270.00
Time delay types are available – refer NHP for details.			
Auxiliary & Alarm switches	<b>General type (2 A @ 240 V Inductive)</b>		
AX	1 C/O Auxiliary with terminals	T2AX00M3STA	134.00
	1 C/O 1 <sup>st</sup> Auxiliary with 700 mm leads	T2AX00M3SWA	146.00
	1 C/O 2 <sup>nd</sup> Auxiliary with 700 mm leads	T2AX00M4SWA	146.00
	1 C/O 3 <sup>rd</sup> Auxiliary with 700 mm leads	T2AX00M5SWA	146.00
	1 <sup>st</sup> , 2 <sup>nd</sup> , 3 <sup>rd</sup> aux have different numbered wire leads, otherwise identical.		
AL	1 C/O Alarm	T2AL00M4STA	129.00
	1 C/O Alarm with 700 mm wire leads	T2AL00M5SWA	141.00
<b>Heavy-duty type (4 A @ 240 V Inductive)</b>			
	1 N/O Auxiliary	T2AX00B1STA	146.00
	1 N/C Auxiliary	T2AX00B2STA	146.00
	1 N/O Alarm	T2AL00B1STA	146.00
	1 N/C Alarm	T2AL00B2STA	146.00
<b>Micro switching type (very low voltages and currents)</b>			
	1 C/O Auxiliary	T2AX00M3RTA	187.00
	1 C/O Alarm	T2AL00M3RTA	187.00

## Accessories for 800 - 1000 A MCCBs

### External accessories

### Cat. No.

### Price \$

Operating handles Direct mounting, fixed depth, IP 54	<b>Suits MCCB types 800 - 1000AF</b>		
	Grey/black IP 54	<b>T2HB80UR5BN</b>	<b>495.00</b>
	Red/yellow IP 54	<b>T2HB80UR5RN</b>	<b>495.00</b>
	<b>HB</b>		
Door interlocking variable depth handles	<b>800 A to 1000 A</b>		
	<b>T2HS compact handle</b>		
	Grey IP55 handle + 320 mm shaft	<b>T2HS80R6GM</b>	<b>470.00</b>
	Red/yellow IP55 handle + 320 mm shaft	<b>T2HS80R6RM</b>	<b>470.00</b>
	<b>METAL compact handle</b>		
	Silver IP 65 handle + 320 mm shaft	<b>T2HP80R6ME</b>	<b>470.00</b>
	<b>T2HP square handle</b>		
	Grey, IP 55 handle + 320 mm shaft	<b>T2HP80R6BN</b>	<b>690.00</b>
	Red/yellow, IP 55 handle + 320 mm shaft	<b>T2HP80R6RN</b>	<b>470.00</b>
	<b>HP</b>		
	<b>Handle options</b>		
	Large escutcheon plate option: 100 mm <sup>2</sup>	<b>T2HSESC100</b>	<b>18.20</b>
	390 mm T pin shaft for T2HS - no flexi coupling	<b>T2HS400SHAFT</b>	<b>47.00</b>
	Handle shaft CAM for trapped key interlock	<b>1499 7702</b>	<b>235.00</b>
	MCCB/handle mech padlock attachment	<b>T2HP80PALK</b>	<b>47.50</b>
	MCCB identification labels	<b>T80CAPLAB</b>	<b>3.50</b>
	<b>External Neutral CT</b>		
	<b>S1250, S1600</b>		
	Optional neutral CT, Ground Fault MCCBs	<b>T2GBX6N12A</b>	<b>410.00</b>
	Optional neutral CT, Ground Fault MCCBs	<b>T2GBX6N16A</b>	<b>410.00</b>
	<b>GB</b>		



T2HB fixed depth  
"direct mount" handle



T2HS handle



T2HP handle

## Accessories for 800 – 1000 A MCCBs

<b>External accessories</b>		<b>Cat. No.</b>	<b>Price \$</b>
Mechanical Interlock	Link Interlock – suitable for manual or motorised operation. Will accept handles. Suitable for front or rear connect type MCCBs.  Suits MCCB types <b>800 A to 1000 A</b>		
<b>ML</b>	3 or 4 pole right side section	T2ML80RA	365.00
	3 pole left side section	T2ML80L3A	140.00
	4 pole left side section	T2ML80L4A	140.00
	Slide type - manual operation, padlockable. Does not allow motors, handles or other front mounted accessories to be fitted. Suitable for front or rear connection.		
	<b>S800, S1000</b>		
<b>MS</b>	3 pole	T2MS803SFA	240.00
	4 pole	T2MS804SFA	260.00
	<b>H800</b>		
	3 pole	T2MS803LFA	260.00
	4 pole	T2MS804LFA	280.00
	Cable interlock – allows an MCCB can be mounted horizontally, vertically or diagonally. Accepts Motors and handles. Suitable for 3 or 4 pole MCCBs		
	<b>800 A to 1000 A</b>		
<b>ML</b>	Interlock kit less wire	T2MW80CA	335.00
	Wire for above interlocks		
	Wire 1.0 m	T2MW00SA	63.00
	Wire 1.5 m	T2MW00LA	73.00

3



Link interlock



Cable interlock

## Accessories for 800 - 1000A MCCBs

External accessories	Cat. No.	Price \$
Terminal covers - front connected MCCBs Rear connect terminal covers RC <b>CR</b>	<b>Suits MCCB types S800, S1000</b>	
3 pole cover set of 2	<b>T2CR803SHGA</b>	<b>170.00</b>
4 pole cover set of 2	<b>T2CR804SHGA</b>	<b>210.00</b>
<b>H800</b>		
3 pole cover set of 2	<b>T2CR803LHGA</b>	<b>210.00</b>
4 pole cover set of 2	<b>T2CR804LHGA</b>	<b>240.00</b>
Terminal covers for plug in base <b>CB</b>	<b>S800, S1000, H800</b>	
3 pole cover set	<b>T2CB803GHNA</b>	<b>170.00</b>
4 pole cover set	<b>T2CB804GHNA</b>	<b>210.00</b>
Extended terminal covers FC <b>CF</b>	Terminal covers are the same width as the MCCB <b>S800, S1000, H800</b>	
3 pole cover set	<b>T2CF803SLHGA</b>	<b>205.00</b>
4 pole cover set	<b>T2CF804SLHGA</b>	<b>260.00</b>
Terminal cover locking clip	<b>800 A to 1000 A</b>	
A clip that provides additional terminal cover locking, and also allows a lead seal to be fitted	<b>T2CF00LA</b>	<b>8.80</b>
Interpole Barriers <sup>1)</sup> <sub>2)</sub>	<b>S800, S1000</b>	
Interpole barrier (Qty 2)	<b>T2BA803SHA</b>	<b>10.00</b>
<b>H800</b>		
Interpole barrier (Qty 2)	<b>T2BA803LHA</b>	<b>10.00</b>



Terminal covers (T2CR)



T2CR Terminal covers



Extended terminal covers FC



Terminal cover locking clip



Interpole barriers

**Notes:** <sup>1)</sup> Line side interpole barriers or terminal covers must be installed with MCCBs.

<sup>2)</sup> Interpole Barriers are supplied with MCCBs as standard; 2 barriers with 3 pole MCCBs, and 3 barriers with 4 pole MCCBs.

## Accessories for 800 - 1000 A MCCBs

		<b>Cat. No.</b>	<b>Price \$</b>
	<b>External accessories</b>		
Toggle locks	<b>Non Captive:</b> Fits up to 3 padlocks or a multiple lock device <b>Suits MCCB types</b> <b>800 A, 1000 A</b>		
<b>HL</b>	Lock with 5 mm x 16.5 mm slot	<b>T2HL40A</b>	<b>73.00</b>
	<b>Captive:</b> Allows a single padlock or multiple padlock device <b>800 A, 1000 A</b>		
	Lock with single 8 mm hole	<b>T2HL80CAP</b>	<b>125.00</b>
Motor operators	<b>800 - 1000 A</b>		
	110 - 240 V AC	<b>T2MC80A10NA</b>	<b>2570.00</b>
	24 - 48 V DC	<b>T2MC80D10NA</b>	<b>2570.00</b>
	Electrical interlocking connector between motor operators <b>E400, S400, H400, L400, E630, S630</b>		
<b>MC</b>	0.6 m connector 400 A to 1000 A	<b>T2MM40L06A</b>	<b>60.50</b>
	2.1 m connector 400 A to 1000 A	<b>T2MM40L21A</b>	<b>80.00</b>
	0.6 m connector 125 A to 1000 A	<b>T2MM40S06A</b>	<b>58.50</b>
	2.1 m connector 125 A to 1000 A	<b>T2MM40S21A</b>	<b>70.50</b>
	<b>1. Motor options:</b> Contact NHP for key locking and auto reset.		
Rear connect terminal studs	<b>S800</b> for line and load terminals		
	3 pole kit, set of 6 studs	<b>T2RP803HA</b>	<b>1150.00</b>
	4 pole kit, set of 8 studs	<b>T2RP804HA</b>	<b>1440.00</b>
	<b>H800</b> for line terminals		
	3 pole kit, set of 3 studs	<b>T2RP803MA</b>	<b>780.00</b>
	4 pole kit, set of 4 studs	<b>T2RP804MA</b>	<b>840.00</b>
	<b>H800</b> for load terminals		
<b>RP</b>	3 pole kit, set of 3 studs	<b>T2RP803NA</b>	<b>780.00</b>
	4 pole kit, set of 4 studs	<b>T2RP804NA</b>	<b>840.00</b>
	<b>S1000</b> for line and load terminals		
	3 pole kit, set of 6 studs	<b>T2RPX03HA</b>	<b>1420.00</b>
	4 pole kit, set of 8 studs	<b>T2RPX04HA</b>	<b>1830.00</b>
Door Flange	Provides an attractive panel cut-out surround for MCCBs or MOTORS		
	<b>800 to 1000 A</b>		
<b>FW</b>	MCCB IP 30 gland and gasket	<b>T2FW40L3A</b>	<b>415.00</b>
	MOTOR IP 30 gland and gasket	<b>T2FW40L4A</b>	<b>560.00</b>
Wire Lead Terminal Block	MCCB mounted terminal block connected to internal accessories. This accessory is a <b>FACTORY FIT ITEM</b> .		
<b>TF</b>	Terminal block and wiring loom RIGHT side	<b>T2TF40RGA</b>	<b>189.00</b>
	Terminal block and wiring loom LEFT side	<b>T2TF40LGA</b>	<b>189.00</b>

## Accessories for 800 - 1000 A MCCBs

<b>External accessories <sup>1) 2)</sup></b>		<b>Cat. No.</b>	<b>Price \$</b>
TemPlug	TemPlug MCCB line-side plug in attachment		
	<b>Suits MCCB types</b>		
	<b>S800</b>		
<b>UP</b>	3 pole TemPlug	<b>T2UPX3800</b>	<b>690.00</b>
	<b>S1000</b>		
	3 pole TemPlug	<b>T2UPX31000</b>	<b>950.00</b>
Plug in MCCBs	Plug in MCCB base kit. Includes MCCB plugs and other parts for converting an MCCB to a plug in MCCB. Mounting bases are ordered separately. <b>MCCB conversion kits:</b>		
	<b>S800, S1000</b>		
	3 pole kit	<b>2H...TBA</b>	<b>POA</b>
	4 pole kit	<b>2H...TBA</b>	<b>POA</b>
	Plug in bases, IP20, includes rear insulation screen. The base includes terminal studs which are suitable for front or rear connection. Interpole barriers can be used with these bases, but not terminal covers. Plug in mounting bases:		
	<b>S800, S1000</b>		
<b>PM</b>	3 pole kit	<b>T2PM80A3A</b>	<b>485.00</b>
	4 pole kit	<b>T2PM80A4A</b>	<b>640.00</b>
	Control wiring plugs and sockets for plug in MCCBs		
	3 pin plug for aux/alarms – MCCB side	<b>2H6959CAA1</b>	<b>37.00</b>
	3 pin plug for shunt/UVT – MCCB side	<b>2H6959CBA1</b>	<b>37.00</b>
	3 pin socket for panel mount base	<b>T2TP003A</b>	<b>37.00</b>
	Extension bars		
	3 pole kit	<b>T2PF803HA</b>	<b>235.00</b>
	4 pole kit	<b>T2PF804HA</b>	<b>290.00</b>



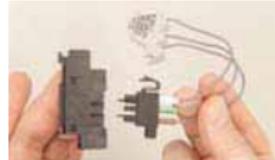
TemPlug



Plug in MCCBs



Plug in MCCBs



Plug in MCCBs

**Notes:** <sup>1)</sup> Up to 4 control wiring plug kits can be used in a base.

<sup>2)</sup> Internal accessories are used with the above plugs and sockets

## TemBreak 2 Electronic type S1250GE

**85 kA**

**Current rating:** 500 – 1250 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

Voltage	Icu	Ics
AC use	415	85
	400	100
		76



3

### Over Current Relay:

- Electronic, for general & selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_R$  is adjustable from 40% - 100% of the nominal rated current  $I_N$
- STD setting 2.5 – 10 ( $x I_R$ ) <sup>1)</sup>
- INST setting 14 (Max 12  $x I_R$ ) <sup>1)</sup>

### OCR Options:

- Ground Fault Trip
- Neutral Pole protection
- Pre-Trip Alarm

### Dimensions (mm)

Poles	3	4
H	370	370
W	210	280
D (less toggle)	120	120

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$	4 pole Price \$
1000	400 - 1250	S1250 GE 3 1250	8650.00	
		S1250 GE 4 1250		10250.00

### Price Adder for OCR options. Add to above MCCB price

	MCCB Cat. No. with option	3 pole Price \$	4 pole Price \$
3 P OCR options:	PTA <sup>2)</sup>	S1250 GE 3 AP #	180.00
	GF <sup>2)</sup>	S1250 GE 3 AG #	180.00
	PTA + GF <sup>2)</sup>	S1250 GE 3 APG #	180.00
4 P OCR options:	PTA <sup>2)</sup>	S1250 GE 4 AP #	180.00
	AP <sup>2)</sup>	S1250 GE 4 AN #	180.00
	PTA + NP <sup>2)</sup>	S1250 GE 4 APN #	360.00
	GF + NP <sup>2)</sup>	S1250 GE 4 AGN #	360.00

**Notes:** <sup>1)</sup> The STD and Instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_R$  settings the values will vary. Curve 1 & 2  $I_{sd} = 2.5 \times I_{R_n}$ , curve 3  $I_{sd} = 5 \times I_{R_n}$ , curve 4 - 6  $I_{sd} = 8 \times I_{R_n}$ .  $I_R$  dial setting 0.4 – 0.63  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.8 – 1.0  $I_i = 10 \times I_R$ .

<sup>2)</sup> To order a MCCB with the above options insert the required amp rating after the option to make up the Cat. No. Eg: S1250GE 4 AGN 800 is an S1250GE 4 Pole 800 A MCCB c/w Neutral Protection and Ground Fault protection.

For additional information on OCR settings, options and applications refer section 9 or part C catalogue.

**Replaces:** XS1250SE. Note: check exact ratings or dimensions to suit your application requirement.

## TemBreak 2 Electronic type S1600NE

**85 kA**

**Current rating:** 640 – 1600 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:**

	Voltage	Icu	Ics
AC use	415	85	65
	400	100	76



**3**

**Over Current Relay:**

- Electronic, for general & selectivity applications
- 7 dial selectable characteristic curves suited for a variety of applications
- Base current  $I_R$  is adjustable from 40% - 100% of the nominal rated current  $I_N$
- STD setting 2.5 – 10 ( $x I_R$ )<sup>1)</sup>
- INST setting 14 (Max 12  $x I_R$ )<sup>1)</sup>

**OCR Options:**

- Ground Fault Trip
- Neutral Pole protection
- Pre-Trip Alarm

**Dimensions (mm)**

Poles	3	4
H	370	370
W	210	280
D (less toggle)	140	140

Ampere Rating NRC	Adj. Ir Min. – Max.	Cat. No.	3 pole Price \$	4 pole Price \$
1000	400 - 1250	S1600 NE 3 1250	9820.00	
		S1600 NE 4 1250		11500.00

**Price Adder for OCR options.**  
Add to above MCCB price

	MCCB Cat. No. with option	3 pole Price \$	4 pole Price \$
3 P OCR options:	PTA <sup>2)</sup>	S1600 NE 3 AP #	180.00
	GF <sup>2)</sup>	S1600 NE 3 AG #	180.00
	PTA + GF <sup>2)</sup>	S1600 NE 3 APG #	180.00
4 P OCR options:	PTA <sup>2)</sup>	S1600 NE 4 AP #	180.00
	AP <sup>2)</sup>	S1600 NE 4 AN #	180.00
	PTA + NP <sup>2)</sup>	S1600 NE 4 APN #	360.00
	GF + NP <sup>2)</sup>	S1600 NE 4 AGN #	360.00

**Notes:** <sup>1)</sup> The STD and Instantaneous pickup currents ( $I_{sd}$  &  $I_i$ ) settings are not individually adjustable, however by selecting different curve types and different  $I_R$  settings the values will vary. Curve 1 & 2  $I_{sd} = 2.5 \times I_{R_n}$ , curve 3  $I_{sd} = 5 \times I_{R_n}$ , curve 4 - 6  $I_{sd} = 8 \times I_{R_n}$ .  $I_R$  dial setting 0.4 – 0.63  $I_i = 14 \times I_R$  and  $I_R$  dial setting 0.8 – 1.0  $I_i = 10 \times I_R$ .

<sup>2)</sup> To order a MCCB with the above options insert the required amp rating after the option to make up the Cat. No. Eg: S1600NE 4 AGN 800 is an S1600NE 4 Pole 800 A MCCB c/w Neutral Protection and Ground Fault protection.

For additional information on OCR settings, options and applications refer section 9 or part C catalogue.

**Replaces:** XS1600SE. Note: check exact ratings or dimensions to suit your application requirement.

## Accessories for 1250 - 1600 A MCCBs



	<b>Internal accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
Shunt trips	Internal accessories are common for MCCBs 800 A to 1600 A. All have screw terminals except those indicated below with wire leads as indicated.		
<b>For 3 and 4 pole MCCBs</b>			
SH	110 V AC	T2SH00A10TA	255.00
	230 - 240 V AC	T2SH00A20TA	255.00
	400 - 415 V AC	T2SH00A40TA	255.00
	12 V DC	T2SH00D01TA	255.00
	24 V DC (suits 24 V AC)	T2SH00D02TA	255.00
	48 V DC	T2SH00D04TA	255.00
	110 V DC	T2SH00D10TA	255.00
	230 V DC	T2SH00D20TA	255.00
Undervoltage trips	<b>Instantaneous operation</b>		
UV	110 V AC	T2UV80A10NTA	270.00
	200 - 240 V AC	T2UV80A20NTA	270.00
	380 - 450 V AC	T2UV80A40NTA	270.00
	24 V DC	T2UV80D02NTA	270.00
	110 V DC	T2UV80D10NTA	270.00
	230 V DC	T2UV80D20NTA	270.00
Time delay types are available – refer NHP for details.			
Auxiliary & Alarm switches	<b>General type (2 A @ 240 V Inductive)</b>		
AX	1 C/O Auxiliary with terminals	T2AX00M3STA	134.00
	1 C/O 1 <sup>st</sup> Auxiliary with 700 mm leads	T2AX00M3SWA	146.00
	1 C/O 2 <sup>nd</sup> Auxiliary with 700 mm leads	T2AX00M4SWA	146.00
	1 C/O 3 <sup>rd</sup> Auxiliary with 700 mm leads	T2AX00M5SWA	146.00
	1 <sup>st</sup> , 2 <sup>nd</sup> , 3 <sup>rd</sup> aux have different numbered wire leads, otherwise identical.		
AL	1 C/O Alarm	T2AL00M4STA	129.00
	1 C/O Alarm with 700 mm wire leads	T2AL00M5SWA	141.00
<b>Heavy-duty type (4 A @ 240 V Inductive)</b>			
	1 N/O Auxiliary	T2AX00B1STA	146.00
	1 N/C Auxiliary	T2AX00B2STA	146.00
	1 N/O Alarm	T2AL00B1STA	146.00
	1 N/C Alarm	T2AL00B2STA	146.00
<b>Micro switching type (very low voltages and currents)</b>			
	1 C/O Auxiliary	T2AX00M3RTA	187.00
	1 C/O Alarm	T2AL00M3RTA	187.00

## Accessories for 1250 - 1600 A MCCBs

### External accessories

### Cat. No.

### Price \$

Operating-handles  
Suits MCCB types  
**1250 - 1600 A**

Direct mounting,  
fixed depth,  
IP 54

Grey/black IP 54  
Red/yellow IP 54

**T2HBX6UR5BN**  
**T2HBX6UR5RN**

**560.00**  
**560.00**

### HB

3

Door interlocking variable depth handles

**1250 - 1600 A**

**T2HS compact handle**

Grey IP55 handle + 320 mm shaft  
Red/yellow IP55 handle +  
320 mm shaft

**T2HSX6R6GM**  
**T2HSX6R6RM**

**550.00**  
**550.00**

### HS

**METAL compact handle**

Silver IP 65 handle + 320 mm shaft

**T2HPX6R6ME**

**830.00**

### HP

**T2HP square handle**

Grey, IP 55 handle + 320 mm shaft  
Red/yellow, IP 55 handle +  
320 mm shaft

**T2HPX6R6BN**  
**T2HPX6R6RN**

**550.00**  
**550.00**

**Handle options**

Large escutcheon plate option:  
100 mm<sup>2</sup>

**T2HSESC100**

**18.20**

390 mm T pin shaft for T2HS -  
no flexi coupling

**T2HS400SHAFT**

**47.00**

Handle shaft CAM for trapped  
key interlock

**1499 7702**

**235.00**

MCCB/handle mech padlock  
attachment

**T2HPX6PALK**

**85.00**

MCCB identification labels

**TX6CAPLAB**

**3.50**



T2HB fixed depth  
"direct mount" handle



T2HS handle



T2HP handle

## Accessories for 1250 - 1600 A MCCBs

3

<b>External accessories</b>		<b>Cat. No.</b>	<b>Price \$</b>
Mechanical Interlock	Rear cable interlock – allows an MCCB can be mounted horizontally, vertically or diagonally. Accepts motors and handles. <u>Suitable for 3 or 4 pole MCCBs</u>		
<b>Suits MCCB types</b> <b>1250 - 1600 A</b>			
<b>MW</b>	Interlock kit less wire – <b>Factory fit item</b>	<b>T2MWX6CA</b>	<b>445.00</b>
	Wire for above interlocks		
	Wire 1.0 m	<b>T2MW00S</b>	<b>60.50</b>
	Wire 1.5 m	<b>T2MW00L</b>	<b>70.50</b>
<b>Slide type</b> - manual operation, padlockable. Does not allow motors, handles or other front mounted accessories to be fitted. <u>Suitable for front or rear connection.</u>			
<b>MS</b>	<b>S1250, S1600</b>		
	3 pole	<b>T2MSX63SFA</b>	<b>360.00</b>
	4 pole	<b>T2MSX64SFA</b>	<b>450.00</b>
<b>Rear walking beam interlock</b> – allows 2 MCCBs to be interlocked side by side. Combinations of 3 and 4 pole types are possible.			
<b>1250 - 1600 A</b>			
<b>MB</b>	For 3 pole S1250	<b>T2MBX33P</b>	<b>850.00</b>
	For 4 pole S1250 <b>Factory fit only</b>	<b>T2MBX34P</b>	<b>1130.00</b>
	For 3 pole S1600	<b>T2MBX63P</b>	<b>850.00</b>
	For 4 pole S1600 <b>Factory fit only</b>	<b>T2MBX64P</b>	<b>1130.00</b>

## Accessories for 1250 - 1600A MCCBs

External accessories	Cat. No.	Price \$
Terminal covers - front connected MCCBs	Terminal covers are the same width as the MCCB	
Extended terminal covers FC	Suits MCCB types <b>S1250</b>	
	3 pole cover	<b>T2CFX33SLHGA</b> <b>225.00</b>
	4 pole cover	<b>T2CFX34SLHGA</b> <b>280.00</b>
	Terminal covers are not available for S1600 MCCBs	
<b>CR</b>		
Terminal cover locking clip <b>CF</b>	<b>800 A to 1600 A</b> A clip that provides additional terminal cover locking, and also allows a lead seal to be fitted	<b>T2CF00LA</b> <b>8.80</b>
Interpole Barriers <sup>1)</sup> <sub>2)</sub>	<b>S1250, S1600</b> Interpole barrier (Qty 2)	<b>T2BAX63LHA</b> <b>10.00</b>
<b>BA</b>		
External Neutral CT	<b>S1250, S1600</b> Optional neutral CT, Ground Fault MCCBs	<b>T2GBX6N12A</b> <b>430.00</b>
<b>GB</b>	Optional neutral CT, Ground Fault MCCBs	<b>T2GBX6N16A</b> <b>430.00</b>



Extended terminal covers FC



Terminal cover locking clip

**Notes:** <sup>1)</sup> Line side interpole barriers or terminal covers must be installed with MCCBs.

<sup>2)</sup> Interpole Barriers are supplied with MCCBs as standard; 2 barriers with 3 pole MCCBs, and 3 barriers with 4 pole MCCBs.

## Accessories for 1250 - 1600A MCCBs

	<b>External accessories</b>	<b>Cat. No.</b>	<b>Price \$</b>
Toggle locks	Non Captive: Fits up to 3 padlocks or a multiple lock device  Suits MCCB types <b>1250 A, 1600 A</b>		
<b>HL</b>	Lock with three 8 mm holes  Captive: Allows a single padlock or multiple padlock device <b>1250 A, 1600 A</b>	<b>T2HLX6A</b>	<b>77.00</b>
	Lock with two 8 mm holes	<b>T2HLX6CAP</b>	<b>165.00</b>
Motor operators	<b>1250 A, 1600 A</b>		
	110 V AC	<b>T2MCX6A10NA</b>	<b>3150.00</b>
<b>MC</b>	240 V AC	<b>T2MCX6A24NA</b>	<b>3150.00</b>
	24 V DC	<b>T2MCX6D02NA</b>	<b>3150.00</b>
Rear connect terminal studs	<b>1250 A, 1600 A (factory fit only)</b>		
	3 pole kit, set of 6 studs (1250 A)	<b>T2RPX335B</b>	<b>1350.00</b>
<b>RP</b>	4 pole kit, set of 8 studs (1250 A)	<b>T2RPX345B</b>	<b>1940.00</b>
	3 pole kit, set of 6 studs (1600 A)	<b>T2RPX635B</b>	<b>1730.00</b>
	4 pole kit, set of 8 studs (1600 A)	<b>T2RPX645B</b>	<b>2250.00</b>



T2RP rear connect studs



T2HLX6A



Rear connect terminal studs fitted



Motor operator fitted to MCCB

## TemBreak 1 series Electronic XS2000NE

**85 kA**

**Current rating:** 1000 – 2000 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)



**3**

Voltage	Icu kA	Ics kA
AC use 400/415 <sup>1)</sup>	85	64

### Trip unit:

Adjustable long, short and instantaneous trip

LTD adjustment: I<sub>1</sub>: 0.8 – 1 t: 5 – 30 s

STD adjustment: I<sub>2</sub>: 2 – 10 t: 0.1 – 0.3 s

Instantaneous Adj: I<sub>3</sub>: 3 – 12 NRC

**OCR options:** Pre-trip alarm, fault indication and contacts, ground fault trip

### Dimensions (mm)

Poles	3	4
H <sup>2)</sup>	450	450
W	320	429
D (less toggle)	185	185
Weight (kg)	55.0	67

### Amp rating

NRC	Min.	Max.	Cat. No.	Price \$
<b>3 Pole</b>				
2000	1000	2000	XS2000NE 20003 RC	17400.00
<b>4 Pole</b>				
2000	1000	2000	XS2000NE 20004 RC	23310.00
<b>Ground Fault Trip MCCBs<sup>3)</sup></b>				
<b>3 Pole</b>				
2000	1000	2000	XS2000NE 20003L	18250.00
<b>4 Pole</b>				
2000	1000	2000	XS2000NE 20004L	24160.00

**Notes:** <sup>1)</sup> 415 V Icu rating to IEC 60947-2.

<sup>2)</sup> H excludes attached busbar.

<sup>3)</sup> GF MCCBs require a 4th Neutral CT to be ordered for 3 and 4 pole MCCB applications. (If a neutral is present) Refer accessories.

NRC: Nominal rated current

## TemBreak 1 series Electronic XS2500NE

**85 kA**

**Current rating:** 1250 – 2500 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)

Voltage	Icu kA	Ics kA
AC use 400/415 <sup>1)</sup>	85	64



3

**Trip unit:** Adjustable long, short and instantaneous settings

LTD adjustment:  $I_1$ : 0.8 – 1 t: 5 – 30 s

STD adjustment:  $I_2$ : 2 – 10 t: 0.1 – 0.3 s

Instantaneous Adj:  $I_3$ : 3 – 12 NRC

**OCR options:** Pre-trip alarm, fault indication and contacts, ground fault trip

### Dimensions (mm)

Poles	3	4
H <sup>2)</sup>	450	450
W	320	429
D (less toggle)	185	185
Weight (kg)	66.0	78

### Amp rating

NRC	Min.	Max.	Cat. No.	Price \$
<b>3 Pole</b>				
2500	1250	2500	XS2500NE 2500 RC3	19410.00
<b>4 Pole</b>				
2500	1250	2500	XS2500NE 2500 RC4	25880.00
<b>Ground Fault Trip MCCBs<sup>2)3)</sup></b>				
<b>3 Pole</b>				
2500	1250	2500	XS2500SE 25003L	20280.00
<b>4 Pole</b>				
2500	1250	2500	XS2500SE 25004L	26750.00

**Notes:** <sup>1)</sup> 415 V Icu rating to IEC 60947-2.

<sup>2)</sup> H excludes attached busbar.

<sup>3)</sup> GF MCCBs require a 4th Neutral CT to be ordered for 3 and 4 pole MCCB applications. (If a neutral is present) Refer accessories.

NRC: Nominal rated current.

## TemBreak 1 series Electronic XS3200NE

**85 kA**

**Current rating:** 1600 – 3200 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)



**3**

	Voltage	Icu kA	Ics kA
AC use	400/415	85	64
I <sub>CW</sub> for 0.5 sec		38	

**Trip unit:** Adjustable long, short and instantaneous settings

LTD adjustment: I<sub>1</sub>: 0.8 – 1 t: 5 – 30 s

STD adjustment: I<sub>2</sub>: 2 – 10 t: 0.1 – 0.3 s

Instantaneous Adj: I<sub>3</sub>: 3 – 12 NRC

**OCR options:** Pre-trip alarm, fault indication with relay contact

### Dimensions (mm)

Poles	3
H <sup>1)</sup> )	450
W	320
D (less toggle)	185
Weight (kg)	66.0

### 3 Pole

Amp rating NRC	Min.	Max.	Cat. No.	3 pole Price \$
3200	1600	3200	XS3200NE32003 RC	23810.00

**Notes:** <sup>1)</sup> H excludes attached busbar.  
NRC: Nominal rated current.

## Accessories to suit 2000 – 3200 AF

<b>Internal accessories - factory fit</b>		<b>Cat. No.</b>	<b>Price \$</b>
Shunt trips	110 V AC/DC (110–115 V)	2H1526BAA	560.00
	240 V AC (200–480 V)	2H1527BAA	560.00
	12 V DC	2H1528BAA	560.00
	24 V DC	2H1529BAA	560.00
	48 V DC	2H1530BAA	560.00
	200 V DC (200–230 V)	2H1531BAA	560.00
	415 V AC	2H1541BAB	560.00
	24 V AC	2H1532BAA	560.00
	48 V AC	2H1533BAA	560.00
	AC coil <sup>1)</sup>	2H1509BAA	455.00
Undervoltage trips	100–230 V DC coil <sup>2)</sup>	2H1510BAA	465.00
	24 V DC coil <sup>2)</sup>	2H1511BAA	465.00
	48 V DC coil <sup>2)</sup>	2H1512BAA	465.00
	60 V DC coil <sup>2)</sup>	2H1513BAA	465.00
	110 V AC instantaneous controller	UXUB0013B	113.00
	240 V AC instantaneous controller	UXUB0014B	113.00
	440 V AC instantaneous controller	UXUB0015B	113.00
	110 V AC time delay controller	UXUB0016B	220.00
	240 V AC time delay controller	UXUB0017B	220.00
	440 V AC time delay controller	UXUB0018B	215.00
Auxiliary switches	200–230 V DC controller	UXUB0038B	113.00
	AUX SW right hand 1C	UXXB0013C	350.00
	AUX SW right hand 2C	UXXB0014C	400.00
	AUX SW right hand 3C	UXXB0015C	465.00
	AUX SW right hand 4C	UXXB0016C	540.00
	AUX SW right hand 5C	UXXB0017C	590.00
Alarm switch	AUX SW right hand 6C	UXXB0018C	640.00
	ALT SW right hand	UXLB0012C	445.00
Alarm & auxiliary switch	ALT/AUX right hand 1C	UXLB0019D	510.00
	ALT/AUX right hand 2C	UXLB0020C	580.00
	ALT/AUX right hand 3C	UXLB0021C	670.00
	ALT/AUX right hand 5C	UXLB0023C	790.00

**Notes:** 1) An AC UVT controller is required for 100–440 V AC.

2) A DC UVT controller is needed for 200–230 V DC operation.  
None required for 24–110 V DC.

## Accessories to suit 2000 – 3200 AF

3

<b>Internal accessories - factory fit</b>		<b>Cat. No.</b>	<b>Price \$</b>
Ground fault trip (GFT)	An option for all 2000-2500 A types	<b>LSIG</b>	<b>870.00</b>
Optional ext. 4th CTs	<b>Add</b>		
2000 A 4th CT		<b>UXOY0006A</b>	<b>720.00</b>
2500 A 4th CT		<b>UXOY0007A</b>	<b>880.00</b>
Fault indication with contacts	An option for all 2000–3200 A types	<b>FI</b>	<b>730.00</b>
<b>Add FI then voltage</b>			
Fault indication	LED's mounted at top of OCR	<b>FILED</b>	<b>2050.00</b>
Pre-trip alarm	An option for all 2000–3200 A types	<b>LSIP</b>	<b>700.00</b>

<b>External accessories - most user fit</b>		<b>Cat. No.</b>	<b>Price \$</b>
Front connect busbar (factory fit)	3 P attached busbars XS2000 (6 in kit) <sup>1)</sup>	<b>TXRD0003A</b>	<b>2030.00</b>
	4 P attached busbars XS2000 (8 in kit) <sup>1)</sup>	<b>TXRD0004A</b>	<b>2810.00</b>
	Mounting bolts <sup>1)</sup>	<b>TXRD0005A</b>	<b>210.00</b>
Motor operators	110 V AC motor	<b>UXMB0006B</b>	<b>3820.00</b>
	240 V AC motor	<b>UXMB0008B</b>	<b>3820.00</b>
	110 V DC motor	<b>UXMB0009B</b>	<b>3820.00</b>
Mechanical interlocks (factory fit)	3 P rear mechanical interlock	<b>UXKC0012A</b>	<b>2090.00</b>
	4 P rear mechanical interlock	<b>UXKC0013A</b>	<b>3120.00</b>
	Interlock wire (cable style interlock)	<b>UXKC0020A</b>	<b>83.00</b>
	Interlock mechanism - cable type <sup>2)</sup>	<b>UXKC0025B</b>	<b>650.00</b>
Handle operator	Direct mount handle mechanism <sup>3)</sup>	<b>XFE10</b>	<b>1690.00</b>
	Handle extension	<b>UXHB0001B</b>	<b>195.00</b>
Toggle locks factory fit	Blocks toggle activation (non captive)	<b>UXKB0001A</b>	<b>79.00</b>
Accessory lead terminal	Accessory lead block (factory fit)	<b>UXYD0001A</b>	<b>26.80</b>
	Terminal bolt (6 in kit)	<b>UXYD0002A</b>	<b>2.20</b>
OCR sealing kit	Tamperproof cover for OCR adjustment dials	<b>XS2000OCRSK</b>	<b>60.50</b>

**Notes:** <sup>1)</sup> When an XS2000NE MCCB is configured for "front connection", the Front Connect busbar kits TXRD0003A & 4A already include mounting screws for the FC terminals.

The TXRD0005A mounting bolts, which also include spacers, are required to mount the MCCB itself. TXRD0005A is always required for FC 2000A MCCBs, but not RC.

<sup>2)</sup> Order one interlock mechanism per breaker.

<sup>3)</sup> Extension shaft handle not available.

## Integral Earth Leakage Moulded Case Circuit Breakers

### ZS Earth Leakage Circuit Breakers 125 A and 250 A

The ZS earth leakage MCCB from Terasaki offers machine or personnel protection within a standard 125 A, 160 / 250 A MCCB frame size. The ZS earth leakage MCCB also maintains the full functionality of a standard thermal-magnetic overload / short circuit protection device.

#### Features

- Thermal/ magnetic MCCB
- Standard 125 A or 250 A frame
- Thermal magnetic trip unit ratings:  
12 A - 125 A (125 AF), 100 - 250 A (250 AF)
- Fixed magnetic characteristic
- 65 kA fault interruption rating @ 400 / 415 V as standard



3

#### Earth Leakage features

- Switching utilisation voltage up to 550 V AC (160 V AC minimum)
- Suitable for use at 40 / 50 / 60 Hz (except for the 3 A setting @ 40 Hz)
- 3 or 4 pole types
- Yellow earth leakage TRIP indication flag
- Grey TEST button
- Green 'Power ON' LED
- Adjustable thermal characteristic dial setting from 63 - 100 % of  $I_R$
- Adjustable earth leakage ranges: 30 mA, 100 mA, 300 mA, 500 mA, 1 A, 3 A
- Trip time selection: 0, 60, 200, 400, 700 mS or NT (No Trip)
- 30 mA trip time defaults to a less than 300 mS trip time as per AS/NZS standard requirements
- Built-in dielectric test disconnection test plug
- Remove trip function (standard)
- Harmonics inhibition (standard)
- Pre trip alarm unit (TCU) with cause of trip output

#### Options and accessory fitting

- Accepts auxiliaries and alarm switches
- Will not accept shunts and under voltage trips
- Accepts all external accessories, except mechanical interlocks
- ZS 125/250 A MCCBs can be installed on standard XA, XB, XC chassis
- ZS 250 can be fitted to HC Chassis
- Seal label available for sealing the residual current dial setting area for use at 30 mA (Catalogue number of label sheet T12CPLAB)
- Captive padlock attachment that includes a dial sealing feature
- ZS ELCBs with unswitched or switched neutral poles are available

**Notes:** Fault interruption and other performance data for ZS125-250GJ ELCBs, is the same as the standard S125-250GJ MCCBs, except:

- Rated to an operational voltage of 550 V AC maximum
- Magnetic characteristic is fixed

## Earth Leakage Circuit Breaker

### ZS125GJ/ ZS250GJ

**65 kA****Current rating:** 20 – 250 A**Approvals and Tests:** AS/NZS 3947-2, IEC 60947-2,  
Annex B, EN/IEC 60755**Operating voltage:** 200 - 580 V 50/60 Hz**Interrupting capacity:**

	Voltage	Icu kA	Ics kA
AC use	380/415	65	36
DC use	250 V	40	40

**3****Trip unit:** Adjustable thermal (0.63 I<sub>r</sub> to 100 % I<sub>r</sub>) and fixed magnetic**Earth leakage characteristic:** Type 'A' - suitable for AC and residual pulsating DC currents.**Earth leakage adjustments:** - 30 mA, 100 mA, 300 mA, 500 mA, 1 A, 3 A.

- NT 1), 0, 60, 200, 400, 700 mS

- 30 mA time setting non adjustable for instant trip

**Neutral pole option:**

ZS ELCBs are available with switched or unswitched (or 'solid neutral') neutral poles. Many general distribution applications can use switched neutral types, whereas for UPS and some other uses, an unswitched neutral pole is preferred.

## Earth Leakage Circuit Breaker

### ZS125GJ

#### Dimensions (mm)

Poles	3	4
H	155	155
W	90	120
D (less toggle)	68	68
Toggle cut-out	104	104

#### 3 Pole

Amp rating NRC	Adj. I <sub>r</sub> <sup>1)</sup> Min. – Max.	Fixed I <sub>m</sub> <sup>1)</sup> (Amps)	Cat. No. <sup>2)</sup>	3 pole Price \$
20	12 - 20	240	ZS125 GJ 3 20	2000.00
32	20 - 32	384	ZS125 GJ 3 32	2000.00
50	32 - 50	600	ZS125 GJ 3 50	2000.00
63	40 - 63	756	ZS125 GJ 3 63	2000.00
100	63 - 100	1200	ZS125 GJ 3 100	2230.00
125	80 - 125	1250	ZS125 GJ 3 125	2380.00

3

#### 4 Pole - fixed neutral type

Amp rating NRC	Adj. I <sub>r</sub> <sup>1)</sup> Min. – Max.	Fixed I <sub>m</sub> <sup>1)</sup> (Amps)	Cat. No. <sup>2)</sup>	4 pole Price \$
20	12 - 20	240	ZS125 GJ 4 20 <sup>2)</sup>	2200.00
32	20 - 32	384	ZS125 GJ 4 32 <sup>2)</sup>	2200.00
50	32 - 50	600	ZS125 GJ 4 50 <sup>2)</sup>	2200.00
63	40 - 63	756	ZS125 GJ 4 63 <sup>2)</sup>	2200.00
100	63 - 100	1200	ZS125 GJ 4 100 <sup>2)</sup>	2560.00
125	80 - 125	1250	ZS125 GJ 4 125 <sup>2)</sup>	2750.00

#### 4 Pole - solid neutral type

Amp rating NRC	Adj. I <sub>r</sub> <sup>1)</sup> Min. – Max.	Fixed I <sub>m</sub> <sup>1)</sup> (Amps)	Cat. No. <sup>2)</sup>	4 pole Price \$
20	12 - 20	240	ZS125GJ 420 SN	2200.00
32	20 - 32	384	ZS125GJ 432 SN	2200.00
50	32 - 50	600	ZS125GJ 450 SN	2200.00
63	40 - 63	756	ZS125GJ 463 SN	2200.00
100	63 - 100	1200	ZS125GJ 4100 SN	2560.00
125	80 - 125	1250	ZS125GJ 4125 SN	2750.00

**Notes:** <sup>1)</sup> NRC: Nominal rated current. Adj. I<sub>r</sub>: Adjustable thermal setting  
 Fixed I<sub>m</sub>: Fixed magnetic setting NT: No Trip  
<sup>2)</sup> Use list prices above for unswitched versions.

## Earth Leakage Circuit Breaker ZS250GJ

### Dimensions (mm)

Poles	3	4
H	165	165
W	105	140
D (less toggle)	68	68
Toggle cut-out	104	104



3

### 3 Pole

Amp rating NRC	Adj. Ir <sup>1)</sup> Min. – Max.	Fixed Im <sup>1)</sup> (Amps)	Cat. No. <sup>2)</sup>	Price \$
160	100-160	1760	ZS250 GJ 3 160	2490.00
250	160-250	2750	ZS250 GJ 3 250	2780.00

### 4 Pole

160	100-160	1760	ZS250 GJ 4 160 <sup>2)</sup>	2890.00
			ZS250 GJ 4 160 SN <sup>2)</sup>	2890.00
250	160-250	2750	ZS250 GJ 4 250 <sup>2)</sup>	3110.00
			ZS250 GJ 4 250 SN <sup>2)</sup>	3110.00

**Notes:** <sup>1)</sup> Unswitched (solid neutral) type.  
<sup>2)</sup> Use list prices above for unswitched versions.

## Integral Earth Leakage Circuit Breaker

### ZS 400 A - 800 A

The ZS 400 – 800A Earth Leakage Circuit Breaker from Terasaki offers machine protection within a standard 400 A, 630 / 800 A MCCB frame size.

The full functionality of a standard thermal-magnetic overload / short circuit protection MCCB is maintained.

#### Standard Features

- AS/NZS 60947.6, JIS Standards compliance
- Thermal/magnetic MCCB
- 3 or 4 pole 400 A, 630/800 A 3 pole only
- Switching utilisation up to 110 to 440 V AC
- Suitable for use at 40/50/60 Hz
- Trip unit ratings: 250 A – 400 A (400 AF),  
500 A – 800 A (800AF)
- Fixed thermal setting, adjustable magnetic setting
- 70 kA / 50kA fault interruption rating 400 AF / 800 AF
- Harmonics inhibition
- Megger / Dielectric test voltage: 500 V DC Maximum



3

#### Earth Leakage features

- Yellow ground fault TRIP indication flag
- Grey TEST button
- Green 'Power ON' LED
- Adjustable thermal characteristic dial setting from 63 - 100 % of IR
- Adjustable earth leakage ranges: 100 mA, 200 mA, 500 mA,
- Trip time selection: Fixed
- Type "AC" earth leakage device suitable for AC currents

#### Options, Internal and external accessories

- Accessories are a customer fit.
- Auxiliaries & Alarms can be used. The quantities refer to standard MCCB quantity configurations
- Cannot fit Shunt & UVTs
- Standard MCCB external accessories can be installed, except for T2ML link and T2MW wire interlocks.T2MS slide interlocks can be installed
- Will fit to XC and HC chassis

 Available  
late  
2013

## Integral Earth Leakage Circuit Breaker

### ZS 400 A - 800 A

#### Settings & Features:



Available  
late  
2013

3

- Earth leakage (RCD) Test button
- Earth leakage tripped indicator flag
- Current sensitivity
- Trip button

#### Rated breaking capacities (Ics kA):

##### ZS ELCB model & kA Rating (Ics)

Voltage range	ZS400GF	ZS630NF	ZS800NF
AC440 V	70	50	50
AC100/240 V	100	85	85

#### Overcurrent relay ratings and adjustment:

Trip mechanism type	Thermal magnetic all types
ZS400NF/GF	trip unit ampere ratings:
ZS630NF	500 A, 600 A, 630 A, 700, 800 A
ZS800NF	fixed thermal / Adj mag 6 -12 x I <sub>t</sub>

ZS400NF/GF	trip unit ampere ratings:	250, 300, 350, 400 A	fixed thermal / Adj mag 6 -12 x I <sub>t</sub>
ZS630NF		500 A, 600 A, 630 A, 700, 800 A	fixed thermal / Adj mag 5 -10 x I <sub>t</sub>
ZS800NF			fixed thermal / Adj mag 5 -10 x I <sub>t</sub>

## Integral Earth Leakage Circuit Breaker

### ZS 400 A - 800 A



3

#### Dimensions

##### Outline

Dimensions (mm)	ZS400GF	ZS630NF	ZS800NF
H	260	273	273
W	140 3P / 185 4P	210 3P	210 3P
D	103	103	103

## Integral Earth Leakage Circuit Breaker

### ZS 400GF

**70 kA****Current rating:** 250 – 400 A**Approvals and Tests:** AS/NZS 3947-2, IEC 60947-2,  
AS/NZS 2081: 2011, JIS C 8201**Operating voltage:** 110 – 440 V 50/60 Hz**Interrupting capacity:****3**

AC use	Voltage Icu	Icu
	380/415	70


  
New 400AF  
ZS ELCB
**Trip unit:** Fixed thermal, adjustable magnetic 6 x 12 li**Earth leakage characteristic:** Type "AC" - suitable for AC currents.**Earth leakage adjustments:** 100 mA, 200 mA, 500 mA

Fixed operating time: 0.1 second maximum

**Options:**

TemBreak 2, 400 A internal and external accessories can be installed, except for shunts, UVTs, Trip Control Units, T2ML / MW Interlocks.

**Neutral Pole**

ZS ELCBs are available with switched neutral poles.

**Dimensions**

Poles	3	4
H (less attached busbars)	260	260
W	140	185
D (less toggle)	103	103


  
Available  
late  
2013

Ampere Rating NRC	Fixed Ir <sup>1)</sup> Amps	Adj. li <sup>1)</sup> Amps	Cat. No.	3 Pole Price \$	4 Pole Price \$
250	250	1500 - 3000	<b>ZS400 GF 3 250</b>	<b>3900.00</b>	
			<b>ZS400 GF 4 250</b>		<b>4600.00</b>
300	300	1800 - 3600	<b>ZS400 GF 3 300</b>	<b>3900.00</b>	
			<b>ZS400 GF 4 300</b>		<b>4600.00</b>
350	350	2100 - 4200	<b>ZS400 GF 3 350</b>	<b>4150.00</b>	
			<b>ZS400 GF 4 350</b>		<b>4800.00</b>
400	400	2400 - 4800	<b>ZS400 GF 3 400</b>	<b>4300.00</b>	
			<b>ZS400 GF 4 400</b>		<b>4950.00</b>

**Notes:** 1) NRC: Nominal rated current, Fixed

Ir : Fixed thermal setting,

Adj. Fixed li: Adjustable magnetic setting,

## Integral Earth Leakage Circuit Breaker

### ZS630NF and ZS800NF



3

#### 50 kA

**Current rating:** 500 – 800 A

**Approvals and Tests:** AS/NZS 3947-2, IEC 60947-2,  
AS/NZS 2081: 2011, JIS C8201

**Operating voltage:** 110 – 440 V 50/60 Hz

**Interrupting capacity:**

AC use	Voltage	Icu	Icu
	380/415	50	

**Trip unit:** Fixed thermal, adjustable magnetic 6 x 10 li

**Earth leakage characteristic:** Type "AC" - suitable for AC currents.

**Earth leakage adjustments:** 100 mA, 200 mA, 500 mA

Fixed operating time: 0.1 second maximum

#### Options:

TemBreak 2, 630 - 800 A internal and external accessories can be installed, except for shunts, UVTs, Trip Control Units, T2ML / MW Interlocks

#### Neutral Pole

ZS ELCBs are available with switched neutral poles.

Available  
late  
2013

#### Dimensions

Poles	3	4
H (less attached busbars)	273	273
W	210	280
D (less toggle)	103	103

Ampere Rating NRC	Fixed Ir <sup>1)</sup> Amps	Adj. li <sup>1)</sup> Amps	Cat. No.	Price \$
500	500	2500 - 5000	<b>ZS630 NF 3 500</b>	<b>4920.00</b>
600	600	3000 - 6000	<b>ZS630 NF 3 600</b>	<b>5200.00</b>
630	630	3150 - 6300	<b>ZS630 NF 3 630</b>	<b>5200.00</b>
700	700	3500 - 7000	<b>ZS800 NF 3 700</b>	<b>5900.00</b>
800	800	4000 - 8000	<b>ZS800 NF 3 800</b>	<b>6200.00</b>

**Notes:** 1) NRC: Nominal rated current, Fixed

Ir : Fixed thermal setting,

Adj. Fixed li: Adjustable magnetic setting,

Q-Pulse Id ATMS 130722001317 of 1633  
Price schedule 'T3'

GST not included

NHP Sales 1500 NHP NHP

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## TemBreak 2 MCCB Switch Disconnectors (non-auto MCCBs)

**Current rating:** 125 – 2500 A

**Approvals:** Standards AS/NZS 3947-2 and IEC 60947-2

- Accepts MCCB internal and external accessories
- No overcurrent protection (isolator only)
- Suitable for use as a panelboard or switchboard isolator switch
- AC 23 and DC 22 rated to IEC 60947-3
- Rated impulse withstand voltage Uimp = 8 kV



3

### 3 Pole

Amp rating NRC	Short time rating kA for 0.3 sec (lcw)	Rated short-circuit making capacity (Icm)(kA)	Cat. No.	3 pole Price \$
125	2	3.6	S125NN3	430.00
160	3	6	S160NN3	500.00
250	3	6	S250NN3	500.00
400	5	9	S400NN3	1650.00
630	5	9	S630NN3	2490.00
800	10	15	S800NN3	3150.00
1250	15	32	S1250NN3	7600.00
1600	20	45	S1600NN3	8700.00
2000	35	90	XS2000NN3RC	15610.00
2500 <sup>1)</sup> )	35	90	XS2500NN3RC	15990.00

### 4 Pole

Amp rating NRC	Short time rating kA for 0.3 sec (lcw)	Rated short-circuit making capacity (Icm)(kA)	Cat. No.	4 pole Price \$
125	2	3.6	S125NN4	570.00
160	3	6	S160NN4	670.00
250	3	6	S250NN4	670.00
400	5	9	S400NN4	2200.00
630	5	9	S630NN4	3320.00
800	10	15	S800NN4	3990.00
1250	15	32	S1250NN4	8950.00
1600	20	45	S1600NN4	9900.00
2000 <sup>1)</sup> )	35	90	XS2000NN4RC	20820.00
2500 <sup>1)</sup> )	35	90	XS2500NN4FC	23660.00

**Notes:** <sup>1)</sup> TemBreak 1 MCCBs

Refer Part C catalogue for additional technical details and dimensions.  
UVTs and shunts are operated by the MCCBs trip lever which remains fitted in MCCB Switch disconnectors (Non Auto MCCBs)

## Moulded Case Circuit Breakers

### TemBreak DC rated MCCBs

- Special "ND" models for 350 V to 600 V DC use <sup>1)</sup>
- Thermal magnetic and Magnetic only types
- 3 and 4 pole types
- 125 A – 2500 A
- Will accept standard accessories on sizes to 630 A
- Will accept standard external accessories for sizes 800 - 2500 A
- Refer NHP for internal accessory fitting for types XS800 - XS2500



3

### DC MCCBs to 800 A

Ampere frame	Trip unit / OCR Sensor ratings (Amps) <sup>2)</sup>	Poles	OCR type	Cat. No.	Price \$
125 AF	20, 32, 50, 63, 100, 125	3	Therm Mag	S125ND3	POA
125 AF	20, 32, 50, 63, 100, 125	4	Therm Mag	S125ND4	POA
250 AF	20, 32, 50, 63, 100, 125, 160	3	Therm Mag	S160ND3	POA
250 AF	20, 32, 50, 63, 100, 125, 160	4	Therm Mag	S160ND4	POA
250 AF	250	3	Therm Mag	S250ND3	POA
250 AF	250	4	Therm Mag	S250ND4	POA
400 AF	400	3	Therm Mag	S400ND3	POA
800 AF	630, 800	3	Therm Mag	S800ND4	POA

New MCCBs  
to 1000 V DC  
available

**Notes:** <sup>1)</sup> All standard thermal magnetic MCCBs are rated to switch DC currents up to 250 V DC.

<sup>2)</sup> Connect poles in series for 350 V DC and above.

The time constant (L/R) of the circuit should be less than 2 ms at or below rated current, less than 7 ms for short circuit equal and below 10 kA, less than 15 ms for short circuits over 10 kA, the connections should be as shown in the diagrams on following page.

## Moulded Case Circuit Breakers

### Ratings

350 V	DC Breaking capacity (kA)			Poles ¹)	OCR type	Current adjust.	Cat. No.
	500 V	600 V					
10	—	—		3	Therm Mag	63-100 % $I_r$	<b>S125ND</b>
10	7.5	5		4	Therm Mag	63-100 % $I_r$	<b>S125ND</b>
10	—	—		3	Therm Mag	63-100 % $I_r$	<b>S160ND</b>
10	7.5	5		4	Therm Mag	63-100 % $I_r$	<b>S160ND</b>
10	—	—		3	Therm Mag	63-100 % $I_r$	<b>S250ND</b>
10	7.5	5		4	Therm Mag	63-100 % $I_r$	<b>S250ND</b>
20	15	15		3	Therm Mag	63-100 % $I_r$	<b>S400ND</b>
30	20	20		3	Therm Mag	50-100 % $I_r$	<b>S800ND</b>

Ampere rating	Device type	Part Prefix	DC Utilisation voltage
20 - 2500	MCCB	S125 - 2500 ND	600 V
250 - 800	MCCB	PVS 400 - 800 NDL	750 V
250 - 800	MCCB	PVS 400 - 800 NDH	1000 V
160 - 800	Isolator	PVS 160 - 800 NNL	800 V
160 - 800	Isolator	PVS 400 - 800 NNH	1000 V

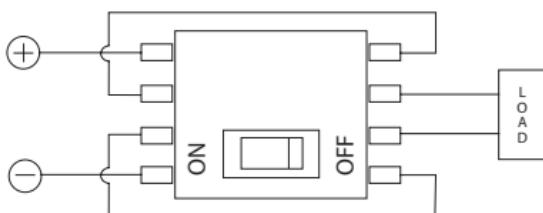
### 3 and 4 pole series connection

The following wiring connection diagrams should be followed to obtain the kA switching rating levels indicated in the table above.

#### 3 pole in series



#### 4 pole in series



**Notes:** ¹) Connect poles in series for 350 V DC and above.

The time constant ( $L/R$ ) of the circuit should be less than 2 ms at or below rated current, less than 7 ms for short circuit equal and below 10 kA, less than 15 ms for short circuits over 10 kA, the connections should be as shown in the diagrams on following page.

## DC magnetic types 630 A – 2500 A



- Ampere range 630 – 2500 A
- 3 pole
- Special shunt and UVT available for sizes 1250 A to 1600 A
- Magnetic adjustment range 4 - 8 x I<sub>m</sub>

### 3 pole

Amp rating NRC	Trip Unit Type	3 Pole Cat. No. <sup>2)</sup> <sup>3)</sup>	3 pole Price \$
1000 <sup>4)</sup>	Thermal Magnetic	XS1000ND10003FC	9630.00
1250	Magnetic only	XS1250ND12503FC <sup>2)</sup> <sup>3)</sup>	10160.00
1600	Magnetic only	XS1600ND16003FC <sup>1)</sup> <sup>3)</sup>	16750.00
2000	Magnetic only	XS2000ND20003RC	18460.00
2500	Magnetic only	XS2500ND25003RC	20710.00

3

**Notes:** 1) 3 pole sizes stocked.

2) Mounting details for DC Applications series are identical to those for the same frame size Standard series (i.e. for XS1000ND refer to XS800NJ, XS1250ND and XS1600ND refer to XS1600NE, XS2000ND and XS2500ND refer to XS2500NE).

3) For 1250 A and 1600 A DC MCCBs some internal accessories may differ from standard AC types. Information is as follows. Internal accessories are a FACTORY fit.

- Auxiliaries and alarms - Same as standard AC MCCB type
- Shunt trips are type: 2H2438BAA - 110 V DC or 2H2439BDA - 220 V DC
- Under voltage trips are type: 2H3776CBB - 110 V DC or 2H3776CCB - 220 V DC + barrier 2H3748EBA

4) Thermal/magnetic adjustment down to 630 amps.

NRC: Nominal rated current.

All TemBreak thermal magnetic MCCBs can be used for DC applications

## Plug in MCCBs: 125 – 630 AF TemBreak 2

### External accessories

#### Plug-in MCCBs<sup>1)</sup>

A range of MCCBs are stocked with a rear mounted pre-fitted plug-in section that plugs into the panel mounted base section. The panel mounted base section is ordered separately. The TemBreak 2 plug-in bases include a safety interlock system where the MCCB must be switched OFF to allow MCCB removal. The plug-in base allows for the fitting of up to 4 terminal blocks when auxiliaries, alarms, shunts or UVTs are used. Rear connect terminal covers can be used on the front of the MCCB for IP 20 ingress protection. Standard MCCB conversion to plug-in – NHP can convert standard MCCB to plug-in use.

3

PM

#### MCCBs complete with base plug (3 pole types below are stocked)<sup>1)</sup>

MCCB Ampere Rating NRC	400/415 V <sup>6)</sup> kA rating	3 pole Cat. No.	Price \$
20	30 kA	S125NJ320PM	850.00
32	30 kA	S125NJ332PM	850.00
50	65 kA	S125GJ350PM	850.00
63	65 kA	S125GJ363PM	850.00
100	65 kA	S125GJ3100PM	1050.00
125	65 kA	S125GJ3125PM	1210.00
160	65 kA	S160GJ3160PM	1440.00
250	65 kA	S250GJ3250PM	1780.00
400	70 kA	S400GE3400PM	3010.00
630 (530 A) <sup>2)</sup>	70 kA	S630GE3630PM	3600.00

#### MCCB panel mounting bases

3 pole kit for 125 AF <sup>3)</sup>	T2PM12A3A	159.00
4 pole kit for 125 AF <sup>3)</sup>	T2PM12A4A	200.00
3 pole kit for 160/250 AF <sup>3)</sup>	T2PM25A3A	178.00
4 pole kit for 160/250 AF <sup>3)</sup>	T2PM25A4A	235.00
3 pole kit for 400/630 AF <sup>3)</sup>	T2PM40A3A	380.00
4 pole kit for 400/630 AF <sup>3)</sup>	T2PM40A4A	510.00

#### Control wiring terminals for plug-in MCCBs<sup>3) 4) 5)</sup>

3 pin plug for aux/alarm - MCCB side	2H6959CAA1	37.00
3 pin plug for shunt/UVT - MCCB side	2H6959CBA1	37.00
3 pin socket for panel mount section	T2TP003A	37.00

**Notes:** <sup>1)</sup> Other MCCBs not listed can be supplied on request or converted to plug-in, refer next page.

<sup>2)</sup> S630 MCCBs when used with a plug-in base must be derated to 530 A.

<sup>3)</sup> Up to 4 control wiring plug and socket sets can be used in a base.

<sup>4)</sup> Control wiring kits include pin lugs for internal accessories.

<sup>5)</sup> Internal accessories must be ordered separately.

<sup>6)</sup> TemBreak 2 MCCBs types E/S/H/L can be converted for plug-in use.

## Accessories to suit 125 – 630 AF TemBreak 2

### FC connection bars ↘‘L’ shaped terminal bar set

	Cat. No.	Price \$
<b>S125</b>		
3 pole kit of 3 bars	T2PF123BA	34.00
4 pole kit of 4 bars	T2PF124BA	46.00
<b>S160, S250</b>		
3 pole kit of 3 bars	T2PF253BA	71.00
4 pole kit of 4 bars	T2PF254BA	94.00
<b>S400, S630</b>		
3 pole kit of 3 bars	T2PF403BA	215.00
4 pole kit of 4 bars	T2PF404BA	280.00

Plug in MCCB kits	Suits MCCB types	Cat. No.	Price \$
Kit parts to convert a standard MCCB to a plug in type (T2PM base to be ordered separately)			
	<b>E125, S125</b>		
	3 pole kit (base not included)	2H6843CAB	105.00
	4 pole kit (base not included)	2H6844CAB	127.00
	<b>S160, E/S 250</b>		
	3 pole kit (base not included)	2H6845CAA	132.00
	4 pole kit (base not included)	2H6846CAA	167.00
	<b>H/L 125-160-250 (not S250PE/H250NE)</b>		
	3 pole kit (base not included)	2H6940CAB	220.00
	4 pole kit (base not included)	2H6941CAB	275.00
	<b>S250PE, H250NE</b>		
	3 pole kit (base not included)	2H6940CBA	250.00
	4 pole kit (base not included)	2H6941CBA	305.00
	<b>E400, S400 (not for H/L400)</b>		
	3 pole kit (base not included)	2H6847CAA	305.00
	4 pole kit (base not included)	2H6848CAA	395.00
	<b>S630</b>		
	3 pole kit (base not included)	2H7234CAA	500.00
	4 pole kit (base not included)	2H7235CAA	640.00



“S.....PM”  
MCCB with  
plugs fitted

MCCB

3



T2PM base



Plug in MCCBs

## TemBreak 2 & TemBreak 1 MCCB cross reference

### TemBreak 2 MCCB



3

Ampere Range	TemBreak 2 Icu	TemBreak 2 415 V kA Ics	Thermal-Mag. Adjustable	Adjustment	TemBreak 2 Catalogue Number
12.5 – 125	25	19	Yes	–	E125NJ
16 – 125	25	13	No	–	S125NF
15 – 100	65	33	No	–	S100GF
12.5 – 125	36	36	Yes	–	S125NJ
12.5 – 125	65	36	Yes	–	S125GJ
12.5 – 125	125	85	Yes	–	H125NJ
12.5 – 125	200	150	Yes	–	L125NJ
16 – 160	25	19	No	–	S160NF
12.5 – 160	36	36	Yes	–	S160NJ
32 – 160	65	36	Yes	–	S160GJ
100 – 160	125	85	Yes	–	H160NJ
100 – 160	200	150	Yes	–	L160NJ
12.5 – 250	25	19	Yes	–	E250NJ
160 – 250	36	36	Yes	–	S250NJ
160 – 250	65	36	Yes	–	S250GJ
16 – 250	70	70	–	Yes	S250PE
160 – 250	125	85	Yes	–	H250NJ
16 – 250	125	85	–	Yes	H250NE
160 – 250	200	150	Yes	–	L250NJ
100 – 400	25	25	Yes	–	E400NJ
160 – 400	36	36	Yes	–	S400CJ
160 – 400	50	50	Yes	–	S400NJ
100 – 400	50	50	–	Yes	S400NE
160 – 400	70	50	Yes	–	S400GJ
100 – 400	70	50	–	Yes	S400GE
100 – 400	85	85	–	Yes	S400PE
100 – 400	125	85	–	Yes	H400NE
100 – 400	200	150	–	Yes	L400NE
252 – 630	36	36	–	Yes	E630NE
252 – 630	50	50	–	Yes	S630CE
252 – 630	70	50	–	Yes	S630GE

**Notes:** The above equivalents are approximate only. Physical sizes may vary slightly as well as kA ratings.

## TemBreak 2 & TemBreak 1 MCCB cross reference

### TemBreak 1 MCCB



To obtain stocked TemBreak 1 MCCBs  
125 - 400 A Refer Section 6 or refer NHP

#### TemBreak 1 – approximate equivalent

Primary equivalent 1, secondary 2, third 3, / & 415 V kA rating

	1	2	3	
XS125CJ	18 kA	XS125NJ	25 kA	XE225NC 18 kA
XS125CS	14 kA	XS125NS	25 kA	-
XH125NJ	50 kA	-	-	
XS125NJ	25 kA	XS125CJ	18 kA	XE225NC 18 kA
XH125NJ	50 kA	TL100NJ	85 kA	XH125PJ 50 kA
TL30F	120 kA	TL100F	120 kA	TL100NJ 85 kA
TL225B	180 kA	-	-	
-	-	-	-	
XS250NJ	25 kA	XH160PJ	50 kA	XE225NC 18 kA
XH250NJ	50 kA	XH250PJ	85 kA	XH160PJ 50 kA
TL250NJ	85 kA	TL225F	120 kA	TL100F 120 kA
TL225B	180 kA	TL100C	180 kA	-
XS250NJ	25 kA	XE225NC	18 kA	-
XS250NJ	25 kA	-	-	
XH250NJ	50 kA	TL250NJ	85 kA	-
XH400SE	65 kA	XS400SE	50 kA	-
TL250NJ	85 kA	XH250PJ	65 kA	-
TL400NE	85 kA	TL225F	120 kA	-
TL225B	180 kA	-	-	
XS400CJ	35 kA	-	-	
XS400CJ	35 kA	-	-	
XS400NJ	50 kA	-	-	
XS400SE	50 kA	XH400SE	65 kA	XH400PE 65 kA
XH400PJ	65 kA	-	-	
XH400SE	65 kA	XH400PE	65 kA	TL400NE 85 kA
TL400NE	85 kA	-	-	
TL400NE	85 kA	TL630NE	125 kA	-
-	-	-	-	
XS630CJ	42 kA	XS630NJ	50 kA	-
XS630SE	50 kA	XS630NJ	50 kA	-
XH630SE	65 kA	XH630PE	65 kA	XS630PJ 85 kA

3

**Notes:** MCCBs with the same colours have the same outline dimensions, though in the case of 400 AF & 630 AF, main terminal heights vary.

## TemBreak 2 & TemBreak 1 MCCB cross reference

### TemBreak 2 MCCB



#### Isolators - Short time rating for 0.3 seconds Icw (kA)

3

Ampere Range	Icu	TemBreak 2 415 V kA	Thermal-Mag Adjustable	Electronic Adjustment	TemBreak 2 Catalogue Number
125	2	—	—	—	S125NN
160	3	—	—	—	S160NN
250	3	—	—	—	S250NN
400	5	—	—	—	S400NN
630	5	—	—	—	S630NN

### TemBreak 1 MCCB



#### TemBreak 1 – approximate equivalent

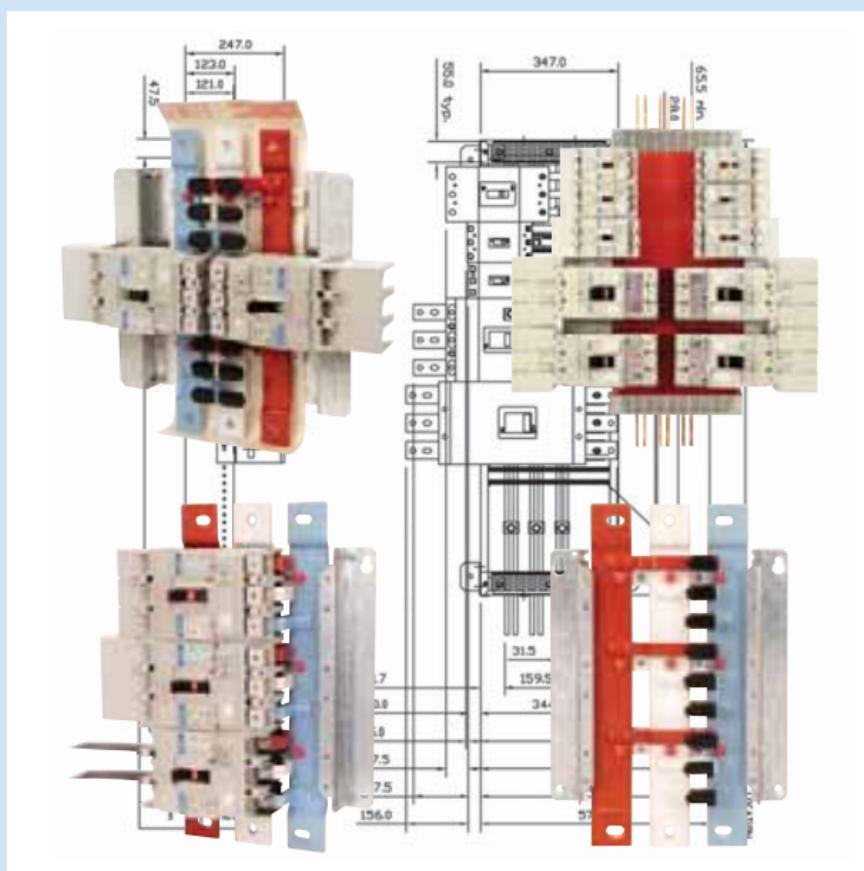
#### Primary equivalent 1, secondary 2, third 3, & 415 V kA rating

1	2	3
XS125NN	1.8 kA	—
XS250NN	4 kA	XE250NNC 3 kA
XS250NN	4 kA	—
XS400NN	5 kA	—
XS630NN	10 kA	XS800NN 10 kA

**Notes:** The above equivalents are approximate only. Physical sizes may vary slightly as well as kA ratings.

## Chassis assemblies for the TemBreak range

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## Moulded Case Circuit Breaker Chassis Systems

### General features of TemWay XA, XB, PXB, XC chassis

- 36 and 40 kA ratings on standard TemWay XA, XB, PXB chassis
- 50 and 65 kA ratings on TemWay XC chassis
- XC 1000 A chassis are now stocked with 400 A and 250 A tee off combinations
- A range of TemWay 4 pole XA and XB chassis, suitable for earth leakage MCCBs
- A simplified range of single sided chassis for 250 AF MCCBs, 20 – 250 A
- Suitable for 690 V AC applications



### General features of heavy current "HC" chassis

- For MCCBs, 20 - 1250 A
- Compact single sided version
- Common configurations of HC chassis now stocked - fully assembled for quick delivery
- 11 box sizes – more economical sizing to suit applications and save cost
- Suitable for 690 V AC applications

4

### Testing

Both TemWay and HC Chassis have been unconditionally type tested (no MCCBs fitted) in Australia, at the short time withstand ratings shown in the table below.

### Chassis ratings

Chassis Type	Description	Main bar rating (A)	Fault current level Icw rating	MCCB frame size	MCCB type
XA	Double sided	630, 800 A <sup>1)</sup>	36 kA 1 sec. / 40 kA 0.5 sec.	125 AF	E/S/ZS125 12A-125A
XB	Double sided	800 A <sup>1)</sup>	36 kA 1 sec. / 40 kA 0.5 sec.	250 AF	E/S/ZS250 NJ/GJ 12 A-250 A
XBSS	Single sided Left or right sided	800 A <sup>1)</sup>	36 kA 1 sec. / 40 kA 0.5 sec.	250 AF	E/S/ZS250 NJ/GJ 12 A-250 A
PXB	Double sided	800 A	36 kA 1 sec. / 40 kA 0.5 sec	250 AF	S250PE, or a mix of 250 AF sizes
XC	Double sided	1000 A <sup>1)</sup>	50 kA 1 sec. / 65 kA 0.5 sec.	250 AF, 400 AF	E/S/ZS160-250 up to E/S400
HC	Double sided or single sided left or right	1250 A, 1600 A, 2200 A	65 kA 1 Sec.	250 AF to 1250 AF	E/S160 up to XS1250SE

**Notes:** 1) XB and PXB Chassis main bars are rated at 800 A. Optional for XA chassis. To comply to the new Australian New Zealand AS/NZS 3000 - 2007 standard regarding separation, XA, XB, PXB and XC chassis should be only used in switchboards having operational currents less than 800 A. For chassis that include integral separation and for currents equal to, and exceeding 800 A, a HC high current chassis must be used.

## XA / XB Chassis for 125 - 250 AF MCCBs

3 pole, double sided

### Features

- Complies with AS/NZS 3439, AS/NZS 3000 - 2007
- Suits TemBreak MCCBs 125-250 A
- Top and bottom fed
- Busbars fully insulated
- Side mounting rail now standard for quicker mounting on all chassis
- XA and XB chassis now rated up to : 36 kA for 1 second  
40 kA for 0.5 seconds

### XA 630 and XA 800

#### Suits E125, S125, ZS125 MCCBs

No. Poles	Cutout <sup>1)</sup> Pan		Cat. No.	630 A Price \$	Cat. No.	800 A Price \$ <sup>2)</sup>
	Height (mm)	Height (mm)				
6	92	90	XA6306U	275.00	XA8006U	285.00
12	182	180	XA63012U	390.00	XA80012U	400.00
18	272	270	XA63018U	500.00	XA80018U	540.00
24	362	360	XA63024U	670.00	XA80024U	670.00
30	452	450	XA63030U	750.00	XA80030U	800.00
36	542	540	XA63036U	900.00	XA80036U	960.00
42	632	630	XA63042U	1020.00	XA80042U	1090.00
48	722	720	XA63048U	1130.00	XA80048U	1180.00
60	902	900	XA63060U	1380.00	XA80060U	1450.00
72	1082	1080	XA63072U	1650.00	XA80072U	1730.00

### XB 800

#### Suits S160, S250NJ, S250GJ, ZS250 MCCBs (not S250PE)

No. Poles	Cutout <sup>1)</sup> Height (mm)	Pan Height (mm)	Cat. No.	800 A Price \$ <sup>2)</sup>
6	107	105	XB8006U	455.00
12	212	210	XB80012U	400.00
18	317	315	XB80018U	740.00
24	422	420	XB80024U	670.00
30	527	525	XB80030U	1120.00
36	632	630	XB80036U	1330.00
42	737	735	XB80042U	1540.00
48	842	840	XB80048U	1760.00
60	1052	1050	XB80060U	2130.00
72	1262	1260	XB80072U	2710.00

**Notes:** <sup>1)</sup> The length of the escutcheon cut-out

<sup>2)</sup> XB Chassis main bars are rated at 800 A, while for XA chassis it is an option.

To comply to the new Australian New Zealand AS/NZS 3000 - 2007 standard regarding separation, XA, XB chassis should be used in switchboards having operational currents less than 800 A. For chassis that include integral separation and for currents equal to, and exceeding 800 A, a HC high current chassis must be used.

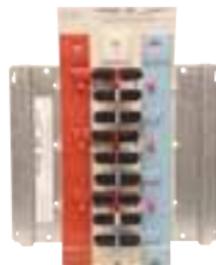
For XB chassis with Form 3bih separation, refer NHP.

## PXB Chassis for 250AF electronic / thermal magnetic MCCBs

### 3 pole, double sided

#### Features

- Complies with AS/NZS 3439, AS/NZS 3000 - 2007
- Suitable for MCCBs 12 A - 250 A
- Suits either all electronic or a mix of electronic and thermal magnetic MCCBs
- Top and bottom fed
- Busbars fully insulated
- PXB chassis rated: 36 kA for 1 second  
40 kA for 0.5 seconds



PXB80018U

chassis shown

#### PXB 800

Suits S250PE electronic, S160, E250, S250, ZS250 thermal mag. MCCBs

4

No. of Poles	Cutout Height <sup>1)</sup> (mm)	Pan Height <sup>2)</sup> (mm)	800 A Cat. No.	Price \$
6	107	105	PXB8006U	510.00
12	212	210	PXB80012U	590.00
18	317	315	PXB80018U	810.00
24	422	420	PXB80024U	1040.00
30	527	525	PXB80030U	1230.00
36	632	630	PXB80036U	1600.00
42	737	735	PXB80042U	1850.00
48	842	840	PXB80048U	2120.00
60	1052	1050	PXB80060U	2540.00
72	1262	1260	PXB80072U	3250.00

PXB Chassis showing add-on brackets for mounting thermal magnetic MCCBs



#### PXB chassis details

##### Fitting S250PE Electronic MCCBs

The PXB chassis has extra long tee offs to accommodate 103 mm deep S250PE electronic MCCBs. An S250PE MCCB will not mount onto a standard XB chassis.

##### Fitting S250PE electronic, S160, E250 and S250 thermal magnetic MCCBs

The PXB chassis caters for a mix of 103 mm deep S250PE and 68mm deep thermal magnetic S160, E250, S250 MCCBs. The chassis comes as standard with add-on metal brackets & screws, to allow shallower 68 mm deep MCCBs to be installed in any position on the chassis. The total quantity of 3 pole brackets supplied equals the number of 3 pole tee off sets.

##### Notes:

- 1) The length of the escutcheon cut-out.
- 2) Busbars extend 50 mm beyond the pan length at the top and bottom on XA, XB, XC chassis.

PXB Chassis main bars are rated at 800 A. In order for adhere to the new Australian New Zealand AS/NZS 3000 - 2007 standard regarding separation, XB chassis should be used in switchboards having operational currents less than 800 A. For chassis that includes integral separation and for utilisation currents equal to, and exceeding 800 A, a HC high current chassis must be used.

## XA / XB Chassis for 125 - 250AF MCCBs

### 4 pole, double sided

#### Features

- Complies with AS/NZS 3439, AS/NZS 3000 - 2007
- Suits TemBreak MCCBs 125-250 A
- Top and bottom fed
- Busbars fully insulated
- Side mounting rail now standard for quicker mounting on all chassis
- XA and XB chassis now rated up to : 36 kA for 1 second  
40 kA for 0.5 seconds



800A chassis shown <sup>3)</sup>

#### X A 630 and X A 800

#### Suits E125, S125, ZS125 MCCBs

No. Poles	Cutout <sup>1)</sup> Height (mm)	Pan Height (mm)	Cat. No.	630 A Price \$
8	122	150	XA6308U4POLE	760.00
16	242	270	XA63016U4POLE	910.00
24	362	390	XA63024U4POLE	1320.00
32	482	510	XA63032U4POLE	1680.00
40	602	630	XA63040U4POLE	2010.00
48	722	750	XA63048U4POLE	2360.00
56	842	850	XA63056U4POLE	2920.00
64	962	990	XA63064U4POLE	3110.00

No. Poles	Cutout <sup>1)</sup> Height (mm)	Pan Height (mm)	Cat. No. <sup>2)</sup>	800 A Price \$
8	122	150	XA8008U4POLE	840.00
16	242	270	XA80016U4POLE	940.00
24	362	390	XA80024U4POLE	1380.00
32	482	510	XA80032U4POLE	1780.00
40	602	630	XA80040U4POLE	2170.00
48	722	750	XA80048U4POLE	2600.00
56	842	850	XA80056U4POLE	3020.00
64	962	990	XA80064U4POLE	3370.00

**Notes:** <sup>1)</sup> The length of the escutcheon cut-out.

<sup>2)</sup> XB Chassis main bars are rated at 800 A, while for XA chassis it is an option.

To comply to the new Australian New Zealand AS/NZS 3000 - 2007 standard regarding separation, XA, XB chassis should be only used in switchboards having operational currents less than 800 A. For chassis that include integral separation and for currents equal to, and exceeding 800 A, a HC high current chassis must be used.

<sup>3)</sup> XA and XB 4 pole chassis have a common pan width. 630A chassis use 4 main bars while 800 A have 5 main bars (2 neutral bars).

## XA / XB Chassis for 125 - 250AF MCCBs

**4 pole, double sided**

**XB 800****Suits S160, S250NJ, S250GJ, ZS250 MCCBs (not S250PE)**

No. Poles	Cutout <sup>1)</sup> Height (mm)	Pan Height (mm)	Cat. No. <sup>2)</sup>	800 A Price \$
8	142	175	XB8008U4POLE	930.00
16	282	315	XB80016U4POLE	1170.00
24	422	455	XB80024U4POLE	1630.00
32	562	595	XB80032U4POLE	2100.00
40	702	735	XB80040U4POLE	2540.00
48	842	875	XB80048U4POLE	3060.00

4

**Notes:** <sup>1)</sup> The length of the escutcheon cut-out.<sup>2)</sup> XB Chassis main bars are rated at 800 A, while for XA chassis it is an option.

To comply to the new Australian New Zealand AS/NZS 3000 - 2007 standard regarding separation, XA, XB chassis should be only used in switchboards having operational currents less than 800 A. For chassis that include integral separation and for currents equal to, and exceeding 800 A, a HC high current chassis must be used.

## XB SS Chassis for 125 - 250 AF MCCBs

**3 pole, single sided**



### Features

- Single sided MCCB mounting
- Different chassis for left or right side MCCB mounting
- Complies with AS/NZS 3439, AS/NZS 3000 - 2007
- Suits TemBreak, 160 / 250 A Frame MCCBs
- Current ratings of MCCBs range 12 A to 250 A
- Top and bottom fed
- Busbars fully insulated
- Side mounting rail now standard for quicker mounting on all chassis
- XA and XB chassis now rated up to : 36 kA for 1 second  
40 kA for 0.5 seconds

### Single Sided Chassis

Suits **S160NJ, E250NJ, S250NJ, S160GJ, S250GJ, ZS250** MCCBs  
(not S250PE)

4

### XB SSL 800

**LEFT hand single sided 3 pole** (MCCB loadside connections at LEFT)

No. Poles	Cutout <sup>1)</sup> Height (mm)	Pan Height (mm)	Cat. No. <sup>2)</sup>	800 A Price \$
3	107	105	XBSSL 800 3U	370.00
6	212	210	XBSSL 800 6U	440.00
9	317	315	XBSSL 800 9U	590.00
12	422	420	XBSSL 800 12U	750.00
15	527	525	XBSSL 800 15U	890.00
18	632	630	XBSSL 800 18U	1080.00
21	737	735	XBSSL 800 21U	1220.00
24	842	840	XBSSL 800 24U	1760.00
30	1052	1050	XBSSL 800 30U	2130.00
36	1262	1260	XBSSL 800 36U	2710.00

### Notes:

- 1) The length of the escutcheon cut-out.
- 2) Busbars extend 50 mm beyond the pan length at the top and bottom on XA, XB, XC chassis.

PXB Chassis main bars are rated at 800 A. In order for adhere to the new Australian New Zealand AS/NZS 3000 - 2007 standard regarding separation, XB chassis should be used in switchboards having operational currents less than 800 A. For chassis that includes integral separation and for utilisation currents equal to, and exceeding 800 A, a HC high current chassis must be used.

## XB SS Chassis for 125 - 250 AF MCCBs

**3 pole, single sided**

### XB SSR 800

**RIGHT hand single sided 3 pole** (MCCB loadside connections at RIGHT)

No. Poles	Cutout <sup>1)</sup> Height (mm)	Pan Height (mm)	Cat. No. <sup>2)</sup>	800 A Price \$
3	107	105	<b>XBSSR 800 3U</b>	<b>370.00</b>
6	212	210	<b>XBSSR 800 6U</b>	<b>440.00</b>
9	317	315	<b>XBSSR 800 9U</b>	<b>590.00</b>
12	422	420	<b>XBSSR 800 12U</b>	<b>750.00</b>
15	527	525	<b>XBSSR 800 15U</b>	<b>890.00</b>
18	632	630	<b>XBSSR 800 18U</b>	<b>1080.00</b>
21	737	735	<b>XBSSR 800 21U</b>	<b>1220.00</b>
24	842	840	<b>XBSSR 800 24U</b>	<b>1760.00</b>
30	1052	1050	<b>XBSSR 800 30U</b>	<b>2130.00</b>
36	1262	1260	<b>XBSSR 800 36U</b>	<b>2710.00</b>

4

**Notes:**

- 1) The length of the escutcheon cut-out.
- 2) Busbars extend 50 mm beyond the pan length at the top and bottom on XA, XB, XC chassis.

PXB Chassis main bars are rated at 800 A. In order for adhere to the new Australian New Zealand AS/NZS 3000 - 2007 standard regarding separation, XB chassis should be used in switchboards having operational currents less than 800 A. For chassis that includes integral separation and for utilisation currents equal to, and exceeding 800 A, a HC high current chassis must be used.

## XC Chassis for 160 / 250 A - 400 A MCCBs

### 3 pole, double sided

#### Features

- Complies with AS/NZS 3439, AS/NZS 3000 - 2007
- Suits TemBreak MCCB amp ratings 20 A - 400 A
- Top and bottom fed
- Busbars fully insulated
- Side mounting rail now standard for quicker mounting on all chassis
- XC chassis now rated up to : 50 kA for 1 second  
65 kA for 0.5 second
- Now stocked with combinations of 250 A and 400 A tee offs 40 kA for 0.5 seconds



#### XC 1000

**Suits S160, E250, S250NJ, S250GJ, ZS250 MCCBs<sup>3)</sup> (not S250PE)**

No. Poles	Cutout <sup>1)</sup> Height (mm)	Pan Height (mm)	Cat. No. <sup>2)</sup>	1000 A Price \$
6	107	170	XC10006U	710.00
12	212	275	XC100012U	800.00
18	317	380	XC100018U	1110.00
24	422	485	XC100024U	1430.00
30	527	590	XC100030U	1660.00
36	632	695	XC100036U	1980.00
42	737	800	XC100042U	2340.00
48	842	905	XC100048U	2580.00

4

**Notes:** <sup>1)</sup> The length of the escutcheon cut-out

<sup>2)</sup> XC Chassis main bars are rated at 1000 A. To comply to the new Australian New Zealand AS/NZ 3000 - 2007 standard regarding separation, XC chassis should be only used in switchboards having operational currents less than 800 A.

For chassis that include integral separation and for currents equal to, and exceeding 800 A, a HC high current chassis must be used.

<sup>3)</sup> XC chassis can be custom built for alternate combinations of 250 A MCCBs, and up to 2 x 400 AF MCCBs, and ZS125 (125 AF) ELCBs. 630 A MCCB mounting is not possible.

## XC Chassis for 160 / 250 A - 400 A MCCBs

3 pole, double sided

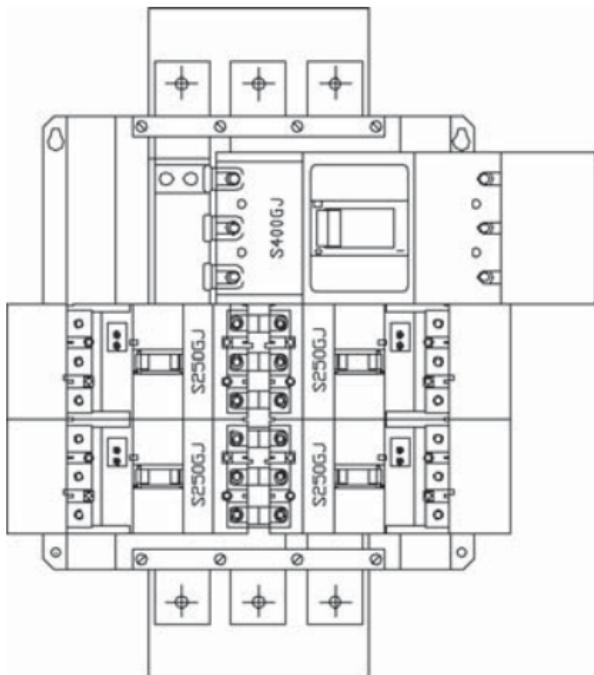
### XC 1000 Chassis

**Suits 250 A and 400 A MCCBs<sup>2)</sup> (not S250PE)**

As an alternative to a larger high current chassis, where only up to 2 x 400 A and up to 12 x 68 mm deep 250 A MCCBs need to be installed, the configurations of stocked XC chassis below can be used.

Pan Height (mm)	Chassis configured for MCCBs below <sup>2) 3)</sup>	Cat. No. <sup>1)</sup>	1000 A Price \$
415	1 x 400 A and 4 x 250 A	XC10001X4R12U	1490.00
625	1 x 400 A and 8 x 250 A	XC10001X4R24U	2100.00
835	1 x 400 A and 12 x 250 A	XC10001X4R36U	2800.00
555	2 x 400 A and 4 x 250 A	XC10002X4R12U	2320.00
765	2 x 400 A and 8 x 250 A	XC10002X4R24U	2930.00
975	2 x 400 A and 12 x 250 A	XC10002X4R36U	3630.00

4



**Notes:** 1) XC Chassis main bars are rated at 1000 A. To comply to the new Australian New Zealand AS/NZS 3000 - 2007 standard regarding separation, XC chassis should be only used in switchboards having operational currents less than 800 A.

For chassis that include integral separation and for currents equal to, and exceeding 800 A, a HC high current chassis must be used.

2) XC chassis can be custom built for alternate combinations of 250 A MCCBs, and up to 2 x 400 AF MCCBs, and ZS125 (125 AF) ELCBs.

**630 A MCCB mounting is not possible.**

3) 400 A MCCB right side mounted as standard. LH mounting optional to special order.

## Chassis

### to suit 125 – 250 AF MCCBs

#### TemWay chassis ratings and cut-out detail

Chassis Type	Amps	(lcw) kA short time with-stand	Standard Chassis suits MCCBs <sup>1)</sup>
XA	630	36 kA for 1 sec	
	630	40 kA for 0.5 sec	E125, S125NJ, S125GJ, ZS125
	800	36 kA for 1 sec	
	800	40 kA for 0.5 sec	
XB / XBSS	800	36 kA for 1 sec	S160NJ, E250NJ, S250NJ, ZS250
	800	40 kA for 0.5 sec	S160GJ, S250GJ
PXB	800	36 kA for 1 sec	S250PE or a mix of 250 AF sizes.
	800	40 kA for 0.5 sec	
XC	800	50 kA for 1 sec	S160NJ/GJ, E250NJ
	800	65 kA for 0.5 sec	(400 A MCCBs <sup>2)</sup> ) S250NJ/GJ, ZS250

4

#### Testing

TemWay chassis have been unconditionally type tested (without MCCBs fitted) at the above short time kA ratings (lcw).

#### MCCB dimensions (mm)

	H	W	D
<b>E125, S125NJ/GJ, ZS125</b>			
1 pole	155	30	68
3 pole	155	90	68
<b>S160, S250NJ/GJ, ZS250</b>			
1 pole	165	40	68
3 pole	165	105	68

#### MCCB dimensions (mm)

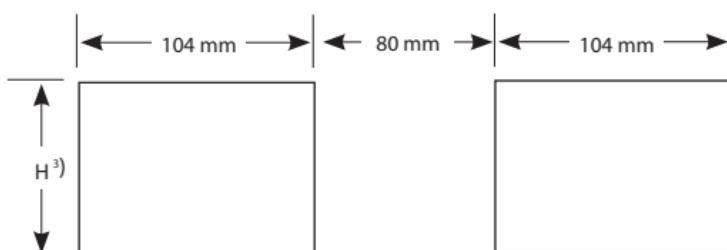
	H	W	D
<b>E400, S400</b>			
1 pole	—	—	—
3 pole	260	140	103

#### Escutcheon cut-out dimensions (mm)

Applicable to:

TemBreak 2 MCCBs: E/S 125/160/250 AF/400 AF

TemBreak 1 MCCBs: XS/XH 125/250 AF



**Notes:** 1) TemBreak 1, XS/XH MCCBs can be fitted to the above chassis.

2) Refer XC chassis ordering page in this section for special XC chassis that accept 400 A MCCBs.

3) For height dimensions for MCCB cut-out refer to "H" in the charts above.

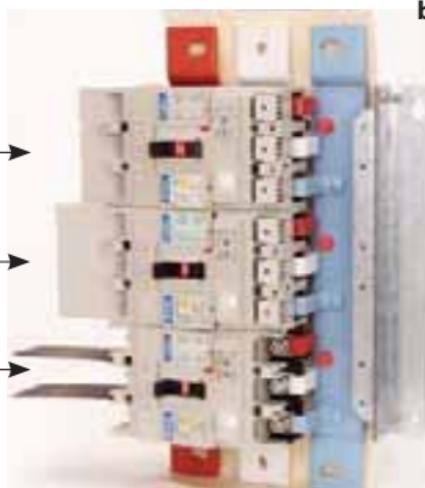
## Terminal cover options for TemWay XA, XB, XBSS and XC Chassis

### Installation considerations

- MCCBs on the chassis are to be reverse connected, that is, connect the 'bottom' of breaker to the chassis tee offs
- Terminal or interpole barriers or "other adequate insulation material" must be fitted at MCCB load side, (top of MCCB) which is the gas venting end of the MCCB

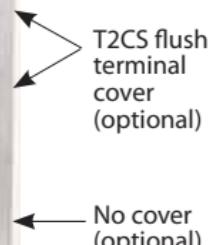
### Load Side

#### Terminal or interpole barriers below:

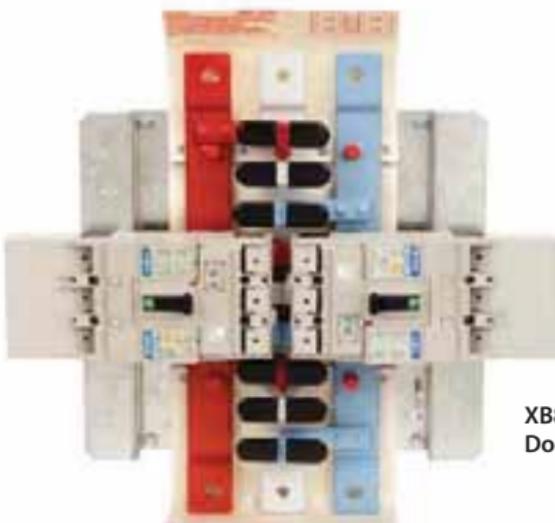


### Line Side

#### Optional covers below:



**XBSSL8009U**  
Single Sided Chassis



**XB80018U**  
Double Sided Chassis

## Terminal cover selection

### 20 A - 1250 A MCCBs

	Suit MCCB types	Cover length	Cat. No.	Price \$
<b>Flush IP 20 covers (FC)</b>	<b>E125, S125</b>			
	1 pole cover - set of 2	-	T2CS121SG	10.60
	2 pole cover - set of 2	-	T2CS122SG	12.00
	3 pole cover - set of 2	-	T2CS123SG	44.00
	4 pole cover - set of 2	-	T2CS124SG	55.00
	<b>H125, S160, H160, E250, S250, H250</b>			
	1 pole cover - set of 2	-	T2CS251SG	10.00
	3 pole cover - set of 2	-	T2CS253SG	54.00
	4 pole cover - set of 2	-	T2CS254SG	60.50
	<b>E400, S400, H400, E630, S630</b>			
	3 pole cover set - RC cov c/w cut-outs		T2CR403SG	93.50
	4 pole cover set - RC cov c/w cut-outs		T2CR404SG	111.00
<b>Start terminal covers (FC)</b>	<b>E125, S125</b>			
	3 pole cover set of 2	22 mm	T2CF123SSNBA	60.50
	4 pole cover set of 2	22 mm	T2CF124SSNBA	71.00
	<b>S160, E250, S250 – except S250PE</b>			
	3 pole cover set of 2	30 mm	T2CF253SSNBA	67.00
	4 pole cover set of 2	30 mm	T2CF254SSNBA	77.50
<b>Extended terminal covers (FC)</b>	<b>E125, S125</b>			
	1 pole cover – set of 2	40 mm	T2CF121SLNG	35.00
	3 pole cover – set of 2	40 mm	T2CF123SLNG	64.50
	4 pole cover – set of 2	40 mm	T2CF124SLNG	73.00
	<b>S160, E250NJ, S250NJ, S250GJ (not S250PE)</b>			
	1 pole cover – set of 2	55 mm	T2CF161SLNG	40.00
	3 pole cover – set of 2	55 mm	T2CF253SLNG	67.00
	4 pole cover – set of 2	55 mm	T2CF254SLNG	77.50
	<b>H125, H160, S250PE, H250</b>			
	3 pole cover – set of 2	55 mm	T2CF253LLNG	71.00
	4 pole cover – set of 2	55 mm	T2CF254LLNG	77.50
	<b>E400, S400, H400, E630, S630</b>			
	3 pole cover – narrow set of 2	80 mm	T2CF403SLNG	190.00
	3 pole cover – wide set of 2	110 mm	T2CF403SWNG	190.00
	<b>XS630, XH630, XS800, XH800</b>			
	3 pole cover – set of 2	130 mm	2H1417DAB	215.00
<b>400/630 A narrow and wide terminal cover options shown</b>	IP20 pole insert - order 1 per terminal		2A1787DBA	6.20
	<b>XS1250</b>			
	3 pole cover – set of 2	130 mm	2H1419DAB	235.00
	IP20 pole insert - order 1 per terminal		2A1787DBA	6.20

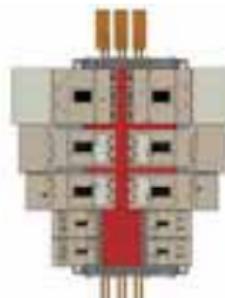
## Terminal cover selection

	Suit MCCB types	Cat. No.	Price \$
<b>Rear Connect terminal covers (RC)</b>	<b>E125, S125</b> 3 pole cover – set of 2 4 pole cover – set of 2	<b>T2CR123SG</b> <b>T2CR124SG</b>	<b>44.00</b> <b>55.00</b>
	<b>H125, S160, H160, E250, S250, H250</b> 3 pole cover – set of 2 4 pole cover – set of 2	<b>T2CR253SG</b> <b>T2CR254SG</b>	<b>54.00</b> <b>60.50</b>
	<b>E400, S400, H400, E630, S630</b> 3 pole cover – set of 2	<b>T2CR403SG</b>	<b>93.50</b>
	<b>XS630, XH630, XS800, XH800</b> 3 pole cover – set of 2	<b>UXPD0013C</b>	<b>220.00</b>
<b>4 Terminal cover locking clip</b>	A clip that provides terminal cover locking, and allows a seal device to be fitted.	<b>T2CF00L</b>	<b>9.10</b>
<b>Interpole Barriers</b>	<b>E125, S125</b> Interpole barrier – set of 2	<b>T2BA123SHA</b>	<b>17.40</b>
	<b>S160, E250NJ, S250NJ, S250GJ (not S250PE)</b> Interpole barrier – set of 2	<b>T2BA253SHA</b>	<b>20.00</b>
	<b>H125, H160, S250PE, H250</b> Interpole barrier – set of 2	<b>T2BA253LHA</b>	<b>20.00</b>
	<b>E400, S400, E630, S630</b> Interpole barrier – set of 2	<b>T2BA403SHA</b>	<b>21.60</b>
	<b>XS630, XH630, XS800, XH800, XS1250</b> Interpole barrier – 1 only	<b>UXQH0004B</b>	<b>10.40</b>

## HC High Current chassis for 250 AF to 1250 AF MCCBs

### Features

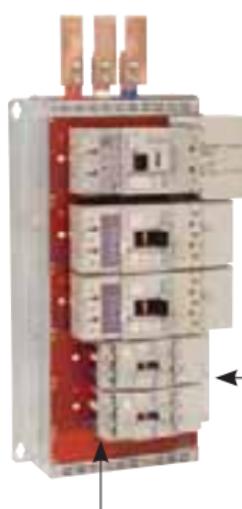
- Double sided 3 pole MCCB chassis
- Compact single sided chassis 3 or 4 pole
- 1250 A, 1600 A or 2200 A rated main bars
- 11 enclosure sizes for economical chassis sizing
- Front connect tags supplied as standard
- Complies with AS/NZS 3439, AS/NZS 3000 - 2007
- Form of separation 4bih. AS/NZS 3439.1 : 2000 (Annex ZF)
- Circuit breakers are reverse fed as standard
- 4th pole neutral bars 100 % rated
- Accepts MCCBs rated 12 A to 1250 A
- Ordering: choose from pre-assembled types, or custom assembly



**Stocked assembled chassis selection - Suit MCCB amp frames shown below:**

4

Main bar rating (A)	Chassis Size	800 A 6 units	630 A 5 units	400 A 4 units	250 A 3 units	Cat. No.	Price \$
1600 A DS	-	2 x 630	2 x 400	4 x 250		HCSTD1DS16153	3990.00
1600 A DS	-	4 x 630	-	8 x 250		HCSTD2DS16243	5680.00
1600 A SS left	-	1 x 630	1 x 400	2 x 250		HCSTD3SSL16153	3990.00
1600 A SS right-	-	1 x 630	1 x 400	2 x 250		HCSTD4SSR16153	3990.00
1600 A SS left	-	1 x 630	1 x 400	4 x 250		HCSTD5SSL16213	5460.00
1600 A SS right-	-	1 x 630	1 x 400	4 x 250		HCSTD6SSR16213	5460.00
2200 A SS left	1 x 800	1 x 630	1 x 400	3 x 250		HCSTD7SSL22243	7000.00
2200 A SS right	1 x 800	1 x 630	1 x 400	3 x 250		HCSTD8SSR22243	7000.00



Example of a single side HC chassis with MCCBs and terminal covers fitted

Standard T2CF front connect terminal covers

T2CR rear connect terminal covers

## Initial Installation Of MECB Chassis

## HC High Current chassis for 250 AF to 1250 AF MCCBs

## Chassis box selection – for custom assembly

Chassis Size	Main bar rating (A)	Icw kA (1 sec)	MCCB unitspace	Overall height (mm) <sup>(1)</sup>	Cat. No.	Price \$
1	1250 A (2 x 10 x 20 mm bars)	65	15 U	610	HC12153	1140.00
2			18 U	718	HC12183	1510.00
3			21 U	826	HC12213	1840.00
4			24 U	934	HC12243	1930.00
5			27 U	1042	HC12273	2090.00
6			30 U	1150	HC12303	2300.00
7			33 U	1258	HC12333	2430.00
8			36 U	1366	HC12363	2620.00
9			39 U	1474	HC12393	2710.00
10			42 U	1582	HC12423	3000.00
11			45 U	1690	HC12453	3240.00
1	1600 A (2 x 10 x 30 mm bars)	65	15 U	610	HC16153	1710.00
2			18 U	718	HC16183	2050.00
3			21 U	826	HC16213	2360.00
4			24 U	934	HC16243	2570.00
5			27 U	1042	HC16273	2850.00
6			30 U	1150	HC16303	3240.00
7			33 U	1258	HC16333	3360.00
8			36 U	1366	HC16363	3620.00
9			39 U	1474	HC16393	3800.00
10			42 U	1582	HC16423	3930.00
11			45 U	1690	HC16453	4200.00
1	2200 A (2 x 10 x 50 mm bars)	65	15 U	610	HC22153	2640.00
2			18 U	718	HC22183	2840.00
3			21 U	826	HC22213	3140.00
4			24 U	934	HC22243	3430.00
5			27 U	1042	HC22273	3710.00
6			30 U	1150	HC22303	3980.00
7			33 U	1258	HC22333	4210.00
8			36 U	1366	HC22363	4350.00
9			39 U	1474	HC22393	4490.00
10			42 U	1582	HC22423	4680.00
11			45 U	1690	HC22453	4910.00

**Notes:** <sup>1)</sup> Height excludes extended and attached busbar

- Overall chassis depth when MCCBs are fitted is 269 mm
  - Refer next page for chassis Tee Off details
  - For detailed dimensions, refer to the chassis technical catalogue
  - For an ordering form, refer to the chassis technical catalogue
  - HC chassis' are not compatible with TemBreak 1, 125 A - 400 A MCCBs

## HC High current MCCB chassis MCCB

### HC Chassis TEE OFFs<sup>1)</sup>

Frame	MCCB Amp Frame (A)	MCCB width	Single sided Cat. No. Right load	Single sided Cat. No. Left load	Double sided Cat. No.	Price \$
S160 / 250	250	3 U	HCR250	HCL250	HCD250	355.00
H125 / S250PE	250	3 U	HCR250P	HCL250P	HCD250P	355.00
E/S400-630 Narrow	400-630	4 U	HCRN630	HCLN630	HCDN630	510.00
E/S400-630 Wide	400-630	5 U	HCRW630	HCLW630	HCDW630	510.00
XS/XH630-800	630-800	6 U	HCR800	HCL800	HCD800	740.00
XS1250 Right hand load	1250	6 U	HCR1250	-	HCR1250	770.00
XS1250 Left hand load	1250	6 U	-	HCL1250	HCL1250	770.00

4

### Ordering notes

- <sup>1)</sup> Add tee offs as required to the chassis enclosure to complete the chassis components list.
- <sup>2)</sup> Note: If MCCB below 32 A and a kA rating above 30 kA are required, use H125NJ320 and H125NJ332 with 250 A Tee Off Catalogue Number above.
- <sup>3)</sup> 400 A MCCBs fitted with a same width narrow cover are 4 units in width.
- <sup>4)</sup> 630 A MCCBs fitted with a 'wide' width cover are 5 units in width.
- <sup>5)</sup> For ordering, use order from chassis catalogue or contact NHP.
- <sup>6)</sup> All MCCBs to be reverse fitted on chassis.

MCCBS:	Example: Single sided chassis	Chassis components	Quantity
800 A	Chassis box 1600 A, less tee offs	HC16183	1
630 A	800 A left load tee off set	HCL800	1
630 A	630 A left load tee off set	HCLW630	1
400 A	400 A left load tee off set	HCLN630	1
250 A	250 A left load tee off set	HCL250	1
250 A	250 A left load tee off set	HCL250	1

### Testing

The HC chassis has been unconditionally type tested (no MCCBs fitted) in Australia, at a short time rating of 65 kA for 1 second.

**Notes:** <sup>1)</sup> Refer to NHP for HC chassis with new TemBreak 2 800 A - 1250 A MCCBs. Bottom or top extended main bar are optional.  
For MCCB terminal cover selection use refer pages 4 - 13 and 4 - 14

## Chassis to suit:

**TemBreak 2 125 A - 630 AF, TemBreak 1 630 A - 1250 A**

### 400 / 630 A terminal covers

Terminal covers for 400 A and 630 AF MCCBs can be supplied as wide or narrow types, depending on the size of conductors to be connected to the MCCB. Generally for 400 A rated MCCBs, a narrow cover can be used for its smaller conductors, while a wide cover is used for the 630 A size.

A 630 A MCCB using a T2CF403SWNG wide cover is  
5 units of width  
(Narrow cover optional)



5 Units wide: MCCB + wide cover

4

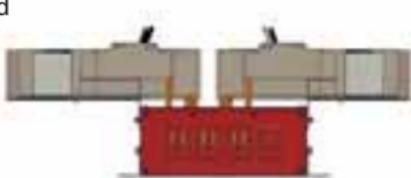
A 400 A MCCB using a T2CF-403SLNG narrow (same width as MCCB) cover is 4 units wide  
(Wide cover optional)



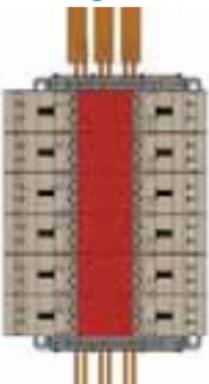
4 Units wide: MCCB + narrow cover

### HC Chassis MCCB mounting brackets

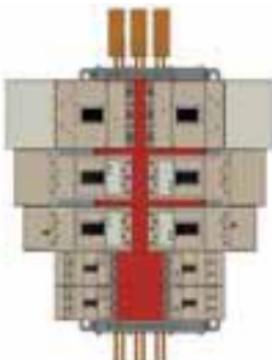
Metal extension brackets are attached to the side of HC chassis to cover rear of fitted MCCBs and terminal covers



### HC Chassis configuration types – 2 examples



HC Chassis with 250 A Frame  
MCCBs Double sided, 3 pole,  
1250 A main bars



HC Chassis with 250 A – 800 A  
MCCBs Double sided, 3 pole,  
2200 A main bars

## MCCB transfer switches and controllers

Page

### Terasaki

Transfer switch types	5 - 2
Transfer switch selection	5 - 7
Transfer switch component ordering	5 - 12
Logic panel selection	5 - 28
Transfer switch options	5 - 34
Accessories to suit 125 - 630 AF MCCB	5 - 36

5



**TemBreak**  
Transfer Switches

TemBreak 2 transfer switches are available from 20 A to 630 A, and consist of mechanically interlocked circuit breakers, with or without a motor fitted. The transfer switches can be either 'link' interlocked, or cable interlocked. Link types are pictured below.

Transfer switches can be ordered as pre-assembled and wired units, or in broken down component form, for user assembly. A common loadside busbar kit is an option.

**Basic types****MTS**

5

**BTS**

**TemBreak**  
The standard arrangement of MCCBs

**ATS**



**Changeover logic panel / Controller**

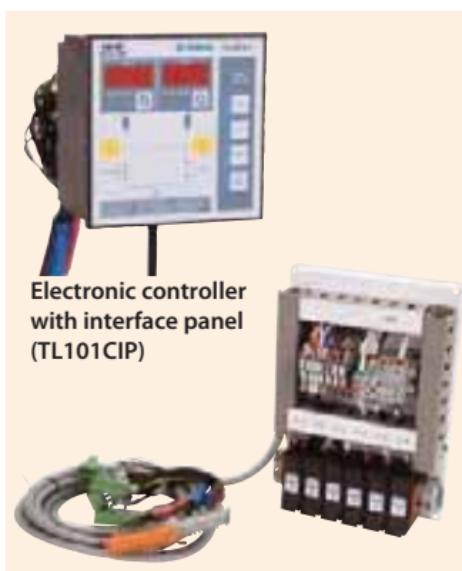
+

5

**OR**



Relay/Timer Controller (TLP2)



Electronic controller with interface panel (TL101CIP)

**MTS** = Manual transfer switch: no motors and no logic panel

**BTS** = Basic transfer switch: MCCBs have motors, but no logic panel

**ATS** = BTS and logic panel

**TemBreak****TemBreak 1 transfer switches**

TemBreak 1 transfer switches are factory assembled, and range from 400 A to 2500 A. The switches are interlocked via rear mounted walking beam interlock, or are available with a rod or cable interlock in sizes 400 A to 2500 A. Common loadside busbars (CLSBB) are an option.

A basic transfer switch fitted with motors, can be coupled with a TemLogic control panel TL101 electronic controller or TLP1 relay controller that will automatically changeover to a standby power supply in the event of power failure. The transfer switches are fitted with a mechanical interlock so as to prevent both breakers from being switched to the ON position at the same time.

**Basic types****MTS**

5

**BTS**

**TemBreak**

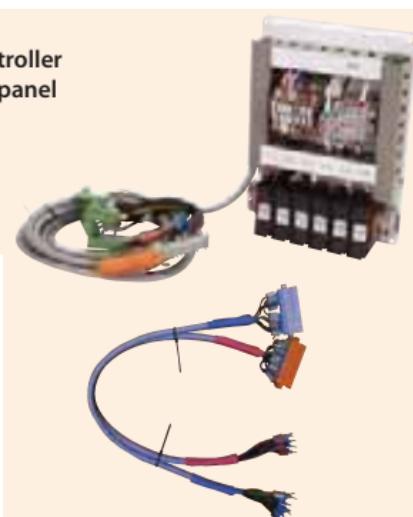
The standard arrangement of MCCBs:

**ATS****Logic panel**

+

Electronic controller  
plus interface panel  
(TL101CIP)

5

**OR**Relay/timer logic panel type  
controller Cat. No. TLP1An Interconnection wire loom is  
also required to connect between  
the TL101 interface panel and  
terminals on the transfer switch.  
Cat. No. TLP2L1CABLE**MTS** = Manual transfer switch: no motors and no logic panel**BTS** = Basic transfer switch: MCCBs have motors mounted on them, no logic panel**ATS** = BTS and logic panel

## TemBreak 1 and 2 transfer switch ordering



### Type definition

**MTS** = Manual Transfer Switch

**BTS** = Basic Transfer Switch

**ATS** = Automatic Transfer Switch (consists of a BTS and controller)

TemBreak 2, MCCB transfer switches can be ordered in a number of ways:

### 1. Pre-Assembled

Pre-assembled BTS transfer switches using a link interlock, up to 630 A.

### 2. Components

Components for complete user assembly. This is applicable to TemBreak 2 transfer switches to 630 A, using either link or cable interlocks, in manual or basic transfer switch configuration.

### 3. Manual Transfer Switches to 630 A

TemBreak 2, manual transfer switches to 630 A are not assembled by NHP. The user orders the components.

### 4. 630 A – 2500 A Transfer Switches

Larger TemBreak 1, 630 A – 2500 A transfer switches, both automatic and manual types are pre-assembled to customer order by NHP.

### 5. Change-Over Controllers

Transfer switch change-over controllers, either electronic or relay logic, are ordered separately by the user for all above types, except where a completely enclosed transfer switch is being assembled by NHP.

### Standards conformity

#### Product: TemBreak MCCB based automatic Transfer Switches

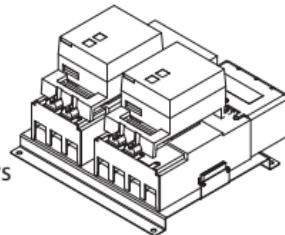
Terasaki confirm that the TemBreak MCCB based automatic Transfer Switches have been designed and comply with the international standard IEC 60947-6.1, and the Australian New Zealand standards AS/NZS 3947.6.1 and AS/NZS 3000 - 2007, for a utilisation class of AC31B for the following MCCB types:

E125, S125, H125, L125, S160, H160, L160, E250, S250, H250, L250, E400, S400, H400, L400, E630, S630, XS630, XH630, XS800, XH800, XS1250, XS1600, XS2000, XS2500

Class CB means: ATSE (Automatic Transfer Switching Equipment) provided with over-current releases and the main contacts of which are capable of making and are intended for breaking short-circuit currents.

**TemBreak****Basic Transfer Switches (BTS)****3 or 4 pole****Features / options:**

- Motor driven MCCBs
- 3 or 4 pole types
- Front mounting link interlock used
- Pre-assembled and wired on a mounting plate
- Automatic changeover controller option
- A choice of Relay-Logic, or electronic controllers
- Common load side busbar option
- Conforms to AS/NZS 60947.6.1

**BTS selection chart and catalogue numbers**

MCCBs used	Amp range	kA Icu	3 or 4 Pole outline dimensions			3 pole BTS Cat. No.	4 pole BTS Cat. No.
			V H	W	D		
S125NJ	40-63	36 <sup>1)</sup>				<b>BTSS1NJ6333</b>	<b>BTSS1GJ6344</b>
S125NJ	63-100	36 <sup>1)</sup>				<b>BTSS1NJ10033</b>	<b>BTSS1GJ10044</b>
S125NJ	80-125	36 <sup>1)</sup>				<b>BTSS1NJ12533</b>	<b>BTSS1GJ12544</b>
S125GJ	40-63	65	260	305	180	<b>BTSS1GJ6333</b>	<b>BTSS1GJ6344</b>
S125GJ	63-100	65				<b>BTSS1GJ10033</b>	<b>BTSS1GJ10044</b>
S125GJ	80-125	65				<b>BTSS1GJ12533</b>	<b>BTSS1GJ12544</b>
S160NJ	40-63	36 <sup>1)</sup>				<b>BTSS16NJ6333</b>	<b>BTSS16GJ6344</b>
S160NJ	63-100	36 <sup>1)</sup>				<b>BTSS16NJ10033</b>	<b>BTSS16GJ10044</b>
S160NJ	100-160	36 <sup>1)</sup>	279	340	180	<b>BTSS16NJ16033</b>	<b>BTSS16GJ16044</b>
S250NJ	160-250	36 <sup>1)</sup>				<b>BTSS2NJ25033</b>	<b>BTSS2GJ25044</b>
S160GJ	100-160	65				<b>BTSS16GJ16033</b>	<b>BTSS16GJ16044</b>
S250GJ	160-250	65				<b>BTSS2GJ25033</b>	<b>BTSS2GJ25044</b>
S250PE	50-125	70	279	340	215	<b>BTSS2PE12533</b>	<b>BTSS2PE12544</b>
S250PE	100-250	70				<b>BTSS2PE25033</b>	<b>BTSS2PE25044</b>
S400NJ	160-250	50				<b>BTSS4NJ25033</b>	<b>BTSS4NJ25044</b>
S400NJ	250-400	50				<b>BTSS4NJ40033</b>	<b>BTSS4NJ40044</b>
S400GJ	160-250	70				<b>BTSS4GJ25033</b>	<b>BTSS4GJ25044</b>
S400GJ	250-400	70	360	415	244	<b>BTSS4GJ40033</b>	<b>BTSS4GJ40044</b>
S400NE	100-250	50				<b>BTSS4NE25033</b>	<b>BTSS4NE25044</b>
S400NE	160-400	50				<b>BTSS4NE40033</b>	<b>BTSS4NE40044</b>
S400GE	100-250	70				<b>BTSS4GE25033</b>	<b>BTSS4GE25044</b>
S400GE	160-400	70				<b>BTSS4GE40033</b>	<b>BTSS4GE40044</b>
S630CE	315-630	50	360	415	244	<b>BTSS6CE63033</b>	<b>BTSS6CE63044</b>
S630GE	315-630	70				<b>BTSS6GE63033</b>	<b>BTSS6GE63044</b>

**Notes:** Transfer switches are stocked off the shelf in sizes 125 A to 630 A in some sizes, while others are made to order. Contact NHP for availability.

Refer following pages for information on TLP2 logic and TL101 electronic changeover controllers.

Wire interlocks must be used for transfer switches combining MCCBs of different frame size (different heights).

<sup>1)</sup> 4 Pole types are 65 kA rated.

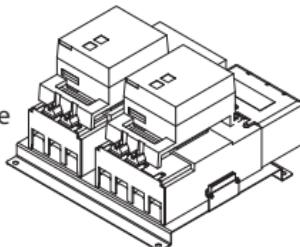
## TemBreak

### Basic Transfer Switches (BTS)

#### 3 or 4 pole combination types

##### **Features / options:**

- Motor driven MCCBs
- 3 or 4 pole MCCB combinations
- Front mounting link interlock used
- Pre-assembled and wired on a mounting plate
- Automatic changeover controller option
- A choice of Relay-Logic, or electronic controllers
- Common load side busbar option
- Conforms to AS/NZS 60947.6.1



##### **BTS selection chart and catalogue numbers**

MCCBs used	Amp range	kA Icu	400 V			3 or 4 Pole outline dimensions (mm)		3 : 4 pole BTS Cat. No.	4 : 3 pole BTS Cat. No.
			H	W	D				
S125GJ	40-63	65						BTSS1GJ6334	BTSS1GJ6343
S125GJ	63-100	65	260	305	180			BTSS1GJ10034	BTSS1GJ10043
S125GJ	80-125	65						BTSS1GJ12534	BTSS1GJ12543
S160GJ	40-63	65						BTSS16GJ6334	BTSS16GJ6343
S160GJ	63-100	65						BTSS16GJ10034	BTSS16GJ10043
S160GJ	100-160	65	279	340	180			BTSS16GJ16034	BTSS16GJ16043
S250GJ	160-250	65						BTSS2GJ25034	BTSS2GJ25043
S250PE	50-125	70	279	340	215			BTSS2PE12534	BTSS2PE12543
S250PE	100-250	70						BTSS2PE25034	BTSS2PE25043
S400NJ	160-250	50						BTSS4NJ25034	BTSS4NJ25043
S400NJ	250-400	50						BTSS4NJ40034	BTSS4NJ40043
S400GJ	160-250	70						BTSS4GJ25034	BTSS4GJ25043
S400GJ	250-400	70	360	415	244			BTSS4GJ40034	BTSS4GJ40043
S400NE	100-250	50						BTSS4NE25034	BTSS4NE25043
S400NE	160-400	50						BTSS4NE40034	BTSS4NE40043
S400GE	100-250	70						BTSS4GE25034	BTSS4GE25043
S400GE	160-400	70						BTSS4GE40034	BTSS4GE40043
S630CE	315-630	50						BTSS6CE63034	BTSS6CE63043
S630GE	315-630	70						BTSS6GE63034	BTSS6GE63043

**Notes:** Transfer switches are stocked off the shelf in sizes 125 A to 630 A in some sizes, while others are made to order. Contact NHP for availability.

Refer following pages for information on TLP2 logic and TL101 electronic changeover controllers.

Transfer switch 'kits' are also available for quick on-site assembly of the above transfer switches. Refer following pages.

Wire interlocks must be used for transfer switches combining MCCBs of different frame size (different heights).

# TemBreak

## Manual transfer switches

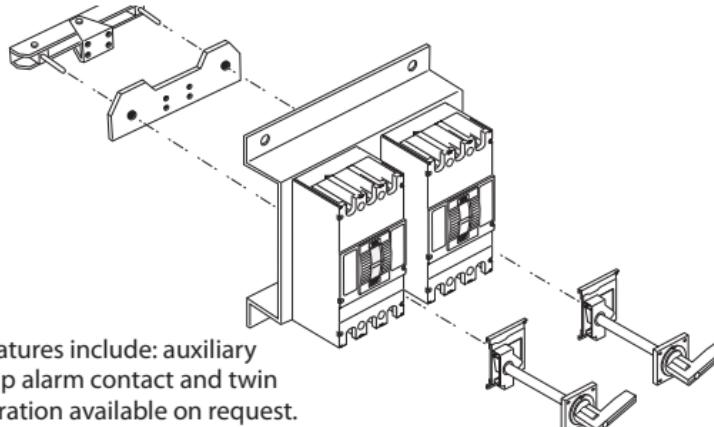
### 3 and 4 pole

**Features / options:**

- 3 or 4 pole types
- Rear walking beam interlock used
- Pre-assembled and wired on a mounting plate
- Will accept handles
- Common load side busbar option
- Conforms to AS/NZS 60947.6.1

**MTS selection chart and catalogue numbers**

MCCBs used	Ampere range	Inter- rupting capac- ity (400 V)				Overall (3 pole) <sup>2)</sup> dimensions (mm)	3 pole MTS Cat. No. <sup>3)</sup>	4 pole MTS Cat. No. <sup>3)</sup>
		Icu	Ics	W	H <sup>1)</sup>			
XS630NJ	250-400	50	25	550	433	182	MS6N433	MS6N444
XS630NJ	400-630	50	25	550	433	182	MS6N633	MS6N644
XS630SE	315-630	50	25	550	433	182	MS6S633	MS6S644
XH630SE	315-630	65	33	550	433	182	MH6S633	MH6S644
XS800NJ	500-800	50	25	550	433	182	MS8N833	MS8N844
XS800SE	400-800	50	25	550	433	182	MS8S833	MS8S844
XH800PE	400-800	65	50	550	433	182	MH8P833	MH8P844
XS1250SE	500-1000	85	65	553	570	198	MS12S1033	MS12S1044
XS1250SE	625-1250	85	65	553	550	198	MS12S1233	MS12S1244
XS1600SE	800-1600	100	75	553	570	198	MS16S1633	MS16S1644
XS2000SE	1000-2000	85	64	774	450	361	MS20E2033	MS20E2044
XS2500SE	1250-2500	85	64	774	450	361	MS25E2533	MS25E2544



Optional features include: auxiliary contacts, trip alarm contact and twin handle operation available on request. Specify when ordering.

- Notes:**
- 1) Height includes attached busbar on MCCBs 630 A and above.
  - 2) Detailed dimensions including 4 pole types refer catalogue Part C.
  - 3) Ordering sheet refer catalogue Part C.

All units are POA.

Transfer switches using 125 - 400 A MCCB are TemBreak 2 types, and are sold in component form. Refer component selection pages in this section.

## TemBreak

### Basic transfer switches (BTS) with motor 3 and 4 pole

#### Features / options:

- Motor driven MCCBs
- 3 or 4 pole types
- Rear walking beam interlock used
- Pre-assembled and wired on a mounting plate
- Automatic changeover controller option
- A choice of Relay-Logic, or electronic controllers
- Common load side busbar option
- Conforms to AS/NZS 60947.6.1



#### Application notes:

- When a TL101CIP electronic controller plus interface panel is used with a TemBreak 1 transfer switch, an interconnection wire loom consisting of 2 cables is also required. This wire loom connects between the interface panel and the standard terminals on the transfer switch. The Cat. No. of the interconnection cable is "TLP2L1CABLE". The cables are 0.5 m long. Longer cable lengths are an option up to 2 metres. Refer page 5 - 32.
- When TLP1 relay controllers are used, an interconnection cable is not required.
- TLP2 relay controllers for TemBreak 2 transfer switches cannot be used with Tembreak 1 transfer switches.

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#### BTS selection chart and catalogue numbers

MCCBs used	Ampere range	Inter-rupting capacity (400 V)				Overall dimensions (3 pole) <sup>3)</sup> (mm)	3 pole BTS Cat. No. <sup>4)</sup>	4 pole BTS Cat. No. <sup>4)</sup>
		Icu	Ics	W	H <sup>1)</sup>			
XS630NJ	250-400	50	25	550	433	341	BS6N433	BS6N444
XS630NJ	400-630	50	25	550	433	341	BS6N633	BS6N644
XS630SE	315-630	50	25	550	433	341	BS6S633	BS6S644
XH630SE	315-630	65	33	550	433	341	BH6S633	BH6S644
XS800NJ	500-800	50	25	550	433	341	BS8N833	BS8N844
XH800SE	400-800	65	33	550	433	341	BH8S833	BH8S844
XS800SE	400-800	50	25	550	433	341	BS8S833	BS8S844
XS1250SE	500-1000	85	65	553	530	300	BS12S1033	BS12S1044
XS1250SE	625-1250	85	65	553	530	300	BS12S1233	BS12S1244
XS1600SE	800-1600	100	75	553	570	320	BS16S1633	BS16S1644
XS2000SE	1000-2000	85	64	774	490	361 <sup>2)</sup>	BS20E2033	BS20E2044
XS2500SE	1250-2500	85	64	774	490	361 <sup>2)</sup>	BS25E2533	BS25E2544

**Notes:** <sup>1)</sup> Height includes attached busbar on sizes 630 A and above.

<sup>2)</sup> Depth does not include rear connect busbars.

<sup>3)</sup> Detailed dimensions 3/4 pole refer catalogue Part C.

<sup>4)</sup> Ordering sheet refer catalogue Part C.

All units are POA.

# TL101 AUTOMATIC TRANSFER SWITCH SYSTEM

High level functionality and ease of use.



POWER PROTECTION

PP-TERASAKI-ATS-CPB

## COMPLETE AUTOMATIC TRANSFER SWITCH SOLUTIONS



### Terasaki TemLogic 2 TL101 automatic transfer switch controller

- Genuine 144 x 144 mm controller solution
- User friendly display and menu selection
- Large selection of functions and options as standard

### Terasaki TemLogic 2 to TemBreak interface panel

- The optional TemBreak interface panel provides a safe link between the Terasaki TemLogic 2 TL101 controller and a temBreak 1 or 2 MCCB transfer switch.
- The TemBreak interface panel comes complete with 'plug 'n' play' style connectors, eliminating the need for separate control and power wiring.

### Terasaki TemBreak 1 or 2 transfer switch

- Large range of amp-frame sizes available
- Enclosed types and options
- Selection of mechanical interlocks
- Suitable for TemBreak 1 or 2 125-2500 A

**TERASAKI**  
Innovators in Protection Technology

# TemBreak

## Basic transfer switches – Component ordering

**125 A (E125, S125) MCCBs fitted with a LINK interlock<sup>1) 2) 3)</sup>**

Item	Description	Comment
1	Left and right side MCCBs	MCCB depth 68 mm <sup>1)</sup>
2	Link mechanical Interlock	For 3 or 4 pole MCCB right side For 3 pole MCCB left side For 4 pole MCCB left side
3	Left & right side 1 C/O alarm switches	Wire type alarm
4	Left & right side 2 C/O auxiliary switches	Wire type auxiliary
5	240 V AC Motor operator	Other voltages available
6	Interlock connection wire	For motor electrical interlocking <sup>4)</sup>
7	WAGO male connector Left	For TLP2 / TL101 controllers only
8	WAGO male connector Right	For TLP2 / TL101 controllers only
9	Optional 3P:3P mounting plate	With pre threaded mounting holes
10	Optional 4P:4P / 4P:3P mounting plate	With pre threaded mounting holes

**125 A (H125, L125) MCCBs fitted with a LINK interlock<sup>1) 2) 3)</sup>**

5	Left and right side MCCBs	MCCB depth 103 mm <sup>1)</sup>
2	Link mechanical interlock	For 3 or 4 pole MCCB right side For 3 pole MCCB left side For 4 pole MCCB left side
3	Left & right side 1 C/O alarm switches	Wire type alarm
4	Left & right side 2 C/O auxiliary switches	Wire type auxiliary
5	240 V AC Motor operator	Other voltages available
6	Interlock connection wire	For motor electrical interlocking <sup>4)</sup>
7	WAGO male connector - Left	For TLP2 / TL101 controllers only
8	WAGO male connector - Right	For TLP2 / TL101 controllers only
9	Optional 3 & 4P mounting plate	With pre threaded mounting holes

**Notes:** 1) The left and right side MCCBs have to be the same depth for correct interlocking function.

2) Where E / S and H / L MCCBs of a different height need to be interlocked, a Cable Interlock must be used. Refer following pages.

3) MCCB marker and capacity size labels can be ordered for mounting on motors etc. Use ratings label sheet Cat. No. T25CAPLAB.

4) One electrical interlock wiring loom is required between motors on motorised transfer switches.

**TemBreak**  
**Manual and basic transfer switches –**  
**Component ordering**

**Component quantity****BTS****Cat. No.**

2	E125, S125NJ/GJ
1	T2ML12RA
1	T2ML12L3A
1	T2ML12L4A
2	T2AL00M3SWA
4	T2AX00M3SWA
2	T2MC12A24NB
1	T2MM25L05A
1	231-612-019-000
1	231-642-019-000
1	T2SB123334
1	T2SB124344

2	H125NJ, L125NJ
1	T2ML125RA
1	T2ML125L3A
1	T2ML125L4A
2	T2AL00M3SWA
4	T2AX00M3SWA
2	T2MC25A24NB
1	T2MM25L05A
1	231-612-019-000
1	231-642-019-000
1	T2SB2533344344



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## TemBreak

### Basic transfer switches – Component ordering

#### **160 A and 250 A MCCBs fitted with a LINK interlock<sup>1) 2) 3)</sup>**

<b>Item</b>	<b>Description</b>	<b>Comment<sup>2) 3)</sup></b>
1	Left or right side MCCBs	MCCB depth 68 mm <sup>1)</sup>
		MCCB depth 103 mm <sup>1)</sup>
2	Link mechanical interlock	For 3 or 4 pole MCCB right side For 3 pole MCCB left side For 4 pole MCCB left side
3	Left & right side 1 C/O alarm switches	Wire type alarm
4	Left & right side 2 C/O auxiliary switches	Wire type auxiliary
5	240 V AC Motor operator	Other voltages available
6	Interlock connection wire	For motor electrical interlocking <sup>4)</sup>
7	WAGO male connector - Left	For TLP2 / TL101 controllers only
8	WAGO male connector - Right	For TLP2 / TL101 controllers only
9	Optional 3 & 4P mounting plate	With pre threaded mounting holes

5

**Notes:** 1) The left and right side MCCBs have to be the same depth for correct interlocking function.

2) Where E / S and H / L MCCBs of a different height need to be interlocked, a Cable Interlock must be used. Refer following pages.

3) MCCB marker and capacity size labels can be ordered for mounting on motors etc. Use ratings label sheet Cat. No. T25CAPLAB.

4) One electrical interlock wiring loom is required between motors on motorised transfer switches.

## ***TemBreak***

### Manual and basic transfer switches – Component ordering

Component quantity	BTS	Cat. No.
	2	S160NJ / GJ ES250NJ / GJ
	2	H160,S250PE H250NJ / NE
	1	T2ML25RA
	1	T2ML25L3A
	1	T2ML25L4A
	2	T2AL00M3SWA
	4	T2AX00M3SWA
	2	T2MC25A24NB
	1	T2MM25L05A
	1	231-612-019-000
	1	231-642-019-000
	1	T2SB253334344

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## TemBreak

### Basic transfer switches – Component ordering

#### 400 A MCCBs fitted with a LINK interlock

<b>Item</b>	<b>Description</b>	<b>Comment<sup>1)</sup><sup>2)</sup></b>
1	Left and right side MCCBs	MCCB depth 103 mm <sup>1)</sup>
		MCCB depth 140 mm <sup>1)</sup>
2	Link mechanical interlock (For motorised MCCBs)	For 3 or 4 pole MCCB right side For 3 pole MCCB left side For 4 pole MCCB left side
3	Link mechanical interlock (for MCCBs with handles)	For 3 or 4 pole MCCB right side For 3 pole MCCB left side For 4 pole MCCB right side
4	Left & right side 1 C/O alarm switches	Wire type alarm
5	Left & right side 2 C/O auxiliary switches	Wire type auxiliary
6	240 V AC Motor operator	Other voltages available
7	Interlock connection wire	For motor electrical interlocking
8	WAGO male connector - Left	For TLP2 / TL101 controllers only
9	WAGO male connector - Right	For TLP2 / TL101 controllers only
10	Optional 3P: 3P mounting plate	With pre threaded mounting holes
11	Optional 4P: 4P / 4P: 3P mounting plate	With pre threaded mounting holes



- Notes:**
- 1) Where E / S and H / L MCCBs of a different height need to be interlocked, a Cable Interlock must be used. Refer following pages.
  - 2) MCCB marker and capacity size labels can be ordered for mounting on motors etc. Refer to page 5 - 36.

***TemBreak***  
**Manual and basic transfer switches –**  
**Component ordering**

Component quantity	BTS	Cat. No.
2		E400NJ S400CJ S400NJ S400NE S400GJ S400GE
2		H400NE L400NE
1		T2ML40RB
1		T2ML40L3B
1		T2ML40L4B
—		T2MLH40RB
—		T2MLH40L3B
—		T2MLH40L4B
2		T2AL00M3SWA
4		T2AX00M3SWA
2		T2MC40A10NB
1		T2MM40L06A
1		231-612-019-000
1		231-642-019-000
1		T2TSB403334MP
1		T2TSB404344MP

## TemBreak

### Basic transfer switches – Component ordering

#### 630 A MCCBs fitted with a LINK interlock<sup>2)</sup><sup>3)</sup>

Item	Description	Comment
1	Left and right side MCCBs	MCCB depth 103 mm <sup>1)</sup>
2	Link mechanical interlock <sup>5)</sup> <sup>6)</sup> (For motorised MCCBs)	For 3 or 4 pole MCCB right side For 3 pole MCCB left side For 4 pole MCCB left side
3	Link mechanical interlock (For MCCBs with handles)	For 3 or 4 pole MCCB right side For 3 pole MCCB left side For 4 pole MCCB right side
3	Left & right side 1 C/O auxiliary switches	Wire type alarm
4	Left & right side 2 C/O auxiliary switches	Wire type auxiliary
5	240 V AC Motor operator	Other voltages available
6	Interlock connection wire	For motor electrical interlocking <sup>4)</sup>
7	WAGO male connector - Left	For TLP2 / TL101 controllers only
8	WAGO male connector - Right	For TLP2 / TL101 controllers only
9	Optional 3P: 3P mounting plate	With pre threaded mounting holes
10	Optional 4P: 4P / 4P: 3P mounting plate	With pre threaded mounting holes

5

- Notes:**
- 1) The Left and Right side MCCBs have to be the same depth for correct interlocking function.
  - 2) Where E / S and H / L MCCBs of a different height need to be interlocked, a Cable Interlock must be used. Refer following pages.
  - 3) MCCB marker and capacity size labels can be ordered for mounting on motors etc. Use ratings label sheet Cat. No. T40CAPLAB.
  - 4) One electrical interlock wiring loom is required between motors on motorised transfer switches.
  - 5) 400 A / 630 A link interlocks must use handles for manual transfer switches.
  - 6) An alternative interlock type is the manual 'slide interlock', which does not require a handle to be fitted. Refer S630 Accessories in Section 3.

***TemBreak***  
**Manual and basic transfer switches –**  
**Component ordering**

Component quantity	BTS	Cat. No.
2		E630NE
		S630CE / GE
1		T2ML40RB
1		T2ML40L3B
1		T2ML40L4B
–		T2MLH40RB
–		T2MLH40L3B
–		T2MLH40L4B
2		T2AL00M3SWA
4		T2AX00M3SWA
2		T2MC40A10NB
1		T2MM40L06A
1		231-612-019-000
1		231-642-019-000
1		T2TSB403334MP
1		T2TSB404344MP

5



## TemBreak

### Manual and basic transfer switches – Component ordering

**125 A (E125, S125) MCCBs fitted with a CABLE interlock<sup>2)</sup><sup>3)</sup>**

Item	Description	Comment
1	Left and right side MCCBs	MCCB depth 68 mm <sup>1)</sup>
2	Cable mechanical interlock	For 3 or 4 pole MCCBs 1.0 m length of cable - option 1 1.5 m length of cable - option 2
3	Left & right side 1 C/O alarm switch	Wire type alarm
4	Left & right side 2 C/O auxiliary switches	Wire type auxiliary
5	240 V AC Motor operator	Other voltages available
6	Interlock connection wire	For motor electrical interlocking <sup>4)</sup>
7	WAGO male connector - Left	For TLP2 / TL101 controllers only
8	WAGO male connector - Right	For TLP2 / TL101 controllers only
9	Optional 3P:3P mounting plate	With pre threaded mounting holes
10	Optional 4P:4P / 4P:3P mounting plate	With pre threaded mounting holes

**125 A (E125, S125) MCCBs fitted with a CABLE interlock<sup>2)</sup><sup>3)</sup>**

Item	Description	Comment
1	Left and right side MCCBs	MCCB depth 103 mm <sup>1)</sup>
2	Cable mechanical interlock	For 3 or 4 pole MCCBs 1.0 m length of cable - option 1 1.5 m length of cable - option 2
3	Left & right side 1 C/O alarm switches	Wire type alarm
4	Left & right side 2 C/O auxiliary switches	Wire type auxiliary
5	240 V AC Motor operator	Other voltages available
6	Interlock connection wire	For motor electrical interlocking <sup>4)</sup>
7	WAGO male connector - Left	For TLP2 / TL101 controllers only
8	WAGO male connector - Right	For TLP2 / TL101 controllers only
9	Optional 3P:3P mounting plate	With pre threaded mounting holes
10	Optional 4P:4P / 4P:3P mounting plate	With pre threaded mounting holes

5

- Notes:**
- 1) Where E / S and H / L MCCBs of a different height need to be interlocked, a Cable Interlock must be used.
  - 2) MCCB marker and capacity size labels can be ordered for mounting on motors etc. Use ratings label sheet Cat. No. T25CAPLAB.
  - 3) Using TemBreak 2 MCCBs and by using a cable interlock, any combination of frame size or poles can be interlocked.
  - 4) One electrical interlocking connection wire is required between motors on motorised transfer switches. Cat. No. T2MM.  
Refer alternate lengths, 160/250 A motor accessories in Section 3.

**TemBreak**  
**Manual and basic transfer switches –**  
**Component ordering**

MTS	Component quantity	BTS	Cat. No.
2		2	E125NJ, S125NJ / GJ
1		1	T2MW12CA
1		1	T2MW00SA
1		1	T2MW00LA
-		2	T2AL00M3SWA
-		4	T2AX00M3SWA
-		2	T2MC12A24NB
-		1	T2MM25L15A
-		1	231-612-019-000
-		1	231-642-019-000
1		1	T2SB123334
1		1	T2SB124344

MTS	Component quantity	BTS	Cat. No.
2		2	H125NJ, L125NJ
1		1	T2MW25CA
1		1	T2MW00SA
1		1	T2MW00LA
-		2	T2AL00M3SWA
-		4	T2AX00M3SWA
-		2	T2MC25A24NB
-		1	T2MM25L15A
-		1	231-612-019-000
-		1	231-642-019-000
1		1	T2SB253334
1		1	T2SB254344

5



## TemBreak

### Manual and basic transfer switches – Component ordering

#### **160 A and 250 A MCCBs fitted with a CABLE interlock <sup>2)3)</sup>**

<b>Item</b>	<b>Description</b>	<b>Comment</b>
1	Left or right side MCCBs	MCCB depth 68 mm <sup>1)</sup>
		MCCB depth 103 mm <sup>1)</sup>
2	Cable mechanical interlock	For 3 or 4 pole MCCBs 1.0 m length of cable - option 1 1.5 m length of cable - option 2
3	Left & right side 1 C/O alarm switch	Wire type alarm
4	Left & right side 2 C/O auxiliary switches	Wire type auxiliary
5	240 V AC Motor operator	Other voltages available
6	Interlock connection wire	For motor electrical interlocking <sup>4)</sup>
7	WAGO male connector - Left	For TLP2 / TL101 controllers only
8	WAGO male connector - Right	For TLP2 / TL101 controllers only
9	Optional 3P:3P mounting plate	With pre threaded mounting holes
10	Optional 4P:4P / 4P:3P mounting plate	With pre threaded mounting holes

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- Notes:**
- 1) Where E / S and H / L MCCBs of a different height need to be interlocked, a Cable Interlock must be used.
  - 2) MCCB marker and capacity size labels can be ordered for mounting on motors etc. Use ratings label sheet Cat. No. T25CAPLAB.
  - 3) Using TemBreak 2 MCCBs and by using a cable interlock, any combination of frame size or poles can be interlocked.
  - 4) One electrical interlocking connection wire is required between motors on motorised transfer switches. Cat. No. T2MM.

***TemBreak***  
**Manual and basic transfer switches –**  
**Component ordering**

MTS	Component quantity	BTS	Cat. No.
2		2	S160NJ / GJ ES250NJ / GJ
2		2	H160, S250PE H250NJ / NE
1		1	T2MW25CA
1		1	T2MW00SA
1		1	T2MW00LA
-		2	T2AL00M3SWA
-		4	T2AX00M3SWA
-		2	T2MC25A24NB
-		1	T2MM25L15A
-		1	231-612-019-000
-		1	231-642-019-000
1		1	T2SB253334
1		1	T2SB254344

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## TemBreak

### Manual and basic transfer switches – Component ordering

#### **400 A MCCBs fitted with a CABLE interlock<sup>2)3)</sup>**

<b>Item</b>	<b>Description</b>	<b>Comment</b>
1	Left and right side MCCBs	MCCB depth 103 mm <sup>1)</sup>
	* 400/ 630 A interlocks must use a motor or handle operator	
		MCCB depth 140 mm <sup>1)</sup>
2	Cable mechanical interlock <sup>5) 6)</sup>	For 3 or 4 pole MCCBs with motors For 3 or 4 pole MCCBs with handles 1.0 m length of cable - option 1 1.5 m length of cable - option 2
3	Left & right side 1 C/O alarm switch	Wire type alarm
4	Left & right side 2 C/O auxiliary switches	Wire type auxiliary
5	240 V AC Motor operator	Other voltages available
6	Interlock connection wire	For motor electrical interlocking <sup>4)</sup>
7	WAGO male connector - Left	For TLP2 / TL101 controllers only
8	WAGO male connector - Right	For TLP2 / TL101 controllers only
9	Optional 3P:3P mounting plate	With pre threaded mounting holes
10	Optional 4P:4P / 4P:3P mounting plate	With pre threaded mounting holes

5

- Notes:**
- 1) Where E / S and H / L MCCBs of a different height need to be interlocked, a Cable Interlock must be used.
  - 2) MCCB marker and capacity size labels can be ordered for mounting on motors etc. Use ratings label sheet Cat. No. T40CAPLAB..
  - 3) Using TemBreak 2 MCCBs and by using a cable interlock, any combination of frame size or poles can be interlocked.
  - 4) One electrical interlocking connection wire is required between motors on motorised transfer switches. Cat. No. T2MM.  
Refer alternate lengths for 400/630 A motor accessories in Section 3.
  - 5) 400 A and 630 A interlocks must use handles for manual transfer switches.
  - 6) An alternative interlock type is a manual "slide interlock", which does not require a handle to be fitted. Slide interlocks will not allow handles or motors to be fitted. Refer 400/630 A accessories in Section 3 for further information.

**TemBreak**  
**Manual and basic transfer switches –**  
**Component ordering**

MTS	Component quantity		Cat. No.
	BTS		
2	2		E400NJ S400CJ S400NJ S400NE S400GJ S400GE
2	2		H400NJ / NE L400NJ / NE
-	1		T2MW40CB
-	1		T2MWH40CB
1	1		T2MW00SA
1	1		T2MW00LA
-	2		T2AL00M3SWA
-	4		T2AX00M3SWA
-	2		T2MC40A10NB
-	1		T2MM40L21A
-	1		231-612-019-000
-	1		231-642-019-000
1	1		T2TSB403334MP
1	1		T2TSB404344MP

5



## TemBreak

### Manual and basic transfer switches – Component ordering

**630 A MCCBs fitted with a CABLE interlock<sup>2)3)</sup>**

Item	Description	Comment
1	Left and right side MCCBs	MCCB depth 103 mm <sup>1)</sup>
2	Cable mechanical interlock <sup>5) 6)</sup>	For 3 or 4 pole MCCBs with motors For 3 or 4 pole MCCBs with handles 1.0 m length of cable - option 1 1.5 m length of cable - option 2
3	Left & right side 1 C/O alarm switches	Wire type alarm
4	Left & right side 2 C/O auxiliary switches	Wire type auxiliary
5	240 V AC Motor operator	Other voltages available
6	Interlock connection wire	For motor electrical interlocking <sup>4)</sup>
7	WAGO male connector - Left	For TLP2 / TL101 controllers only
8	WAGO male connector - Right	For TLP2 / TL101 controllers only
9	Optional 3P:3P mounting plate	With pre threaded mounting holes
10	Optional 4P:4P / 4P:3P mounting plate	With pre threaded mounting holes

5

- Notes:**
- 1) Where E / S and H / L MCCBs of a different height need to be interlocked, a Cable Interlock must be used.
  - 2) MCCB marker and capacity size labels can be ordered for mounting on motors etc. Use ratings label sheet Cat. No. T40CAPLAB..
  - 3) Using TemBreak 2 MCCBs and by using a cable interlock, any combination of frame size or poles can be interlocked.
  - 4) One electrical interlocking connection wire is required between motors on motorised transfer switches. Cat. No. T2MM.  
Refer alternate lengths for 400/630 A motor accessories in Section 3.
  - 5) 400 A and 630 A interlocks must use handles for manual transfer switches.
  - 6) An alternative interlock type is a manual "slide interlock", which does not require a handle to be fitted. Slide interlocks will not allow handles or motors to be fitted. Refer 400/630 A accessories in Section 3 for further information.

**TemBreak**  
**Manual and basic transfer switches –**  
**Component ordering**

MTS	Component quantity BTS	Component quantity	Cat. No.
		BTS	
2	2		E630NE S630CE / GE
1	1		T2MW00CB
1	1		T2MWH40CB
1	1		T2MW00SA
1	1		T2MW00LA
-	2		T2AL00M3SWA
-	4		T2AX00M3SWA
-	2		T2MC40A10NB
-	1		T2MM40L21A
-	1		231-612-019-000
-	1		231-642-019-000
1	1		T2TSB403334MP
1	1		T2TSB404344MP

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## TemBreak Automatic transfer switches (ATS) Logic controller for Tembreak 2

### Timer / Relay logic controller

NHP offers a choice of electromagnetic (relay) logic panels with various options, or a PLC controller type. The basic timer/relay logic controller includes the following standard features:

- Voltage and phase sequence sensing relay
- Time delay normal to emergency and back
- Common power supply relays
- Normal supply phase sequence relay
- Control wiring terminals
- A 4 position mode selector switch is provided loose (Manual / Automatic / Test / Off) - SSW5
- Optional PLC logic panel (TLPc2)



**TLP2**  
Relay/timer  
Controller panel

### TLP logic controller and options

Description	Cat. No. <sup>1)</sup>	Price \$
Logic Panel for Tembreak 2 ATS	<b>TLP2</b>	<b>2250.00</b>

5

Option <sup>1,2)</sup>	Description	Cat. No. <sup>1)</sup>	Price \$
2	Emergency supply phase sequence and voltage sensing relays	<b>EPSR / EVSR</b>	<b>310.00</b>
3	Emergency supply frequency relay	<b>EFR</b>	<b>560.00</b>
4	Engine run-on time delay	<b>ERTD</b>	<b>335.00</b>
5	Engine start time delay	<b>ESTD</b>	<b>305.00</b>
6	Inhibit return control (Prevents auto-return to normal from emergency)	<b>IRC</b>	<b>119.00</b>
7	Cranking limiter time delay	<b>CLTD</b>	<b>310.00</b>
8	Additional mode selection 'Normal supply'	<b>SSW2</b>	<b>390.00</b>
9	Additional contacts for remote indication of mode switch position (includes option 8)	<b>SSW3</b>	<b>405.00</b>
10	Alarm lock-out relay. (Prevents breaker closure after overload or short circuit trip)	<b>ALR</b>	<b>465.00</b>
13	Mains stability timer	<b>MST</b>	<b>210.00</b>
14	Surge protection – single phase	<b>SPD1</b>	<b>210.00</b>
15	Surge protection – 3 phase	<b>SPD3</b>	<b>280.00</b>

**Notes:** 1) NHP has limited the number of gear tray plates to three (3) standard sizes, which cover all optional features.

2) NHP stock basic TLP2 logic panels. All others are built to order. Standard and custom logic panel ordering sheet, refer Catalogue Part C. Due to component and wiring differences, TemBreak 1 logic panels are not configured to work with TemBreak 2 Transfer Switches and vice versa.

**Do not use TLP1 with TemBreak 2 Motor operators otherwise motor burnout will occur. Use TLP2 for TemBreak 2.**

## TemBreak

### Automatic transfer switches (ATS)

#### Logic controller for Tembreak 1

#### Timer / Relay logic controller

NHP offers a choice of electromagnetic (relay) logic panels with various options, or a PLC controller type. The basic timer/ relay logic controller includes the following standard features:

- Voltage and phase sequence sensing relay
- Time delay normal to emergency and back
- Common power supply relays
- Normal supply phase sequence relay
- Control wiring terminals
- A 4 position mode selector switch is provided loose (Manual / Automatic / Test / Off) - SSW1
- Optional PLC logic panel (TLPc1)



#### TLP logic controller and options

Description	Cat. No. <sup>1)</sup>	Price \$
Logic Panel for Tembreak 1 ATS	TLP1	2250.00

Option <sup>1,2)</sup> Description	Cat. No. <sup>1)</sup>	Price \$
2 Emergency supply phase sequence and voltage sensing relays	EPSR / EVSR	310.00
3 Emergency supply frequency relay	EFR	560.00
4 Engine run-on time delay	ERTD	335.00
5 Engine start time delay	ESTD	305.00
6 Inhibit return control (Prevents auto-return to normal from emergency)	IRC	119.00
7 Cranking limiter time delay	CLTD	310.00
8 Additional mode 'Normal supply'	SSW2	390.00
9 Additional contacts for remote indication of mode switch position (includes option 8)	SSW3	405.00
10 Alarm lock-out relay (Prevents breaker closure after MCCB trip.)	ALR	465.00
11 Changeover time delay (required for ACB C/O switch)	COTD	365.00
13 Mains stability timer	MST	210.00
14 Surge protection – single phase	SPD1	210.00
15 Surge protection – 3 phase	SPD3	280.00

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**Notes:** <sup>1)</sup> NHP has limited the number of gear tray plates to three (3) standard sizes, which cover all optional features.

<sup>2)</sup> NHP stock basic TLP1 logic panels. All others are built to order. Standard and custom logic panel ordering sheet, refer catalogue Part C. Do not use TLP1 with TemBreak 2 Motor operators otherwise motor burnout will occur. Use TLP2 for TemBreak 2.

## **TemLogic**

### TL101 Transfer switch controller

The Temlogic2 TL101 automatic transfer switch controller will control and supervise the primary and secondary power of an installation and initiate transferring of the mains to a back-up source in the event of main source interruption. The changeover from one power source to the other can be fully automatic or manually operated. The logic controller includes all necessary features to monitor energy distribution systems or generating sets, and transfer equipment, such as motorised circuit breakers.



The TL101 is simply programmed from the front panel with visual LED indication or can be pre-programmed by NHP. The circuit breakers can be manually controlled using the function keys on the front face of the controller.

#### **TL101 Provides:**

Control of minimum voltage, maximum voltage, phase loss, asymmetry, minimum frequency, maximum frequency, with independent enable and delay.

FOR  
 TEMBREAK 1  
 & TEMBREAK 2  
 TRANSFER  
 SWITCHES

#### **Front panel operation and display**

Refer Part C Section 8 or TL101 manual.

5

#### **Technical features**

- Flush mount 144 mm<sup>2</sup> housing
- Plug-in removable connections
- Phase to phase voltage measure inputs: 80-800 V AC
- Voltage transformer programming
- True RMS voltage measure
- Frequency measurement 45-65 Hz
- Control functions: phase sequence, phase loss, maximum/minimum voltage, asymmetry, maximum/minimum frequency
- Two displays for voltage/frequency viewing
- 8 digital programming inputs/ 7 relay programmable outputs
- RS 232 interface (refer NHP for RS 485)
- Modbus communication <sup>1)</sup>

**Notes:** 1) Modbus communications: A 24 V DC power supply is needed.

## TemLogic

### TL101 Transfer switch controller

#### Interface panel

The interface panel provides short circuit protection via fuses between the transfer switch and TL101 controller. The interface panel comes complete with pre-terminated cable looms, enabling fast 'plug 'n' play' electrical connection between system components.

#### Ordering details - controller and interface panel

Heading	Cat. No.	Price \$
TemLogic2 TL101 controller only	<b>TL101240V</b>	<b>1900.00</b>
TemLogic2 TL101 controller plus interface panel <sup>2)</sup>	<b>TL101CIP</b>	<b>2990.00</b>
TemBreak 1 Transfer switch inter-connection cable (0.5 m standard length or refer next page)	<b>TLP2L1LCABLE<sup>1)</sup></b>	<b>114.00</b>

- Notes:** <sup>1)</sup> This cable is used to connect between a TL101 electronic controller interface panel (LTLP2 or LTLP2S) and a standard TemBreak 1 transfer switch. Refer page 5 - 33 for a features comparison table between TLP1, TLP2 & TL101.
- <sup>2)</sup> Modbus communications: A 24 V DC power supply is needed.

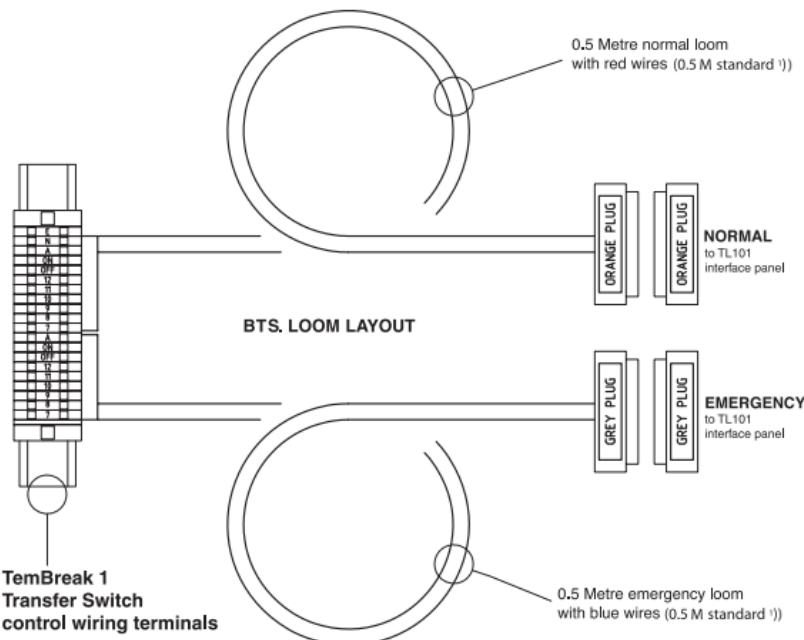
## TemBreak Basic Transfer Switch (BTS)

### Inter-connection cable for Tembreak 1 transfer switches using TLP1 controllers

#### **TLP2L1LCABLE**

For use with a TL101 CIP (electronic controller and interface panel) when used with a TemBreak 1 transfer switch.

The connector cable connects to the standard BTS control wiring terminals.



#### **Red and blue cable lengths**

	Cat. No.	Price \$
0.5 m (standard)	<b>TLP2L1LCABLE</b>	<b>114.00</b>
1.0 m	<b>TLP2L1CABLE10</b>	<b>125.00</b>
1.5 m	<b>TLP2L1CABLE15</b>	<b>140.00</b>
2.0 m	<b>TLP2L1CABLE20</b>	<b>156.00</b>
2.5 m	<b>TLP2L1CABLE25</b>	<b>176.00</b>
3.0 m	<b>TLP2L1CABLE30</b>	<b>197.00</b>

**Notes:** 1) Alternate interconnecting cable lengths are available on application. Refer NHP catalogue numbers for the alternate lengths indicated above.

**TemLogic****Temlogic controller types****For Tembreak 1 and 2 transfer switches**

This page is a cross reference of features and options. For more specific information on each controller type, refer to the previous pages.

**CONTROLLER TYPES****Features and options cross reference<sup>1)</sup>**

Standard and optional features	Cat. No.	Relay/Timer controller to suit	Relay/Timer controller to suit	Electronic controller unit to suit
		TemBreak 1 MCCBs	TemBreak 2 MCCBs	TemBreak 1 or 2 MCCBs
Normal voltage sensing phase failure relay	(NVSR)	✓	✓	✓
Time delay emergency to normal	(TDEN)	✓	✓	✓
Time delay normal to emergency	(TDNE)	✓	✓	✓
Common power supply relay	(CPSR)	✓	✓	✓
2 Emergency supply phase sequence relay	(EPSR)	0	0	✓
Emergency supply voltage sensing relay	(EVSR)	0	0	✓
3 Emergency supply frequency relay	(EFR)	0	0	✓
4 Engine run-on time delay	(ERTD)	0	0	✓
5 Engine start time delay	(ESTD)	0	0	✓
6 Inhibit return control	(IRC)	0	0	✓
7 Cranking limiter time delay	(CLTD)	0	0	–
8 Additional mode selection 'Normal supply'	(SSW2)	0	0	✓
9 Additional contacts for remote indication of mode switch position	(SSW3)	0	0	✓
10 Alarm lock-out relay	(ALR)	0	0	✓
11 Changeover time delay	(COTD)	0	0	✓
13 Mains stability timer	(MST)	0	0	✓
Interface with building management system		– <sup>1)</sup>	– <sup>1)</sup>	✓
Load shedding control		–	–	✓
14 Surge protection single phase(SPD1)	(SPD1)	0	0	0
15 Surge protection 3 phase	(SPD3)	0	0	0
16 Modbus communications		–	–	TL102 required (RS485)

✓ = Standard,

O = Optional

– = Not available

**Notes:** 1) PLC logic panels: TLPC2 and TLPC1 are available as options. Refer NHP. NHP PLC logic panels are ideally suited to BMS applications due to the multiple I/O of the PLC providing status to the BMS.

# TemLogic

## Basic Transfer Switches (BTS) and Manual Transfer Switches (MTS)

### Options and accessories

Common loadside busbars – for connection to BOTTOM of MCCBs<sup>2)</sup>

Tembreak 2: 250 – 630 A, Tembreak 1: 630 – 1250 A

3 pole CLSBB

Busbar Amp Rating	Dimensions (mm)			3 pole set Cat. No.
	H	W	D	
250 A <sup>1)</sup>	349	340	176	T2CLSB25033
400 A <sup>1)</sup>	505	415	244	T2CLSB40033
630 A <sup>1)</sup>	505	415	244	T2CLSB63033
630/800 A	633	550	341	CLSB63033
1000/1250	950	553	301	CLSB125033

4 pole CLSBB

Busbar Amp Rating	Dimensions (mm)			4 pole set Cat. No.
	H	W	D	
250 A <sup>1)</sup>	349	340	176	T2CLSB25044
400 A <sup>1)</sup>	505	415	244	T2CLSB40044
630 A <sup>1)</sup>	505	415	244	T2CLSB63044
630/800 A	633	690	341	CLSB63044
1000/1250	950	693	301	CLSB125044

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### 3 & 4 pole combination CLSBB

Busbar Amp Rating	Dimensions (mm)			4 P and 3 P set Cat. No.
	H	W	D	
250 A <sup>1)</sup>	349	340	176	T2CLSB25043
400 A <sup>1)</sup>	505	415	244	T2CLSB40043
630 A <sup>1)</sup>	505	415	244	T2CLSB63043
630/800 A	633	550/690	341	-
1000/1250	950	553/693	301	-



250 A Transfer switch  
Common loadside bars  
(for MCCB loadside only)



400 – 630 A Transfer switch  
Common loadside bars  
(for MCCB loadside only)

**Notes:** 1) Do not fit TemBreak 1 transfer switches.

2) Bars not designed for MCCB top mounting. Refer NHP for options.

## Automatic transfer switches

### Interlocked and enclosed types

#### Cable mechanical interlocked MCCBs

##### TemBreak 1 types

The cable wire is supplied. Please specify length.

##### TemBreak 2 types

Any combination of 125 – 630 A can be interlocked by a cable interlock.

 Cable  
interlocking  
for vertical /  
horizontal /  
diagonal  
mounting


125 A and 250 A MCCBs shown.  
(S125NJ / H250NJ)



Interlocked 3 pole types  
MCCB to MCCB: 2000 A and 400 A

#### Enclosed automatic transfer switches, free-standing or wall mounted

Enclosed automatic transfer switches are assembled to order from stock components on a fast-track delivery system. The basic transfer switch section and associated logic panel are housed inside a pre-specified enclosure. A mode selector is supplied as standard and optional indicator lights may be mounted externally on the cabinet door.

##### Standard features include:

- IP 65 rated enclosure
- Common loadside busbars
- Standard 240 V control (other voltage on application)
- Neutral and earth bars

##### Optional features:

- Busbar flags for large cable termination
- Pushbuttons or other front controls



Enclosed transfer switch

## TemBreak<sup>2</sup> Accessories

**to suit 125 - 630 AF MCCBs External accessories**

### MCCB rating labels

Can be used to identify the MCCBs ratings and type when a motor or interlock is fitted to an MCCB.



### Accessory label sheets - stocked

A4 sheets with multiple small catalogue number and rating labels for TemBreak2 MCCBs

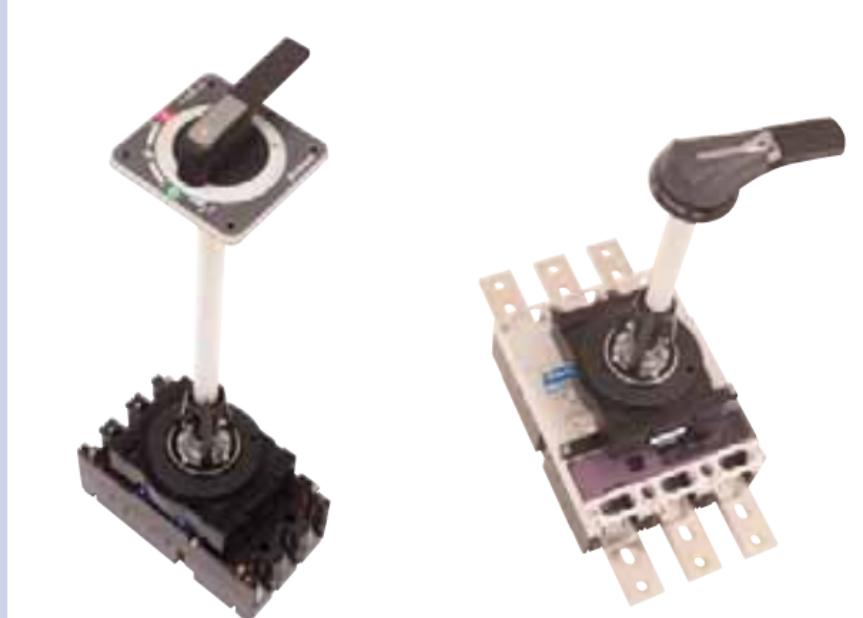
125 AF	T12CAPLAB	3.50
160/250 AF	T25CAPLAB	3.50
400/630 AF	T40CAPLAB	3.50
MCCB types	Left side Marker label Cat. No.	Rights side Marker label Cat. No.
E125NJ	2H4322SAB	2H4324SAA
S125NJ	2H4223SAB	2H4218SAA
S125GJ	2H4223SAB	2H4219SAA
H125NJ	2H4299SAA	2H4307SAA
L125NJ	2H4300SAA	2H4308SAA
S160NJ	2H4227SAB	2H4221SAB
S160GJ	2H4227SAB	2H4222SAB
H160NJ	2H4299SAA	2H4307SAA
L160NJ	2H4300SAA	2H4308SAA
E250NJ	2H4224SAB	2H4220SAA
S250NJ	2H4227SAB	2H4221SAB
S250GJ	2H4227SAB	2H4222SAB
S250PE	2H4277SAB	2H6972SAA
H250NJ	2H4299SAA	2H4307SAA
H250NE	2H4299SAA	2H6973SAA
L250NJ	2H4300SAA	2H4308SAA
E400NJ	2H5161SAB	2H5162SAA
E400CJ	2H5153SAB	2H5331SAA
S400NJ	2H5153SAB	2H5154SAA
S400GJ	2H5153SAB	2H5155SAA
S400GE	2H5153SAB	2H6198SAA
E630NE	2H5161SAB	2H6871SAA
S630CE	2H5153SAB	2H6872SAA
S630GE	2H5153SAB	2H6873SAA

### Isolator switches

S125NN	2H4645SAB	2H4648SAB	7.20
S160NN	2H4650SAC	2H4653SAB	7.20
S250NN	2H4650SAC	2H4653SAB	7.20
S400NN	2H5364SAC	2H5365SAB	7.20
S630NN	2H5364SAC	2H5365SAB	7.20

**TemBreak 1, 630 A - 1600 A and 1000 V mining MCCBs**

	Page
Selection and location guide for MCCBs	<b>6 - 2</b>
2013 stocking guide for 125 A - 400 A TemBreak 1 MCCBs	<b>6 - 3</b>
<b>MCCBs and accessories</b>	
VS125NJ 1000 V MCCB	<b>6 - 5</b>
VS250NJ 1000 V MCCB	<b>6 - 6</b>
TL100EM 1000 V MCCB	<b>6 - 7</b>
XV400NE 1000 V MCCB	<b>6 - 9</b>
XS/XH630/800	<b>6 - 13</b>
XV630/800 1000 V MCCB	<b>6 - 24</b>
XS1250SE	<b>6 - 28</b>
XV1250NE 1000 V MCCB	<b>6 - 30</b>
XS1600SE	<b>6 - 31</b>
TL630NE	<b>6 - 32</b>
TL800NE	<b>6 - 33</b>
TL1250NE	<b>6 - 34</b>



## TemBreak 1 – selection and location guide

Amps	kA	OCR Type	Base current adj.	TemBreak Cat. No.	CPB Sect.
0.7-12	85	Hydraulic/magnetic	Fixed	XM30PB	3
16-125	14	Thermal magnetic	Fixed	XS125CS	-
16-125	25	Thermal magnetic	Fixed	XS125NS	-
12.5-125	18	Thermal magnetic	63-100 %	XS125CJ	-
12.5-125	25	Thermal magnetic	63-100 %	XS125NJ	-
12.5-125	50	Thermal magnetic	63-100 %	XH125NJ	-
12.5-125	50	Thermal magnetic	63-100 %	XH125PJ	-
100-250	25	Thermal magnetic	63-100 %	XS250NJ	-
100-250	50	Thermal magnetic	63-100 %	XH250NJ	-
160-250	65	Thermal magnetic	63-100 %	XH250PJ	-
160-400	35	Thermal magnetic	63-100 %	XS400CJ	-
160-400	50	Thermal magnetic	63-100 %	XS400NJ	-
250-400	65	Thermal magnetic	63-100 %	XH400PJ	-
80-400	50	Electronic	50-100 %	XS400SE	-
80-400	65	Electronic	50-100 %	XH400SE	-
125-400	65	Electronic	50-100 %	XH400PE	-
250-630	42	Thermal magnetic	63-100 %	XS630CJ	-
250-630	50	Thermal magnetic	63-100 %	XS630NJ	6
250-630	85	Thermal magnetic	63-100 %	XH630PJ	6
315-630	50	Electronic	50-100 %	XS630SE	6
315-630	65	Electronic	50-100 %	XH630SE	6
315-630	65	Electronic	50-100 %	XH630PE	6
500-800	50	Thermal magnetic	63-100 %	XS800NJ	6
500-800	85	Thermal magnetic	63-100 %	XH800PJ	6
400-800	50	Electronic	50-100 %	XS800SE	6
400-800	65	Electronic	50-100 %	XH800SE	6
400-800	65	Electronic	50-100 %	XH800PE	6
500-1250	85	Electronic	50-100 %	XS1250SE	6
800-1600	100	Electronic	50-100 %	XS1600SE	6
1000-2000	85	Electronic	50-100 %	XS2000NE	3
1250-2500	85	Electronic	50-100 %	XS2500NE	3
12.5-100	85	Thermal magnetic	63-100 %	TL100NJ	-
100-250	85	Thermal magnetic	63-100 %	TL250NJ	-
200-400	85	Electronic	50-100 %	TL400NE	-
315-630	125	Electronic	50-100 %	TL630NE	6
400-800	125	Electronic	50-100 %	TL800NE	6
500-1250	125	Electronic	50-100 %	TL1250NE	6
630-2500	20-40	Magnetic	63-100 %	XS-ND	3
15-100	10	Thermal magnetic	Fixed	TL100EM	6
80-400	12.5	Electronic	50-100 %	XV400NE	6
200-630	18	Electronic	50-100 %	XV630PE	6
400-800	18	Electronic	50-100 %	XV800PE	6
200-1250	20	Electronic	50-100 %	XV1250NE	6

**Notes:** TemBreak 1 and 2 cross reference chart, refer section 3.

## 2013 stocking guide:

### 125 A - 400 A TemBreak 1 MCCBs

This table can be used as a guide for situations where an older TemBreak 1 MCCB must be used. TemBreak 1 consists of the 'TemBreak' and 'TemBreak PLUS' series of MCCBs.

The breakers marked 'stocked' can be used to replace those others which are not stocked. The stocked types will typically have a higher kA rating.<sup>2)</sup>

#### MCCBs contained in CPB section 6: Standard MCCBs

Amps	kA rating	OCR type	Base current adjustment	TB1 type stocked in 2012	MCCB type Cat. No.
12.5	85	Therm Mag	Fixed	stocked	XM30PB
16-125	14	Therm Mag	Fixed	use XS125NS	XS125CS
16-125	25	Therm Mag	Fixed	stocked	XS125NS
12.5-125	18	Therm Mag	63-100 %	use XH125NJ	XS125CJ
12.5-125	25	Therm Mag	63-100 %	use XH125NJ	XS125NJ
12.5-125	50	Therm Mag	63-100 %	stocked	XH125NJ
12.5-125	50	Therm Mag	63-100 %	use XH125NJ <sup>2)</sup>	XH125PJ
125-225	18	Therm Mag	Fixed	use E250NJ <sup>2)</sup>	XE225NC
100-160	50	Therm Mag	63-100 %	use XH250NJ/160 <sup>2)</sup>	XH160PJ
100-250	25	Therm Mag	63-100 %	stocked	XS250NJ
100-250	50	Therm Mag	63-100 %	stocked	XH250NJ
100-250	65	Therm Mag	63-100 %	use S400GJ/250 <sup>1)</sup>	XH250PJ
160-400	35	Therm Mag	63-100 %	use XS400NJ	XS400CJ
160-400	50	Therm Mag	63-100 %	stocked	XS400NJ
160-400	65	Therm Mag	63-100 %	use XH400SE <sup>2)</sup>	XH400PJ
125-400	50	Electronic	50-100 %	use XH400SE	XS400SE
125-400	65	Electronic	50-100 %	stocked	XH400SE
125-400	65	Electronic	50-100 %	use XH400SE <sup>2)</sup>	XH400PE
250-630	42	Therm Mag	63-100 %	use XS630NJ	XS630CJ
250-630	50	Therm Mag	63-100 %	stocked	XS630NJ
250-630	85	Therm Mag	63-100 %	stocked	XH630PJ
315-630	50	Electronic	50-100 %	stocked	XS630SE
315-630	65	Electronic	50-100 %	stocked	XH630SE
315-630	65	Electronic	50-100 %	stocked	XH630PE
12.5-100	85	Therm Mag	50-100 %	use H125NJ	TL100NJ
160-250	85	Therm Mag	50-100 %	use H250NJ <sup>1)</sup>	TL250NJ
200-400	85	Electronic	50-100 %	use S400PE	TL400NE

- Notes:**
- 1) TemBreak 2 MCCB. This is an electrical equivalent, though check the application as the physical size of the TemBreak 2 equivalent will be different.
  - 2) Ics ratings are lower on SE / NJ types compared to PE / PJ types. TemBreak 1 and 2 cross reference chart refer section 3.

## 2012 stocking guide:

### 125 A - 400 A TemBreak 1 MCCBs

#### Mining MCCBs

Amps	kA rating	OCR type	Base current adjustment	TB1 type stocked in 2012	MCCB type Cat. No.
15-100	10	Therm Mag	Fixed	stocked	TL100EM
80-400	12.5	Therm Mag	Fixed	stocked	XV400NE
200-630	18	Electronic	50-100 %	stocked	XV630PE
400-800	18	Electronic	50-100 %	stocked	XV800PE
200-1250	20	Electronic	50-100 %	stocked	XV1250NE

#### Non auto / switch disconnectors

Amps	kA rating	OCR type	Base current adjustment	TB1 type stocked in 2012	MCCB type Cat. No.
125	-	Non Auto	Fixed	use S125NN <sup>1)</sup>	XS125NN
250	-	Non Auto	Fixed	stocked	XS250NN
400	-	Non Auto	Fixed	use S400NN <sup>1)</sup>	XS400NN
630	-	Non Auto	Fixed	use S630NN <sup>1)</sup>	XS630NN

**Notes:** 1) TemBreak 2 MCCB. This is an electrical equivalent, though check the application as the physical size of the TemBreak 2 equivalent will be different.

## 1000V AC Mining MCCBs

### VS125NJ

**6 kA****Current rating:** 12.5-125 A**Approvals and tests:** Standards AS/NZS 3947-2, and IEC60947-2**Interrupting capacity:**

Voltage	Icu kA	Ics kA	Types
AC use	1100	4	20 A, 32 A
	1100	6	50 A, 63 A, 100 A, 125 A

**Trip unit:****Adjustable thermal:** 63 % Ir to 100% Ir**Adjustable magnetic:** 6 x Im to 12 x Im for 20 – 100 A trip unit types

6 x Im to 10 x Im for 125 A trip unit types

**Dimensions (mm)**

Poles	3
H	155
W	90
D (less toggle)	68



Amp rating NRC	Adj. Ir Min.	Adj. Ir Max.	Adj. Im Min.	Adj. Im Max.	Cat. No.	Price \$
20	12.5	20	120	240	VS125NJ320	1250.00
32	20	32	192	384	VS125NJ332	1250.00
50	32	50	300	600	VS125NJ350	1250.00
63	40	63	378	756	VS125NJ363	1250.00
100	63	100	600	1200	VS125NJ3100	1250.00
125	80	125	750	1250	VS125NJ3125	1450.00

6

**Notes:** The rear insulation barrier, terminal covers, and terminal screw caps supplied with the MCCB, must be used for MCCB installation.

For internal and external accessory selection refer TemBreak 2 standard 125/250 AF accessories, section 3.

NRC: Nominal rated current

Adj. Ir: Adjustable thermal setting

Adj. Im: Adjustable magnetic setting

**Replaces: TL100EM. Check exact ratings and dimensions to suit your application requirement.**

## 1000V AC Mining MCCBs

### VS250NJ

**6 kA****Current rating:** 100 – 250A**Approvals and tests:** Standards AS/NZS 3947-2, and IEC60947-2**Interrupting capacity:**

Voltage	Icu kA	Ics kA
AC use 1100	6	4

**Trip unit:****Adjustable thermal:** 63% Ir to 100% Ir**Adjustable magnetic:**  $6 \times I_m$  to  $13 \times I_m$  for 160 A trip unit types $6 \times I_m$  to  $10 \times I_m$  for 250 A trip unit types**Dimensions (mm)**

Poles	3
H	165
W	105
D (less toggle)	68

Amp rating NRC	Adj. Ir Min.	Adj. Ir Max.	Adj. I <sub>m</sub> Min.	Adj. I <sub>m</sub> Max	Cat. No.	Price \$
160	100	160	960	2080	VS250NJ3160	1750.00
250	160	250	1500	2500	VS250NJ3250	1850.00

**Notes:** The rear insulation barrier, terminal covers, and terminal screw caps supplied with the MCCB, must be used for MCCB installation.

For internal and external accessory selection refer TemBreak 2 standard 125/250 AF Accessories, section 3.

NRC: Nominal rated current

Adj. Ir: Adjustable thermal setting

Adj. I<sub>m</sub>: Adjustable magnetic setting

## TemBreak 1000 V mining circuit breakers TL100EM

**50 kA****Current rating:** 15-100 A

**Approvals and tests:** Complies with AS 2184 /  
AS/NZS 3947-2  
Complies with IEC 60947-2

**Interrupting capacity:** 10 kA at 900 V AC (sym)  
6.5 kA at 1100 V AC (sym) <sup>1)</sup>

**Trip unit:** Fixed

**Thermal setting:** Fixed 40 °C industrial  
45 °C and 50 °C marine

**Magnetic setting:** Fixed**Dimensions (mm)**

Poles	3
H	165
W	105
D (less toggle)	125
Weight (kg)	3.2

Ampere rating	Cat. No.	Price \$
15	TL100EM 15 3K	2330.00
20	TL100EM 20 3K	2330.00
30	TL100EM 30 3K	2330.00
40	TL100EM 40 3K	2330.00
50	TL100EM 50 3K	2330.00
60	TL100EM 60 3K	2330.00
75	TL100EM 75 3K	2330.00
100	TL100EM 100 3K	2330.00

Refer previous  
pages for new  
VS125/250  
1000 V MCCBs

**Notes:** <sup>1)</sup> Ratings based upon IEC 60947-2.  
TL100EM must use line-side terminal cover supplied with MCCB.

## Accessories to suit TL100EM / F

### Internal accessories

Description		Cat. No.	Price \$
Shunt trips	110 V AC sht (100-115 V)	<b>7VF 2M1</b>	<b>280.00</b>
	240 V AC sht (200-480 V)	<b>7VF 2M2-B</b>	<b>280.00</b>
	48 V DC sht	<b>7VF 2M6</b>	<b>280.00</b>
	24 V DC sht	<b>7VF 2M7</b>	<b>280.00</b>
Undervoltage trips	440 V AC	<b>7UF 2D5B</b>	<b>360.00</b>
	110 V AC	<b>7UF 2D6B</b>	<b>360.00</b>
	240 V AC	<b>7UF 2D7B</b>	<b>360.00</b>
	110 V DC	<b>7UF 2FD1</b>	<b>360.00</b>
	24 V DC	<b>7UF 2FD2</b>	<b>360.00</b>
Auxiliary switches	AUX SW right hand 1C	<b>7XA 2D31B</b>	<b>245.00</b>
	AUX SW left hand 1C	<b>7XA 2D41B</b>	<b>245.00</b>
Alarm switches	ALT SW right hand	<b>7AB 2D11B</b>	<b>245.00</b>

### External accessories

Description		Cat. No.	Price \$
Screw tunnel lugs	3 P solderless term. (6)	<b>7T 2M1</b>	<b>110.00</b>
Rear connect studs	3 P RC studs (6)	<b>7RC 2LE</b>	<b>210.00</b>
Motor operators	110 V AC motor	<b>7MB 3BA1</b>	<b>1910.00</b>
Handle operators	Door interlocking handle kit	<b>TFH 22D</b>	<b>335.00</b>
	IP 55 handle kit (plastic)	<b>TL100EMR5GM</b>	<b>390.00</b>
	IP 65 handle kit (plastic)	<b>TL100EMR6BN<sup>1)</sup></b>	<b>280.00</b>
	IP 65 handle kit (metal)	<b>YASD22D</b>	<b>445.00</b>
Toggle locks	IP 55 direct mounting handle kit	<b>TFJ 22LU</b>	<b>355.00</b>
	Toggle lock	<b>7KB 3BA</b>	<b>60.00</b>
	Lock plate	<b>UXKE0030A</b>	<b>2.20</b>
Accessory lead terminal	Accessory lead terminal, black	<b>7YD3</b>	<b>55.00</b>

**Notes:** 1) 'HS' handle option Cat. No. TL100EMR5GM (IP 55).

**TemBreak 1000 V  
mining circuit breakers Electronic XV400NE**

12.5 kA

**Current rating: 80-400 A**

**Approvals and tests:** Standards AS/NZS 3947-2  
Complies with IEC 60947-2

**Interrupting capacity:** 12.5 kA at 1000/1100 V AC,  
(IEC 60947-2)

### Trip unit:

Trip unit:	Fixed	
LTD adjustment:	$I_1$ : 0.8-1	t: 5-30 s
STD adjustment:	$I_2$ : 2-10	t: 0.1-0.3 s
INST adjustment:	$I_3$ : 3-12	
Instantaneous Adj:	$I_p$ : 0.7-1	t: fixed at 40 s (sep control power req.)



## Dimensions (mm)

<b>Poles</b>	<b>3</b>
H	260
W	140
D (Less toggle)	103
Weight (kg)	5.0

Amp rating NRC	ASR Min.	ASR Max.	Cat. No.	Price \$
160	80	160	XV400NE 160 3K <sup>2)</sup>	3860.00
250	125	250	XV400NE 250 3K <sup>2)</sup>	3860.00
400	200	400	XV400NE 400 3K <sup>2)</sup>	4080.00

**XV400 MINING BREAKERS MUST  
USE LINE-SIDE TERMINAL COVERS,  
TERMINAL BOLT COVERS and REAR  
INSULATION PLATES.  
All items supplied with breaker<sup>1)</sup> <sup>3)</sup>**

**Notes:** <sup>1)</sup> Applicable for front connect MCCBs. Contact NHP for rear connect details.

<sup>2)</sup> For FAULT INDICATION option add 'FI' and nominate control voltage.

<sup>3)</sup> Installation and incoming connection information is supplied with each MCCB or can be requested from NHP.

#### NRC: Nominal rated current

## ASR: Adjustable setting range

Overcurrent trip combinations: (specify combinations req.)

LSI - standard,

LS - optional,

LSIP - optional (pre-trip alarm).

Special current ratings available on indent, refer NHP.

## Accessories to suit 400 AF

### Internal accessories

Description	Cat. No.	Price \$
Shunt trips	110 V AC/DC (100 - 115 V)	2H1305BAA 405.00
	240 V AC (200 - 480 V)	2H1306BAA 405.00
	12 V DC	2H1307BAA 405.00
	24 V DC	2H1308BAA 405.00
	48 V DC	2H1309BAA 405.00
	24 V AC	2H1311BAA 405.00
Undervoltage trips	AC coil <sup>1)</sup>	2H1492BAA 315.00
	100-230 V DC coil <sup>2)</sup>	2H1493BAA 315.00
	24 V DC coil <sup>2)</sup>	2H1494BAA 315.00
	48 V DC coil <sup>2)</sup>	2H1495BAA 315.00
	60 V DC coil <sup>2)</sup>	2H1496BAA 315.00
	110 V AC instantaneous controller	UXUB0013B 113.00
	240 V AC instantaneous controller	UXUB0014B 113.00
	440 V AC instantaneous controller	UXUB0015B 113.00
	110 V AC time delay controller	UXUB0016B 220.00
	240 V AC time delay controller	UXUB0017B 220.00
Auxiliary switches	440 V AC time delay controller	UXUB0018B 215.00
	200-230 V DC controller	UXUB0038B 113.00
	AUX SW right hand 1C	UXXB0004D 169.00
Alarm switch	AUX SW right hand 2C	UXXB0005D 220.00
	AUX SW right hand 3C	UXXB0006D 255.00
	ALT SW right hand	UXLB0009D 178.00
Alarm & auxiliary switch	ALT/AUX SW right hand 1C	UXLB0013D 189.00
	ALT/AUX SW right hand 2C Add then voltage	UXLB0014D 220.00
Pre-trip alarm	For electronic OCR MCCBs only	Pre-trip alarm 770.00
Fault indication & contacts	Side of breaker mounted module. Electronic MCCBs only	FI 900.00
Fault indication	LEDs mounted at top of OCR (electronic breakers only)	FILED 2050.00

**Notes:** Footnotes, refer to page 6 - 12.

## Accessories to suit 400 AF

### External accessories

Description	Cat. No.	Price \$
Attached busbars	3 P attached busbars (6 in kit)	2H1384DAA
	4 P attached busbars (8 in kit)	2H1385DAA
Screw tunnel terminals	3 P solderless terminals (6 in kit)	2H2012DAB
	4 P solderless terminals (8 in kit)	2H2012DBB
Rear connect studs	3 P RC studs (6 in kit)	UXRC0006C
	4 P RC studs (8 in kit)	UXRC0007C
Motor operators (XMC4)	110 V AC motor <sup>11)</sup>	UXMC0001B
	110 V DC motor <sup>11)</sup>	UXMC0003B
	24 V DC motor <sup>11)</sup>	UXMC0004B
	240 V AC motor <sup>11)</sup>	UXMC0005B
	Motor base support <sup>11)</sup>	UXMD0001B
Mechanical interlocks	3 P mechanical interlock <sup>3)</sup>	UXKC0001B
	3/4 P mechanical interlock <sup>4)</sup>	UXKC0002B
	4 P mechanical interlock <sup>5)</sup>	UXKC0003B
Cable mechanical interlocks	Interlock cable (wire)	UXKC0020A
	Cable interlock mechanism <sup>6)</sup>	UXKC0021B
Handle operators	IP 55 grey vari-depth handle + 320 mm shaft	T1HS40R5GM
	T1HS escutcheon plate option: 100 mm <sup>2</sup>	T2HSESC100
	390 mm T pin shaft for T1HS - no flexi coupling	T2HS400SHAFT
	IP 65 grey vari-depth handle + shaft	T1HP40R6BNA4
	IP 65 vari-depth metal handle + shaft	YASD34
	Padlock attachment for T2HP/ HS mechanism	T1HP40PALK
	IP 55 direct mount fixed depth handle <sup>7)</sup>	TFJ34XU
	T1HS handle shaft cam for Prosafe and Fortress locks	1499 7702
		235.00
Toggle locks	Toggle lock – non captive (Padlockable)	2H1956BAA
	Toggle -lock – captive (Padlockable)	XKA4
	Resin for XKA4	LOCTITE 480
		83.00

6

**Notes:** Footnotes, refer to page 6 - 12.

## Accessories to suit 400 AF

### External accessories

Description	Cat. No.	Price \$
Terminal covers	3 P front connecting terminal cover - busbar connect type	2H1413DAB
	4 P front connecting terminal cover - busbar connect type	2H1414DAB
	3 P front connecting terminal cover - cable connect type	2H1415DAB
	4 P front connecting terminal cover - cable connect type	2H1416DAB
	IP 20 protective cover - busbar connect type <sup>8)</sup>	2A1787DBA
	IP 20 protective cover - cable connect type <sup>8)</sup>	2A1788DAA
	3 P rear connecting terminal cover	UXPD0011B
	4 P rear connecting terminal cover	UXPD0012A
Accessory lead terminal	Accessory lead terminal	UXYD0001A
	Terminal and bolt <sup>9)</sup>	UXYD0002A
TemPlugs <sup>13)</sup>	3 P TemPlug 400 A <sup>12)</sup>	UPX3440
Interpole barrier	Interpole barrier <sup>10)</sup>	UXQH0004B
OCR sealing kit	Tamperproof cover for OCR adjustment dials	XS4000CRSK

6

- Notes:**
- 1) An AC UVT controller is required for 100-440 V AC.
  - 2) A DC UVT controller is needed for 200-230 V DC operation. None required for 24-110 V DC.
  - 3) For 3 P circuit breakers without motors.
  - 4) For 4 P circuit breakers without motors or 3 P circuit breakers with motors.
  - 5) For 4 P circuit breakers with motors.
  - 6) Order one interlock mechanism for each circuit breaker.
  - 7) Flush plate included.
  - 8) 6 pieces required for 3 P / 8 pieces required for 4 P.
  - 9) Specify quantity required (up to 6 pieces).
  - 10) Order individually.
  - 11) Order a motor base support for each motor : UXMD0001B.
  - 12) Price Schedule T3 applies to TemPlug.
  - 13) Not to be used with 1000V mining MCCB type XV400.

## MCCB isolating switch

### Non-auto MCCB, XS800NN

- Accepts MCCB accessories
- Standards AS/NZS 3947-2 and IEC 60947-2
- Motor or motorised circuit isolation - no overcurrent protection
- Will accept auxiliaries, UVTs & shunt trips <sup>2)</sup>

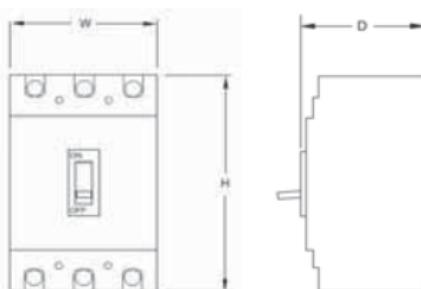


#### Ordering details

Ampere rating	Short time rating (kA)	3 pole Cat. No. <sup>1)</sup>	Price \$
630/800	10 kA for 0.3 sec	XS800NN3	3450.00

#### Dimensions (mm)

Ampere rating	Height <sup>3)</sup>	Width 3 P	Width 4 P	Depth	Weight (kg) 3 P	Weight (kg) 4 P
630/800	273	210	280	103	9.00	12.2



6

**Notes:** <sup>1)</sup> Additional technical details, refer to Part C.

<sup>2)</sup> UVTs & shunts are operated by the MCCBs trip lever which is fitted in non-auto MCCBs.

<sup>3)</sup> Height excludes attached busbar.

## TemBreak 1 series

### Current limiting thermal magnetic type

### XS630NJ

**50 kA**

**Current rating:** 250 – 630 A

**Approvals and Tests:** Standards: AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)



Voltage	Icu kA	Ics kA
AC use	400/415	50
DC use	250	40

**Trip unit:** Adjustable thermal adjustable magnetic

**OCR options:** Special calibrated or disabled thermal trip

**Dimensions (mm)**

Poles	3
H <sup>1)</sup>	273
W	210
D (less toggle)	103
Weight (kg)	9.6
4 pole	

#### 3 Pole

**Amp rating**

6

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
400	250	400	XS630NJ 400 3	2990.00
630	400	630	XS630NJ 630 3	2990.00

**Notes:** 1) H excludes attached busbar.  
Magnetic only available on application.  
NRC: Nominal rated current.  
ASR: Adjustable setting range.  
Specify for DC rating.

## TemBreak PLUS PowerBreaker Ics = 50 kA

Thermal magnetic type  
**XH630PJ**

### **85 kA**

**Current rating:** 250 – 630 A

**Approvals and Tests:** Standards: AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)

	Voltage	Icu kA	Ics kA
AC use	400	100	50
	415	85	50
DC use	250	40	–



**Trip unit:** Adjustable thermal adjustable magnetic

**OCR options:** Special calibrated or disabled thermal trip

#### **Dimensions (mm)**

Poles	3
H <sup>1)</sup>	273
W	210
D (less toggle)	103
Weight (kg)	9.6
4 pole on indent	

#### **3 Pole**

#### Amp rating

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
400	250	400	XH630PJ 400 3	4350.00
630	400	630	XH630PJ 630 3	4810.00

6

**Notes:** 1) H excludes attached busbar  
Magnetic only available on application.  
NRC: Nominal rated current.  
ASR: Adjustable setting range.

## TemBreak PLUS selectivity series

**Electronic type**

**XS630SE**

**50 kA**

**Current rating:** 315 – 630 A

**Approvals and Tests:** Standards: AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)



Voltage	Icu kA	Ics kA
AC use	400/415	50
		25

**Trip unit:**

Electronic trip unit: Adjustable long, short and instantaneous trip.

Trip unit: Fixed.

LTD adjustment:  $I_1$ : 0.8 – 1      t: 5 – 30 s

STD adjustment:  $I_2$ : 2 – 10      t: 0.1 – 0.3 s

Instantaneous Adj:  $I_3$ : 3 – 12      NRC

**OCR options:** Pre-trip alarm, fault indication and contacts, ground fault trip

**Dimensions (mm)**

Poles	3	4
H <sup>1)</sup>	273	273
W	210	280
D (less toggle)	103	103
Weight (kg)	9.6	12.2

**3 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
630	315	630	XS630SE 630 3	3100.00

**4 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	4 pole Price \$
630	315	630	XS630SE 630 4	4130.00

**Ground Fault Trip MCCB <sup>2)</sup>**

**3 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
630	315	630	XS630SE 6303LSIG	3960.00

**4 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	4 pole Price \$
630	315	630	XS630SE 6304LSIG	6280.00

**Notes:** <sup>1)</sup> H excludes attached busbar.

<sup>2)</sup> GF MCCBs require a 4th Neutral CT to be ordered for 3 and 4 pole MCCB applications. (If a neutral is present) Refer accessories.

NRC: Nominal rated current. ASR: Adjustable setting range.

## TemBreak PLUS selectivity series

**Electronic type**

**XH630SE**

**65 kA**

**Current rating:** 315 – 630 A

**Approvals and Tests:** Standards: AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)



Voltage	Icu kA	Ics kA
AC use	400/415	65
		33

**Trip unit:**

Electronic trip unit: Adjustable long, short and instantaneous trip.

Trip unit: Fixed.

LTD adjustment:  $I_1$ : 0.8 – 1      t: 5 – 30 s

STD adjustment:  $I_2$ : 2 – 10      t: 0.1 – 0.3 s

Instantaneous Adj:  $I_3$ : 3 – 12      NRC

**OCR options:** Pre-trip alarm, fault indication and contacts, ground fault trip

**Dimensions (mm)**

Poles	3	4
H <sup>1)</sup>	273	273
W	210	280
D (less toggle)	103	103
Weight (kg)	9.6	12.2

**3 Pole**

<b>Amp rating</b>	<b>ASR Min.</b>	<b>ASR Max.</b>	<b>Cat. No.</b>	<b>3 pole Price \$</b>
NRC	315	630	XH630SE 630 3	3260.00

6

**4 Pole**

<b>Amp rating</b>	<b>ASR Min.</b>	<b>ASR Max.</b>	<b>Cat. No.</b>	<b>4 pole Price \$</b>
NRC	315	630	XH630SE 630 4	4350.00

**Ground Fault Trip MCCB <sup>2)</sup>**

**3 Pole**

<b>Amp rating</b>	<b>ASR Min.</b>	<b>ASR Max.</b>	<b>Cat. No.</b>	<b>3 pole Price \$</b>
NRC	315	630	XH630SE6303LSIG	4110.00

**4 Pole**

<b>Amp rating</b>	<b>ASR Min.</b>	<b>ASR Max.</b>	<b>Cat. No.</b>	<b>4 pole Price \$</b>
NRC	315	630	XH630SE6304LSIG	6420.00

**Notes:** <sup>1)</sup> H excludes attached busbar.

<sup>2)</sup> GF MCCBs require a 4th Neutral CT to be ordered for 3 and 4 pole MCCB applications. (If a neutral is present) Refer accessories.

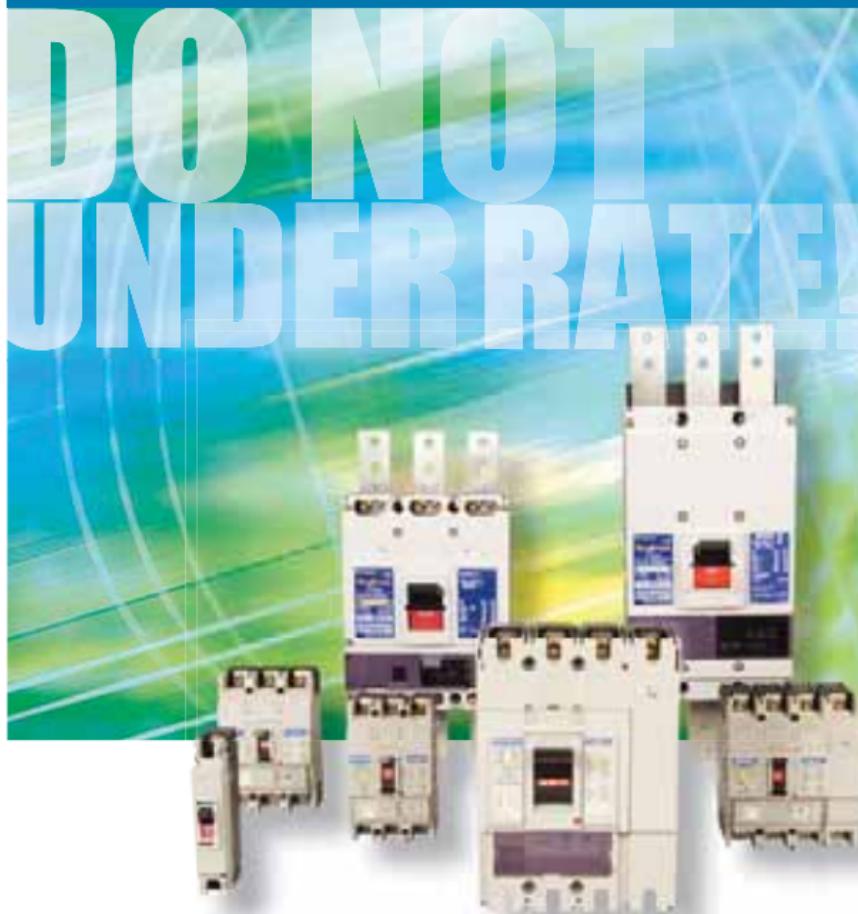
NRC: Nominal rated current. ASR: Adjustable setting range.

# THERMAL/MAGNETIC CIRCUIT BREAKERS

**NHP**

Terasaki thermal/magnetic circuit breakers offer superior protection when harmonics exist in a network.

POWER PROTECTION



PP-TERASAKI-MCCBs-CPB

**Terasaki thermal/magnetic circuit breakers:**

- Respond directly to the heat produced by the true RMS value of the load current
- Ensure protection irrespective of the harmonic distortion any future loads may cause
- Protect up to the infinite harmonic
- Are suitable for DC applications

 **TERASAKI**  
Innovators in Protection Technology

## TemBreak 1 series

### Current limiting thermal magnetic type

### XS800NJ

#### **50 kA**

**Current rating:** 500 – 800 A

**Approvals and Tests:** Standards: AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)



Voltage	Icu kA	Ics kA
AC use	400/415 <sup>1)</sup>	50
DC use	250	40

**Trip unit:** Adjustable thermal adjustable magnetic

**OCR options:** Special calibrated or disabled thermal trip

#### **Dimensions (mm)**

Poles	3	4
H <sup>1)</sup>	273	273
W	210	280
D (less toggle)	103	103
Weight (kg)	9.7	12.2

#### **3 Pole**

Amp rating NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
800	500	800	XS800NJ 800 3	3850.00

#### **4 Pole**

Amp rating NRC	ASR Min.	ASR Max.	Cat. No.	4 pole Price \$
800	500	800	XS800NJ 800 4	5130.00

6

**Notes:** <sup>1)</sup> H excludes attached busbar.

NRC: Nominal rated current.

ASR: Adjustable setting range.

Magnetic only available on application.

Specify for DC rating.

# **TemBreak PLUS PowerBreaker Ics = 50 kA**

**Thermal magnetic type**

**XH800PJ**

85 kA

**Current rating:** 500 – 800 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)

	Voltage	Icu kA	Ics kA
AC use	400	100	50
	415	85	50
DC use	250	40	-



**Trip unit:** Adjustable thermal adjustable magnetic

**OCR options:** Special calibrated or disabled thermal trip

## Dimensions (mm)

<b>Poles</b>	<b>3</b>	<b>4</b>
H <sup>1)</sup>	273	273
W	210	280
D (less toggle)	103	103
Weight (kg)	9.7	12.2

3 Pole

## Amp rating

rating NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
800	500	800	XH800PJ800 3P	4810.00

4 Pole

## Amp rating

<b>NRC</b>	<b>ASR Min.</b>	<b>ASR Max.</b>	<b>Cat. No.</b>	<b>Price \$</b>
800	500	800	XH800PJ 800 4P	6750.00

**Notes:** 1) H excludes attached busbar.  
Magnetic only available on application.  
NRC: Nominal rated current.  
ASR: Adjustable setting range.

## TemBreak PLUS selectivity series

**Electronic type**

**XS800SE**

**50 kA**

**Current rating:** 400 – 800 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)



Voltage	Icu kA	Ics kA
AC use	400/415	50
		25

**Trip unit:**

Electronic trip unit: Adjustable long, short and instantaneous trip.

Trip unit: Fixed.

LTD adjustment:  $I_1^1$ : 0.8 – 1      t: 5 – 30 s

STD adjustment:  $I_1^2$ : 2 – 10      t: 0.1 – 0.3 s

Instantaneous Adj:  $I_1^3$ : 3 – 12      NRC

**OCR options:** Pre-trip alarm, fault indication and contacts, ground fault trip

**Dimensions (mm)**

Poles	3	4
H <sup>1)</sup>	273	273
W	210	280
D (less toggle)	103	103
Weight (kg)	9.7	12.2

**3 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
800	400	800	XS800SE 800 3	4140.00

**4 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	4 pole Price \$
800	400	800	XS800SE 800 4	5520.00

**Ground Fault Trip MCCB <sup>2)</sup>**

**3 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
800	400	800	XS800SE8003LSIG	4990.00

**4 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	4 pole Price \$
800	400	800	XS800SE8004LSIG	6370.00

**Notes:** <sup>1)</sup> H excludes attached busbar.

<sup>2)</sup> GF MCCBs require a 4th Neutral CT to be ordered for 3 and 4 pole MCCBs.  
(If a neutral is present) Refer accessories.

NRC: Nominal rated current.

ASR: Adjustable setting range.

## TemBreak **PLUS** selectivity series

**Electronic type**

**XH800SE**

**65 kA**

**Current rating:** 400 – 800 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)



Voltage	Icu kA	Ics kA
AC use	400/415	65
		33

**Trip unit:**

Electronic trip unit: Adjustable long, short and instantaneous trip.

Trip unit: Fixed.

LTD adjustment:  $I_1$ : 0.8 – 1      t: 5 – 30 s

STD adjustment:  $I_2$ : 2 – 10      t: 0.1 – 0.3 s

Instantaneous Adj:  $I_3$ : 3 – 12      NRC

**OCR options:** Pre-trip alarm, fault indication and contacts, ground fault trip

**Dimensions (mm)**

Poles	3	4
H <sup>1)</sup>	273	273
W	210	280
D (less toggle)	103	103
Weight (kg)	9.7	12.2

**3 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
800	400	800	XH800SE 800 3	4360.00

**4 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	4 pole Price \$
800	400	800	XH800SE 800 4	6750.00

**Ground Fault Trip MCCB<sup>2)</sup>**

**3 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
800	400	800	XH800SE8003LSIG	5080.00

**4 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	4 pole Price \$
800	400	800	XH800SE8004LSIG	7480.00

**Notes:** <sup>1)</sup> H excludes attached busbar.

<sup>2)</sup> GF MCCBs require a 4th Neutral CT to be ordered for 3 and 4 pole MCCB applications. (If a neutral is present) Refer accessories.

NRC: Nominal rated current.

ASR: Adjustable setting range.

## TemBreak PLUS PowerBreaker Ics = 50 kA

**Electronic type**  
**XH800PE**

**65 kA**

**Current rating:** 400 – 800 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)



Voltage	Icu kA	Ics kA
AC use	400/415	65
DC use	250 V	40

### Trip unit:

Electronic trip unit: Adjustable long, short and instantaneous trip.

Trip unit: Fixed.

LTD adjustment:  $I_1$ : 0.8 – 1      t: 5 – 30 s

STD adjustment:  $I_2$ : 2 – 10      t: 0.1 – 0.3 s

Instantaneous Adj:  $I_3$ : 3 – 12      NRC

**OCR options:** Pre-trip alarm, fault indication and contacts, ground fault trip

### Dimensions (mm)

Poles	3	4
H <sup>1)</sup>	273	273
W	210	280
D (less toggle)	103	103
kg	9.7	12.2

### 3 Pole

#### Amp rating

NRC	ASR Min.	ASR Max.	Cat. No.	Price \$
800	400	800	XH800PE 800 3	4700.00

6

### 4 Pole

#### Amp rating

NRC	ASR Min.	ASR Max.	Cat. No.	Price \$
800	400	800	XH800PE 800 4	8500.00

**Notes:** <sup>1)</sup> H excludes attached busbar.

NRC: Nominal rated current.

ASR: Adjustable setting range.

## TemBreak 1000 V mining circuit breakers Electronic XV630PE, XV800PE

**18 kA****Current rating:** 200-800 A**Approvals and tests:** Standards AS 2184, AS/NZS 3947-2  
Complies with IEC 60947-2**Interrupting capacity:** 18 kA at 1000 V AC<sup>1)</sup> (IEC 60947-2)  
12.5 kA at 1100 V AC<sup>2)</sup>**Trip unit:**

Trip unit:	Fixed	
LTD adjustment:	I <sub>1</sub> : 0.8-1	t: 5-30 s
STD adjustment:	I <sub>2</sub> : 2-10	t: 0.1-0.3
INST adjustment:	I <sub>3</sub> : 3-12	
PTA adjustment:	I <sub>p</sub> : 0.7-1	t: fixed at 40 s (sep. control power req.)
or GFT adjustment:	I <sub>g</sub> : 0.1-0.4	t: 0.1, 0.2, 0.3, 0.4 or 0.8 s

**Dimensions (mm)**

Poles	3
H <sup>3)</sup>	273
W	210
D (Less toggle)	103
Weight (kg)	11.00

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	Price \$
400	200	400	XV630PE 400 3K <sup>4)</sup>	4270.00
630	315	630	XV630PE 630 3K <sup>4)</sup>	5440.00
800	400	800	XV800PE 800 3K <sup>4)</sup>	8240.00

**XV630/800 MINING BREAKERS MUST USE  
either line-side terminal covers  
OR  
interpole barriers, and a rear  
insulation plate  
(All supplied with breaker)<sup>5)</sup>**

**Notes:** <sup>1)</sup> Actual test voltage 1105 V.<sup>2)</sup> Actual test voltage 1165 V.<sup>3)</sup> H excludes attached busbar.<sup>4)</sup> For FAULT INDICATION option add 'FI' and nominate control voltage.<sup>5)</sup> Installation and incoming connection information can be found with each new MCCB, or by contacting NHP.

NRC: Nominal rated current.

ASR: Adjustable setting range.

Overcurrent trip combinations: (specify combinations req.)

LSI - standard,

LS - optional,

LSIP - optional (pre-trip alarm).

## Accessories

### to suit 630-800 AF

#### Internal accessories

Description	Cat. No.	Price \$
Shunt trips	110 V AC/DC	<b>2H1515BAA</b> 430.00
	240 V AC	<b>2H1516BAA</b> 430.00
	12 V DC	<b>2H1517BAA</b> 430.00
	24 V DC	<b>2H1518BAA</b> 430.00
	48 V DC	<b>2H1519BAA</b> 430.00
	200 V DC	<b>2H1520BAA</b> 430.00
	24 V AC	<b>2H1521BAA</b> 430.00
	48 V AC	<b>2H1522BAA</b> 430.00
Undervoltage trips	AC coil <sup>1)</sup>	<b>2H1503BAA</b> 395.00
	100-230 V DC coil <sup>2)</sup>	<b>2H1504BAA</b> 395.00
	24 V DC coil <sup>2)</sup>	<b>2H1505BAA</b> 395.00
	48 V DC coil <sup>2)</sup>	<b>2H1506BAA</b> 395.00
	60 V DC coil <sup>2)</sup>	<b>2H1507BAA</b> 395.00
	110 V AC instantaneous controller	<b>UXUB0013B</b> 113.00
	240 V AC instantaneous controller	<b>UXUB0014B</b> 113.00
	440 V AC instantaneous controller	<b>UXUB0015B</b> 113.00
	110 V AC time delay controller	<b>UXUB0016B</b> 220.00
	240 V AC time delay controller	<b>UXUB0017B</b> 220.00
	440 V AC time delay controller	<b>UXUB0018B</b> 215.00
	200-230 V DC controller	<b>UXUB0038B</b> 113.00
Undervoltage trips	AUX SW right hand 1C	<b>UXXB0007D</b> 169.00
	AUX SW right hand 2C	<b>UXXB0008D</b> 200.00
	AUX SW right hand 3C	<b>UXXB0009D</b> 240.00
Alarm switch	ALT SW right hand	<b>UXLB0010D</b> 181.00
Alarm & auxiliary switches	ALT/AUX SW right hand 1C	<b>UXLB0015D</b> 195.00
	ALT/AUX SW right hand 2C	<b>UXLB0016D</b> 225.00
Pre-trip alarm	For electronic OCR MCCBs only	Add <b>LSIP</b> 700.00
Fault indication & contacts	Side of breaker mounted module. Electronic MCCBs only	Add <b>- then voltage</b> <b>FI</b> 900.00
Earth fault, with optional 4th external CTs	Earth fault, electronic breakers only (4th CTs optional, add price below)	Add <b>LSIG</b> 730.00
	630 A 4th CT	<b>UXOY0001A</b> 425.00
	800 A 4th CT	<b>UXOY0002A</b> 425.00

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**Notes:** Footnotes, refer to page 6 - 26.

## Accessories to suit 630 – 800 AF

External accessories - user fit		Cat. No.	Price \$
Screw tunnel terminals	3 P solderless terminals for 630 AF (6 in kit)	<b>TXLD0005A</b>	<b>385.00</b>
	4 P solderless terminals for 630 AF (8 in kit)	<b>TXLD0006A</b>	<b>495.00</b>
Rear connect studs	3 P rear connect studs, 630/800 AF (6 in kit)	<b>UXRC0008B</b>	<b>1460.00</b>
	4 P rear connect studs, 630/800 AF (8 in kit)	<b>UXRC0009B</b>	<b>2040.00</b>
Motor operators (XMD6) <sup>2)</sup>	110 V AC motor	<b>2H1299CAC</b>	<b>2750.00</b>
	110 V DC motor	<b>2H1301CAC</b>	<b>2750.00</b>
	24 V DC motor	<b>2H1302CAC</b>	<b>2750.00</b>
	240 V AC motor	<b>2H1303CAC</b>	<b>2750.00</b>
Motor operators (XMC6) <sup>2)</sup>	110 V AC motor	<b>UXMC0006B</b>	<b>3550.00</b>
	110 V DC motor	<b>UXMC0008B</b>	<b>3550.00</b>
	24 V DC motor	<b>UXMC0009B</b>	<b>3550.00</b>
	240 V AC motor	<b>UXMC0010B</b>	<b>3550.00</b>
	Motor base support	<b>UXMD0002B</b>	<b>47.00</b>
Mechanical interlocks (Factory fit)	3 P mechanical interlock rear mounting	<b>UXKC0004A</b>	<b>360.00</b>
	4 P mechanical interlock rear mounting	<b>UXKC0005A</b>	<b>520.00</b>
	Interlock cable (wire)	<b>UXKC0020A</b>	<b>83.00</b>
	Cable interlock mechanism <sup>1)</sup>	<b>UXKC0022B</b>	<b>310.00</b>
	IP 55 Grey variable depth handle + 357mm shaft	<b>T1HS80R5GM</b>	<b>490.00</b>
Handle operators	T1HS escutcheon plate option: 100 mm <sup>2</sup>	<b>T2HSESC100</b>	<b>18.20</b>
	390 mm T pin shaft for T2HS - no flexi coupling	<b>T2HS400SHAFT</b>	<b>47.00</b>
	IP 65 Grey variable depth handle + 420 mm shaft	<b>T1HP80R6BNA4</b>	<b>480.00</b>
	Padlock attachment for T1HP/HS mechanism	<b>T1HP80PALK</b>	<b>49.50</b>
	IP 55 direct mount fixed depth handle	<b>TFJ36XU</b>	<b>510.00</b>
Handle extension	Extends length of toggle	<b>UXKB0002A</b>	<b>60.50</b>
Toggle & handle locks	Toggle lock – non captive (Padlockable)	<b>UXKB0002A</b>	<b>60.50</b>
	Toggle lock – captive (Padlockable)	<b>XKA6</b>	<b>60.50</b>
	Resin for XKA6	<b>LOCTITE 480</b>	<b>83.00</b>

**Notes:** <sup>1)</sup> Order one interlock mechanism for each circuit breaker.

2) XMC6 motors are used on all transfer switches as standard, and require a motor base support along with the motor when ordered. XMD6 motors offer superior ON/OFF/TRIPPED status indication and can be fitted to transfer switches on request. XMD6 motors do not require a motor base support.

Yellow and red handles available.

## Accessories to suit 630 – 800 AF

<b>External accessories - user fit</b>		<b>Cat. No.</b>	<b>Price \$</b>
Terminal covers	3 P front connecting terminal cover	<b>2H1417DAB</b>	<b>215.00</b>
	4 P front connecting terminal cover	<b>2H1418DAB</b>	<b>270.00</b>
	IP 20 protective cover <sup>1)</sup>	<b>2A1787DBA</b>	<b>6.20</b>
	3 P rear connecting terminal cover	<b>UXPD0013C</b>	<b>220.00</b>
	4 P rear connecting terminal cover	<b>UXPD0014B</b>	<b>270.00</b>
Accessory lead terminal	Accessory terminal block	<b>UXYD0001A</b>	<b>26.80</b>
	Terminal and bolt	<b>UXYD0002A</b>	<b>2.20</b>
Plug-in breaker parts 3 pole	Aux. connection block (MCCB) side	<b>UXYC0005A</b>	<b>54.00</b>
	Aux. connection block (panel) side	<b>UXYB0004A</b>	<b>54.00</b>
	Mounting bolts	<b>TXLD0016A</b>	<b>26.80</b>
	Tulip block (6) 630 <sup>2)</sup>	<b>TXLD0012A</b>	<b>340.00</b>
	Tulip block (6) 800 <sup>2)</sup>	<b>2A3308DAA</b>	<b>360.00</b>
Plug-in breaker parts 4 pole	Mounting base	<b>XDM6-3</b>	<b>880.00</b>
	Aux. connection block (MCCB) side	<b>UXYC0005A</b>	<b>54.00</b>
	Aux. connection block (panel) side	<b>UXYB0004A</b>	<b>54.00</b>
	Mounting bolts	<b>TXLD0016A</b>	<b>26.80</b>
	Tulip block (8) 630 <sup>2)</sup>	<b>TXLD0013A</b>	<b>425.00</b>
TemPlug	Tulip block (8) 800 <sup>2)</sup>	<b>2A3308DBA</b>	<b>445.00</b>
	Mounting bolts	<b>XDM6-4</b>	<b>980.00</b>
	TemPlug 800 A rated <sup>3)</sup>	<b>UPX3800</b>	<b>660.00</b>
Interpole barrier	Interpole barrier	<b>UXQH0004B</b>	<b>10.40</b>
OCR sealing kit	Tamperproof cover for OCR adjustment dials	<b>XS630OCRSK</b>	<b>54.00</b>
ProSafe shot bolt interlock	Prosafe shot bolt lock HS handles xx code	<b>TKNHPXX</b>	<b>520.00</b>
	Prosafe standard key xx code for above	<b>TKNNHPKEYX_</b>	<b>130.00</b>
	Cam for T2HS handle shafts Key codes A to Z are available. Specify by changing the key code above.	<b>14997702</b>	<b>235.00</b>

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**Notes:** <sup>1)</sup> 6 pieces required for 3 P / 8 pieces required for 4 P.

<sup>2)</sup> Specify quantity required (up to 6 pieces).

<sup>3)</sup> Price Schedule T3 applies to TemPlug.

## TemBreak PLUS selectivity series

**Electronic type**  
**XS1250SE**

**85 kA****Current rating:** 500 – 1250 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:** Symmetrical amps (kA RMS)

Voltage	Icu kA	Ics kA
AC use	400 V	85
	415 V	65
		49

**Trip unit:**

Electronic trip unit: Adjustable long, short and instantaneous trip.

Trip unit: Fixed.

LTD adjustment:  $I_1$ : 0.8 – 1      t: 5 – 30 sSTD adjustment:  $I_1^1$ : 2 – 10      t: 0.1 – 0.3 sInstantaneous Adj:  $I_1^2$ : 3 – 12      NRC**OCR options:** Pre-trip alarm, fault indication and contacts, ground fault trip**Dimensions (mm)**

Poles	3	4
H <sup>1)</sup>	370	370
W	210	280
D (less toggle)	120	120
Weight (kg)	22	28

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**Notes:** <sup>1)</sup> H excludes attached busbar.

**3 Pole****Amp rating**

<b>NRC</b>	<b>ASR Min.</b>	<b>ASR Max.</b>	<b>Cat. No.</b>	<b>3 pole Price \$</b>
1000	500	1000	XS1250SE 1000 FC3	7010.00
1250	625	1250	XS1250SE 1250 FC3	8770.00

**4 Pole****Amp rating**

<b>NRC</b>	<b>ASR Min.</b>	<b>ASR Max.</b>	<b>Cat. No.</b>	<b>4 pole Price \$</b>
1000	500	1000	XS1250SE 1000 FC4	9220.00
1250	625	1250	XS1250SE 1250 FC4	11680.00

**Ground Fault Trip MCCBs 1)****3 Pole****Amp rating**

<b>NRC</b>	<b>ASR Min.</b>	<b>ASR Max.</b>	<b>Cat. No.</b>	<b>3 pole Price \$</b>
1000	500	1000	XS1250SE 10003LG	7870.00
1250	625	1250	XS1250SE 12503LG	9490.00

**4 Pole****Amp rating**

<b>NRC</b>	<b>ASR Min.</b>	<b>ASR Max.</b>	<b>Cat. No.</b>	<b>4 pole Price \$</b>
1000	500	1000	XS1250SE 10004LG	8940.00
1250	625	1250	XS1250SE 12504LG	12230.00

**Notes:** 1) GF MCCBs require a 4th Neutral CT to be ordered for 3 and 4 pole MCCB applications. (If a neutrel is present) Refer accessories.

NRC: Nominal rated current.

ASR: Adjustable setting range.

# TemBreak 1000 V mining circuit breakers

## Electronic XV1250NE

20 kA

**Current rating:** 200-1250 A

**Approvals and tests:** Standards AS/NZS 3947-2,  
IEC 60947-2

**Interrupting capacity:** 20 kA at 1000/1100 V AC  
(IEC 60947-2)



### Trip unit:

Trip unit:	Fixed
LTD adjustment:	$I_a: 0.8-1$ t: 5-30 s
STD adjustment:	$I_b: 2-10$ t: 0.1-0.3 s
INST adjustment:	$I_c: 3-12$
PTA adjustment:	$I_d: 0.7-1$ t: fixed at 40 s (sep control power req.)
or GFT adjustment:	$I_e: 0.1-0.4$ t: 0.1, 0.2, 0.3, 0.4 or 0.8 s

### Dimensions (mm)

<b>Poles</b>	<b>3</b>
H <sup>1)</sup>	370
W	210
D (Less toggle)	120
Weight (kg)	22.0
4 pole	POA

Amp rating NRC	ASR Min.	ASR Max.	Cat. No.	Price \$
400	200	400	XV1250NE 400 3 K <sup>2)</sup>	10030.00
800	400	800	XV1250NE 800 3 K <sup>2)</sup>	10030.00
1000	500	1000	XV1250NE1000 3 K <sup>2)</sup>	10620.00
1250	630	1250	XV1250NE1250 3 K <sup>2)</sup>	13630.00

XV1250 MINING BREAKERS MUST USE  
either line-side terminal covers  
OR  
interpole barriers, and a rear  
insulation plate  
(All supplied with breaker) <sup>3)</sup>

**Notes:** <sup>1)</sup> H excludes attached busbar.

<sup>2)</sup> For FAULT INDICATION option add "FI" and nominate control voltage.

<sup>3)</sup> Installation information is supplied with MCCBs or refer NHP prior to purchase.

NRC: Nominal rated current.

ASR: Adjustable setting range.

Overcurrent trip combinations: (specify combinations req.)

LSI - standard,

LS - optional,

LSIP - pre-trip alarm,

## LSIG - trip indicators - optional.

## TemBreak PLUS selectivity series

**Electronic type**  
**XS1600SE**

**100 kA****Current rating:** 800 – 1600 A**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2**Interrupting capacity:** Symmetrical amps (kA RMS)

	Voltage	Icu kA	Ics kA
AC use	400 V	100	75
	415 V	85	64

**Trip unit:**

Electronic trip unit: Adjustable long, short and instantaneous trip

Trip unit: Fixed.

LTD adjustment:  $I_1$ : 0.8 – 1      t: 5 – 30 sSTD adjustment:  $I_1$ : 2 – 10      t: 0.1 – 0.3 sInstantaneous Adj:  $I_2$ : 3 – 12      NRC**OCR options:** Pre-trip alarm, fault indication and contacts, ground fault trip**Dimensions (mm)**

Poles	3	4
H <sup>1)</sup>	370	370
W	210	280
D (less toggle)	140	140
Weight (kg)	27	35

**3 Pole****Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
1600	800	1600	XS1600SE 1600 FC3	10050.00

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**4 Pole****Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	4 pole Price \$
1600	800	1600	XS1600SE 1600 FC4	13390.00

**Ground Fault Trip MCCBs<sup>2)</sup>****3 Pole****Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
1600	800	1600	XS1600SE 16003LG	10780.00

**4 Pole****Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	4 pole Price \$
1600	800	1600	XS1600SE 16004LG	14120.00

**Notes:** <sup>1)</sup> H excludes attached busbar.<sup>2)</sup> GF MCCBs require a 4th Neutral CT to be ordered for 3 and 4 pole MCCB applications. (If a neutrel is present) Refer accessories.

NRC: Nominal rated current.

ASR: Adjustable setting range.



## TemBreak PLUS LimitorBreaker Ics = 70 kA

**Electronic type**  
**TL800NE**



### 125 kA

**Current rating:** 400 – 800 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)

Voltage	Icu kA	Ics kA
AC use	400/415	125
		70

#### Trip unit:

Electronic trip unit: Adjustable long, short and instantaneous trip

Trip unit: Fixed.

LTD adjustment:  $I_1$ : 0.8 – 1      t: 5 – 30 s

STD adjustment:  $I_2$ : 2 – 10      t: 0.1 – 0.3 s

Instantaneous Adj:  $I_3$ : 3 – 12      NRC

**OCR options:** Pre-trip alarm, fault indication and contacts, ground fault trip

#### Dimensions (mm)

Poles	3
H <sup>1)</sup>	370
W	210
D (less toggle)	140
Weight (kg)	25.8
4 pole	

#### 3 Pole

#### Amp rating

NRC	ASR Min.	ASR Max. <sup>2)</sup>	Cat. No.	3 pole Price \$
800	400	800	TL800NE 800 3	8850.00

#### Ground Fault Trip MCCBs <sup>2)</sup>

#### 3 Pole

#### Amp rating

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
800	400	800	TL800NE3LSIG	9580.00

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**Notes:** <sup>1)</sup> H excludes attached busbar.

<sup>2)</sup> GF MCCBs require a 4th Neutral CT to be ordered for 3 and 4 pole MCCB applications. (If a neutrel is present) Refer accessories.

NRC: Nominal rated current.

ASR: Adjustable setting range.

Accessories, refer to page 6 - 35.

## TemBreak PLUS LimitorBreaker Ics = 65 kA

**Electronic type**  
**TL1250NE**

**125 kA**

**Current rating:** 500 – 1250 A

**Approvals and Tests:** Standards AS/NZS 3947-2 and IEC 60947-2

**Interrupting capacity:** Symmetrical amps (kA RMS)



Voltage	Icu kA	Ics kA
AC use	400/415	125      65

**Trip unit:**

Electronic trip unit: Adjustable long, short and instantaneous trip

Trip unit: Fixed.

LTD adjustment:  $I_1$ : 0.8 – 1      t: 5 – 30 s

STD adjustment:  $I_2$ : 2 – 10      t: 0.1 – 0.3 s

Instantaneous Adj:  $I_3$ : 3 – 12      NRC

**OCR options:** Pre-trip alarm, fault indication and contacts, ground fault trip

**Dimensions (mm)**

Poles	3
H 1)	370
W	210
D (less toggle)	140
Weight (kg)	26
4 pole	

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**3 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
1000	500	1000	TL1250NE 1000 3 FC	11690.00
1250	625	1250	TL1250NE 1250 3 FC	13080.00

**Ground Fault Trip MCCBs<sup>2)</sup>**

**3 Pole**

**Amp rating**

NRC	ASR Min.	ASR Max.	Cat. No.	3 pole Price \$
1000	500	1000	TL1250NE 1000 3 LG	12420.00
1250	625	1250	TL1250NE 1250 3 LG	13810.00

**Notes:** <sup>1)</sup> H excludes attached busbar.

<sup>2)</sup> GF MCCBs require a 4th Neutral CT to be ordered for 3 and 4 pole MCCB applications. (If a neutrel is present) Refer accessories.

NRC: Nominal rated current.

ASR: Adjustable setting range.

Accessories, refer to page 6 - 35.

## Accessories to suit 1250 – 1600 AF

	<b>Internal accessories - factory fit</b>	<b>Cat. No.</b>	<b>Price \$</b>
Shunt trips	110 V AC/DC (110-115 V)	2H1197BAA	520.00
	240 V AC (200-480 V)	2H1198BAA	520.00
	12 V DC	2H1199BAA	520.00
	24 V DC	2H1200BAA	520.00
	48 V DC	2H1201BAA	520.00
	200 V DC (200-230 V)	2H1202BAA	520.00
	24 V AC	2H1203BAB	520.00
	48 V AC	2H1204BAA	520.00
Undervoltage trips	AC coil <sup>1)</sup>	2H1208BAA	425.00
	100-230 V DC coil <sup>2)</sup>	2H1209BAA	425.00
	24 V DC coil <sup>2)</sup>	2H1210BAA	425.00
	48 V DC <sup>2)</sup>	2H1211BAA	425.00
	60 V DC <sup>2)</sup>	2H1212BAA	425.00
	110 V AC instantaneous controller	UXUB0013B	113.00
	240 V AC instantaneous controller	UXUB0014B	113.00
	440 V AC instantaneous controller	UXUB0015B	113.00
Auxiliary switches	110 V AC time delay controller	UXUB0016B	220.00
	240 V AC time delay controller	UXUB0017B	220.00
	440 V AC time delay controller	UXUB0018B	215.00
	200-230 V DC controller	UXUB0038B	113.00
	AUX SW right hand 1C / 3 P	UXXB0010D	335.00
	AUX SW right hand 2C / 3 P	UXXB0011D	415.00
	AUX SW right hand 3C / 3 P	UXXB0012D	490.00
	AUX SW right hand 1C / 4 P	UXXB0023D	335.00
Alarm switches	AUX SW right hand 2C / 4 P	UXXB0024D	415.00
	AUX SW right hand 3C / 4 P	UXXB0025D	490.00
	ALT SW right hand / 3 P	UXLB0011D	315.00
	ALT SW right hand / 4 P	UXLB0024D	315.00
Alarm & auxiliary switches	ALT/AUX right hand 1C / 3 P	UXLB0017D	385.00
	ALT/AUX right hand 2C / 3 P	UXLB0018D	460.00
	ALT/AUX right hand 2C / 4 P	UXLB0025D	385.00
	ALT/AUX right hand 1C / 4 P	UXLB0026D	460.00

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**Notes:** <sup>1)</sup> An AC UVT controller is required for 100–440 V AC.

<sup>2)</sup> A DC UVT controller is needed for 200-230 V DC operation.  
None required for 24–110 V DC.

## Accessories to suit 1250 – 1600 AF

<b>Internal accessories - factory fit</b>		<b>Cat. No.</b>	<b>Price \$</b>
Fault indication & contacts	An option for all 1250-1600 A types	Add then voltage	FI 900.00
Fault indication	LED's mounted at top of OCR	FILED	2050.00
Pre-Trip alarm	An option for all 1250-1600 A types	Add	LSIP 700.00
Ground fault trip (GFT)	An option for all 1250-1600 A types	Add	LSIG 730.00
Optional ext. 4th CT's	1000 A 4th CT	UXOY0003A	445.00
	1250 A 4th CT	UXOY0004A	445.00
	1600 A 4th CT	UXOY0005A	445.00

<b>External accessories - factory fit</b>		<b>Cat. No.</b>	<b>Price \$</b>
Rear connect tags	3 P rear connect studs (6 in kit) 1250 A	2H1959DAB	1750.00
	4 P rear connect studs (8 in kit) 1250 A	2H1959DBB	2330.00
	3 P rear connect studs (6 in kit) 1600 A	2H1960DAA	2310.00
	4 P rear connect studs (8 in kit) 1600 A	2H1960DBA	3080.00
Motor operators (XMD9)	110 V AC motor - user fit	2H1191CAB	3670.00
	110 V DC motor - user fit	2H1193CAB	3670.00
	24 V DC motor - user fit	2H1194CAB	3670.00
	240 V AC motor - user fit	2H1195CAB	3670.00
Mechanical interlocks	3 P mech l/lock / 1250 A rear connect	UXKC0006D	880.00
	4 P mech l/lock / 1250 A rear connect	UXKC0007D	1170.00
	3 P mech l/lock / 1600 A rear connect	UXKC0026C	880.00
	4 P mech l/lock / 1600 A rear connect	UXKC0027C	1170.00
	Interlock cable (wire)	UXKC0020A	83.00
	Interlock mechanism 1250 A Cable type <sup>1)</sup>	UXKC0023B	460.00
	Interlock mechanism 1600 A Cable type <sup>1)</sup>	UXKC0024B	460.00

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**Notes:** <sup>1)</sup> Order one interlock mechanism for each breaker.

## Accessories to suit 1250 – 1600 AF

<b>External accessories - user fit</b>		<b>Cat. No.</b>	<b>Price \$</b>
Handle operators	IP 55 Grey ext. handle + 320 mm shaft <sup>1)</sup>	T1HSX6R5GM	570.00
	T1HS escutcheon plate option: 100 mm <sup>2</sup>	T2HSESC100	18.20
	390 mm T pin shaft for T2HS - no flexi coupling	T2HS400SHAFT	47.00
	IP 65 Grey variable depth handle + shaft	T1HPX6R6BNA4	570.00
	Padlock attachment for T1HP/HS mechanism	T1HPX6PALK	49.50
	IP 55 direct mount fixed depth handle	TFJ38XU	610.00
	Prosafe shot bolt lock HS handles xx code	TKNHP_	520.00
	Prosafe standard key xx code for above	TKNHPKEY_	130.00
	Cam for T2HS handle shafts Key codes A to Z are available. Specify by changing the key code above.	14997702	235.00
Handle extension	Handle extension	2A2272BAB	123.00
Toggle & handle locks	Toggle lock – non captive (Padlockable)	UXKB0003A	80.00
Terminal covers	3 P FC terminal cover / 1250 <sup>5)</sup>	2H1419DAB	235.00
	4 P FC terminal cover / 1250 <sup>5)</sup>	2H1420DAB	290.00
Accessory lead terminal	IP 20 protective cover <sup>2)</sup>	2A1787DBA	6.20
	Accessory terminal block	UXYD0001A	26.80
	Terminal and bolt <sup>3)</sup>	UXYD0002A	2.20
Interpole barrier	Interpole barrier <sup>4)</sup>	UXQH0004B	10.40
OCR sealing kit	Tamperproof cover for OCR adjustment dials	XS1250CRSK	40.00

6

**Notes:** <sup>1)</sup> Yellow and red handles available.

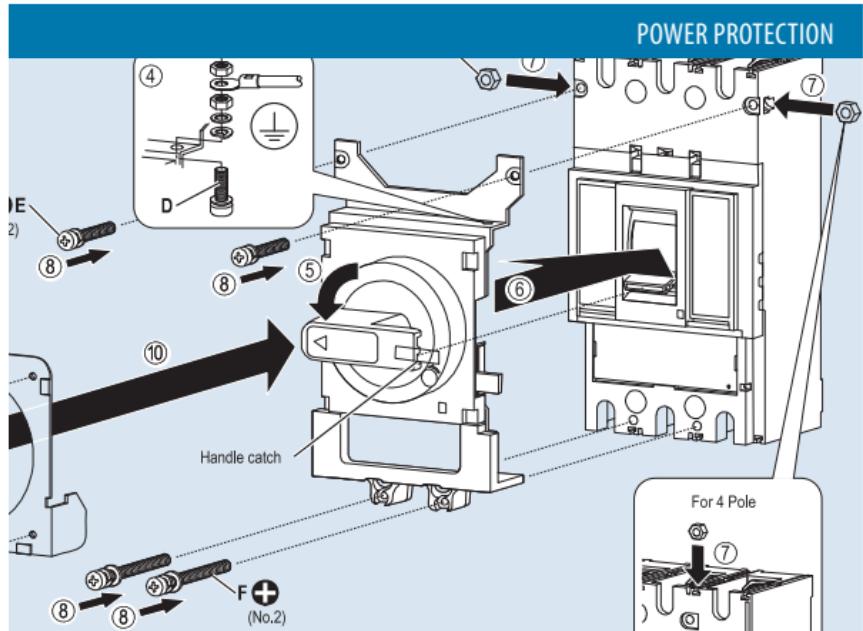
<sup>2)</sup> 6 pieces required for 3 P / 8 pieces required for 4 P.

<sup>3)</sup> Specify quantity required (up to 6 pieces).

<sup>4)</sup> Individual barrier (not a set).

<sup>5)</sup> Use interpole barriers for 1600 A MCCBs.

# APPLICATION, INSTALLATION AND INSTRUCTION GUIDES



PPTERASAKI-INST-CPB

## For Terasaki TemBreak 2 MCCBs and accessories

### Installation sheets

Accessories listed below can be found in NHP Price List Catalogue Part C.

### Internal accessories

- Auxiliary switches
- Alarm switches
- Shunt trips
- Undervoltage trips

### External accessories

- Operating handles
- Motor operators
- Mechanical interlocks
- Interpole barriers
- Terminal covers
- Flush plates
- TemPlug
- Plug-in MCCB bases
- Toggle locks and locking devices
- Rear connection terminal studs
- Tunnel clamp terminals
- Attached flat bar

**TERASAKI**  
Innovators in Protection Technology

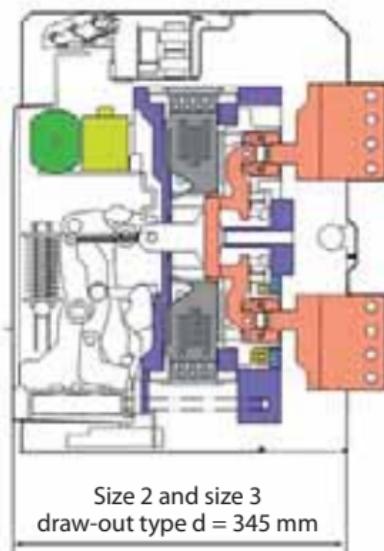
## TemPower 2 Air Circuit Breakers and Arc Detection Relays

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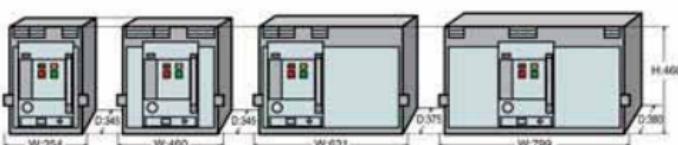
## TemPower Introduction

Meeting the requirements of contemporary switchboard manufacturers, consultants and end users, the TemPower 2 ACB boasts an attractive range of features including fast fault clearing times, advanced digital Overcurrent Relay (OCR) options and a small, compact design that maintains high Ampere Interrupting Capacities (AIC).



### Maximum power from minimum volume

**7**  
3 Pole model



<b>Standard series</b>	800 - 2000 A	2500 - 3200 A	4000 A	5000 - 6300 A
<b>High fault series</b>	1600 - 2000 A	1600 - 3200 A	Size AR4	Size AR6

**Notes:** Measurements on 3 pole model show in mm.

## **TemPower**

### Standards and certifications

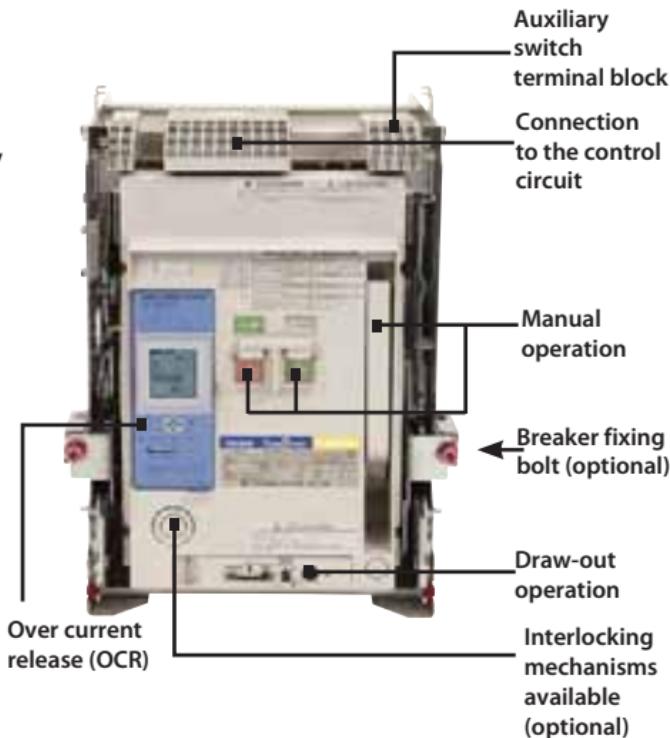
#### Based Standards

<b>AS 3947-2</b>	Australian Standard
<b>IEC 60947-2</b>	International Electrotechnical Commission
<b>EN60947-2</b>	European Standard
<b>JIS C8372</b>	Japanese Industrial Standard
<b>NEMA PUB NO.SG3</b>	National Electrical Manufacturers Association
<b>ANSI C37.13</b>	American National Standard Institute

#### Certification and Authorisation

<b>ASTA, UK</b>	ASTA Certification Services
<b>NK, Japan</b>	Nippon Kaiji Kyokai
<b>LR, UK</b>	Lloyd's Register of Shipping
<b>ABS, USA</b>	American Bureau of Shipping
<b>GL, Germany</b>	Germanischer Lloyd
<b>BV, France</b>	Bureau Veritas

For easy wiring access, control voltage, auxiliary and position switch terminals are all mounted at the front on the ACB body. Due to a general increase in the level of harmonics in modern power distribution systems, the neutral phase is fully rated as standard on 4P models.



## TemPower Stocked ACBs

Stocked ACBs are kept on the shelf in a standard pre-built configuration providing fast customer delivery. ACB bodies (withdrawable part) and carriages (fixed part) are ordered separately according to the required carriage terminal configuration.

### Stocked ACB specification

- Approvals and test: IEC 60947, A.S.T.A. certified
- AR-S type ACB body, 3 pole
- TemPro PLUS overcurrent release (type AGR21BL-PG) (240 V AC control voltage)
- Adjustable 'LSI'+GF protection standard (GF comes set enabled as default)<sup>1)</sup>
- Single trip indicator contact for 'LSI+GF' standard
- MODBUS communications facility (data monitoring as standard)
- Ground fault ready (external 4th CT required, see below)<sup>1)</sup>
- 240 V AC continuous rated shunt trip
- 7 C/O auxiliary switch
- IP 41 door flange
- ON/OFF push button covers are padlockable as standard
- Position padlock facility (locks ACB inside carriage in 'connected' or 'test' position)

Description	Current rating (A)	400/415 V interrupting capacity (kA)	ACB body Cat. No.	Price \$
AR-S ACB body	1250	65	ARB2123STD	11180.00
	1600	65	ARB2163STD	11290.00
	2000	65	ARB2203STD	13380.00
	2500	85	ARB3253STD	14090.00
	3200	85	ARB3323STD	15920.00
	4000	100	ARB4403STD	22650.00

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**Notes:** The above specification is fixed. If different accessories are required (e.g. UVT, OCR, different shunt voltage) please contact NHP sales to place a fully manufactured order.

'LSI+GF': long time delayed trip, short time delayed trip, instantaneous trip, ground fault trip

<sup>1)</sup> This function provides ground fault protection to TN-C or TN-S power distribution systems on the load side.

<sup>2)</sup> The ground fault protection setting is set to enabled as default. If GF is not required GF must be set to OFF by the user before ACB energisation.

**TemPower**  
**Stocked ACBs**

**Stocked ACB carriage specification<sup>1)</sup>**

- 3 pole carriage to suit standard ACB body

Description	Suits ACB Body Cat. No.	Terminal arrangement		ACB carriage Cat. No.	Price \$
		Top	Bottom		
AR-S ACB Carriage	ARB2123STD	Horizontal	Horizontal	ARC2123HHSTD	4480.00
		Vertical	Vertical	ARC2123VVSTD	4480.00
ARB2163STD	ARB2203STD	Horizontal	Vertical	ARC2123HVSTD	4480.00
		Vertical	Horizontal	ARC2123VHSTD	4480.00
ARB3253STD	ARB3323STD	Horizontal	Horizontal	ARC2203HHSTD	4950.00
		Vertical	Vertical	ARC2203VVSTD	4950.00
ARB3323STD	ARB4403STD	Horizontal	Vertical	ARC2203HVSTD	4950.00
		Vertical	Horizontal	ARC2203VHSTD	4950.00
ARB3323STD	ARB4403STD	Horizontal	Horizontal	ARC3323HHSTD	7470.00
		Vertical	Vertical	ARC3323VVSTD	7470.00
ARB3323STD	ARB4403STD	Horizontal	Vertical	ARC3323HVSTD	7470.00
		Vertical	Horizontal	ARC3323VHSTD	7470.00
ARB4403STD		Vertical	Vertical	ARC4403VVSTD	11120.00

**Notes:** 1) The stock carriages are suitable for use with the NHP 'stock body' shown on the previous page. If you require a different ACB specification to that listed on the previous page please contact NHP sales to place a fully manufactured order.

## ***TemPower*** Standard accessories

### Ground fault 4th CT

The external ground fault 4th CT is required to be fitted to the switchboard neutral bar when the ground fault protection function used.



Description	Rated Pri. current	Suits ACB type	4th CT Cat. No.	Price \$
Ground fault 4th CT	1250 A	ARB2123STD	XCW0840LS13	330.00
	1600 A	ARB2163STD	XCW0840LS16	330.00
	2000 A	ARB2203STD	XEC1640LS20	330.00
	2500 A	ARB3253STD	XEC1640LS25	650.00
	3200 A	ARB3323STD	XEC1640LS32	650.00
	4000 A	ARB4403STD	XEC1640LS40	1240.00

### Stocked ACB instruction manual

- Customer to specify required quantity at time of order  
(not supplied as standard)

Description	Cat. No.	Price \$
TemPro Plus (AGR21B) Installation manual	ARAGR21BMANUAL	10.40
TemPro Premier (AGR31B) Installation manual	ARAGR31BMANUAL	10.40

## **TemPower**

### Standard accessories

These items are factory fit / NHP service:

<b>Item</b>	<b>Description</b>	<b>Price \$</b>
Motor operator	A motor is used to remotely charge / close the ACB (specify voltage)	<b>POA</b>
Shunt trip (continuously rated)	Allows remote opening of the ACB (specify voltage)	<b>POA</b>
Under voltage trip (UVT)	Trips the ACB during an undervoltage (specify voltage) (single phase)	<b>POA</b>
Trapped key l/lock	Rockwell or Fortress type Prosafe	<b>POA</b>
Mech. Interlock – 2 way	Cable interlock. /per ACB	<b>POA</b>
Mech. Interlock – 3 way	Cable interlock. /per ACB	<b>POA</b>
Door interlock	Prevents enclosure door being opened unless ACB is isolated	<b>POA</b>
Fixing bolts for ACB	Holds the breaker firmly inside the carriage.	<b>POA</b>
Off position padlock facility	Allows the ACB to be padlocked in the OFF position	<b>POA</b>
Cycle counter	A 5 digit counter of the ACBs ON-OFF cycles	<b>POA</b>
Auxiliary contacts	10C changeover contacts.	<b>POA</b>
Position switch	A contact set that switches to indicate the ACB status in a carriage	<b>POA</b>
Storage draw-out handle	Draw-out handle that is stored inside the ACB body	<b>POA</b>

**Notes:** TEMPro PREMIER pricing is POA. Please contact NHP estimating with required specification.

## TemPower

### Standard accessories

These items can be fitted by the customer:

<b>Item</b>	<b>Description</b>	<b>Cat. No.</b>	<b>Price \$</b>
Interpole barrier	Suits 3P 800 A - 2000 A AR ACB	<b>1H1894BAA</b>	<b>250.00</b>
Interpole barrier	Suits 3P 2500 A, 3200 A AR ACB	<b>1H1895BAA</b>	<b>250.00</b>
Interpole barrier	Suits 3P 4000 A AR ACB	<b>1H1896BAA</b>	<b>250.00</b>
Standard door flange	IP41 front surround for ACB	<b>1H2243BAA</b>	<b>156.00</b>
IP 55 door cover	A clear plastic hinged door cover	<b>1H2300CAB</b>	<b>1220.00</b>
Padlock main safety shutters	Suits 3/4P 800 A-3200 A AR ACB	<b>1H1627CAA</b>	<b>340.00</b>
Padlock main safety shutters	Suits 3/4P 4000 A AR ACB	<b>1H2022CAA</b>	<b>114.00</b>
Lifting lugs	Attachable lifting brackets for ACB bodies only	<b>1A3430BAB</b>	<b>41.50</b>
Lifting truck	Available for lifting an ACB	<b>ARACBTRUCK</b>	<b>17610.00</b>
OCR checker	Hand held secondary injection test unit	<b>ANU1AC200</b>	<b>5510.00</b>
Test jumper	5 m lead for maintenance purpose	<b>1H1615BAA</b>	<b>990.00</b>



OCR checker



IP 41 door flange



IP 55 door cover



Lifting lugs



Interpole barriers



Test jumper

## **TemPower**

### ACB ordering information

**ACBs can be manufactured to suit specific customer requirements.**

**About TEMPOWER 2 AR ACB Ordering:** TemPower 2 AR ACBs are locally assembled by NHP along with many variations and options available to suit specific end user applications. The listing below represents typical specifications to be considered at the time of ordering:

- 1. ACB type and current rating** (AR, 1250 A)
- 2. Number of poles** (3 P or 4 P)
- 3. Main circuit and control circuit voltage and frequency** (415 or 690 V AC)
- 4. Operating temperatures** (40 degree C ambient)
- 5. Type of mounting.** (Draw out type ACB is available, fixed type is not available)
- 6. Terminal arrangements.** For example rear connect vertical or horizontal main terminals. Front connect terminals are also an option.
- 7. Type of charging.** Manual lever (standard) or motor operated. If a motor is chosen then the operating voltage has to be specified.
- 8. The OCR** (overcurrent relay or 'release').  
The OCR type needs to be chosen depending on the requirements of the installation. NHP / Terasaki have as standard "LSI" OCRs fitted with LCDs, MODBUS communications facilities in all ACBs. The control voltage must be specified at the time of order.
- 9. Electrical tripping devices:** Other options such as Shunt trips, Under voltage releases, or capacitor trips need to be considered.
- 10. Other accessories,** some of which are:  
ON-OFF cycle counter  
Auxiliary switch type (7 C is standard)  
Key lock devices – standard or Trap key interlock etc.  
Mechanical interlocks  
IP 55 Cover  
OFF padlock  
Door flange
- 11. Contact your NHP sales office** for any other special requirements such as service or repair, retrofitting, spare parts, test reports etc.
- 12. Prices:** Contact your NHP sales office for a pricing of non standard equipment.



An AR ordering sheet is available covering the above ordering process.

Refer NHP.

## **TemPower Specifications**

Rated from 200 A to 6300 A NHP can provide a withdrawable Terasaki Air Circuit Breaker (ACB) designed to meet the stringent demands of the industrial and marine market.

The AR series is available in four frame sizes:

- frame size 1 which ranges from 200 to 2000 A (AR2)
  - frame size 2 which ranges from 2500 to 3200 A (AR3)
  - frame size 3 which is rated at 4000 A (AR4)
  - frame size 4 which is rated at 5000 to 6300 A (AR6)



## Main power circuit terminals specifications

Main circuit configuration is available in either horizontal or vertical form, a combination of both, or front connected. Refer to the table below, which indicates which terminal types are available for different ACB types. Specification of the desired terminal configuration should be made at the time of ordering the ACB or carriage. A cross 'x' below, indicates a configuration that is unavailable.

### AR-S standard series

Ampere rating (A)	ACB type	ACB mounting method	Horizontal terminals	Vertical terminals	Front connect terminals
800 A	AR208S	Draw-out	✓	✓	✓
1250 A	AR212S	Draw-out	✓	✓	✓
1600 A	AR216S	Draw-out	✓	✓	✓
2000 A	AR220S	Draw-out	✓	✓	✓
2500 A	AR325S	Draw-out	✓	✓	✓
3200 A	AR332S	Draw-out	✓	✓	✓
4000 A	AR440S	Draw-out	X	✓	X

### AR-H high kA series

Ampere rating (A)	ACB type	ACB mounting method	Horizontal terminals	Vertical terminals	Front connect terminals
1600 A	AR216H	Draw-out	✓	✓	X
2000 A	AR220H	Draw-out	✓	✓	X
1600 A	AR316H	Draw-out	✓	✓	X
2000 A	AR320H	Draw-out	✓	✓	X
2500 A	AR325H	Draw-out	✓	✓	X
3200 A	AR332H	Draw-out	✓	✓	X

### AR650 / AR663

Ampere rating (A)	ACB type	ACB mounting method	Horizontal terminals	Vertical terminals	Front connect terminals
5000 A	AR650	Draw-out	X	✓	X
6300 A	AR663	Draw-out	X	✓	X

# TemPower

## Performance specification of the AR ACB

<b>AR-S TemPower 2 -STANDARD</b>		<b>AR208S</b>	<b>AR212S</b>	<b>AR216S</b>
Rated current ( $I_{n}$ ) <sup>1)</sup> <sup>2)</sup>	(A)	800	1250	1600
Number of poles <sup>3)</sup> <sup>4)</sup>		3 & 4	3 & 4	3 & 4
Current transformer ratings ( $I_{ct}$ )	(A)	200 400 800	200 400 800 1250	200 400 800 1250 1600
Insulation voltage (Ui) (V 50/60 Hz)	(V AC)	1000	1000	1000
Operational voltage (Ue) (V 50/60 Hz)	(V AC)	690	690	690
Impulse voltage (Uiimp)	(kV)	12	12	12
Breaking capacity kA IEC, AS <sup>5)</sup> <sup>7)</sup> ( $I_{cs} = I_{cu}$ ) [kA sym rms]	690 V 440 V	50 65 <sup>6)</sup>	50 65 <sup>6)</sup>	50 65 <sup>6)</sup>
Making capacity	690 V	105	105	105
(kA peak)	440 V	143	143	143
Rated short time withstand (Icw)	1 Sec 3 Sec	65 50	65 50	65 50
Total breaking time	Sec	0.03	0.03	0.03
Motor charging time (max)	Sec	10	10	10
Closing time (max)	Sec	0.08	0.08	0.08
Latching current	(kA)	65	65	65

**Notes:** <sup>1)</sup> Values in open air at 40° C (45° C for marine applications).

<sup>2)</sup> Values of AR208S, AR212S, AR216S for draw-out type with horizontal terminals, values of the other ACBs for draw-out type with vertical terminals.

<sup>3)</sup> For 2 pole ACBs use outside poles of 3 pole ACB.

<sup>4)</sup> 4 Pole ACBs without Neutral phases protection can not apply IT earthing system.

<sup>5)</sup> Contact NHP for the details.

<sup>6)</sup> For 500 V AC.

<sup>7)</sup> Please contact NHP for DC applications.

When the INST trip function is set to NON, the MCR function should be enabled, otherwise, the rated breaking capacity is reduced to the rated latching current.

**TemPower**

<b>AR220S</b>	<b>AR325S</b>	<b>AR332S</b>	<b>AR440S</b>	<b>AR650S</b>	<b>AR663S</b>
2000	2500	3200	4000	5000	6300
3 & 4	3 & 4	3 & 4	3 & 4	3 & 4	3 & 4
200	200	200	4000	5000	6300
400	400	400			
800	800	800			
1250	1250	1250			
1600	1600	1600			
2000	2000	2000			
	2500	3200			
1000	1000	1000	1000	1000	1000
690	690	690	690	690	690
12	12	12	12	12	12
50	65	65	75	85	85
65 °)	85 °)	85 °)	100	120	120
105	143	143	165	187	187
143	187	187	220	264	264
65	85	85	100	120	120
50	65	65	85	85	85
0.03	0.03	0.03	0.03	0.05	0.05
10	10	10	10	10	10
0.08	0.08	0.08	0.08	0.08	0.08
65	85	85	100	120	120

## Tempower

### Performance specification of the AR-H ACB

A 'High Fault' series of AR ACB is available (the AR-H) on INDENT. For applications that require a larger breaking capacity than the standard series.

<b>AR-H Tempower 2-HIGH FAULT</b>		<b>AR216H</b>	<b>AR220H</b>
Rated current (In)	(A)	1600	2000
Number of poles		3 & 4	3 & 4
		200	200
		400	400
		800	800
Current transformer ratings (Ict)	(A)	1250 1600	1250 1600 2000
AC Insulation voltage (Ui)	(V AC)	1000	1000
Operational voltage	(V AC)	690	690
Impulse voltage (Uiimp)	(kV)	12	12
Breaking capacity <sup>1)</sup> <sub>2)</sub> kA IEC, AS (Ics = Icu) [kA sym rms]	690 V 440 V	55 80	55 80
Making capacity (kA peak) IEC, AS	690 V 440 V	121 176	121 176
Rated short time withstand (Icw)	1 Sec 3 Sec	80 55	80 55
Total breaking time	Sec	0.03	0.03
Motor charging time	Sec	10	10
Closing time (max)	Sec	0.08	0.08
Latching current	(kA)	65	65



<b>AR316H</b>	<b>AR320H</b>	<b>AR325H</b>	<b>AR332H</b>
1600	2000	2500	3200
3 & 4	3 & 4	3 & 4	3 & 4
200	200	200	200
400	400	400	400
800	800	800	800
1250	1250	1250	1250
1600	1600	1600	1600
	2000	2000	2000
		2500	2500
			3200
1000	1000	1000	1000
690	690	690	690
12	12	12	12
85	85	85	85
100	100	100	100
187	187	187	187
220	220	220	220
100	100	100	100
75	75	75	75
0.03	0.03	0.03	0.03
10	10	10	10
0.08	0.08	0.08	0.08
85	85	85	85

## TemPower

### Overcurrent Release (OCR) specification

Boasting an impressive range of standard features and specialised options, the Terasaki overcurrent release range is suitable for commercial, industrial and marine applications. The Terasaki OCR is divided into two performance ranges; the **TEMPro PLUS** and **TEMPro PREMIER**.

#### **TEMPro PLUS (Type AGR-21B)**

Featuring a backlit liquid crystal display (LCD) for easy visual identification and a soft rubber key activated scrolling menu system the **TEMPro PLUS** can display<sup>1)</sup>:

- Phase currents I<sub>1</sub>, I<sub>2</sub>, I<sub>3</sub> (accuracy + 2.5 %)
- Fault current value
- Tripping delay time
- The maximum phase current
- Cause of fault (LTD, STD, INST, GF<sup>2)</sup>)

Providing adjustable LSI and GF<sup>3)</sup> protection featuring **MODBUS communications** plus a built-in current meter as standard, the **TEMPro PLUS** is perfect for basic and mid range applications.



- Notes:**
- 1) Trip variables can be viewed after an event via the LCD providing control power is constantly available.
  - 2) LTD-Long time delay trip, STD-Short time delay trip, INST-Instantaneous trip, GF-Unrestricted ground fault (not available for 'S' curve model OCR).
  - 3) This function provides ground fault protection to TN-C or TN-S power distribution systems on the load side.

## TemPower

### Overcurrent Release (OCR) specification

#### **TEMPro PREMIER (Type AGR-31B)**

The **TEMPro PREMIER** is an advanced OCR that offers the same LCD appearance and protective functions as the **TEMPro PLUS**. In addition to the current meter measurements listed above the **TEMPro PREMIER** has an inbuilt energy analyser which indicates:

- Phase currents  $I_1, I_2, I_3$  (accuracy + 1.5 %)
- Line voltages (V)  $V_{12}, V_{23}, V_{31}$ <sup>1)</sup>
- Phase voltage (V)  $V_{1N}, V_{2N}, V_{3N}$  (accuracy + 1.0 %)
- Active power (kW) (accuracy + 2.5 %)
- Demanded active power (kW)
- Electric energy (kWh) (accuracy + 3.0 %)
- Power factor ( $\cos \phi$ ) (accuracy + 2.5 %)
- Frequency (Hz) (accuracy + 0.5 Hz)
- Fault current value
- Tripping delay time
- The maximum phase current
- Cause of fault (LTD, STD, INST, GF<sup>2)</sup>)



Furthermore the **TEMPro PREMIER** is available with a range of optional features that make it ideal for use in specialised applications.

#### **Field test facility**

Type AGR-21B/31B OCRs are equipped with a field test function to verify the long time delay, short time delay, instantaneous and ground fault trip features without the need for tripping of the ACB.

**Notes:** <sup>1)</sup> Line voltage and phase voltage cannot be displayed at the same time.  
<sup>2)</sup> LTD-Long time delay trip, STD-Short time delay trip, INST-Instantaneous trip, GF-Unrestricted ground fault (not available for 'S' curve model OCR).

## TemPower

### TEMPro PLUS and PREMIER appearance

OCR control voltage: Confirm the terminal connections to match the indicated control voltage. Refer to page 9 - 51 for terminal designations.

OCR type: TemPro PLUS (AGR21B) or TemPro Premier (AGR31B)

Unrestricted Ground fault: If coloured in black it means this function is available. It does not indicate if the function is on or off, confirm this by checking the OCR GF setting (SET 2).

Special functions:  
Must be requested at time of order.  
REF: Restricted earth fault  
NP: Neutral phase protection  
OH: Contact temperature alarm  
Zone: Zone interlocking  
RP: Reverse power

Inbuilt current meter for TEMPro PLUS or inbuilt energy analyser for TEMPro PREMIER

Setting adjustment confirmation button



OCR protection curve: Can be 'L'-general feeder protection, 'R'-IEC 60255 conforming or 'S' - generator protection types. Curve type must be specified at the time of order.

Alarm contact indication: Standard trip contact indicator is LSI+GF. This is a single contact indicator. Other contact indicators such as individual GF, pre-trip alarm, system alarm and motor spring charge is available on special request.

Modbus & signaling options:  
Data Monitor:  
Interrogate variables  
Remote open: The ACB can trip / open via a Modbus command.

Backlit LCD for easy viewing. The LCD flashes on and off when alarm / trip event occurs

Soft rubber keys for menu navigation

Easy identification of the CT rated current and the set rated current

**Notes:** Indicative picture only

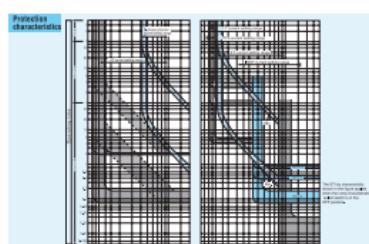
## TemPower

### TEMPro application protection curves

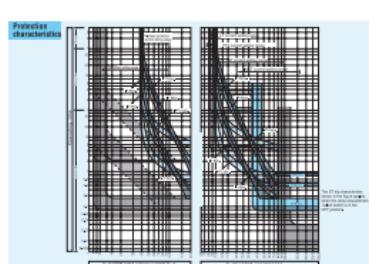
The TEMPro PLUS and TEMPro PREMIER OCR range is available in three model variations:

- **Standard protection curve, or 'L' type** – designed for general feeder applications and will achieve most selectivity and protection requirements.
- **High selectivity curve or 'R' type** - offers 3 curve characteristics to IEC60255 and is used when selectivity can not be achieved with other system protective devices (i.e. fuses or other relays).
- **Generator protection curve or 'S' type.** – Specifically designed for generator and marine applications.

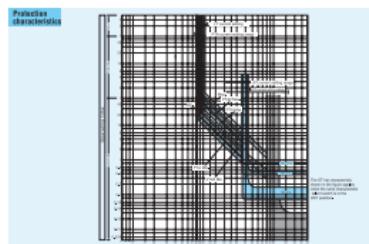
It is recommended that all general feeder circuits be protected by the 'L' type unless the results of a selectivity study indicate that an 'R' type is required to discriminate with another system protective device. **The application curve type must be specified at the time of order.**



L type is designed for General Feeder installations.



R type is used for high selectivity applications and offers 3 curve characteristics to IEC 60255.



S type is best utilised for generator and marine power protection.

**TemPower**

## TEMPro PLUS and TEMPro PREMIER

### Standard protection features

**TEMPro PLUS and TEMPro PREMIER** have adjustable LSI - long time delay, short time delay, INSTANTANEOUS and GF as standard. This provides an adjustable time delay on overload and also the  $I^2t$  ramp characteristic which is essential to provide selectivity when grading with other protective devices such as downstream fuses and upstream relays. The standard 'LSI' curve provides more than five million combinations of unique time current characteristics.

<b>Standard feature</b>	<b>Description</b>	<b>Application curve</b>		
		<b>L</b>	<b>R</b>	<b>S</b>
LTD trip	Adjustable overload protection area trip	✓	✓	✓
STD trip	Adjustable short circuit protection area trip (with intentional delay)	✓	✓	✓
INST trip	Adjustable short circuit protection area trip (with NO intentional delay)	✓	✓	✓
GF trip <sup>1)</sup>	Adjustable unrestricted earth fault protection (GF) (requires external 4th CT for 3 pole model)	✓	✓	✗
Single Alarm contact indicator	As standard the single contact alarm indicator is available that indicates when the LTD trip, STD trip, INST/MCR trip or the GF trip function is activated.	✓	✓	✓
MODBUS I/F	MODBUS communication interface allows monitoring of available data variables. ACB control is non standard, refer to communications page.	✓	✓	✓
Backlit LCD with current meter TEMPro PLUS	Displays phase currents $I_1$ , $I_2$ , $I_3$ and $I_{GF}$ , fault current values, tripping time delay, the maximum phase current and the cause of fault (LTD, STD, INST, GF) TEMPro PLUS ONLY	✓	✓	✓
Backlit LCD with energy analyser TEMPro	Displays phase currents $I_1$ , $I_2$ , $I_3$ and $I_{GF}$ , Line voltages (V) $V_{12}$ , $V_{23}$ , $V_{31}$ , Phase voltage (V) $V_{1N}$ , $V_{2N}$ , $V_{3N}$ , Active power (kW), Demanded active power (kW), Electric energy (kWh), Power factor ( $\cos \emptyset$ ), Frequency (Hz) TEMPro PREMIER ONLY	✓	✓	✓

**Notes:** <sup>1)</sup> This function provides ground fault protection to TN-C or TN-S power distribution systems on the load side.

✓ = standard ✗ = not available

## TemPower

### TEMPro PLUS and TEMPro PREMIER

#### Specialised optional features

TEMPro OCRs can be 'optioned up' with specialised application functions to suit customer requirements.

Please indicate what special application functions are required at the time of order as all are factory installed.

Standard feature	Description	Application curve
		L R S
System Alarm	Activates if an internal fault exists within the OCR. System alarm can be monitored remotely via the MODBUS communications interface.	✓ ✓ ✓
Pre trip alarm	Activates if the monitored load current reaches the user set indication threshold. Useful for load shedding applications. This alarm is available via the MODBUS interface only.	✓ ✓ ✓
N-Phase protection 4 pole ACB ONLY	In 3-phase, 4-wire systems that contain harmonic distortion, the 3rd harmonic may cause large currents to flow through the neutral conductor. The N-phase protection function (NP) is available on 4 pole ACBs and prevents the neutral conductor from sustaining damage or burnout due to these large currents. The NP trip pickup current can be set between 40 % and 100 % of the OCR rated primary current for L and R-characteristics. This protection function is not available for special 'generator protection' 'S' type OCRs, and is available on an INDENT basis.	✓ ✓ ✓
Zone interlocking (TemPro Premier ONLY)	The zone-selective interlock (ZSI) capability permits tripping of the ACB upstream of and nearest to a fault point in the shortest operating time, irrespective of the short time delay trip time setting, and minimizes thermal and mechanical damage to the power distribution line. ZSI cannot be fitted with a UVT.	✓ ✓ ✓
Phase rotation protection	This function detects the negative-phase current occurring due to reverse phase or phase loss and prevents burnout of a motor or damage to equipment.	✓ ✓ ✓
Contact over heat protection (TemPro Premier only)	This function monitors the temperature of the ACBs main contacts. An alarm indicates when the temperature exceeds 155 °C. Continuous monitoring of the contact temperature provides valuable input for preventative and predictive maintenance programs.	✓ ✓ ✓

**Notes:** All special application functions are available on an indent basis.  
 For further information on special application functions please contact NHP.  
 ✓ = standard X = not available

**TemPower**  
**TEMPro PLUS and TEMPro PREMIER**  
**Specialised optional features**

Standard feature	Description	Application curve L R S
Undervoltage alarm function (TemPro Premier only)	<p>This function monitors the main circuit voltage, and gives an alarm on the LCD and an output signal via an alarm contact when the voltage drops below the setting voltage. The alarm is activated when the main circuit voltage drops below the setting voltage (selectable from 40 %, 60 % or 80 % of the rated main circuit voltage [Vn]), and is deactivated when the main circuit voltage rises to the recovery setting voltage (selectable from 80 %, 85 %, 90 % or 95 % of the rated main circuit voltage [Vn]).</p> <p>Note 1: The undervoltage alarm function is disabled unless the main circuit voltage has once risen to the recovery setting voltage or higher.</p> <p>Note 2: If the undervoltage alarm function is used in conjunction with the undervoltage trip device, an alarm may occur after the ACB trips open depending on the alarm setting voltage.</p>	✓ ✓ ✓
Reverse power trip function RPT	(TemPro Premier AGR-31BS only.)  The RPT function protects 3-phase generators running in parallel against reverse power. The RPT pickup current can be set in seven levels: 4 % thru 10 % of the generator rated power.	✓ ✓ ✓



CORP-PROJECTS-A05-CPB

## THINK MAJOR PROJECTS. THINK NHP.

When it comes to Major Projects, our staff involvement is always driven by long term results, actively seeking to support you with the right product and technical solutions before, during and after project completion.

### Major Projects Team

No matter what the project, from the initial stages of concept design, through to post-commissioning and future upgrades, NHP's Major Projects Team is there to see the project through together with you - our customer.

Our quality people have a diverse reach across Australia and New Zealand and their vast industry experience is sure to be there for you when you need it.

Think Major Projects. Think NHP.

# TEMPro PLUS and TEMPro PREMIER Specifications

## Standard features

OCR type	Cat. No.	Application protection curve <sup>1)</sup>	LCD monitoring	Basic protection <sup>2)</sup>			
				LTD	STD	INST	GF <sup>3)</sup>
TEMPro PLUS	AGR-21B-L-PG	'L'	Current meter (A)	✓	✓		
	AGR-21B-R-PG	'R'	Current meter (A)	✓	✓		
	AGR-21B-S-PS	'S'	Current meter (A)	✓		✗	
TEMPro PREMIER	AGR-31B-L-PG	'L'	Energy analyser	✓	✓		
	AGR-31B-R-PG	'R'	Energy analyser	✓	✓		
	AGR-31B-S-PS	'S'	Energy analyser	✓		✗	

## OCR control power

If the control power is not supplied or is lost, each function operates as follows:

### Function when no power

LT, ST, INST, RPT

GF

MCR

PTA

1-channel PTA

Alarm contact output from OCR

LCD/ COMMUNICATIONS

Field test facility & MODBUS

**Notes:** <sup>1)</sup> L/R/S refers to the application protection curve, please specify at time of ordering.

<sup>2)</sup> LTD-Long time delay trip, STD-Short time delay trip, INST-Instantaneous trip, GF-Unrestricted ground fault, (load side GF).

<sup>3)</sup> Trip variables can be viewed after an event via the LCD providing control power is constantly available.

The OCR does not require control power to operate as a protective device, however it is recommended.

Refer to the table above to see how absence or loss of control power affects the operation of the OCR.

<sup>4)</sup> RPT- Reverse power trip. AGR-31BS-PS becomes AGR-31BS-PR with RPT.

<sup>5)</sup> This function provides ground fault protection to TN-C or TN-S power distribution systems on the load side.

✓ = Standard, ✗ = Not available, OPT = Optional



Single contact indicator (LTD) STD/INST, GF	Modbus Facility (data monitoring only)	RPT <sup>4)</sup>	Control power <sup>3)</sup>
✓	✓	✗	Required
✓	✓	✗	Required
✓	✓	✗	Required
✓	✓	✗	Required
✓	✓	✗	Required
✓	✓	✗	Required

### Operation

Operates normally.

Operates normally.

When the CT rated primary current (ICT) is less than 800 A and the GF pick-up current is set to 10 %, the GF becomes inoperative.

Operates as INST.

Is inoperative. (Has a 40 ms operation)

Is inoperative.

No display when no other power source is available. Communications is disabled.

Is inoperative.

## TemPower

### Tripping options - Shunt trip coil

The TEMPOWER 2 AR ACB has two methods of remote tripping of the main contacts:

- Shunt trip coil
- Undervoltage Trip (UVT) Device

#### **Shunt trip coil**

The shunt trip coil is available in three varieties;

- single shunt - short time rated (STR) and should be wired in series with a N/C auxiliary contact.
- single shunt - which is continuously rated (CR)
- double shunt - which is short time rated and should be wired in series with a N/C auxiliary contact.



Shunt coils are available in different voltages and are factory fit accessories / NHP service site visit. Below is a basic list of shunt coils, for voltages not shown on this list please contact your NHP representative.

<b>Rated Voltage</b>	<b>Single shunt coil (CR)</b>	<b>Double shunt coil</b>	<b>Single shunt (STR)</b>
AC 110 V	✓	X	<input type="checkbox"/>
AC 220 V	<input type="checkbox"/>	X	<input type="checkbox"/>
AC 240 V	✓	<input type="checkbox"/>	<input type="checkbox"/>
DC 24 V	✓	<input type="checkbox"/>	<input type="checkbox"/>
DC 48 V	✓	X	<input type="checkbox"/>
DC 100 V	✓	X	<input type="checkbox"/>
DC 110 V	<input type="checkbox"/>	X	<input type="checkbox"/>

**Continuously rated shunt trip and undervoltage trip can not be fitted to the same ACB. However, the STR shunt trip can be used together with an undervoltage trip.**

**Notes:** Double shunts require a special wiring loom to be fitted during manufacture.  
UVT cannot be fitted with a double shunt.

✓ - Stocked   X - Not available

Available on indent only.

# ***TemPower***

## Tripping options

### Continuously-rated shunt trip device (CR)

Type	Rated voltage (V)	Operational voltage (V)	Max. excitation current (A)	Opening time (max.) (ms)
AVR-1C	AC 100	AC 70 - 110	0.48	40
	AC 110	AC 77 - 121	0.39	
	AC 120	AC 84 - 132	0.37	
	AC 200	AC 140 - 220	0.24	
	AC 220	AC 154 - 242	0.19	
	AC 240	AC 168 - 264	0.18	
	DC 24	DC 16.8 - 26.4	1.65	
	DC 30	DC 21 - 33	1.33	
	DC 48	DC 33.6 - 52.8	0.86	
	DC 100	DC 70 - 110	0.39	
	DC 110	DC 77 - 121	0.37	
	DC 125	DC 87.5 - 137.5	0.31	
	DC 200	DC 140 - 220	0.19	
	DC 220	DC 154 - 242	0.18	

## Tripping options - Undervoltage Trip (UVT) Device

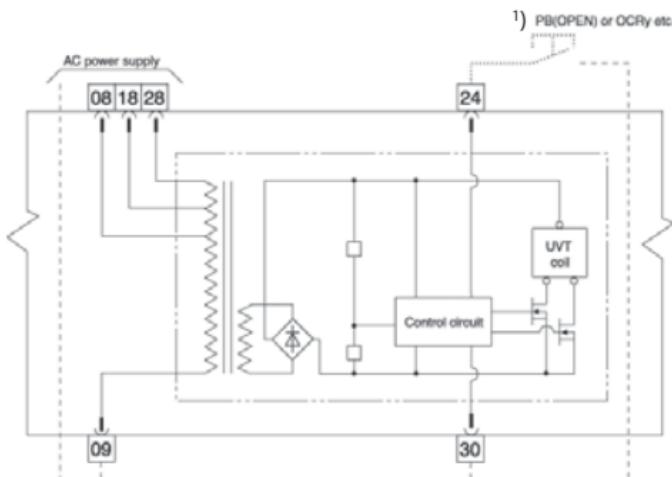
**Can be used to shunt trip the ACB**

The Undervoltage Trip Device (UVT) monitors a single phase and trips the ACB when the control voltage drops below the opening voltage. When the control voltage is restored to the pick-up voltage, the ACB can be closed. The pick-up voltage is fixed to 85 % of the rated voltage. The UVT device is available in an instantaneous or a 500 ms time delay version. Please refer to NHP for available monitoring voltages.

When a shunt facility is required to remotely open the ACB, a N/O push button or relay contact can be wired between control terminals 24 and 30 to remotely open the ACB main contacts. This is the recommended method of remotely opening the ACB because it uses the UVTs fail safe coil to 'trip' the main contacts. Alternatively a single shunt (STR) can be fitted together with the UVT coil. The UVT is a separate controller and coil that is not the same as the UV alarm.

## Single Phase Monitoring

#### **Undervoltage trip control circuit (for AC)**



**Notes:** --- Customer wiring

1) 1 PB and wiring to be supplied by user. Tripping signal PB contact must be rated for 48 V DC/5 mA. Apply tripping signal for at least 80 ms.

If a separate shunt trip facility is required (i.e. not using UVT trip terminals 24 and 30 as described above), a short time rated (STR) device can be provided.

## TemPower

### Tripping options

Type of UVT Control Device	Rated voltage 50/60Hz (V)	Operation- Pickup al voltage (V)	Voltage (V)	Coil Excitation Current (A)	Power Consumption (VA)	
					Normal	Reset
AUR-1CS	AC 100	35 – 70	85			
AUR-1CD	AC 110	38.5 – 77	93.5			
	AC 120	42 – 84	102			
	AC 200	70 – 140	170			
	AC 220	77 – 154	187			
	AC 240	84 – 168	204			
	AC 380	133 – 266	323	0.1	8	10
	AC 415	133 – 266	352			
	AC 440	154 – 308	374			
	DC 24 <sup>1)</sup>	8.4 – 16.8	20.4			
	DC 48 <sup>1)</sup>	16.8 – 33.6	40.8			
	DC 100 <sup>1)</sup>	35 – 70	85			

**Notes:** 1) Special specification.

If a separate shunt trip facility is required (i.e. not using UVT trip terminals 24 and 30 as described above), a short time rated (STR) device can be provided.

## TemPower Communications facility

As standard the TEMPro PLUS and TEMPro PREMIER are equipped with a MODBUS communications facility conforming to the following network interface I/O specifications:

<b>TEMPro OCR</b>	
<b>Protocol</b>	MODBUS
<b>Transmission standard</b>	RS-485
<b>Transmission method</b>	Two wire (half duplex)
<b>Topology</b>	Multi drop bus
<b>Transmission rate</b>	19.2 kbps maximum
<b>Transmission distance</b>	1.2 km max. (at 19.2 kbps)
<b>Data format</b>	Modbus-RTU
<b>Maximum number of data nodes</b>	32

The standard MODBUS communications facility enables variable monitoring only. ACB control (OPEN / CLOSE) over the MODBUS link requires an additional communications interface.

### Communications options

NHP offers additional external communications interfaces for other protocols such as Profibus®, DeviceNet™ and Ethernet. Furthermore ACBs fitted with the TEMPro range of OCRs can be remotely monitored and controlled via the TemVision Pro touch screen <sup>1)</sup>.

Description (required per ACB) <sup>1)</sup>	Cat. No.	Price \$
Profibus® monitor & control Interface	ARCOMMSMODPRO	4210.00
DeviceNet™ monitor & control Interface	ARCOMMSMODDEV	4210.00
Ethernet monitor & control Interface	ARCOMMSMOD2ETH	4210.00



**Notes:** <sup>1)</sup> ACBs must be fitted with a remote tripping device and charging motor. For TemVision Pro information, refer to NHP.

# TemPower

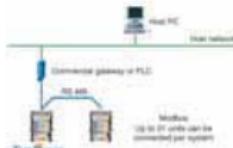
## Monitored and communicated variables

Data variable	Description	TEMPro PLUS	TEMPro PREMIER
max./min. reset	Recorded max./min. variable	✓	✓
open/close status	Indicates the state of the main contacts	✓	✓
diagnosis - system alarm status	Is the system alarm active?	✓	✓
OL pickup status	Is the overload status true?	✓	✓
STD pickup status	Is the short time delay status true?	✓	✓
INST pickup status	Is the Instant status true?	✓	✓
GFT pickup status	Is the UREF status true?	✓	✓
Line side earth fault status <sup>1)</sup>	Is the status true?	✗	✓
current - Ia	Phase current A (A)	✓	✓
current - Ib	Phase current B (A)	✓	✓
current - Ic	Phase current C (A)	✓	✓
current - IN	(A) (4P ACB as a special spec.)	✓	✓
current - Ig	Phase current GF (A)	✓	✓
line voltage - Vab	-	✗	✓
line voltage - Vbc	-	✗	✓
line voltage - Vca	-	✗	✓
power factor - Pf	-	✗	✓
frequency - F	Supply frequency	✗	✓
fault trip time	Speed of trip	✓	✓
diagnosis - MHT disconnect status	Is tripping coil connected?	✓	✓
active power - P	(kW)	✗	✓
total real energy - EP (High-High)	(kWh)	✗	✓
maximum current - I	Maximum phase current recorded	✓	✓
maximum current - Iinst	Maximum inst. current recorded	✓	✓
maximum active power - Pmax (kW)		✗	✓
fault current value	(A)	✓	✓
maximum voltage	Maximum voltage recorded	✗	✓

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All communications cabling should conform to the MODBUS standard. At a minimum the cabling should be shielded, of twisted pair construction and be AWG 24.

Typical MODBUS communication network



**Notes:** 1) Restricted earth fault model only, not standard.

## TemPower

### TemRelay external alarm module

The TemRelay external alarm module provides individual trip/alarm indication from the OCR as well as monitoring basic variables. The TemRelay connects to ACBs via the RS485 interface.



### TemVision remote monitoring and control

The TemVision Pro series of touch screens is for remote monitoring and control of Terasaki ACBs on a 2-wire half-duplex RS485 network via the MODBUS protocol.

#### Features

- Monitoring of variables from the OCR such as:
  - On/off and trip status
  - Phase currents
  - Line voltages <sup>1)</sup>
  - Active power (kW) <sup>1)</sup>
  - Reactive power (kVar) <sup>1)</sup>
  - Power factor <sup>1)</sup>
  - Power consumption (kWh) <sup>1)</sup>
- On/off control of ACBs
- Trip indication and history of trip events
- Maintenance mode
- View and change protection settings
- Password protection

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TemVision Pro 6" screen  
Maximum 6 ACBs



TemVision Max 10" screen  
Maximum 15 ACBs

Description	Cat. No.	Price \$
TemRelay	TEMRELAY	POA
TemVision Pro	TEMVISIONPRO	POA
TemVision Max	TEMVISIONMAX	POA

**Notes:** <sup>1)</sup> TEMPro Premier only.

**TemPower**

## TemPower Rack remote racking device for AR ACBs

NHP have developed a remote racking device for Terasaki AR ACBs to help improve operator safety in switchrooms.

## Features

- Racks ACBs between connected, test and isolated positions
  - Remote operation of ACB on/off controls
  - Controlled by a pendant attached to a 10 metre lead
  - Integrated lifting trolley for ACB bodies
  - Rechargeable battery power supply
  - Requires no modification to ACBs - can be used on existing installations



Scan the QR code  
to view the  
Tempower  
Back video

7

<b>Description</b>	<b>Cat. No.</b>	<b>Price \$</b>
TemPower Rack unit	<b>ARTEMPOWERRACK</b>	<b>POA</b>

## TemPower

### TemPower 2 AR ACB service life and maintenance

		AR12S	AR16S	AR22S	AR32S	AR33S	AR44S
Mechanical	With maintenance 30000	30000	30000	25000	20000	20000	15000
	Without maintenance 15000	15000	15000	12000	10000	10000	8000
Endurance in number of ON/OFF cycles <sup>1)</sup>	AC 460 V	12000	12000	10000	7000	7000	3000
	AC 690 V	10000	10000	7000	5000	5000	2500

#### NHP ACB servicing

NHP offers a wide range of ACB preventative maintenance and servicing programs to keep your ACB fully operational. Offered services include:

- Trip unit calibration and secondary injection testing.
- ACB scheduled maintenance and servicing including contact restoration / replacement, parts lubrication, arc chute restoration, mechanical and electrical functional testing.
- On site commissioning and application support (field service).
- Full service reports are provided.

For further information on the available services and pricing please contact the NHP service department.



**Notes:** 1) Expected service life based on endurance test. The service life of ACB depends on the working and environmental conditions. Refer to NHP for the AR ACB "Maintenance, Inspection and Parts Replacement" guide for further information.

## **TemPower**

### Retrofitting kits and installation kits

When replacing an obsolete air circuit breaker it is almost always necessary to modify the existing busbar alignment, mounting position and door cut-out. Retrofit kits and installation kits provide a cost effective third party solution that allows you to install a completely new Terasaki AR Air Circuit Breaker into many of the popular older brands cubicle with minor re-work and down time.

Retrofit kit: this is the remaking of connections etc. within the existing carriage to suit the new ACB. Typically the existing carriage remains in an altered form.

Installation kit: duplicates the connection and fixing points of the original ACB. The existing carriage is fully removed. Switchboard isolation is required.

Retrofit and installation kits can be purchased from NHP subject to our limitations of liability statement. For further details please contact NHP.

The table below shows the existing / obsolete ACB details (column 1), the Terasaki AR ACB body and carriage replacement (column 2), and either retrofit or installation kit type (column 3). Before selecting a retrofit or installation kit it is important to fully understand the specification of the existing/obsolete ACB .

Existing / Obsolete air circuit breaker	Terasaki AR ACB equivalent frame size <sup>1)</sup>	Kit type	Cat. No.	Price \$
Terasaki AT12, 3P, V/V	AR212S, 3P	Installation	CONTACT NHP	POA
Terasaki AT12, 3P, H/H	AR212S, 3P (HH T&B)	Installation	CONTACT NHP	POA
Terasaki AT16, 3P, V/V	AR216S, 3P (VV T&B)	Installation	CONTACT NHP	POA
Terasaki AT16, 3P, H/H	AR216S, 3P (HH T&B)	Installation	CONTACT NHP	POA
Terasaki AT20, 3P, V/V	AR220S, 3P (VV T&B)	Installation	CONTACT NHP	POA
Terasaki AT25, 3P, V/V	AR325S, 3P (VV T&B)	Installation	CONTACT NHP	POA
Terasaki AT32, 3P, V/V	AR332S, 3P (VV T&B)	Installation	CONTACT NHP	POA
Nilsen NAB1 D8 3P	AR208S, 3P (HV T&B)	Retrofit	CONTACT NHP	POA
Nilsen NAB1 D12 3P	AR212S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA
Nilsen NAB1 D16 3P	AR216S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA
Nilsen NAB1 D20 3P	AR220S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA

**Notes:** 1) VV = vertical; HH = horizontal, T&B = top terminal and bottom terminal.

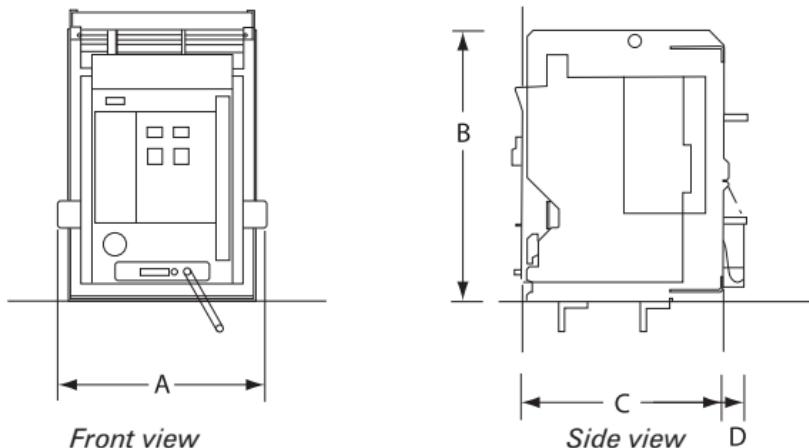
## TemPower

### Retrofitting kits and installation kits

Existing / Obsolete Air circuit breaker	Terasaki AR ACB equivalent frame size <sup>1)</sup>	Kit type	Cat. No.	Price \$
Nilson NAB1 D25 3P	AR325S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA
Nilson NAB1 D31 3P	AR332S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA
Nilson NAB1 D40 3P	AR440S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA
Nilson NAB2 CBM 3P	AR212S, 3P (VV T&B)	Retrofit	CONTACT NHP	POA
NAB2 3P Jig Set	Required for use for Retrofit Nilson NAB2 Kit		CONTACT NHP	POA
Nilson AB5/AB7 3P	AR208S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA
Nilson AB5/AB7 3P	AR216S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA
Nilson AB5/AB7 3P	AR332S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA
Unelec C9/8W 3P	AR208S, 3P (VV T&B)	Retrofit	CONTACT NHP	POA
Unelec C9/12W 3P	AR212S, 3P (VV T&B)	Retrofit	CONTACT NHP	POA
Unelec C9/16W 3P	AR216S, 3P (VV T&B)	Retrofit	CONTACT NHP	POA
Unelec C9/20W 3P	AR220S, 3P (VV T&B)	Retrofit	CONTACT NHP	POA
Unelec C9/31W 3P	AR332S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA
AEG 1600A 3P	AR216S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA
Hundtwebr LH16 3P	AR216S, 3P (VV T&B)	Retrofit	CONTACT NHP	POA
Hundtwebr LH20 3P	AR220S, 3P (VV T&B)	Retrofit	CONTACT NHP	POA
Hawker CNP/16W 3P	AR216S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA
Hawker CNP/20W 3P	AR220S, 3P (HH T&B)	Retrofit	CONTACT NHP	POA

**Notes:** 1) VV = vertical; HH = horizontal, T&B = top terminal and bottom terminal.  
 As highlighted in the table above not all kit types are available ex-stock.  
 All INDENT kits have a 4-6 week lead time from the receipt of a customer purchase order.

## TemPower Outline dimensions

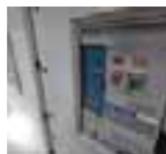


### TemPower 2 draw-out type – 3 and 4 pole outline dimensions (mm)

Cat. No.		AR220S/ AR320H/				AR332S/ AR320H/		AR440SAR650	AR663
		AR212S	AR216S	AR220H/	AR325S	AR316H			
No. of Poles	3 P 4 P	3 P 4 P	3 P 4 P	3 P 4 P	3 P 4 P	3 P 4 P	3 P 4 P	3 P 4 P	3 P 4 P
Draw-out type	A 354 439	354 439	354 439	460 580	460 580	631 801	799 1035	799 1034	
	B 460	460	460	460	460	460	460 460	460 460	
	C 345	345	345	345	345	375	380 380	380 380	
	D 40	40	40	40	40	53	60 60	60 60	
Approx. Body & Weights carriage (kg)	73 86	76 90	79 94	105 125	105 125	139 176	200 260	220 285	
Front & rear connect with-drawable <sup>1)</sup>	Body only	45 51	46 52	46 52	56 68	56 68	71 92	125 160	140 180
	Carriage only	28 35	30 38	33 42	49 57	49 57	68 84	75 100	80 105

**Notes:** 1) Weights are based on normal specifications with the OCR and standard accessories.

**TemPower**  
**Our customers' needs**  
**Providing solutions**

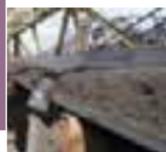
**Switchboard builder**

- Compact size for high packing density
- Zero arc space required for clearance
- Low temperature dissipation
- Built in trip supervision circuit
- Fully rated neutral as standard
- Vertical, horizontal and front terminal connections are available
- Uniform panel cut out size
- Easy access to control, auxiliary and position switch terminals
- Detailed product training available by NHP application engineers
- Manufactured in Australia, allowing for fast delivery and local technical support

**Consultant**

- Approvals and test: IEC 60947, AS3947-2 and A.S.T.A. certified
- Time Current Characteristics to IEC 60255-3 (SI, VI, EI curves)
- Restricted and Unrestricted ground fault protection in one relay
- LSI characteristic curves as standard
- True r.m.s. protection up to 19th harmonic
- Sophisticated undervoltage/phase failure protection
- Integral reverse power protection and load shedding relay
- Only Terasaki can offer  $I_{cw} = 100 \text{ kA}/1 \text{ second}$  in a small 3200 A frame size
- TemPower 2 ACB suffers no loss in performance when tripped through an external protection relay
- Super fast clearance times under fault

7

**End user**

- System alarms that indicate tripping coil health
- Built in relay tester - can check on line without tripping ACB
- Contact temperature monitoring options
- Fault diagnosis - type of fault, magnitude, tripping time & trip history
- High making capacity for operator safety
- Communication to B.M.S. or S.C.A.D.A. system
- Main contacts can be changed within 15 minutes per pole
- Full technical support and ACB commissioning available via NHP
- Product servicing available from Australia's only Terasaki trained and certified ACB technicians

## Arc D-Tect

### D1000 Arc Fault Protection system



#### Efficient protection of high, medium and low voltage switchgear

A continuous supply of power is important in modern energy infrastructure and most production facilities. Wherever electrical energy is generated and distributed, arc flash faults and accidents are likely to occur. An arc protection system is an efficient way to maximise the safety and minimise the damages.



SELCO's D1000 arc protection system is designed to dramatically reduce the effects of arc flash faults in high, medium and low voltage switchgear.



#### Fast protection is essential

An arc-fault in a switchboard or control gear develops within milliseconds and leads to the discharge of enormous amounts of energy. An arc fault is the result of a rapid release of energy due to an arcing fault between phase bus bars. If the arc flash is allowed to develop the result is that the massive energy discharge burns the bus bars, vaporising the copper and thus causing an explosion. Finally this may cause extensive material damage and jeopardise the safety of operational personnel.

An arc protection system operates much faster than conventional protection relays and thus damages caused by an arc flash fault can be kept at a minimum level. As a general guideline, an arc will not cause any damage if it is eliminated within 35ms. If the arc is allowed to continue and last 100ms some damage will occur. An arc fault lasting 500ms may cause severe damage to the installation and will require extensive repair.

A short arc time is critical in order to avoid damage to personnel and material. It is therefore of vital importance that the source leading to the arc flash time is minimised and the power is disconnected as fast as possible – SELCO's D1000 arc protection system is the solution to this problem.

## Arc D-Tect

### Arc detecting relay system

#### D1000 Functionality

The D1000 arc protection system is an advanced and fast arc protection system, offering the following features and functionality:

- Compact unit - arc fault and overcurrent protection
- High speed arc fault detection less than 1ms
- Over-current protection with detection within 1ms
- Combines optical fibre and point sensors
- Real-time event logging
- Self-supervision of sensors and protection unit
- Easy installation and configuration via USB



#### D1000 Arc flash protection unit

The D1000 is a stand-alone and high speed arc protection unit for electrical power distribution systems. D1000 supports both point and fibre sensor technologies for arc flash detection and supports up to six sensors. The sensors can be combined in any combination, depending on the application and requirements.

#### Easy configuration

The D1000 is easy to install and set-up and in case any changes are needed this is easily done via the USB interface accessible from the front. The built-in user-friendly menu system is embedded in the D1000 unit and activates automatically when the unit is connected to a PC.

The built-in light sensor on the front makes it easy to adjust and verify that all sensors are correctly installed and equally sensitive. With the TRIP LEVEL adjustment on the front plate the sensitivity to light can be adjusted. The light range is 10-25,000 lux enabling use of sensors under different light conditions, indoor light, sunlight etc.

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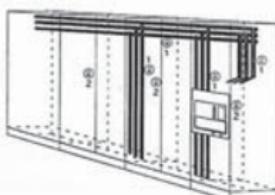
In small installations, the calibration TEST sensor can be used as a single arc detecting sensor, providing additional protection without added cost. Setup of the overcurrent detection, is easily done through the USB interface.

## Arc D-Tect

### Arc detecting relay system

#### Easy installation

The D1000 system is easy to install and made to implement in new switchgear installations as well as retrofit projects. Both the D1000 unit and sensors are quick and easy to install. A general guideline is to mount 1-2 sensors per cubicle or chamber. It is important to cover all horizontal/vertical busbars (1) as well as breaker compartments (2) and drawers. Example is shown below: D1000 relays can be linked (up to 4 relays) to provide expanded installation and sensing requirements.



#### Flexible and efficient sensors

##### A1000 point sensor

The point sensor is a light-sensitive element based on phototransistor technology. It detects visible light radiation which is captured at the cylindrical top. The A1000 point sensor has a detection area of up to 2 m with a characteristic of  $180^\circ \times 360^\circ$ . The A1000 supports self supervision, and a clear blinking built-in LED indicates that the sensor is active. If the sensor reaches the trigger level the LED will light up constantly. The A1000 sensor is supplied with a 10 m shielded cable. 6 sensors maximum.



##### A2000 fibre sensor

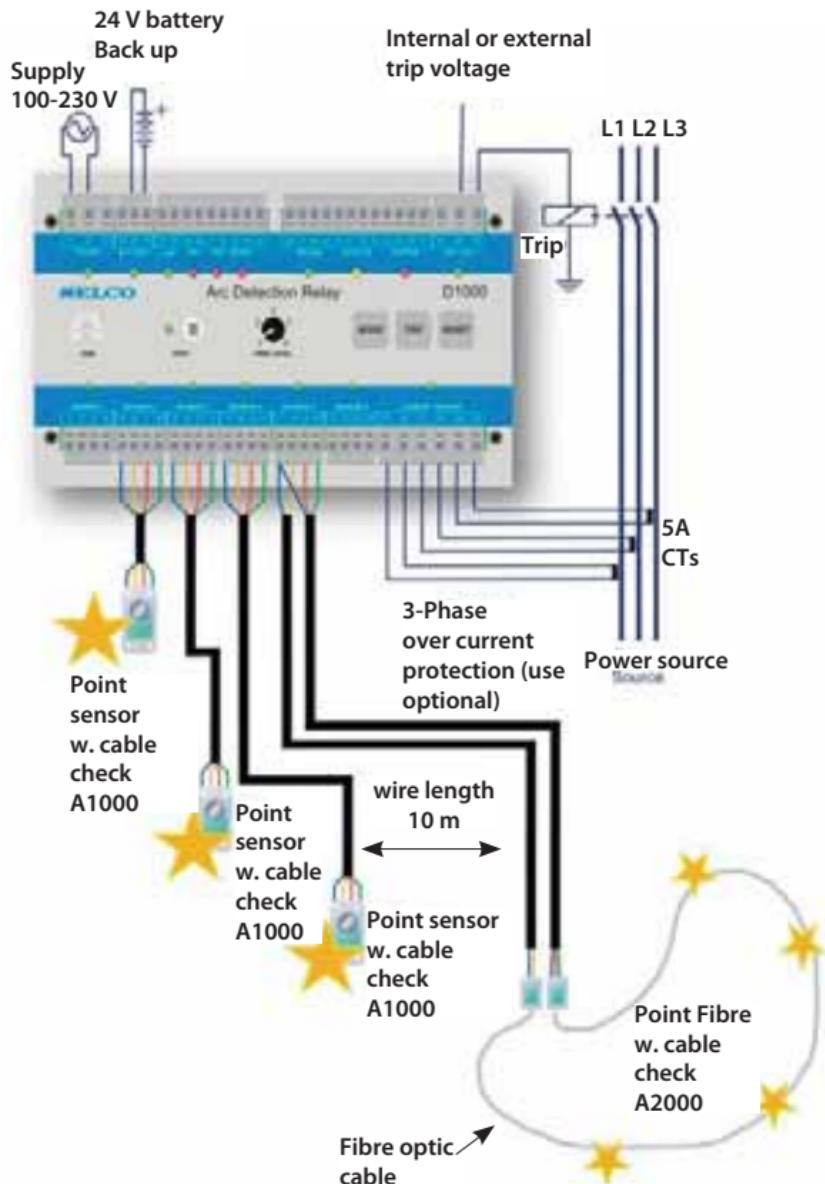
The A2000 fibre sensor is a light sensitive element based on optical fibre technology. The A2000 fibre sensor is a fully flexible fibre with a detection angle of  $360^\circ$  throughout the length of the fibre. The detection radius is up to 2 meters. The fibre sensor is ideal to install in electrical cabinets with drawer sections. Allows the same coverage as approximately 6 x A1000 point sensors. The fibre optic cable is available in 5 m or 8 m lengths. There is also another 10 m of wire cable attached to each end. The wire cable can be extended up to 50 m at each end.



## Arc D-Tect

### Arc detecting relay system

#### D1000 - wiring and installation



## Arc D-Tect

### Arc detecting relay system

<b>D1000 Arc Protection Unit</b>	<b>D1000.0010</b>
Voltage Supply	85 -240 V AC 100 -250 V DC 24 V Battery – Lead acid gel cell
Trip coil output	IGBT switch, 200µs on-time, 2s pulsed (configurable)
Trip coil voltage range	24-600 V DC 24-440 V DC
Signal contacts	Online, Service, Tripped
Sensitivity	10 – 25000 lux, Trip level adj. 1-9
Current inputs	3-phase 5 A (75 A/1 sec)
Burden	<0.25 VA/inputs at 5 A
Current range	1.5-3.0 x ln (7.5-15 A)
Response time	Less than 1ms (arc fault) Less than 1ms (overcurrent)
Number of detectors	Up to 6
System expansion	Up to 4 x D1000 units via Link connection
Interface	USB
Power consumption	<3W
Ambient temperature	-25 to + 70 °C
Dimensions (WxHxD)	200x130x52 mm
Mounting	35 mm DIN Rail or screw-in
<b>A1000 Sensor</b>	<b>A1000.0010</b>
Type	Point sensor
Detection area	180° x 360° - 2 m
Length	10 m shielded cable
Circuit check	Built-in – LED for visual feedback
Dimensions (WxHxD)	32x52x21 mm
<b>A2000 Sensor</b>	<b>A2000.0020</b>
Type	Fibre optical sensor
Detection area	360°
Length	5 m flexible fibre optic cable (plus 10 m of wiring cable)
Circuit check	Built-in – LED for visual feedback
Dimensions (WxHxD)	32x52x21 mm
<b>A2000 Sensor</b>	<b>A2000.0010</b>
Type	Fibre optical sensor
Detection area	360°
Length	8 m flexible fibre optic cable (plus 10 m of wiring cable)
Circuit check	Built-in – LED for visual feedback
Dimensions (WxHxD)	32x52x21 mm
<b>Approvals/standards</b>	
EMC standards	EN60255-26
Enclosure	IP 20

## Arc D-Tect

### D1000 Arc-fault protection system



#### Catalogue Numbers and ordering

	<b>Cat. No.</b>	<b>Price \$</b>
D1000 Arc protection unit	<b>D1000 0010</b>	<b>5610.00</b>
A1000 Arc point sensor 10 m	<b>A1000 0010</b>	<b>550.00</b>
A2000 Arc fibre cable sensor 5 m	<b>A2000 0020</b>	<b>2000.00</b>
A2000 Arc fibre cable sensor 8 m	<b>A2000 0010</b>	<b>3030.00</b>
D1000 DIN rail mounting clips	<b>D1000DINCLIPS</b>	<b>11.40</b>



Built-in overcurrent protection



Extended coverage with links input



Efficient self-supervision

7

**Notes:** Old sensor types ADR/ A0200/ A0300 can be used with the new D1000 relay. Refer NHP for connection details.

## Earth Leakage Relays

	Page
<b>Earth leakage relays</b>	
Surface mounting type TZS series	8 - 2
DIN Rail mounting type RD3A series	8 - 4
DIN Rail mounting type RD1B series	8 - 5
Panel mounting type RD1DF series	8 - 6
Panel mounting type RD1EP series	8 - 7
Panel mounting type RD3E2 series	8 - 8
Panel mounting type RD1G2 series	8 - 10
<b>Mining earth leakage relay</b>	
Panel mount mining relays, DSRM72 and DSR48T Series	8 - 12
Remote current transformer (toroid) TD and DSR Series	8 - 14
Accessories	8 - 15



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**TZS series****Features**

- Adjustable time range 0.3 - 2 s
- Sensitivity (adj.) 30 mA - 1 amp.
- Immune to false tripping via harmonics
- High vibration withstand
- Output C/O contact
- Indication - LED
- Reset function - electrical

**TZS relay**

<b>Mounting</b>	<b>Voltage</b>	<b>Adj. sensitivity</b>	<b>Adj. time range</b>	<b>Cat. No.</b>	<b>Price \$</b>
Surface	120/240 V AC	30 mA-1 amp	0.3-2 s	<b>TZS AD120240V</b>	<b>680.00</b>
Surface	400/440 V AC	30 mA-1 amp	0.3-2 s	<b>TZS AD415440V</b>	<b>680.00</b>
Surface	24 V AC	30 mA-1 amp	0.3-2 s	<b>TZS AD24VAC</b>	<b>680.00</b>
Flush (collar only)	-	-	-	<b>TPD OSZ</b>	<b>102.00</b>

**Tripping times**

<b>Rated operating time (sec)</b>	<b>Operating time range (sec)</b>	<b>Non-operating time range (sec)</b>
0.3	0.2 - 0.36	0.15
0.5	0.4 - 0.6	0.38
1	0.8 - 1.2	0.7 - 1.25
2	1.3 - 2.0	0.7 - 1.25

**Standard features**

Earth leakage detection	current operated type
Internally mounted contact	1 C/O
Earth leakage indication	LED
Reset function (electrical)	Yes
Test button	Yes
Remote reset (power source)	1 VA
Dimensions (mm) W/H/D	60/104/78
Weight (kg) (relay only)	0.22

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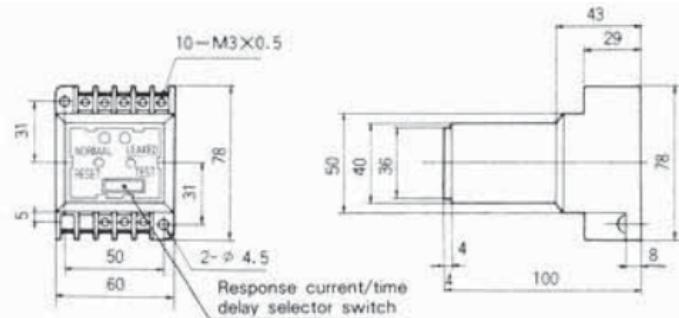
**Toroidal CT - ZCT only (remote, add to relay)**

<b>Max. cable 2 wire</b>	<b>Max. cable 4 wire</b>	<b>Internal diameter</b>	<b>Cat. No.</b>	<b>Price \$</b>
8 mm <sup>2</sup>	5.5 mm <sup>2</sup>	15 mm	<b>TZS-15</b>	<b>113.00</b>
30 mm <sup>2</sup>	22 mm <sup>2</sup>	24 mm	<b>TZS-24</b>	<b>340.00</b>
100 mm <sup>2</sup>	80 mm <sup>2</sup>	40 mm	<b>TZS-40</b>	<b>630.00</b>
325 mm <sup>2</sup>	250 mm <sup>2</sup>	68 mm	<b>TZS-68</b>	<b>1050.00</b>
850 mm <sup>2</sup>	600 mm <sup>2</sup>	100 mm	<b>TZS-100</b>	<b>1610.00</b>

**Notes:** Refer page 9 - 68 for AS/NZS requirements when using earth leakage relays.

## TZS series

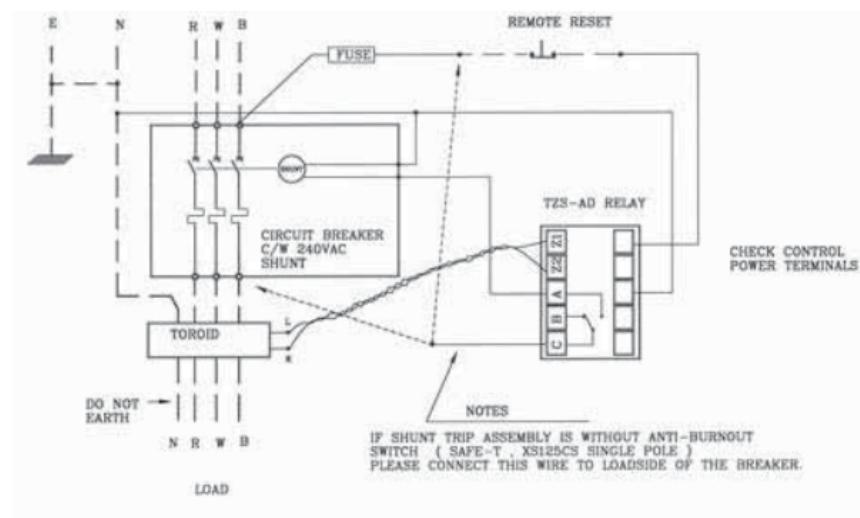
### Outline dimensions (mm)



### Rating of output contact

	Resistance load $\cos \phi = 1$	Inductive load $\cos \phi = 0.4$ ( $L/R=7$ ms)	Min. load
120/230 V AC	6 A	3.5 A	10 mA at 5 V DC
30 V DC	6 A	3 A	10 mA at 5 V DC

### Connection diagram - Residual current relay



**Notes:** For 415 V AC or 440 V AC contact NHP for availability.

The output contacts remain until the RESET button is operated.

Should the control power supply fail the contacts automatically reset.

## DIN rail mount RD series RD3A

- Standard AS 60947-2 (Annex M)
- Core balance earth leakage relay
- Adjustable  $I\Delta n$  up to 30 amps
- Adjustable trip time up to 5 s
- Harmonic filter
- 2 wire toroid connection
- Field selectable negative/positive security
- Instantaneous display as percentage  $I\Delta n$
- DIN rail mounting (2 module)



RD3A

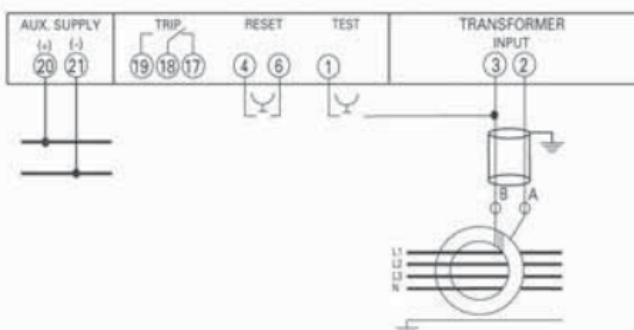
RD relays in conjunction with a ring current transformer (toroid) provide earth leakage protection of electrical distribution systems and electrical equipment.

### Features

- Adjustable: 0, 0.15, 0.25, 0.5, 1, 2.5, 5 sec
- Adjustable trip current: .03, .05, .075, 0.1, 0.15, 0.2, 0.3 A in 3 ranges x 1, x 10, x 100
- Automatic reset option
- Trip: one changeover contact (5 A - 250 V AC cos 1.0, 5 A - 30 V DC)
- Local reset/test and remote reset/test<sup>1)</sup>
- LED indication: green (healthy), red (tripped), yellow (% $I\Delta n$  20 %, 40 %, 60 %)
- IP 50 Front cover, IP 20 terminals
- Test buttons checks relay function and toroid connections

Auxiliary Voltage	Cat. No.	Price \$
24 V AC	RD3AF1N (24 V AC)	910.00
110 V AC	RD3AF12 (110 V AC)	910.00
240 V AC	RD3AF14 (240 V AC)	910.00
415 V AC	RD3AF15 (415 V AC)	910.00
24 - 150 V DC	RD3AF1H (24-150 V DC)	910.00

### Wiring diagram – RD3A



**Notes:** 1) Remote test on AC versions only.

Refer page 9 - 68 for AS/NZS requirements when using earth leakage relays.

## DIN rail mount RD series RD1B

- Standard AS 60947-2 (Annex M)
- Core balance earth leakage relay
- Adjustable  $I\Delta n$  up to 30 amps
- Adjustable trip time up to 5 s
- Harmonic filter
- 2 wire toroid connection
- Field selectable negative/positive security
- Instantaneous display as percentage  $I\Delta n$
- DIN rail mounting (4 module)



RD1B

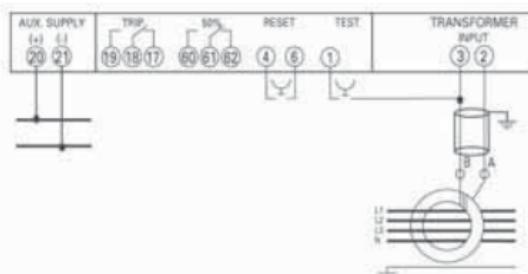
RD relays in conjunction with a ring current transformer (toroid) provide earth leakage protection of electrical distribution systems and electrical equipment.

### Features

- Adjustable: 0, 0.15, 0.25, 0.5, 1, 2.5, 5 sec
- Adjustable trip current: .03, .05, .075, 0.1, 0.15, 0.2, 0.3 A in 3 ranges x 1, x 10, x 100
- Automatic reset option
- Trip: one changeover contact (5 A - 250 V AC cos 1.0, 5 A - 30 V DC)
- Local reset/test and remote reset/test<sup>1)</sup>
- Changeover contact - selectable between alarm preset 50 %  $I\Delta n$  and second trip contact
- Field selectable - high or low harmonic filter circuit
- LED indication: green (healthy), red (tripped), yellow (% $I\Delta n$  20 %, 30%, 40 %, 50 %)
- IP 40 Front cover, IP 20 terminals
- Test buttons checks relay function and toroid connections

Auxiliary Voltage	Cat. No.	Price \$
110 V AC	RD1B212	1080.00
240 V AC	RD1B214	1080.00
415 V AC	RD1B215	1080.00
24 - 150 V DC	RD1B21H	1080.00

### Wiring diagram – RD1B



**Notes:** 1) Remote test on AC versions only.  
Refer page 9 - 68 for AS/NZS requirements when using earth leakage relays.

## Panel mount RD series

### RD1DF

- Standard AS 60947-2 (Annex M)
- Core balance earth leakage relay
- Adjustable  $I_{\Delta n}$  up to 30 amps
- Adjustable trip time up to 5 sec
- Harmonic filter
- 2 wire toroid connection
- Field selectable negative/positive security



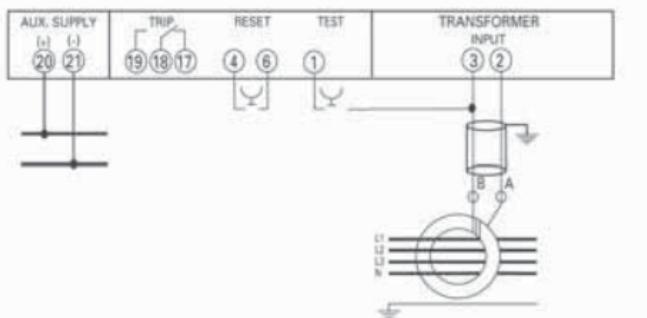
RD1D

#### Features

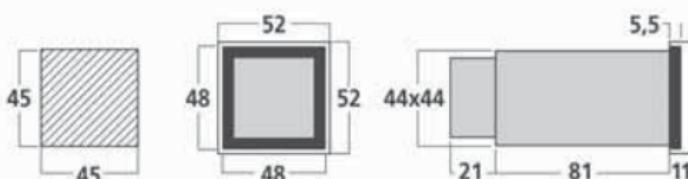
- Panel mounting 48 mm
- Adjustable: 0, 0.15, 0.25, 0.5, 1.0, 2.5, 5 sec
- Adjustable trip current: .03, .05, .075, 0.1, 0.15, 0.2, 0.3 A, in 3 ranges x 1, x 10, x 100
- Automatic reset option
- Trip - one changeover contact (5 A - 250 V AC cos 1.0, 5 A - 30 V DC)
- Local and remote reset/test
- LED indication: green (healthy), red (tripped)
- IP 40 Front cover, IP 20 terminals
- Test buttons checks relay function and toroid connections

Auxiliary Voltage	Cat. No.	Price \$
110 V AC	RD1DF12	520.00
240 V AC	RD1DF14	520.00
415 V AC	RD1DF15	520.00

#### Wiring diagram



#### Dimensions (mm)



## Panel mount RD series

### RD1EP

- Standard AS 60947-2 (Annex M)
- Core balance earth leakage relay
- Adjustable  $I_{\Delta n}$  up to 30 amps
- Adjustable trip time up to 5 sec
- Harmonic filter
- 2 wire toroid connection
- Field selectable negative/positive security



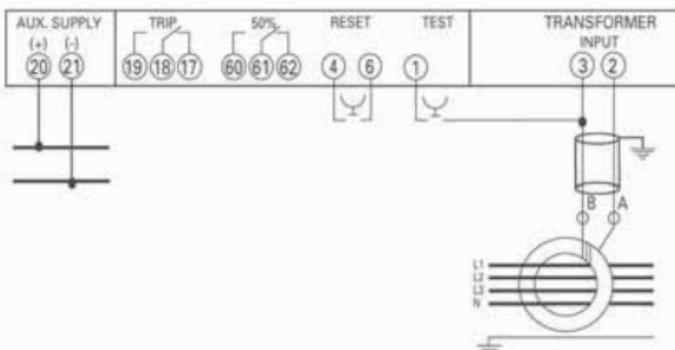
RD1E

#### Features

- Panel mounting 72 mm
- Adjustable: 0, 0.15, 0.25, 0.5, 1.0, 2.5, 5 sec
- Adjustable trip current: .03, .05, .075, 0.1, 0.15, 0.2, 0.3 A in 3 ranges x 1, x 10, x 100
- Changeover contact-selectable between alarm pre-set 50 %  $I_{\Delta n}$  and extra trip contact (5 A - 250 V AC cos 1.0, 5A - 30 V DC)
- Trip - one changeover contact (5 A - 250 V AC, cos 1.0, 5 A - 30 V DC)
- Local and remote reset/test<sup>1)</sup>
- LED indication: green (healthy), red (tripped), yellow (% $I_{\Delta n}$  20 %, 30%, 40 %, 50 %)
- IP 40 Front cover, IP 20 terminals
- Test buttons checks relay function and toroid connections

Auxiliary Voltage	Cat. No.	Price \$
110 V AC	RD1EP212	910.00
240 V AC	RD1EP214	910.00
415 V AC	RD1EP215	910.00
24 - 150 V DC	RD1EP21H	910.00

#### Wiring diagram



**Notes:** 1) Remote test on AC versions only.

Refer page 9 - 68 for AS/NZS requirements when using earth leakage relays.

## Panel mount RD series

### RD3E2

- Standard AS 60947-2 (Annex M)
- Core balance earth leakage relay
- Adjustable  $I\Delta n$  up to 30 amps
- Adjustable trip time up to 5 sec
- Field selectable negative/positive security
- Instantaneous digital display
- 2 wire toroid connection
- Monitor function <sup>1)</sup>



RD3E2

#### Technical data

Aux. voltage	110, 240 & 415 V AC    50/60 HZ or 24 - 150 V DC
Contact rating	5 A - 250 V AC cos 1.0; 3 A - 250 V AC cos 0.4; 5 A - 30 V DC
Pre trip alarm	50 % $I\Delta n$
Indication	Digital display - 3 digits
Test	Tests relay function and toroid connections
IP rating	IP 40 front frame; IP 20 terminals
Operating temperature	-25 °C to +55 °C

#### Features

- Panel mounting 72 mm
- Adjustable time: 0, 0.15, 0.25, 0.5, 1.0, 2.5, 5, sec
- Adjustable trip current-.03, .05, .075, 0.1, 0.15, 0.2, 0.3 A, in 3 ranges x 1, x 10 x 100
- Digital indication of residual current - 3 digits
- N/O contact-selectable between alarm pre-set 50 %  $I\Delta n$  and extra trip contact
- Trip - one changeover contact
- Local and remote reset/test <sup>2)</sup>

Auxiliary Voltage	Cat. No.	Price \$
110 V	RD3E212B	1510.00
240 V	RD3E217B	1510.00
415 V	RD3E218B	1510.00
24 - 150 V DC	RD3E21HB	1510.00

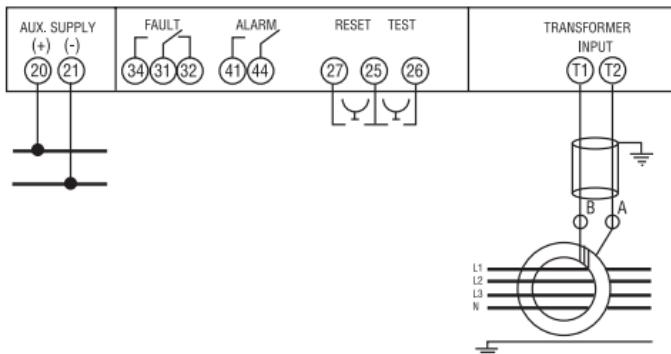
**Notes:** <sup>1)</sup> Relay can operate as an earth leakage relay or as a digital meter with trip contacts and current setting disabled. This monitor function is ideal when first selecting the current settings and monitoring the installation.  
<sup>2)</sup> Remote test on AC version only.  
Refer page 9 - 68 for AS/NZS requirements when using earth leakage relays.

## Panel mount RD series

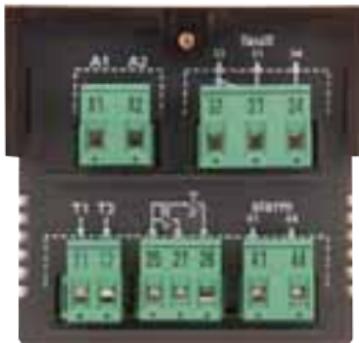
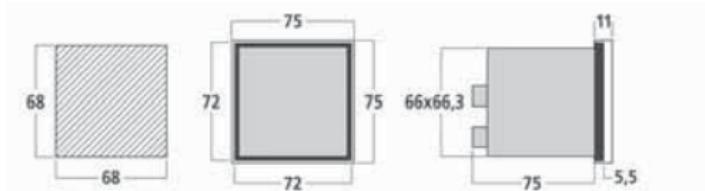
### RD3E2

#### Wiring diagram – RD3E2

S 291/107



#### Dimensions (mm)



Rear view RD3E21

## Panel mount RD series

### RD1G2

- Standard AS 60947-2 (Annex M)
- Core balance earth leakage relay
- Adjustable sensitivity 30 mA to 30 A
- Adjustable trip time up to 5 sec
- Field selectable negative/positive security
- Reduced depth housing
- 2 wire toroid connection
- Continuous permanent test toroid connections
- Harmonic filter
- Pre trip alarm



#### Technical data

Aux. voltage	110 V AC, 240 V AC or 415 V AC 50/60 Hz
Contact rating	5 A-250 V AC cos 1.0; 3 A-250 V AC cos 0.4; 5 A-30 V DC
	Supply healthy – green LED
Indication	Relay tripped – red LED
	% $I\Delta n$ – LEDS 20, 30, 40 and 50 %
	Test button: Tests integrity of relay internal trip circuit
Test	Permanent test: Continuously monitors toroid connections and trip circuit
IP rating	IP 40 front frame; IP 20 terminals
Operating temperature	-5 °C to +55 °C

#### Features

- Panel mounting 96 mm
- Adjustable time delay - 0, 0.15, 0.25, 0.5, 1.0, 2.5, 5 sec
- Adjustable trip current - 0.03, 0.05, 0.75, 0.1, 0.15, 0.2, 0.3 A in range x 1, x 10, x 100
- Field selectable negative/positive security
- Trip – 1 changeover contact
- Local and remote reset/test
- Changeover contact selectable between alarm preset 50 %  $I\Delta n$  and extra trip contact

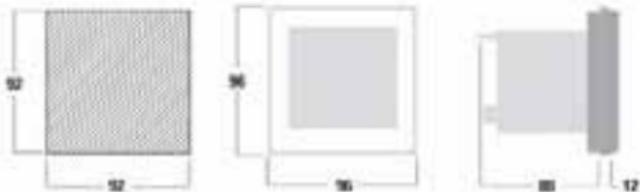
Auxiliary Voltage	Cat. No.	Price \$
110 V AC	RD1G212	1000.00
240 V AC	RD1G214	1000.00
415 V AC	RD1G215	1000.00

**Notes:** Refer page 9 - 68 for AS/NZS requirements when using earth leakage relays.

## Panel mount RD series

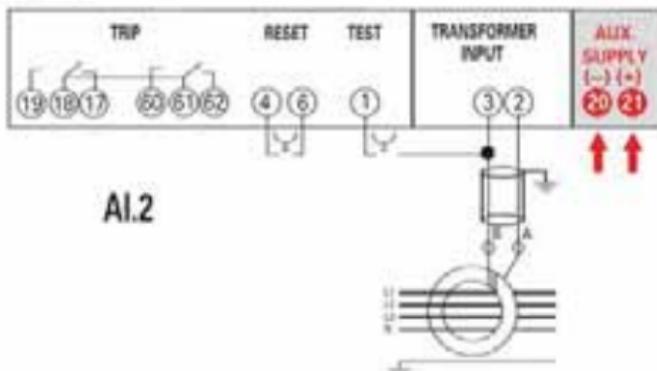
### RD1G2

**Dimensions (mm) RD1G2**

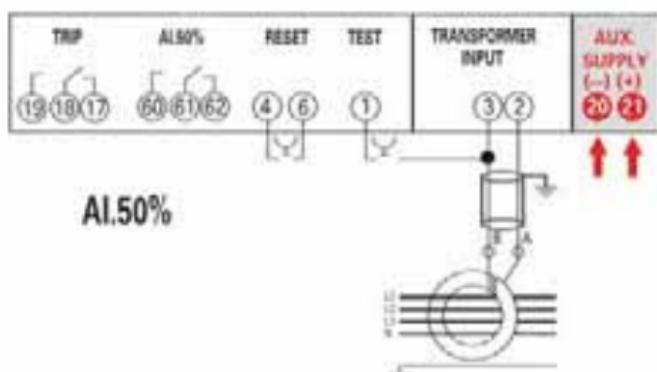


**Wiring diagram – RD1G2**

**S 291/123**



**S 291/86**



## Panel mount mining relay series

### DSRM72 and DSR48T

- Standard AS/NZS 2081:2011
- Core balance earth leakage relay
- Adjustable sensitivity 0.03 A – 0.5 A
- Adjustable trip time 0.05 sec – 0.5 sec
- Separate test unit for circuit integrity testing
- Four wire toroid connection
- Field selectable negative/positive security
- Field selectable function of outputs
- Harmonic filter



#### Technical data (DSRM72)

Aux. voltage	240 V or 110 V AC 50/60 Hz, 24 V DC
Contact rating	5 A-250 V AC cos 1; 3 A 250 V AC cos 0.4; 5 A 30 V DC
	Supply healthy – green LED
	Power fail - Changeover contact
Indication	Relay tripped – red LED
	Toroid fault – flashing red LED
	% IΔn – LEDs 20, 30, 40 and 50 %
Test	Internal relay test button on unit.
	Circuit integrity test using external DSR48T.
IP rating	IP 40 front frame; IP 20 terminals
Operating temperature	-10 °C to +60 °C

#### Features

- Units supplied complete with separate test device DSR48T
- Panel mounting 72 mm
- Adjustable trip current -7 steps: 0.03, 0.06, 0.1, 0.2, 0.3, 0.4 & 0.5
- Adjustable trip time -7 steps: 0.05, 0.1, 0.15, 0.2, 0.3, 0.4 & 0.5
- Choice of output contacts 2 x AL or 1 x AL + 1 x Power Fail
- Negative/Positive security
- Complies with standard AS/NZS 2081:2011
- Latching contact

Auxiliary Voltage	Cat. No.	Price \$
110 V AC	DSRM110V <sup>1)</sup>	1200.00
240 V AC	DSRM240V <sup>1)</sup>	1200.00
24 V DC	DSRM7224 <sup>2)</sup>	980.00
110 V AC	DSRM72110	980.00
240 V AC	DSRM72240	980.00
110 V AC	DSR48TD110	390.00
240 V AC	DSR48TD240	390.00

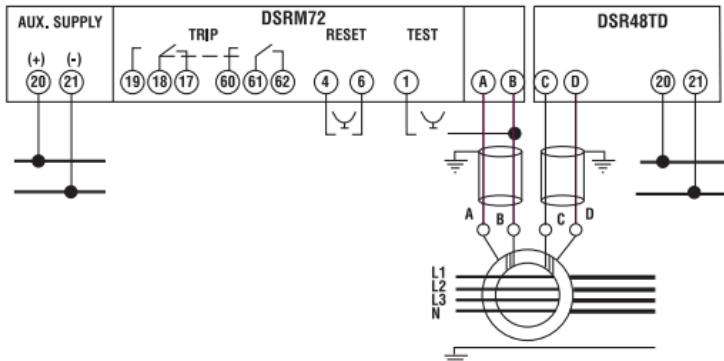
**Notes:** <sup>1)</sup> Part number is made up of 1 x relay & 1 x test unit.

<sup>2)</sup> Can be used with AC test unit.

## Panel mount mining relay series DSRM72 and DSR48T

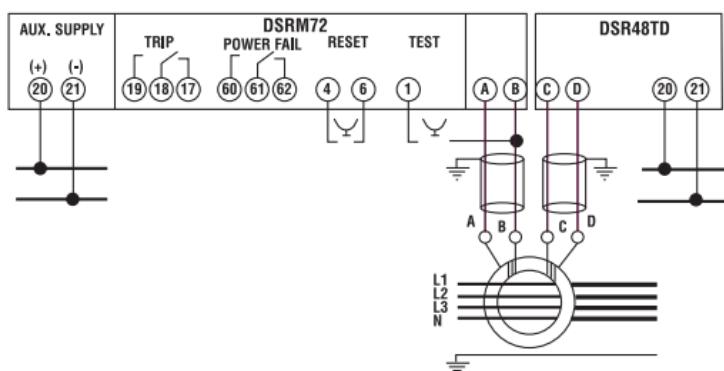
A1.2

A1.2



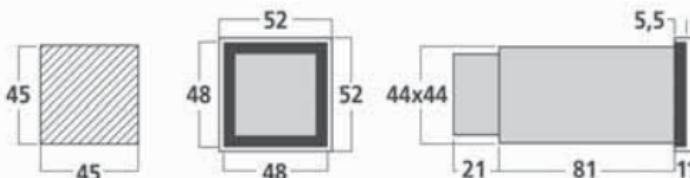
A1.aux

A1.aux

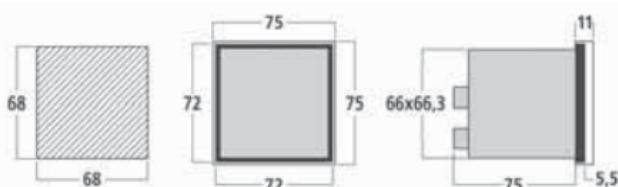


For correct working according to AS/NZS 2081:2011 the device shall be set as positive security Ne.

**DSR48TD - Test device**



**DSRM72 - Relay**



## Remote toroids

### Type TD Series

## TD series

Only TD type toroids are to be used in conjunction with the NHP range of RD residual current relays. Care should be taken to select a toroid size closest to the diameter of the cables being protected. Also ensure the minimum possible distance between the toroid and relay to ensure maximum accuracy.



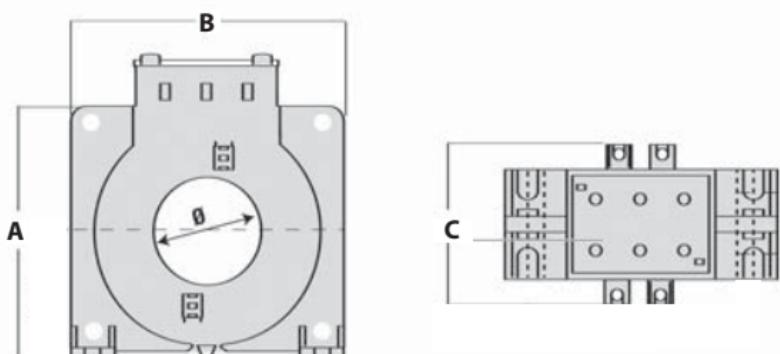
### Closed core toroids (2 wire)

Min. IDn (A) <sup>1</sup>	Nom. In (A) <sup>2</sup>	Max. In (A) <sup>2</sup>	Internal diameter (mm)	Overall dimensions (mm)			Cat. No.	Price \$
				A	B	C		
0.03	65	390	28	59	59	47	TDGA2	225.00
0.03	70	420	35	113	92	56	TDGB2	300.00
0.03	90	540	60	112	105	56	TDGH2	325.00
0.03	170	1020	80	160	125	56	TDGC2	375.00
0.1	250	1500	110	198	165	56	TDGD2	570.00
0.3	250	1500	140	234	200	56	TDGE2	790.00
0.3	400	2400	210	323	290	64	TDGF2	950.00

### **Open (split) core toroids (2 wire)**



Overall dimensions (mm)								
Min. IΔn (A <sup>-1</sup> )	Max. In (A)	Internal diameter (mm)	H	W	D	Cat. No.	Price \$	
0.5	250	1500	110	214	235	79	TDA2	1000.00
0.5	250	1500	150	259	275	79	TDAB2	1310.00
1.0	630	3780	310	386	400	30	TDAC2	2130.00



**Notes:** <sup>1)</sup> Lowest value of  $I\Delta n$  to be set on relay with this toroid connected.  
<sup>2)</sup> Values shown are valid only for conductors passing exactly in the middle of the toroid.

## Remote toroids

### Type DSR Series

#### DSR series

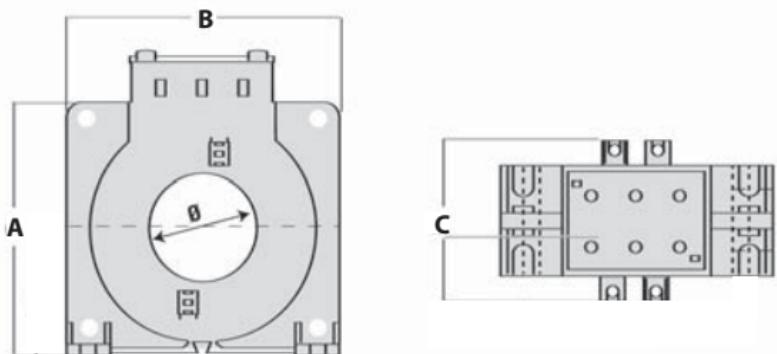
Only the DSR type toroids are to be used in conjunction with the NHP range of DSRM mining relays. The four wire toroid is vital for compliance to AS/NZS 2081:2011.

#### Closed core toroids (4 wire)

Min. $I\Delta n$ (A) <sup>1)</sup>	Nom. In (A)	Max. In (A) <sup>2)</sup>	Internal diameter (mm)	Overall dimensions (mm)			Cat. No.	Price \$
				A	B	C		
0.03	70	420	35	113	92	56	DSR35DEL	305.00
0.03	170	1020	80	160	125	56	DSR80DEL	375.00
0.1	250	1500	110	198	165	56	DSR110DEL	580.00
0.3	250	1500	140	234	200	56	DSR140DEL	800.00
0.3	400	2400	210	323	290	64	DSR210DEL	960.00

#### Accessories

	Cat. No.	Price \$
IP 65 - Front cover to suit 48 x 48 panel mount relay	RD4848C	200.00
IP 65 - Front cover to suit 72 x 72 panel mount relay	RD7272C	200.00
IP 65 - Front cover to suit 96 x 96 panel mount relay	RD9696C	255.00
72 x 72 mm to 96 x 96 mm adapter plate	RD7296A	88.00



- Notes:**
- 1) Lowest value of  $I\Delta n$  to be set on relay with this toroid connected.
  - 2) Values shown are valid only for conductors passing exactly in the middle of the toroid.



## TL101 TRANSFER SWITCH CONTROLLER

The soft touch TL101 controller automatically or manually switches a load from a main line to an emergency supply in the event of a power failure.



- Genuine 144 x 144 mm controller solution
- User friendly display and menu selection
- Large selection of functions and options as standard



## Technical reference data

	Page
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## Din-T MCB

### Features

Description	Din-T 6 2 to 63 A			Din-T 10 0.5 to 63 A				Din-T 15 6 to 63 A				Din-T 10H 80 to 125 A			
No. of poles	1	2	3	1	2	3	4	1	2	3	4	1	2	3	4
Protected poles	1	2	3	1	2	3	4	1	2	3	4	1	2	3	4
Width (mm)	18	36	54	18	36	54	72	18	36	54	72	27	54	81	108
Depth (mm) <sup>4)</sup>	68			68			68				70				
Rated voltage	240/415 V AC			240/415 V AC			240/415 V AC				240/415 V AC				
Max. current In	63 A			63 A			63 A				125 A				
Calibration temp. °C	30			30			40				40				
No. of operations															
220 V In COS=0.9	10000			10000			4000				4000				
415 V In COS=0.9	10000			10000			4000				4000				
Insulation resistance	>10 Mohm			>10 Mohm			>10 Mohm				>10 Mohm				
Dielectric rigidity	>2.5 kV			>2.5 kV			>2.5 kV				>2.5 kV				
Terminal capacity															
line mm <sup>2</sup>	35			35			35				70				
load mm <sup>2</sup>	35			35			35				70				

### DC application <sup>3)</sup>

Description	Din-T 6 2 to 63 A			Din-T 10 0.5 to 63 A			Din-T 15 6 to 63 A			Din-T 10H 80 to 125 A		
Max. voltage	48	110 <sup>1)</sup>	--	48	110 <sup>1)</sup>	--	48	110 <sup>1)</sup>	--	125 <sup>1)</sup>	250 <sup>2)</sup>	--
No. operations at T≤15 ms	10000			10000			10000			40000		
Short circuit kA at T≤15 ms	20	25	-	25	30	-	25	30	-	10	-	10-

**Notes:** DC magnetic trip current is approximately 40 % higher than 50/60 Hz.

<sup>1)</sup> Series connection 2 pole MCB.

<sup>2)</sup> Series connection 4 pole MCB.

<sup>3)</sup> For DC switching at 250 V and 500 V DC refer latest edition of Part C catalogue for ratings information.

<sup>4)</sup> Depth measurement, excluding toggle.

## Effects of frequency on the tripping characteristic

### Din-T 6, 10, 10H, 15

All the MCBs are designed to work at frequencies of 50 - 60 Hz, therefore to work at different values, consideration must be given to the variation of tripping characteristics. The thermal tripping does not change with variation of the frequency but the magnetic tripping values can be up to 50 % higher than the ones at 50-60 Hz.

#### Tripping characteristics according to IEC 60898

<b>60 Hz</b>	<b>100 Hz</b>	<b>200 Hz</b>	<b>300 Hz</b>	<b>400 Hz</b>
1	1.1	1.2	1.4	1.5

#### Power losses Din-T 6, 10, 10H, 15

The power losses are calculated by measuring the voltage drop between the incoming and the outgoing terminals of the device at rated current.

#### Power loss per pole

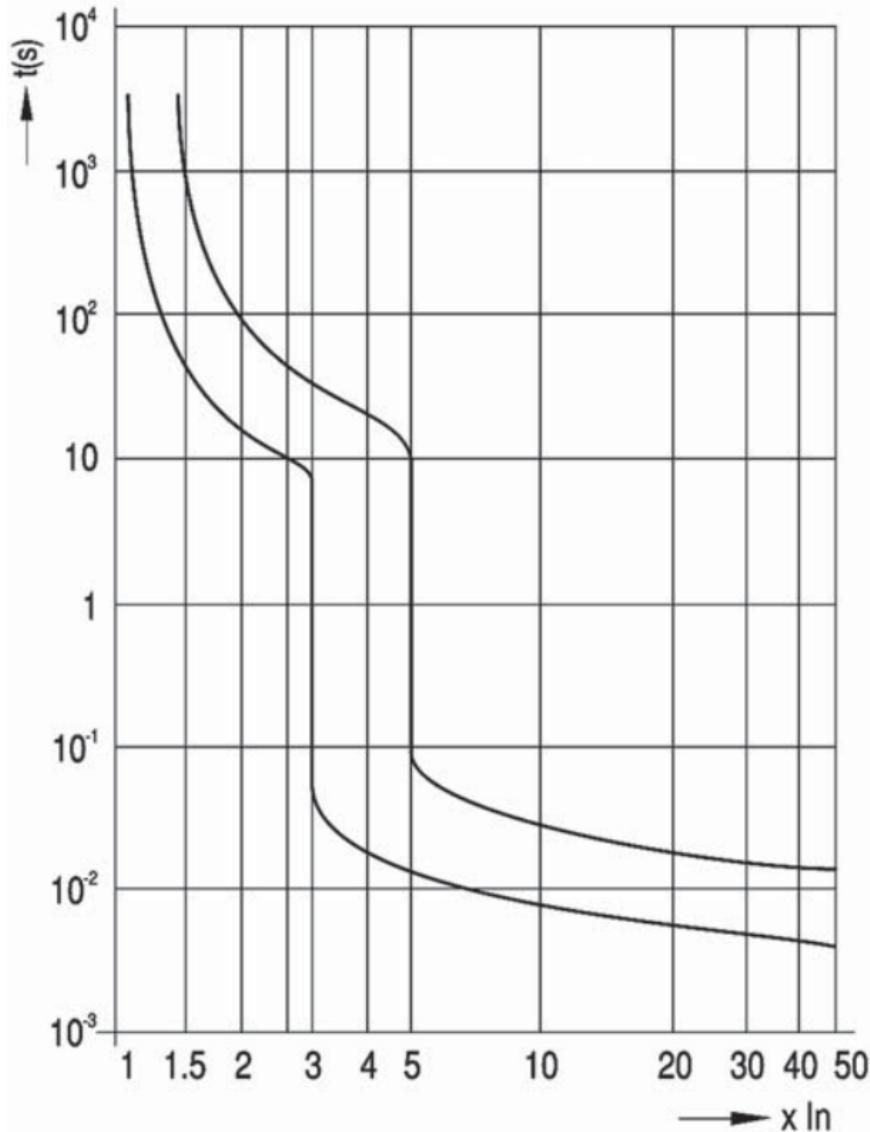
<b>In (A)</b>	<b>Voltage drop (V)</b>	<b>Energy Loss (W)</b>	<b>Resistance (Mohm)</b>
0.5	2.230	1.115	4458.00
1	1.270	1.272	1272.00
2	0.620	1.240	310.00
3	0.520	1.557	173.00
4	0.370	1.488	93.00
6	0.260	1.570	43.60
8	0.160	1.242	19.40
10	0.160	1.560	15.60
13	0.155	2.011	11.90
16	0.162	2.586	10.10
20	0.138	2.760	6.90
25	0.128	3.188	5.10
32	0.096	3.072	3.00
40	0.100	4.000	2.50
50	0.090	4.500	1.80
63	0.082	5.160	1.30
80	0.075	6.000	0.90
100	0.075	7.500	0.75
125	0.076	9.500	0.60

## Din-T time current curves Din-T 6 and 10

## Tripping characteristics according to IEC 60898

## Din-T 10 B Curve devices

### Curve B ( $3 - 5 \times \ln$ )

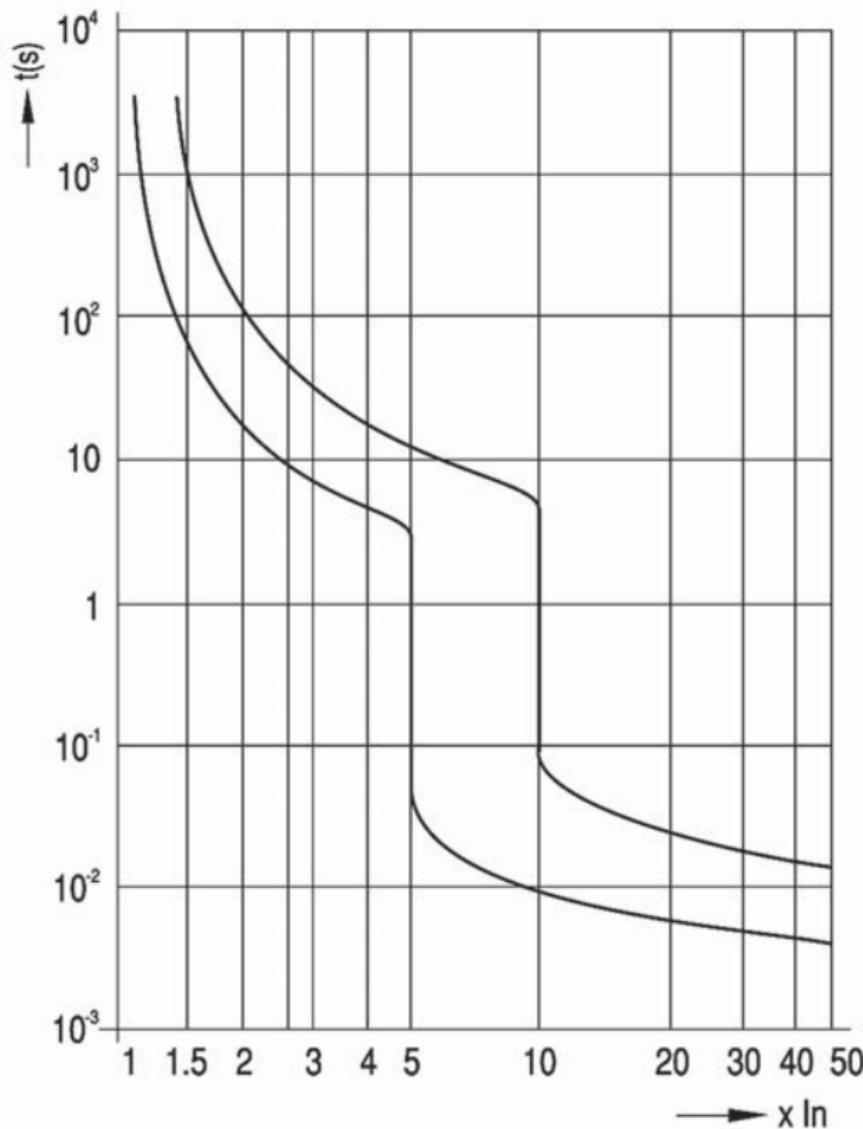


## Din-T time current curves Din-T 6 and 10

Tripping characteristics according to IEC 60898

Din-T 6, 10, 10H, 15, DC

Curve C ( $5 - 10 \times \ln$ )

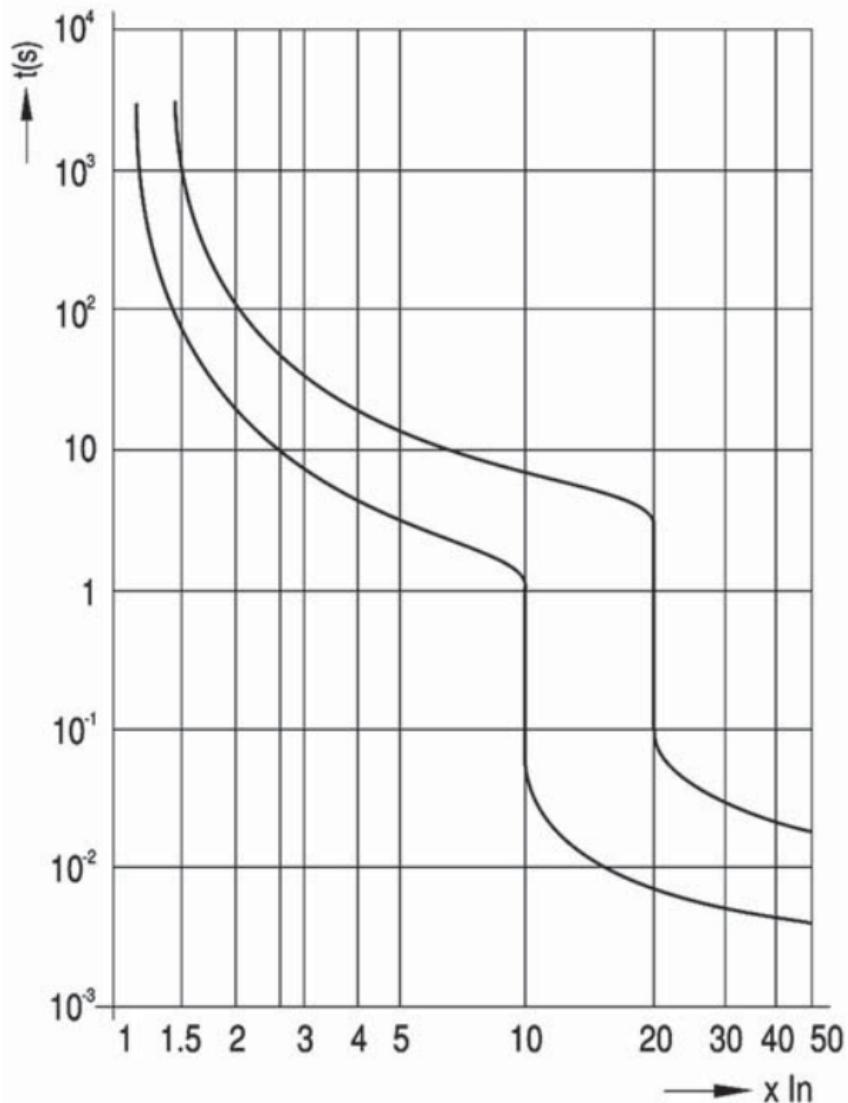


## Din-T time current curves Din-T 6 and 10

Tripping characteristics according to IEC 60898

Din-T 6, 10, 10H, 15

Curve D ( $10 - 20 \times \ln$ )



## Characteristics according to EN 60898

Miniature circuit breakers are intended for the protection of wiring installations against both overloads and short-circuits in **domestic** or **commercial** wiring installations, where operation is possible by **uninstructed** people.

### Magnetic release

An electromagnet with plunger ensures instantaneous tripping in the event of short-circuit. The NHP Din-T range has 3 different types, following the current for instantaneous release: types B, C and D curve.

Icn (A)	Test current	Tripping time	Applications
B	3 x In 5 x In	0.1 < t < 45 s (In ≤ 32 A) 0.1 < t < 90 s (In > 32 A) as: t < 0.1 s	Only for resistive loads such as: - electrical heating - water heater - stoves
C	5 x In 10 x In	0.1 < t < 15 s (In ≤ 32 A) 0.1 < t < 30 s (In > 32 A) t < 0.1 s	Usual loads such as: - lighting - socket outlets - small motors
D	10 x In 20 x In	0.1 < t < 4 s (In ≤ 32 A) 0.1 < t < 8 s (In > 32 A) t < 0.1 s	Control and protection of circuits having important transient inrush currents (large motors)

### Thermal release

The release is initiated by a bimetal strip in the event of overload. The standard defines the range of releases for specific overload values. Reference ambient temperature is 30 °C.

Test current	Tripping time
1.13 x In	t ≥ 1 h (In ≤ 63 A)
	t ≥ 2 h (In > 63 A)
1.45 x In	t < 1 h (In ≤ 63 A)
	t < 2 h (In > 63 A)
2.55 x In	1s < t < 60 s (In ≤ 32 A)
	1s < t < 120 s (In > 32 A)

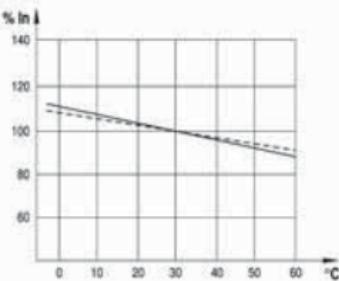
## Temperature compensation curves

### Din-T 6, 10, 10H and 15

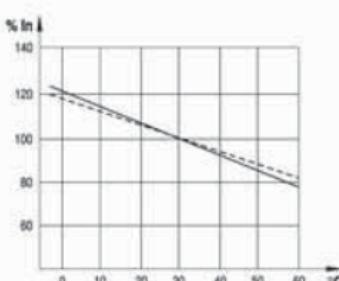
#### Influence of ambient temperature

The thermal calibration of the MCBs was carried out at an ambient temperature of 30 °C. Ambient temperatures different from the calibrated temperature influence the bimetal and this results in earlier or later thermal tripping (see curves).

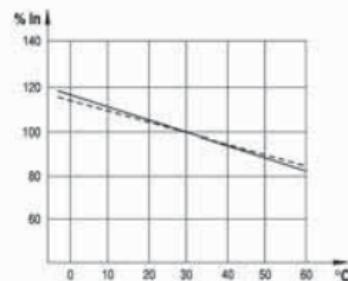
0.5 - 6 A



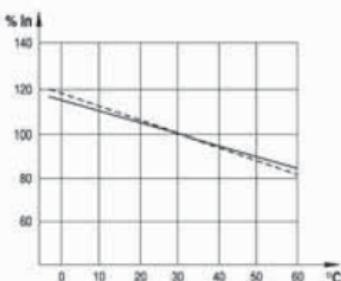
10 A



16 - 40 A



50 - 63 A



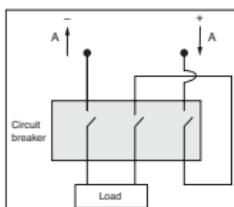
## DC current circuit breaker selection table

Circuit Breaker Type	Rated Current (A)	48 V 1 pole Icu (kA)	110 V 2 poles in series Icu (kA)	250 V 1 pole Icu (kA)	500 V 2 poles in series Icu (kA)
Din-T 6	0.5.....63 A	20	25	-	-
Din-T 10	0.5.....63 A	25	30	-	-
Din-T DC	0.5.....63 A	-	-	6	6
Din-T 15	6 .....25 A	25	30	-	-
Din-T 10H	80.... 125 A	10	10	-	-
Safe-T	6 ..... 100 A	-	5	-	-

MCCB type <sup>2)3)</sup>	24/48/60 V	125 V	250 V	kA Rating below		
				350 V	500 V	600 V
S160NF 1 pole	15	15	-			
ES125/NJ	25	25	25			
SHL125NJ/GJ	50	40	40			
E250NJ	25	25	25			
SHL160/250 <sup>2)</sup>	50	40	40			
E400NJ	25	25	25			
SHL400NJ/GJ <sup>3)</sup>	50	40	40			
XS630NJ	50	40	40	30	20	20
S/XS800NJ/RJ	50	40	40	30	20	20
XS1000ND <sup>1)</sup>	-	40	40	30	20	20
XS1250ND	-	40	40	30	20	20
XS1600ND	-	40	40	30	20	20
XS2000ND <sup>1)</sup>	-	40	40	30	20	20
XS2500ND <sup>1)</sup>	-	40	40	30	20	20

Refer to section 3  
for 'ND' DC  
MCCB's rated  
to 600 V DC at  
20 A - 800 A

THE FOLLOWING CONNECTION  
DIAGRAM SHOULD BE APPLIED.



### Notes for MCCB only:

For voltage levels up to and including 250 V DC standard MCCBs may be used, with two poles connected in series. For voltage levels greater than 250 V DC, three poles are to be connected in series as shown.

The time constant ( $L/R$ ) of the circuit should be:  
less than 2 ms at rated current  
less than 2.5 ms for overload ( $2.5 \times \ln$ )  
less than 7 ms for short circuit  $\leq 10$  kA  
less than 15 ms for short circuit  $> 10$  kA

- Notes:**
- <sup>1)</sup> Magnetic trip only, without overload protection. Available on indent only.
  - <sup>2)</sup> Thermal Magnetic types only can be used on DC.
  - <sup>3)</sup> MCCBs not suitable for 12 V DC.

## Miniature circuit breakers and fuse-fault current limiters co-ordination chart

Circuit breaker Type	kA	Minimum Rating fuse amps      amps <sup>1)</sup>		Maximum fuse – Amps 50 kA      63 kA		DIN
		BS 88	DIN	BS 88	DIN	
<b>Safe-T</b>	6	6-10	50	160 <sup>2)</sup>	160	125 <sup>2)</sup> 125
	6	16-25	63	200 <sup>2)</sup>	200	160 <sup>2)</sup> 160
	6	32	80	200 <sup>2)</sup>	200	160 <sup>2)</sup> 160
	6	40-50	100	200 <sup>2)</sup>	200	160 <sup>2)</sup> 160
	6	63-100	160	200 <sup>2)</sup>	200	160 <sup>2)</sup> 160
<b>SRCB</b>	6	10	50	160	160	125
	6	16-20	63	200	200	160
<b>Din-T</b>	6	2-25	20-63	200	200	160
<b>DTCB6</b>	6	32-63	100	200	200	160
<b>DTCB10 &amp; DTCB15<sup>3)</sup></b>	10, 15	0.5-6	20	250	250	200
	10, 25	10	25	250	250	200
	10, 25	16	35	250	250	200
	10, 20-25	20-32	63	250	250	200
	10, 20-15	40-63	100	250	250	200
<b>DSRCB &amp; DSRCBH (RCBO)</b>	10	10	25	250	250	200
	10	16	35	250	250	200
	10	20-32	63	250	250	200
<b>Din-T10H</b>	10	80	160	200	200	160
	10	100	200	200	200	160
	10	125	250	250	250	–
<b>E125, S125</b>	18/30	16-125	250	400	400	355
						355

**Notes:** 1) Minimum fuse size is based on grading under overload of one MCB with one set of fuses. Where a single set of fuses protects more than one MCB, the minimum fuse size shall be increased to allow for load biasing effects.

2) Maximum fuse size based on testing to AS 3439.1 clause 8.2.3.

3) For specific kA ratings applicable to MCBs, refer page 1-23 ratings chart. Tables based on the following maximum pre-arcing I<sub>2t</sub> for both BS 88 and DIN fuses:

125 A - 0.4 x 105, 160 A - 0.62 x 105, 200 A - 1.2 x 105, 250 A - 2.1 x 105.

Suitable fuses include NHP, GEC, Siemens and Bovara-Crady.

Fuses with higher current ratings may be used provided I<sub>2t</sub> values are equal to, or less than the levels above. Semi-conductor fuses have very low I<sub>2t</sub> values and may suit some applications.

Attention is also drawn to AS 3000 clause 7.10.4.4 regarding the use of fault current limiters in installations containing fire and smoke control equipment, evacuation equipment and lifts.

## Selectivity (discrimination) and cascade

### Selectivity

The principle of Selectivity (Discrimination) is based upon an analysis of several circuit breaker characteristics. These include time-current (tripping) curves, peak-let-through current ( $I_{peak}$ ) and energy let-through ( $I_{2t}$ ).

The figures stated give the maximum selectivity level with the two nominated breakers in series under short-circuit conditions. For an indication on selectivity under overloads refer to the circuit breaker tripping/characteristic curves, or use the NHP TemCurve selectivity analysis software package.

Selectivity can be enhanced beyond the breaking capacity of the downstream breaker provided it is backed up by an appropriately selected upstream breaker, which should not trip (unlatch) under the stated short circuit current.

### Cascade

Cascading is achieved by using an upstream device to assist (back-up) a downstream device in clearing a fault current. This principal is necessary should the downstream device be required to clear a prospective short circuit current greater than the devices' breaking capacity.

In most cascading applications it is generally necessary for the upstream breaker to trip (unlatch), as well as the downstream breaker to give adequate back-up protection. As such, cascade is commonly used in feeding and protecting non-essential loads, such as basic lighting.

For more information on selectivity and cascading please refer to the latest NHP Part C catalogue.

### Cascade / back-up applications

#### Upstream: MCB

#### Downstream: MCB

### Voltage 400/415 V, Icc max. in kA

Downstream: MCBs		Upstream: MCBs		
Series	In (A)	Din-T 10 0.5 ... 63 A	Din-T 15 < 40 A	Din-T 15 50 ... 63 A
Din-T 6	0.5 ... 63	10	20	15
Din-T 10	0.5 ... 63	-	20	15

### Voltage 220/440 V, Icc max. in kA

Downstream: MCBs		Upstream: MCBs		
Series	In (A)	Din-T 10 0.5 ... 63 A	Din-T 15 0.5 ... 63 A	Din-T 15 80 ... 125 A
Din-T 6	0.5 ... 63	30	30	-
Din-T 10	0.5 ... 63	-	30	-
Din-T 10	0.5 ... 63	-	35	-

## Selectivity MCB to MCB:

### Thermal Magnetic

MCBs	MCBs	Upstream C curve								Din-T 6, 10, 15			Din-T 10H		
		10 A	16 A	20 A	25 A	32 A	40 A	50 A	63 A	80 A	A	A	100	125	
	In (A)	(kA below)								C Curve					
<b>Down-stream B curve</b> <b>Din-T 10</b>	6	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	1.5	1.6	1.7			
	10	—	—	0.15	0.18	0.23	0.27	0.35	0.45	1	1.1	1.2			
	16	—	—	—	—	0.23	0.27	0.35	0.45	1	1.1	1.2			
	20	—	—	—	—	0.23	0.27	0.35	0.45	1	1.1	1.2			
	25	—	—	—	—	—	0.27	0.35	0.45	0.9	1.1	1.1			
	32	—	—	—	—	—	0.27	0.35	0.45	0.9	1	1			
	40	—	—	—	—	—	—	—	—	—	0.9	0.9			
	50	—	—	—	—	—	—	—	—	—	—	—			
	63	—	—	—	—	—	—	—	—	—	—	—			

MCBs	MCBs	Upstream C curve								Din-T 6, 10, 15			Din-T 10H		
		10 A	16 A	20 A	25 A	32 A	40 A	50 A	63 A	80 A	A	A	100	125	
	In (A)	(kA below)								C Curve					
<b>Down-stream C curve</b> <b>Din-T 6</b> <b>Din-T 10</b> <b>Din-T 15</b>	6	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	1	1.1	1.2			
	10	—	—	0.15	0.18	0.23	0.27	0.35	0.45	1	1.1	1.2			
	16	—	—	—	—	—	0.27	0.35	0.45	1	1.1	1.2			
	20	—	—	—	—	—	0.27	0.35	0.45	1	1.1	1.1			
	25	—	—	—	—	—	0.27	0.35	0.45	0.9	1	1.1			
	32	—	—	—	—	—	—	0.35	0.45	0.9	0.9	1			
	40	—	—	—	—	—	—	—	0.45	—	—	0.9			
	50	—	—	—	—	—	—	—	—	—	—	—			
	63	—	—	—	—	—	—	—	—	—	—	—			

**Cascade / back-up applications -****Upstream: MCB****Downstream: MCB****Voltage 400/415 V, Icc max. in kA****Downstream: MCBS****Upstream: MCBS**

Series	In (A)	Din-T 10 0.5 ... 63 A	Din-T 15 < 40 A	Din-T 15 50 ... 63 A
Din-T 6	0.5...63	10	20	15
Din-T 10	0.5...63	-	20	15

**Voltage 400/415 V, Icc max. in kA****Downstream: MCBS****Upstream: MCBS**

Series	In (A)	Din-T 10 0.5 ... 63 A	Din-T 15 0.5 ... 63 A	Din-T 15 80 ... 125 A
Din-T 6	0.5...63	20	22	16
Din-T 10	≤ 32	-	50	-
Din-T 15	≥ 40	-	35	-

**Back-up protection with MCBS (DSRCD)**

	Din-T 6		Din-T 10		Din-T 15		Din-T 10H	
	(A)	(kA)	(A)	(kA)	(A)	(kA)	(A)	(kA)
RCCB 2 Poles 240 V (DSRCD)	16	20	20	20	20	10		
	25	20	20	20	20	10		
	40	20	20	20	20	10		
	63	20	20	20	20	10		
	80	-	-	-	-	10		
	100	-	-	-	-	10		
RCCB 4 Poles 415 V (DSRCD)	25	10	10	10	10	10		
	40	10	10	10	10	10		
	63	10	10	10	10	10		
	80	-	-	-	-	10		
	100	-	-	-	-	10		

**Back-up protection with fuses gG (DSRCD)**

	16 A    25 A    32 A    40 A    50 A    63 A    80 A    100 A								
	(A)	(kA)							
RCCB 2 Poles 240 V (DSRCD)	16	100	100	80	50	40	25	16	10
	25	100	100	80	50	40	25	16	10
	40	100	100	80	50	40	25	16	10
	63	100	100	80	50	40	25	16	10
	80	100	100	80	50	40	25	16	10
	100	100	100	80	50	40	25	16	10
RCCB 4 Poles 415 V (DSRCD)	25	100	100	80	50	40	25	16	10
	40	100	100	80	50	40	25	16	10
	63	100	100	80	50	40	25	16	10
	80	100	100	80	50	40	25	16	10
	100	100	100	80	50	40	25	16	10

## Selectivity and Cascade tables @ 400/415 V - MCCBs and MCBs

Downstream MCB		Upstream MCCBs								65 kA S125GJ- ZS125GJ	
		25 kA E125NJ				36 kA S125NJ					
		63	80	100	125	63	80	100	125		
DTCB6	≤20	25 /25	25 /25	25 /25	25 /25	25 /25	25 /25	25 /25	25 /25	35 /35	
	25 & 32	20 /25	20 /25	20 /25	20 /25	20 /25	20 /25	20 /25	20 /25	20 /25	
	40	- /25	20 /25	20 /25	20 /25	- /25	20 /25	20 /25	20 /25	- /25	
	50 & 63	- /25	- /25	20 /25	20 /25	- /25	- 2/5	20 /25	20 /25	- /25	
DINT10, DSRCBH & DSRCB	≤32	25 /25	25 /25	25 /25	25 /25	30 /36	30 /36	30 /36	30 /36	30 /50	
	40	2 /25	20 /25	20 /25	20 /25	- /25	20 /25	20 /25	20 /25	- /25	
	50 & 63	2 /25	- /25	20 /25	20 /25	- 25	- /25	20 /25	20 /25	- /25	
	80			4 /25	4 /25			4 /25	4 /25		
DIN-T10H	100	10			4 /25				4 /25		
	125										
DIN-T15	≤32	25 /25	25 /25	25 /25	25 /25	30 /36	30 /36	30 /36	30 /36	30 /50	
	40	- /25	20 /25	20 /25	20 /25	- /25	20 /25	20 /25	20 /25	- /25	
	50 & 63	- /25	- /25	20 /25	20 /25	- /25	- /25	20 /25	20 /25	- /25	
SAFE-T & SRCB	≤63	6	- /10	3 /10	3 /10	- /10	3 /10	3 /10	3 /10	- /10	

Downstream MCB		Upstream MCCBs										65 kA S250GJ - ZS250GJ		
		25 kA E250NJ						36 kA S250NJ						
		63	80	100	160	200	250	160	200	250	160	200	250	63
DTCB6	≤20	25 /25	25 /25	25 /25	25 /25	25 /25	25 /25	36 /36	36 /36	36 /36	36 /36	36 /36	36 /36	36 /36
	25 & 32	25 /25	25 /25	25 /25	25 /25	25 /25	25 /25	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30	- /30
	40	- /25	20 /25	25 /25	25 /25	25 /25	25 /25	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30
	50 & 63	- /25	- /25	25 /25	25 /25	25 /25	25 /25	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30	- /30
DINT10H, DSRCBH & DSRCB	≤32	25 /25	25 /25	25 /25	25 /25	25 /25	25 /25	36 /36	36 /36	36 /36	40 /65	40 /65	40 /65	40 /65
	40	- /25	20 /25	25 /25	25 /25	25 /25	25 /25	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30	- /30
	50 & 63	- /25	- /25	25 /25	25 /25	25 /25	25 /25	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30	- /30
	80			15 /25	15 /25	15 /25	15 /25	15 /25	15 /25	15 /25	15 /25	15 /25	15 /25	
DIN-T10H	100	10			15 /25	15 /25	15 /25	15 /25	15 /25	15 /25	15 /25	15 /25	15 /25	
	125				- /25	15 /25	15 /25	- /25	15 /25	15 /25	- /25	15 /25	15 /25	
DIN-T15	≤32	25 /25	25 /25	25 /25	25 /25	25 /25	25 /25	36 /36	36 /36	36 /36	40 /65	40 /65	40 /65	40 /65
	40	- /25	25 /25	25 /25	25 /25	25 /25	25 /25	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30	- /30
	50 & 63	- /25	- /25	25 /25	25 /25	25 /25	25 /25	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30	- /30

& 125 kA H125NJ				36 kA S160NJ						65 kA S160GJ & 125 kA H160NJ			
80	100	125	63	80	100	125	160	63	80	100	125	160	
35 /35	35 /35	35 /35	36 /36	36 /36	36 /36	36 /36	36 /36	36 /36	36 /36	36 /36	36 /36	36 /36	
20 /25	20 /25	20 /25	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30	30 /30	
20 /25	20 /25	20 /25	- /30	30 /30	30 /30	30 /30	30 /30	- /30	30 /30	30 /30	30 /30	30 /30	
- /25	20 /25	20 /25	- /30	- /30	30 /30	30 /30	30 /30	- /30	- /30	30 /30	30 /30	30 /30	
30 /50	30 /50	30 /50	36 /36	36 /36	36 /36	36 /36	40 /65	40 /65	40 /65	40 /65	40 /65	40 /65	
25 /25	25 /25	25 /25	- /30	30 /30	30 /30	30 /30	- /30	30 /30	30 /30	30 /30	30 /30	30 /30	
- /25	25 /25	25 /25	- /30	- /30	30 /30	30 /30	30 /30	- /30	- /30	30 /30	30 /30	30 /30	
	4 /25	4 /25			15 /15	15 /15	15 /15			15 /15	15 /15	15 /15	
		4 /25				15 /15	15 /15				15 /15	15 /15	15 /15
							15 /15						15 /15
30 /50	30 /50	30 /50	36 /36	30 /36	30 /36	30 /36	30 /36	40 /65	40 /65	40 /65	40 /65	40 /65	
20 /25	25 /25	25 /25	- /30	30 /30	30 /30	30 /30	30 /30	- /30	30 /30	30 /30	30 /30	30 /30	
- /25	25 /25	25 /25	- /30	- /30	30 /30	30 /30	30 /30	- /30	- /30	30 /30	30 /30	30 /30	
3 /10	3 /10	3 /10											

70 kA & H250NJ-H250NE						36 kA S400CJ				50 kA S400NJ - S400NE				70 kA S400GE			
80	100	125	160	200	250	100	200	250	400	100	200	250	400	100	200	250	400
36/36	36/36	36/36	36/36	36/36	36/36												
30/30	30/30	30/30	30/30	30/30	30/30												
30/30	30/30	30/30	30/30	30/30	30/30												
- /30	30/30	30/30	30/30	30/30	30/30												
40/65	40/65	40/65	40/65	40/65	40/65	36/36	36/36	36/36	36/36	40/50	40/50	40/50	40/50	40/50	40/65	40/65	40/65
30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30
- /30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30
15/15	15/15	15/15	15/15	15/15	15/15	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10
	15/15	15/15	15/15	15/15	15/15	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10
						- /10	10/10	10/10	10/10	- /10	10/10	10/10	10/10	- /10	10/10	10/10	10/10
40/65	40/65	40/65	40/65	40/65	40/65	36/36	36/36	36/36	36/36	40/50	40/50	40/50	40/50	40/50	40/65	40/65	40/65
- /30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30
- /30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30	30/30

## Selectivity & Cascade Tables

@ 400 / 415 V

### Upstream MCCBs<sup>1)</sup>

Down-stream MCCB	kA (RMS)	S250PE		H250NE		S400NE		S400GE		S400PE		H400NE		L400NE		E630NE		S630CE		
		70	125	50	70	85	125	200	36	50										
E125NJ	25	25 / 50	25 / 65	25 / 36	25 / 50	25 / 50	25 / 65	25 / 85	25 / 36	25 / 36										
S125NJ	36	36 / 65	36 / 85	36 / 50	36 / 65	36 / 65	36 / 85	36 / 125	36 / 36	36 / 50										
S125GJ	65	65 / 70	65 / 125	50 / 50	65 / 70	65 / 85	65 / 125	65 / 150	36 / 36	50 / 50										
ZS125GJ																				
H125NJ	125	70 / 70	125 / 125	50 / 50	70 / 70	85 / 85	125 / 125	125 / 200	36 / 36	50 / 50										
S160NJ	36	- / 65	- / 85	36 / 50	36 / 65	36 / 65	36 / 85	36 / 125	36 / 36	36 / 50										
S160GJ	65	- / 70	- / 125	50 / 50	65 / 70	65 / 85	65 / 125	65 / 150	36 / 36	50 / 50										
H160NJ	125	- / 70	- / 125	- / 50	- / 70	- / 85	125 / 125	125 / 200	36 / 36	50 / 50										
E250NJ	25	- / 50	- / 85	25 / 36	25 / 50	25 / 50	25 / 65	25 / 85	25 / 36	25 / 36										
S250NJ	36	- / 65	- / 85	36 / 50	36 / 65	36 / 65	36 / 85	36 / 125	36 / 36	36 / 50										
S250GJ	65	- / 70	- / 125	50 / 50	65 / 70	65 / 85	65 / 125	65 / 150	36 / 36	50 / 50										
ZS250GJ																				
S250PE	70		- / 125	- / 50	- / 70	- / 85	70 / 125	70 / 150	36 / 36	50 / 50										
H250NJ	125			- / 50	- / 70	- / 85	125 / 125	125 / 200	36 / 36	50 / 50										
H250NE	125			- / 50	- / 70	- / 85	125 / 125	125 / 200	36 / 36	50 / 50										
E400NJ	25			- / 36	- / 50	- / 50	- / 65	- / 85	10 / 36	10 / 36										
S400CJ	36			- / 50	- / 65	- / 65	- / 70	- / 100	10 / 36	10 / 50										
S400NE	50				- / 50	- / 70	- / 50	- / 50	10 / 36	10 / 50										
S400NJ	50				- / 70	- / 70	- / 85	- / 125	10 / 36	10 / 50										
S400GJ/GE	70					- / 85	- / 125	- / 150	10 / 36	10 / 50										
S400PE	85					- / 85	- / 125	- / 150	10 / 36	10 / 50										
H400NE	125					- / 85					10 / 36	10 / 50								
E630NE	36																			
E630CE	50																			
S630GE	70																			
XS630CJ	42																			
XS630NJ	65																			
XS630PJ	85																			
XS630SE	50																			
XH630SE	65																			
XH630PE	65																			
XS800NJ	65																			
XS800SE	50																			
XJ800PJ	85																			
XH800SE	65																			
XH800PE	65																			
XS1250SE	65																			
XS1600SE	85																			

Notes: XX Selectivity   YY Cascade

**Selectivity & Cascade Tables**

@ 400 / 415 V

XS630SE	XH630SE	S630GE	TL630NE	XS800SE	XH800SE	TL800NE	XS1250SE	TL1250NE	XS1600SE	XS2000NE	XS2500NE	XS3200NE
50	65	70	125	50	65	125	85	125	100	85		
25 / 36	25 / 50	25 / 50	25 / 25	25 / 36	25 / 36	25 / 36	25 / 25	25 / 25	25 / 25	25 / 25	25 / 25	
36 / 50	36 / 65	36 / 65	36 / 36	36 / 50	36 / 36	36 / 36	36 / 36	36 / 36	36 / 36	36 / 36	36 / 36	
50 / 50	65 / 65	65 / 70	65 / 65	50 / 50	65 / 65	65 / 65	65 / 65	65 / 65	65 / 65	65 / 65	65 / 65	
50 / 50	50 / 65	70 / 70	70 / 125	50 / 50	65 / 65	65 / 125	85 / 85	85 / 125	100 / 100	85 / 85		
36 / 50	36 / 50	36 / 50	36 / 36	36 / 50	36 / 65	36 / 36	36 / 36	36 / 36	36 / 36	36 / 36	36 / 36	
50 / 50	50 / 65	65 / 70	65 / 65	50 / 50	50 / 65	50 / 65	65 / 65	65 / 65	65 / 65	65 / 65	65 / 65	
50 / 50	50 / 65	70 / 70	70 / 125	50 / 50	50 / 65	50 / 125	85 / 85	85 / 125	100 / 100	85 / 85		
25 / 36	25 / 50	25 / 50	25 / 25	25 / 36	25 / 50	25 / 50	25 / 25	25 / 25	25 / 25	25 / 25	25 / 25	
36 / 50	36 / 65	36 / 65	36 / 36	36 / 50	36 / 65	36 / 65	36 / 36	36 / 36	36 / 36	36 / 36	36 / 36	
50 / 50	50 / 65	65 / 70	65 / 65	50 / 50	50 / 65	50 / 65	65 / 65	65 / 65	65 / 65	65 / 65	65 / 65	
50 / 50	50 / 65	70 / 70	70 / 70	50 / 50	65 / 65	50 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	
50 / 50	50 / 65	70 / 70	70 / 125	50 / 50	50 / 65	50 / 125	85 / 85	85 / 125	100 / 100	85 / 85		
50 / 50	50 / 65	70 / 70	70 / 125	50 / 50	65 / 65	50 / 125	85 / 85	85 / 125	100 / 100	85 / 85		
10 / 36	10 / 50	10 / 50	10 / 36	25 / 36	25 / 50	25 / 36	25 / 36	25 / 36	25 / 36	25 / 36	25 / 36	25 / 25
10 / 50	10 / 65	10 / 65	10 / 50	25 / 50	25 / 65	25 / 50	36 / 50	36 / 50	36 / 50	36 / 50	36 / 50	36 / 36
10 / 50	10 / 50	10 / 50	10 / 50	25 / 50	25 / 50	25 / 50	50 / 50	50 / 50	50 / 50	50 / 50	50 / 50	50 / 50
10 / 50	10 / 65	10 / 70	10 / 65	25 / 50	25 / 65	25 / 65	50 / 65	50 / 65	50 / 65	50 / 65	50 / 65	50 / 50
10 / 50	10 / 65	10 / 70	10 / 70	25 / 50	25 / 65	25 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	
10 / 50	10 / 65	10 / 70	10 / 85	25 / 50	25 / 65	25 / 85	70 / 85	85 / 85	85 / 85	85 / 85	85 / 85	
10 / 50	10 / 65	10 / 70	10 / 125	25 / 50	25 / 65	25 / 125	85 / 85	85 / 125	85 / 100	85 / 85	85 / 85	
				25 / 36	25 / 36	25 / 36	36 / 36	36 / 36	36 / 36	36 / 36	36 / 36	
				25 / 50	25 / 50	25 / 50	50 / 50	50 / 50	50 / 50	50 / 50	50 / 50	
							70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	
							30 / 42	30 / 42	30 / 42	30 / 42	35 / 42	
							30 / 65	30 / 65	30 / 65	30 / 65	35 / 65	
							30 / 85	30 / 85	30 / 85	30 / 85	35 / 85	
							30 / 65	30 / 65	30 / 85	30 / 85	30 / 85	
							30 / 65	30 / 65	30 / 85	30 / 85	30 / 85	
							15 / 65	15 / 65	20 / 65	35 / 65		
							15 / 50	15 / 50	20 / 50	35 / 50		
							15 / 85	15 / 85	20 / 85	35 / 85		
							15 / 65	15 / 65	20 / 65	35 / 65		
							15 / 65	15 / 65	20 / 65	35 / 65		
									20 / 65	35 / 65		
										35 / 65		

**Notes:** 1) Refer NHP for TemBreak 2 MCCB combinations not included above.

## Cascade table

### Upstream-Downstream MCCBs (Thermal magnetic upstream)

#### Cascade @ 380 - 415 V AC<sup>1)</sup>

Upstream MCCBs	E125NJ	S125NJ	S125GJ ZS- 125GJ	H125NJ	L125NJ	S160NJ	S160GJ	H160NJ	L160NJ
<b>Downstream kA</b>									
<b>MCCBs (RMS)</b>	<b>25</b>	<b>36</b>	<b>65</b>	<b>125</b>	<b>200</b>	<b>36</b>	<b>65</b>	<b>125</b>	<b>200</b>
<b>E125NJ</b>	<b>25</b>	25	36	50	65	85	36	50	65
<b>S125NJ</b>	<b>36</b>	—	36	65	85	125	36	65	85
<b>S125GJ</b>	<b>65</b>	—	—	65	125	150	36	65	125
<b>H125NJ</b>	<b>125</b>	—	—	65	125	200	36	65	125
<b>S160NJ</b>	<b>36</b>	—	—	65	36	36	65	85	125
<b>S160GJ</b>	<b>65</b>	—	—	—	—	—	65	125	150
<b>H160NJ</b>	<b>125</b>	—	—	—	—	—	65	125	200
<b>E250NJ</b>	<b>25</b>	—	—	—	—	—	25	25	25
<b>S250NJ</b>	<b>36</b>	—	—	—	—	—	65	36	36
<b>S250GJ</b>	<b>65</b>	—	—	—	—	—	—	—	—
<b>S250PE</b>	<b>70</b>	—	—	—	—	—	—	—	—
<b>H250NJ</b>	<b>125</b>	—	—	—	—	—	—	—	—
<b>E400NJ</b>	<b>25</b>	—	—	—	—	—	—	—	—
<b>S400CJ</b>	<b>36</b>	—	—	—	—	—	—	—	—
<b>S400NJ</b>	<b>50</b>	—	—	—	—	—	—	—	—
<b>S400GJ</b>	<b>70</b>	—	—	—	—	—	—	—	—
<b>H400NJ</b>	<b>125</b>	—	—	—	—	—	—	—	—

E250NJ	S250NJ	S250GJ ZS- 250GJ	H250NJ	L250NJ	S400CL	S400NJ	S400GJ	H400NJ	L400NJ	X5- 800NJ
25	36	65	125	200	36	50	70	125	200	65
25	36	50	65	85	36	36	50	65	85	36
25	36	65	85	125	36	50	65	85	125	50
25	36	65	125	150	36	50	70	125	150	65
25	36	65	125	200	36	50	70	125	200	65
25	36	65	85	125	36	50	65	85	125	65
25	36	65	125	150	36	50	70	125	150	65
25	36	65	125	200	36	50	70	125	200	65
25	25	50	65	85	36	36	50	65	85	36
25	36	65	85	125	36	50	65	85	125	65
-	-	65	125	150	36	50	70	125	150	65
-	-	65	125	150	36	50	70	125	150	65
-	-	65	125	200	36	50	70	125	200	65
-	-	25	65	25	36	36	50	65	85	50
-	-	36	70	36	36	50	65	70	100	65
-	-	50	85	50	36	50	70	85	125	50
-	-	50	125	70	36	50	70	125	150	65
-	-	-	-	-	-	-	-	-	200	65

## Application data Load-break / MCCB

### Socomec load-break switch and TemBreak MCCB co-ordination chart

#### TemBreak MCCB

##### Socomec

##### Load-break

##### switch

	MCCB	(kA) rms	MCCB	(kA) rms	MCCB	(kA) rms	MCCB	(kA) rms
<b>SLB63</b>	E125NJ	6.5	S125NJ	6.5	S125GJ <sup>1)</sup>	6.5	H125NJ	7.5
	E125NJ	22	S125NJ	22	S125GJ <sup>1)</sup>	22	H125NJ	30
<b>SLB125</b>	-	-	S160NJ	15	S160GJ	15	H160NJ	27
	E250NJ	15	S250NJ	15	S250GJ <sup>1)</sup>	15	H250NJ	26
<b>SLB200</b>	E125NJ	25	S125NJ	36	S125GJ <sup>1)</sup>	65	H125NJ	80
	-	-	S160NJ	30	S160GJ	30	H160NJ	80
<b>SLB250</b>	E250NJ	25	S250NJ	30	S250GJ <sup>1)</sup>	30	H250NJ	50
	E400NJ	25	S400NJ	25	S400GJ	25	H400NJ	35
<b>SLB315</b>	E250NJ	25	S250NJ	36	S250GJ <sup>1)</sup>	65	H250NJ	100
	E400NJ	25	S400NJ	50	S400GJ	65	H400NJ	100
<b>SLB400</b>	E400NJ	25	S400NJ	50	S400GJ	65	H400NJ	100

#### TemBreak MCCB

##### Socomec

##### Load-break

##### switch

	MCCB	(kA) rms	MCCB	(kA) rms	MCCB	(kA) rms
SLB630	E630NE	35	S630CE	35	TL630NE	24
SLB800	XS800NJ	40	XH800PJ	40	TL800NE	28
SLB1000	XS1250SE	45	XS1600SE	45	TL1250NE45	
SLB1250	XS1250SE	65	XS1600SE	75	TL1250NE70	
SLB1600	XS1600SE	75	XS2000NE	60	-	-
SLB2000	XS2000NE	60	XS2500NE	60	-	-
SLB2500	XS2500NE	60	-	-	-	-

**Notes:** 1) Ratings also apply for ZS125GJ and ZS250GJ.

Figures based on / valid for – 400/415 V AC

Application example:

All Socomec load-break switches can be used in higher prospective fault current level applications, due to the upstream Terasaki TemBreak MCCB reducing the peak let-through current.

Example: SLB250 can be used in a 30 kA application if there is an upstream S250NJ MCCB.

For other combinations please refer to NHP.

## Watts loss for Terasaki MCCBs<sup>1)</sup>

C/B rating MCCBs	Amps	AC Watts	DC Watts
<b>TemBreak 2 MCCBs</b>			
E/S125 NJ - GJ, VS125NJ	125	38	34
S160 NJ - GJ, VS250NJ (160 A)	160	40	36
E/S250 NJ - GJ, VS250NJ	250	55	49
S250PE	250	82	73
E/S400 CJ - NJ - GJ	400	75	67
E/S400 NE - GE	400	70	62
E/S630 NE - CE - GE-PE	630	133	119
<b>TemBreak 1 MCCBs</b>			
XS/XH400SE, XV400NE	400	69	62
XS/XH630SE, XV630PE	630	109	97
XS800NJ	800	150	134
XS/XH800SE, XV800PE	800	151	134
XS1250SE, XV1250NE	1250	194	173
XS1600SE	1600	189	169
XS2000NE	2000	228	204
XS2500NE	2500	357	319
XS3200NE	3200	585	522

**Notes:** 1) Values are valid for the maximum ampere trip units per breaker type.  
(E.g. S125GJ : 125 A) The above watts losses are for 3 poles combined.

## Downstream short-circuit current calculator

Calculation of a downstream short-circuit current is a function of the upstream short-circuit current ( $I_{sco}$ ), cross-section and length of the conductor. The following table provides information to calculate approximately the short-circuit current at a relevant point of the installation.

### Line protection - copper conductor

mm <sup>2</sup>	Length of the line in metres											
1.5										0.8		
2.5										1.2		
4												
6												
10									0.8	1.1	2.1	
16								0.8	1.0	1.3	1.7	3.3
25							1.1	1.3	1.6	2.1	2.6	5.1
35							1.5	1.8	2.2	3.0	3.7	7.2
50						1.0	2.2	2.6	3.1	4.2	5.3	10
70						1.4	3.0	3.6	4.4	5.9	7.4	14
95	0.8	0.9	1.0	2.0	4.1	4.9	6.0	8.0	10	20		
120	0.9	1.0	1.2	1.3	2.5	5.2	6.2	7.5	10	13	25	
150	0.8	1.0	1.1	1.3	1.4	2.7	5.6	6.8	8.2	11	14	27
185	1.0	1.2	1.3	1.5	1.7	3.2	6.7	8.0	9.7	13	16	32
240	1.2	1.5	1.7	1.9	2.1	3.9	8.3	10	12	16	20	39
300	1.4	1.7	2.0	2.2	2.5	4.7	10	12	14	19	24	47
400	1.6	1.9	2.2	2.4	2.7	5.1	11	13	16	21	26	51
500	1.7	2.1	2.4	2.7	3.0	5.7	12	14	17	23	29	57
625	1.8	2.1	2.5	2.8	3.1	5.8	12	15	18	24	30	58
2x95	1.2	1.4	1.6	1.8	2.1	3.9	8.2	9.9	12	16	20	39
2x120	1.5	1.8	2.1	2.3	2.6	4.9	10	12	15	20	25	49
2x150	1.6	2.0	2.3	2.5	2.8	5.4	11	14	16	22	28	54
2x185	1.9	2.3	2.7	3.0	3.3	6.3	13	16	19	26	33	63
2x240	2.4	2.9	3.3	3.7	4.2	7.9	17	20	24	32	41	79
3x95	1.8	2.2	2.5	2.8	3.1	5.9	12	15	18	24	30	59
3x120	2.3	2.7	3.1	3.5	3.9	7.4	16	19	23	30	38	74
3x150	2.5	3.0	3.4	3.8	4.2	8.0	17	20	25	33	41	80
3x185	2.9	3.5	4.0	4.5	5.0	9.5	20	24	29	39	49	95
3x240	3.6	4.4	5.0	5.6	6.2	12	25	30	36	49	61	118

Isc <sub>o</sub> kA	Short-circuit current at the end of the cable											
100	94	93	92	91	90	83	70	66	62	55	49	33
90	85	84	84	83	82	76	65	62	58	52	47	32
80	76	76	75	74	74	69	60	57	54	48	44	31
70	67	67	66	66	65	61	54	52	49	44	41	29
60	58	57	57	57	56	54	48	46	44	40	37	27
50	49	48	48	48	47	45	41	40	38	35	33	25
40	39	39	39	39	38	37	34	33	32	30	28	22
35	34	34	34	34	34	33	30	30	29	27	26	21
30	29	29	29	29	29	28	27	26	25	24	23	19
25	25	25	24	24	24	24	23	22	22	21	20	17
20	20	20	20	20	20	19	18	18	18	17	17	14
15	15	15	15	15	15	15	14	14	14	13	13	12
10	9.9	9.9	9.9	9.9	9.9	9.8	9.6	9.5	9.4	9.2	9.1	8.3
7	7.0	7.0	7.0	7.0	6.9	6.9	6.8	6.8	6.7	6.6	6.5	6.1
5	5.0	5.0	5.0	5.0	5.0	5.0	4.9	4.9	4.9	4.8	4.8	4.5
4	4.0	4.0	4.0	4.0	4.0	4.0	3.9	3.9	3.9	3.9	3.8	3.7
3	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.9	2.9	2.9	2.8
2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9
1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

## 9 Example

Cable with cross-section 95 mm<sup>2</sup> Cu, 45 m length, and short-circuit current at the transformer terminals of 30 kA. Estimated short-circuit current of 12 kA at the end of the cable.

		0.9	1.3	1.6	3.1	6.2	7.8	9.4	13	16	31
1.0	1.3	1.6	2.1	2.6	5.1	10	13	16	21	26	51
1.6	2.1	2.5	3.4	4.2	8.2	16	21	25	34	42	82
2.5	3.1	3.8	5.1	6.4	12	25	31	38	51	64	123
4.1	5.2	6.3	8.4	11	21	41	52	63	84	106	205
6.6	8.3	10	13	17	33	66	83	100	135	170	329
10	13	16	21	26	51	103	130	157	211	265	514
14	18	22	30	37	72	144	182	219	295	371	719
21	26	31	42	53	103	205	259	314	422	530	
29	36	44	59	74	144	288	363	439	590	742	
39	49	60	80	101	195	390	493	596	801		
49	62	75	101	127	246	493	623	752			
54	68	82	110	138	268	536	677	818			
63	80	97	130	163	317	633	800	967			
79	100	120	162	203	394	789	996				
95	120	145	195	244	474	948					
103	130	157	211	265	514						
114	144	174	234	294	571						
117	147	178	240	301	584						
78	99	119	160	201	390	781	986				
99	125	150	202	254	493	986					
107	135	164	220	276	536						
127	160	193	260	327	633						
158	199	241	324	407	789						
117	148	179	240	302	585						
148	187	226	304	381	739						
161	203	245	330	415	804						
190	240	290	390	490	950						
237	299	361	486	610							

20	16	14	11	8.8	4.7	2.4	1.9	1.6	1.2	1.0	0.5
19	16	14	11	8.7	4.7	2.4	1.9	1.6	1.2	1.0	0.5
19	16	14	11	8.6	4.7	2.4	1.9	1.6	1.2	1.0	0.5
18	15	13	10	8.5	4.6	2.4	1.9	1.6	1.2	1.0	0.5
18	15	13	10	8.3	4.6	2.4	1.9	1.6	1.2	0.9	0.5
17	14	12	9.8	8.1	4.5	2.4	1.9	1.6	1.2	0.9	0.5
15	13	12	9.3	7.8	4.4	2.3	1.9	1.6	1.2	0.9	0.5
15	13	11	9.0	7.6	4.4	2.3	1.9	1.6	1.2	0.9	0.5
14	12	11	8.6	7.3	4.3	2.3	1.8	1.5	1.2	0.9	0.5
12	11	9.9	8.2	7.0	4.2	2.3	1.8	1.5	1.2	0.9	0.5
11	10	9.0	7.5	6.5	4.0	2.2	1.8	1.5	1.1	0.9	0.5
9.4	9.0	7.8	6.7	5.9	3.7	2.1	1.7	1.5	1.1	0.9	0.5
7.1	7.0	6.2	5.5	4.9	3.3	2.0	1.6	1.4	1.1	0.9	0.5
5.5	5.0	4.9	4.4	4.1	2.9	1.8	1.5	1.3	1.0	0.8	0.5
4.2	4.0	3.8	3.5	3.3	2.5	1.7	1.4	1.2	1.0	0.8	0.5
3.4	3.0	3.2	3.0	2.8	2.2	1.5	1.3	1.2	0.9	0.8	0.4
2.7	3.0	2.5	2.4	2.3	1.9	1.4	1.2	1.1	0.9	0.7	0.4
1.9	2.0	1.8	1.7	1.7	1.4	1.1	1.0	0.9	0.8	0.7	0.4
1.0	1.0	0.9	0.9	0.9	0.8	0.7	0.7	0.6	0.5	0.5	0.3

**Correction coefficient**

Voltage	K
230 V	0.58
660 V	1.65

- Values shorter than 0.8 m or longer than 1 km are not considered.
- All values are for voltage 400 V.

## Short circuit co-ordination

### What is co-ordination?

The motor starter consists of a combination of contactor, overload relay and short circuit protective device (SCPD) being either fuses or circuit breakers.

During motor starting and at normal loading, the overload relay protects both the motor and cables by tripping the contactor in a time inversely proportional to the current. However, under short circuit conditions, the response time would be too long and the fuses or circuit breaker must take over to interrupt the fault current therefore limiting energy passed through the starter components. When this is successfully achieved, the combination is said to be co-ordinated.

The primary function of co-ordination is to ensure that the selected components result in safe interruption of fault currents while minimising damage to the starter components themselves.

### Why is co-ordination important?

Contactors are designed to switch loads frequently. They can carry the high starting currents of motors, but at short circuit levels, the extremely high current can force the contacts open due to electro-dynamic effects (it is this effect that is needed at normal operating currents to extinguish the arc quickly). Large short circuit currents can therefore lift the contacts possibly resulting in contact welding or further damage to the starter components.

The importance of selecting the correct SCPD is to minimise the effects of short circuits, provide safe interruption and a level of performance to meet the criteria for Type '2' co-ordination.

### Precise contactor control

While the correct selection of SCPD is of prime importance to ensure reliable operation under short circuit conditions, there are other malfunctions which can occur in a control circuit that can create contact welding due to uncontrolled and repetitive switching of the coil circuit (this is referred to as 'contact chatter'). This is particularly important with high current contactors where the switching currents of the respective motors are particularly high.

The electronically controlled mechanism 'ECM' of the CA 6 contactors prevent uncontrolled switching under all voltage conditions by providing precise control over the magnet system, thus preventing contact chatter and minimising contact bounce. Contactors of the CA 5 series are provided with a delayed release mechanism to prevent contact chatter under low voltage conditions.

### High performance contactors

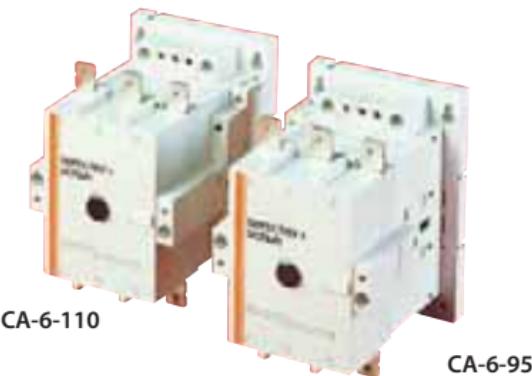
Under normal operating conditions all Sprecher + Schuh contactors offer high mechanical life (up to 10 million operations) with a contact life (electrical) up to 1.3 million under AC 3 conditions. Optimal performance is assured even under adverse conditions due to the design and selection of contactor components. This performance is evident in the design of the CA 6 contactor range which has enabled them to reach their full kilowatt potential under Type '2' conditions with both fuses and circuit breakers (refer co-ordination charts).



Terasaki 'TemBreak'  
tested with  
Sprecher + Schuh  
contactors to  
IEC 60947



The KTA 7 with CA 7 contactors.



Excellent design enables the CA 6 series contactors to reach their full potential under Type '2' conditions with both fuses and circuit breakers.

**TEMBREAK 2 -****2013 ADDITIONS****NHP**

- 250A – 1600A MCCBs
- New 1000 A MCCB in a smaller 800 A Frame
- Ground Fault, Neutral pole, Phase Rotation, Pre Trip Alarm Protection
- Premium OCR - L S I Adjustable
  - Back-lit LCD display
  - Metering: I, U, P, W,  $\text{Cos } \varphi$ , F
  - Modbus communications
  - Intelligent fault analysis
- Basic 2 dial OCR types
- Thermal magnetic to 800 A
- Common internal accessories for 125 A to 1600 A MCCBs
- Metering block for 125 A - 630 A MCCBs



**Availability  
early 2013**

**TemBreak**
**TERASAKI**  
Innovators in Protection Technology

## Type 2 Short Circuit Coordination

Terasaki/Sprecher + Schuh

For DOL motor starting, 50/60 kA @ 400/415 V to AS/NZS 60947.4.1

## TemBreak MCCB circuit breakers

Sprecher + Schuh Thermal magnetic and Electronic overload relays.

**TYPE 2  
50/65 KA  
415 V**

## Component Selection Table C64.0

Motor Kw	Motor Amp Ratings @ 400/415 V	Circuit Breaker	Contactor	Overload Relay	
				Moulded Case Circuit Breaker	Overload Relay Thermal Type
0.18	0.6	XM30PB / 0.7A	CA7-9	CT7N 23 A80	0.55 - 0.8
0.25	0.8	XM30PB / 1.4A	CA7-9	CT7N 23 B10	0.75 - 1.0
0.37	1.1	XM30PB / 1.4A	CA7-9	CT7N 23 B13	0.9 - 1.3
0.55	1.5	XM30PB / 2.0 A	CA7-9	CT7N 23 B20	1.4 - 2.0
0.75	1.8	XM30PB / 2.6A	CA7-9	CT7N 23 B25	1.8 - 2.5
1.1	2.6	XM30PB / 4A	CA7-16	CT7N 23 B32	2.3 - 3.2
1.5	3.4	XM30PB / 5A	CA7-16	CT7N 23 B40	2.9 - 4.0
2.2	4.8	XM30PB / 8A	CA7-16	CT7N 23 B63	4.5 - 6.3
3	6.5	XM30PB / 10A	CA7-23	CT7N 23 B75	5.5 - 7.5
4	8.2	XM30PB / 12A	CA7-23	CT7N 23 C10	7.2 - 10
5.5	11	S125GJ / 20A	CA7-30	CEP7 EEED	5.4 - 27
7.5	14	S125GJ / 20A	CA7-30	CT7N 37 C20	15 - 20
10	17	S125GJ / 20A	CA7-30	CT7N 37 C20	15 - 20
11	21	S125GJ / 32A	CA7-30	CT7N 37 C25	21 - 25
15	28	S125GJ / 50A	CA7-30	CT7N 37 C30	24.5 - 30
18.5	34	S125GJ / 50A	CA7-37	CT7N 37 C38	33 - 38
22	40	S125GJ / 63A	CA7-43	CT7N 43 C47	35 - 47
30	55	S125GJ / 100A	CA7-72	CT7N 85 C60	45 - 60
37	66	S125GJ / 100A	CA7-72	CT7N 85 C75	58 - 75
45	80	S125GJ / 125A	CA7-85	CT7N 85 C90	72 - 90
55	100	S125GJ / 125A	CA6-115	CEP 7 EEEHF	30 - 150
75	130	S160GJ / 160A	CA6-140-EI	CEP 7 EEEHF	30 - 150
90	155	S250GJ / 250A	CA6-140-EI	CEP 7 EEEF	40 - 200
110	200	S250GJ / 250A	CA6-180-EI	CEP 7 EEEKG	60 - 300
132	225	S400GJ / 400A	CA6-420-EI	CEP 7 EEEKG	60 - 300
150	250	S400GJ / 400A	CA6-420-EI	CEP 7 EEEKG	60 - 300
160	270	S400GJ / 400A	CA6-420-EI	CEP 7 EEEKG	60 - 300
185	325	S400GJ / 400A	CA6-420-EI	CEP 7 EELG	100 - 500
200	361	S400GJ / 400A	CA6-420-EI	CEP 7 EELG	100 - 500
220	383	S400GJ / 400A	CA6-630-EI	CEP 7 EEMH	120 - 600
250	425	S630GE / 630A	CA6-860-EI	CEP 7 EEMH	120 - 600
320	538	S630GE / 630A	CA6-860-EI	CEP 7 EEMH	120 - 600
400	700	XH800SE / 800A	CA6-860-EI	CEP 7 EENH	160 - 800

**Notes:** • Thermal or electronic overload relays may be used

- Thermal or electronic overload relays may be used.
  - XM30PB can be replaced with S125GJ/20 and CA7-23/ CA7-30
  - Combinations based on the overload tripping before the circuit breaker at overload currents up to the motor locked rotor current.
  - Thermal magnetic MCCBs may be changed to electronic types if required.
  - Same 'look' handles can be used on XM30PB and S125-630 A MCCBs
  - S125GJ and S250GJ MCCBs can be changed to ZS125GJ and ZS250GJ earth leakage relay MCCBs if required.
  - Refer to NHP for other device combinations
  - The above combinations are designed for motors with an inrush of 7 x FLC for 5 seconds. The instant trip point of MCCBs must be considered when used with high inrush, high efficiency motors.

## Type 2 Short Circuit Coordination

**Terasaki/Sprecher + Schuh**

For DOL motor starting, 50/60 kA @ 400/415 V to AS/NZS 60947.4.1

TemBreak MCCB circuit breakers

Sprecher + Schuh Electronic overload relays.

**TYPE 2  
50/65 KA  
415 V**

### Component Selection Table C64.2

Motor	Circuit Breaker	Contactor	Overload Relay	
Motor Amp Ratings @ 400/415 V	Moulded Case Circuit Breaker	Contactor Type	Overload Relay (Electronic)	Ampere Setting Range
0.18	0.6	XM30PB / 0.7A	CA7-9	CEP 7 EEBB 0.2 – 1.0
0.25	0.8	XM30PB / 1.4A	CA7-9	CEP 7 EEBB 0.2 – 1.0
0.37	1.1	XM30PB / 1.4A	CA7-9	CEP 7 EECB 1.0 – 5.0
0.55	1.5	XM30PB / 2.0 A	CA7-9	CEP 7 EECB 1.0 – 5.0
0.75	1.8	XM30PB / 2.6A	CA7-9	CEP 7 EECB 1.0 – 5.0
1.1	2.6	XM30PB / 4A	CA7-16	CEP 7 EECB 1.0 – 5.0
1.5	3.4	XM30PB / 5A	CA7-16	CEP 7 EECB 1.0 – 5.0
2.2	4.8	XM30PB / 8A	CA7-16	CEP 7 EEEB 5.4 – 27
3	6.5	XM30PB / 10A	CA7-23	CEP 7 EEEB 5.4 – 27
4	8.2	XM30PB / 12A	CA7-23	CEP 7 EEEB 5.4 – 27
5.5	11	S125GJ / 20A	CA7-30	CEP 7 EEED 5.4 – 27
7.5	14	S125GJ / 20A	CA7-30	CEP 7 EEED 5.4 – 27
10	17	S125GJ / 20A	CA7-30	CEP 7 EEED 5.4 – 27
11	21	S125GJ / 32A	CA7-30	CEP 7 EEED 5.4 – 27
15	28	S125GJ / 50A	CA7-30	CEP 7 EEFD 9.0 – 45
18.5	34	S125GJ / 50A	CA7-37	CEP 7 EEFD 9.0 – 45
22	40	S125GJ / 63A	CA7-43	CEP 7 EEFD 9.0 – 45
30	55	S125GJ / 100A	CA7-72	CEP 7 EEEG 18 – 90
37	66	S125GJ / 100A	CA7-72	CEP 7 EEEG 18 – 90
45	80	S125GJ / 125A	CA7-85	CEP 7 EEEG 18 – 90
55	100	S125GJ / 125A	CA6-115	CEP 7 EEEHF 30 – 150
75	130	S160GJ / 160A	CA6-140-EI	CEP 7 EEEHF 30 – 150
90	155	S250GJ / 250A	CA6-140-EI	CEP 7 EEJF 40 – 200
110	200	S250GJ / 250A	CA6-180-EI	CEP 7 EEKG 60 – 300
132	225	S400GJ / 400A	CA6-420-EI	CEP 7 EEKG 60 – 300
150	250	S400GJ / 400A	CA6-420-EI	CEP 7 EEKG 60 – 300
160	270	S400GJ / 400A	CA6-420-EI	CEP 7 EEKG 60 – 300
185	325	S400GJ / 400A	CA6-420-EI	CEP 7 EELG 100 – 500
200	361	S400GJ / 400A	CA6-420-EI	CEP 7 EELG 100 – 500
220	383	S400GJ / 400A	CA6-630-EI	CEP 7 EEMH 120 – 600
250	425	S630GE / 630A	CA6-860-EI	CEP 7 EEMH 120 – 600
320	538	S630GE / 630A	CA6-860-EI	CEP 7 EEMH 120 – 600
400	700	XH800SE / 800A	CA6-860-EI	CEP 7 EENH 160 – 800

**Notes:** • Thermal or electronic overload relays may be used.

- XM30PB can be replaced with S125GJ/20 and CA7-23/ CA7-30
- Combinations based on the overload tripping before the circuit breaker at overload currents up to the motor locked rotor current.
- Electronic MCCBs may be changed to thermal magnetic types if required.
- Same 'look' handles can be used on XM30PB and S125-630 A MCCBs.
- S125GJ and S250GJ MCCBs can be changed to ZS125GJ and ZS250GJ earth leakage relay MCCBs if required.
- Refer to NHP for other device combinations.
- The above combinations are designed for motors with an inrush of 7 x FLC for 5 seconds. The instant trip point of MCCBs must be considered when used with high inrush, high efficiency motors.

## Type 2 Short Circuit Coordination

**Terasaki/Sprecher + Schuh**

For DOL motor starting, 50/60 kA @ 400/415 V to AS/NZS 60947.4.1

TemBreak MCCB circuit breakers

Sprecher + Schuh Electronic overload relays with communications and earth leakage.

**TYPE 2  
50/65 KA  
415 V**

### Component Selection Table C64.11

Motor Kw	Motor Amp Ratings @ 400/415 V	Moulded Case Circuit Breaker	Contactor Type	Overload Relay	
				(Electronic)	Ampere Setting Range
0.18	0.6	S125GJ / 20A	CA7-23	CEP7 C3-23-2	0.4 - 2.0
0.25	0.8	S125GJ / 20A	CA7-23	CEP7 C3-23-2	0.4 - 2.0
0.37	1.1	S125GJ / 20A	CA7-23	CEP7 C3-23-2	0.4 - 2.0
0.55	1.5	S125GJ / 20A	CA7-23	CEP7 C3-23-5	1.0 - 5.0
0.75	1.8	S125GJ / 20A	CA7-23	CEP7 C3-23-5	1.0 - 5.0
1.1	2.6	S125GJ / 20A	CA7-23	CEP7 C3-23-5	1.0 - 5.0
1.5	3.4	S125GJ / 20A	CA7-23	CEP7 C3-23-5	1.0 - 5.0
2.2	4.8	S125GJ / 20A	CA7-23	CEP7 C3-23-5	1.0 - 5.0
3	6.5	S125GJ / 20A	CA7-23	CEP7 C3 23-25	5.0 - 25
4	8.2	S125GJ / 20A	CA7-23	CEP7 C3 23-25	5.0 - 25
5.5	11	S125GJ / 20A	CA7-30	CEP7 C3 43-25	5.0 - 25
7.5	14	S125GJ / 20A	CA7-30	CEP7 C3 43-25	5.0 - 25
10	17	S125GJ / 20A	CA7-30	CEP7 C3 43-25	5.0 - 25
11	21	S125GJ / 32A	CA7-30	CEP7 C3 43-25	5.0 - 25
15	28	S125GJ / 50A	CA7-30	CEP7 C3 43-45	9.0 - 45
18.5	34	S125GJ / 50A	CA7-37	CEP7 C3 43-45	9.0 - 45
22	40	S125GJ / 63A	CA7-43	CEP7 C3 43-45	9.0 - 45
30	55	S125GJ / 100A	CA7-72	CEP7 C3 85-90	18 - 90
37	66	S125GJ / 100A	CA7-72	CEP7 C3 85-90	18 - 90
45	80	S125GJ / 125A	CA7-85	CEP7 C3 85-90	18 - 90
55	100	S125GJ / 125A	CA6-115	CEP7 C3 180 140	28 - 140
75	130	S160GJ / 160A	CA6-140-EI	CEP7 C3 180 140	28 - 140
90	155	S250GJ / 250A	CA6-140-EI	CEP7 C3 180 210	42 - 210
110	200	S250GJ / 250A	CA6-180-EI	CEP7 C3 420 302	60 - 302
132	225	S400GJ / 400A	CA6-420-EI	CEP7 C3 420 302	60 - 302
150	250	S400GJ / 400A	CA6-420-EI	CEP7 C3 420 302	60 - 302
160	270	S400GJ / 400A	CA6-420-EI	CEP7 C3 420 302	60 - 302
185	325	S400GJ / 400A	CA6-420-EI	CEP7 C3 420 420	84 - 420
200	361	S400GJ / 400A	CA6-420-EI	CEP7 C3 420 420	84 - 420
220	383	S400GJ / 400A	CA6-630-EI	CEP7 C3 860 630	125 - 630
250	425	S630GE / 630A	CA6-860-EI	CEP7 C3 860 630	125 - 630
320	538	S630GE / 630A	CA6-860-EI	CEP7 C3 860 630	125 - 630
400	700	XH800SE / 800A	CA6-860-EI	CEP7 C3 860 860	172 - 860

**Notes:** • Thermal or electronic overload relays may be used.

- S125GJ combinations can be replaced with XM30PB and smaller contactors if required.
- Combinations based on the thermal overload relay tripping before the circuit breaker at overload currents up the motor locked rotor current.
- Thermal magnetic MCCBs may be changed to electronic types if required.
- Same look handles can be used on XM30PB and S125 - 630 A MCCBs.
- Refer to NHP for other device combinations.
- The above combinations are designed for motors with an inrush of 7 x FLC for 5 seconds.

The instant trip point of MCCBs must be considered when used with high inrush, high efficiency motors.

## Type 2 Short Circuit Coordination

**Terasaki/Sprecher + Schuh**

For DOL motor starting, 50/60 kA @ 400/415 V to AS/NZS 60947.4.1

TemBreak MCCB circuit breakers

Sprecher + Schuh Thermal magnetic and electronic overload relays.

**TYPE 2  
85 KA  
415 V**

### Component Selection Table C84.0

<b>Motor Kw</b>	<b>Motor Amp Ratings @ 400/415 V</b>	<b>Circuit Breaker</b>	<b>Contactor</b>	<b>Overload Relay</b>	
		Moulded Case Circuit Breaker	Contactor Type	Overload Relay	Amperes Setting Range
0.18	0.6	XM30PB / 0.7A	CA7-9	CT7N 23 A80	0.55 – 0.8
0.25	0.8	XM30PB / 1.4A	CA7-9	CT7N 23 B10	0.75 – 1.0
0.37	1.1	XM30PB / 1.4A	CA7-9	CT7N 23 B13	0.9 – 1.3
0.55	1.5	XM30PB / 2.0 A	CA7-9	CT7N 23 B20	1.4 – 2.0
0.75	1.8	XM30PB / 2.6A	CA7-9	CT7N 23 B25	1.8 – 2.5
1.1	2.6	XM30PB / 4A	CA7-16	CT7N 23 B32	2.3 – 3.2
1.5	3.4	XM30PB / 5A	CA7-16	CT7N 23 B40	2.9 – 4.0
2.2	4.8	XM30PB / 8A	CA7-16	CT7N 23 B63	4.5 – 6.3
3	6.5	XM30PB / 10A	CA7-23	CT7N 23 B75	5.5 – 7.5
4	8.2	XM30PB / 12A	CA7-23	CT7N 23 C10	7.2 – 10
5.5	11	H125NJ / 20A	CA7-30	CEP7 EEEED	5.4 – 27
7.5	14	H125NJ / 20A	CA7-30	CT7N 37 C20	15 – 20
10	17	H125NJ / 20A	CA7-30	CT7N 37 C20	15 – 20
11	21	H125NJ / 32A	CA7-30	CT7N 37 C25	21 – 25
15	28	H125NJ / 50A	CA7-30	CT7N 37 C30	24.5 – 30
18.5	34	H125NJ / 50A	CA7-37	CT7N 37 C38	33 – 38
22	40	H125NJ / 63A	CA7-43	CT7N 43 C47	35 – 47
30	55	H125NJ / 100A	CA7-72	CT7N 85 C60	45 – 60
37	66	H125NJ / 100A	CA7-72	CT7N 85 C75	58 – 75
45	80	H125NJ / 125A	CA7-85	CT7N 85 C90	72 – 90
55	100	H125NJ / 125A	CA6-115	CEP 7 EEEHF	30 – 150
75	130	H160NJ / 160A	CA6-140-EI	CEP 7 EEEHF	30 – 150
90	155	H250NJ / 250A	CA6-140-EI	CEP 7 EEJF	40 – 200
110	200	H250NJ / 250A	CA6-180-EI	CEP 7 EEEKG	60 – 300
132	225	H400NE / 400A	CA6-420-EI	CEP 7 EEEKG	60 – 300
150	250	H400NE / 400A	CA6-420-EI	CEP 7 EEEKG	60 – 300
160	270	H400NE / 400A	CA6-420-EI	CEP 7 EEEKG	60 – 300
185	325	H400NE / 400A	CA6-420-EI	CEP 7 EELG	100 – 500
200	361	H400NE / 400A	CA6-420-EI	CEP 7 EELG	100 – 500
220	383	H400NE / 400A	CA6-630-EI	CEP 7 EEMH	120 – 600
250	425	XH630PJ / 630A	CA6-860-EI	CEP 7 EEMH	120 – 600
320	538	XH630PJ / 630A	CA6-860-EI	CEP 7 EEMH	120 – 600
400	700	XH800PJ / 800A	CA6-860-EI	CEP 7 EENH	160 – 800

**Notes:** • Thermal or electronic overload relays may be used.

- XM30PB can be replaced with H125GJ and CA7-30 if required.
- Combinations based on the thermal overloads relay tripping before the circuit breaker at overload currents up to the motor locked rotor current.
- Thermal magnetic MCCBs may be changed to electronic types if required.
- Same look handles can be used on XM30PB and S125 - 630 A MCCBs
- Refer to NHP for other device combinations.
- The above combinations are designed for motors with an inrush of 7 x FLC for 5 seconds. The instant trip point of MCCBs must be considered when used with high inrush, high efficiency motors.

## Type 2 Short Circuit Coordination

**Terasaki/Sprecher + Schuh**

For DOL motor starting, 50/60 kA @ 400/415 V to AS/NZS 60947.4.1

TemBreak MCCB circuit breakers

Sprecher + Schuh Electronic overload relays.

**TYPE 2  
100 KA  
415 V**

### Component Selection Table C14.3

Motor Kw	Motor Amp Ratings @ 400/415 V	Circuit Breaker	Contactor Type	Overload Relay	
				Moulded Case Circuit Breaker	Overload Relay
0.18	0.6	H125NJ / 20A	CA7-23	CEP 7 EEBB	0.2 – 1.0
0.25	0.8	H125NJ / 20A	CA7-23	CEP 7 EEBB	0.2 – 1.0
0.37	1.1	H125NJ / 20A	CA7-23	CEP 7 EECB	1.0 – 5.0
0.55	1.5	H125NJ / 20A	CA7-23	CEP 7 EECB	1.0 – 5.0
0.75	1.8	H125NJ / 20A	CA7-23	CEP 7 EECB	1.0 – 5.0
1.1	2.6	H125NJ / 20A	CA7-23	CEP 7 EECB	1.0 – 5.0
1.5	3.4	H125NJ / 20A	CA7-23	CEP 7 EECB	1.0 – 5.0
2.2	4.8	H125NJ / 20A	CA7-23	CEP 7 EEDB	3.2 – 16
3	6.5	H125NJ / 20A	CA7-23	CEP 7 EEDB	3.2 – 16
4	8.2	H125NJ / 20A	CA7-23	CEP 7 EEDB	3.2 – 16
5.5	11	H125NJ / 20A	CA7-30	CEP 7 EEED	5.4 – 27
7.5	14	H125NJ / 20A	CA7-30	CEP 7 EEED	5.4 – 27
10	17	H125NJ / 20A	CA7-30	CEP 7 EEED	5.4 – 27
11	21	H125NJ / 32A	CA7-30	CEP 7 EEED	5.4 – 27
15	28	H125NJ / 50A	CA7-30	CEP 7 EEFD	9.0 – 45
18.5	34	H125NJ / 50A	CA7-37	CEP 7 EEFD	9.0 – 45
22	40	H125NJ / 63A	CA7-43	CEP 7 EEFD	9.0 – 45
30	55	H125NJ / 100A	CA7-72	CEP 7 EEEG	18 – 90
37	66	H125NJ / 100A	CA7-72	CEP 7 EEEG	18 – 90
45	80	H125NJ / 100A	CA7-85	CEP 7 EEEG	18 – 90
55	100	H125NJ / 125A	CA6-115	CEP 7 EEEHF	30 – 150
75	130	H125NJ / 125A	CA6-140-EI	CEP 7 EEEHF	30 – 150
90	155	H250NJ / 250A	CA6-140-EI	CEP 7 EEEF	40 – 200
110	200	H250NJ / 250A	CA6-180-EI	CEP 7 EEEKG	60 – 300
132	225	H400NE / 400A	CA6-420-EI	CEP 7 EEEKG	60 – 300
150	250	H400NE / 400A	CA6-420-EI	CEP 7 EEEKG	60 – 300
160	270	H400NE / 400A	CA6-420-EI	CEP 7 EEEKG	60 – 300
185	325	H400NE / 400A	CA6-420-EI	CEP 7 EELG	100 – 500
200	361	H400NE / 400A	CA6-420-EI	CEP 7 EELG	100 – 500
220	383	H400NE / 400A	CA6-630-EI	CEP 7 EEMH	120 – 600
250	425	TL630NE / 630A	CA6-860-EI	CEP 7 EEMH	120 – 600
320	538	TL630NE / 630A	CA6-860-EI	CEP 7 EEMH	120 – 600
400	700	TL800NE / 800A	CA6-860-EI	CEP 7 EENH	160 – 800

- Notes:**
- Thermal or electronic overload relays may be used.
  - Combinations based on the overloads relay tripping before the circuit breaker at overload currents up to the motor locked rotor current.
  - Thermal magnetic MCCBs may be changed to electronic types if required.
  - Same 'look' handles can be used on all MCCBs.
  - Refer to NHP for other device combinations.
  - The above combinations are designed for motors with an inrush of 7 x FLC for 5 seconds. The instant trip point of MCCBs must be considered when used with high inrush, high efficiency motors.

## Type 2 Short Circuit Coordination

**Terasaki ZS ELCB/Sprecher + Schuh**

For DOL motor starting, 50/60 kA @ 400/415 V to AS/NZS 60947.4.1

TemBreak MCCB circuit breakers

Sprecher + Schuh Electronic overload relays.

 TYPE 2  
 50/65 KA  
 415 V

### Component Selection Table EC64.3

Motor	Circuit Breaker		Contactor	Overload Relay	
Motor Amp Ratings @ 400/415 V	Moulded Case Circuit Breaker	Earth Fault Sensing Range	Type	Overload Relay	Ampere Setting Range
0.18	0.6	ZS125GJ / 20A	30mA - 3A	CA7-23	CEP 7 EEBB 0.2 - 1.0
0.25	0.8	ZS125GJ / 20A	30mA - 3A	CA7-23	CEP 7 EEBB 0.2 - 1.0
0.37	1.1	ZS125GJ / 20A	30mA - 3A	CA7-23	CEP 7 EECB 1.0 - 5.0
0.55	1.5	ZS125GJ / 20A	30mA - 3A	CA7-23	CEP 7 EECB 1.0 - 5.0
0.75	1.8	ZS125GJ / 20A	30mA - 3A	CA7-23	CEP 7 EECB 1.0 - 5.0
1.1	2.6	ZS125GJ / 20A	30mA - 3A	CA7-23	CEP 7 EECB 1.0 - 5.0
1.5	3.4	ZS125GJ / 20A	30mA - 3A	CA7-23	CEP 7 EECB 1.0 - 5.0
2.2	4.8	ZS125GJ / 20A	30mA - 3A	CA7-23	CEP 7 EEDB 3.4 - 16
3	6.5	ZS125GJ / 20A	30mA - 3A	CA7-23	CEP 7 EEDB 3.4 - 16
4	8.2	ZS125GJ / 20A	30mA - 3A	CA7-23	CEP 7 EEDB 3.4 - 16
5.5	11	ZS125GJ / 20A	30mA - 3A	CA7-30	CEP 7 EEED 5.4 - 27
7.5	14	ZS125GJ / 20A	30mA - 3A	CA7-30	CEP 7 EEED 5.4 - 27
10	17	ZS125GJ / 20A	30mA - 3A	CA7-30	CEP 7 EEED 5.4 - 27
11	21	ZS125GJ / 32A	30mA - 3A	CA7-30	CEP 7 EEED 5.4 - 27
15	28	ZS125GJ / 50A	30mA - 3A	CA7-30	CEP 7 EEFD 9.0 - 45
18.5	34	ZS125GJ / 50A	30mA - 3A	CA7-37	CEP 7 EEFD 9.0 - 45
22	40	ZS125GJ / 63A	30mA - 3A	CA7-43	CEP 7 EEFD 9.0 - 45
30	55	ZS125GJ / 100A	30mA - 3A	CA7-72	CEP 7 EEEG 18 - 90
37	66	ZS125GJ / 100A	30mA - 3A	CA7-72	CEP 7 EEEG 18 - 90
45	80	ZS125GJ / 125A	30mA - 3A	CA7-85	CEP 7 EEEG 18 - 90
55	100	ZS125GJ / 125A	30mA - 3A	CA6-115	CEP 7 EEEHF 30 - 150
75	130	ZS250GJ / 160A	30mA - 3A	CA6-140-EI	CEP 7 EEEHF 30 - 150
90	155	ZS250GJ / 250A	30mA - 3A	CA6-140-EI	CEP 7 EEEJF 40 - 200
110	200	ZS250GJ / 250A	30mA - 3A	CA6-180-EI	CEP 7 EEEKG 60 - 300
132	225	S400GE AG / 400A	$Ig = 0.2 \times In \text{ min.}$	CA6-420-EI	CEP 7 EEEKG 60 - 300
150	250	S400GE AG / 400A	$Ig = 0.2 \times In \text{ min.}$	CA6-420-EI	CEP 7 EEEKG 60 - 300
160	270	S400GE AG / 400A	$Ig = 0.2 \times In \text{ min.}$	CA6-420-EI	CEP 7 EEEKG 60 - 300
185	325	S400GE AG / 400A	$Ig = 0.2 \times In \text{ min.}$	CA6-420-EI	CEP 7 EELG 100 - 500
200	361	S400GE AG / 400A	$Ig = 0.2 \times In \text{ min.}$	CA6-420-EI	CEP 7 EELG 100 - 500
220	383	S400GE AG / 400A	$Ig = 0.2 \times In \text{ min.}$	CA6-630-EI	CEP 7 EEMH 120 - 600
250	425	S630GE AG / 630A	$Ig = 0.2 \times In \text{ min.}$	CA6-860	CEP 7 EEMH 120 - 600
320	538	S630GE AG / 630A	$Ig = 0.2 \times In \text{ min.}$	CA6-860	CEP 7 EEMH 120 - 600
400	700	XH800SE 800 LSIG	$Ig = 0.2 \times In \text{ min.}$	CA6-860	CEP 7 EENH 160 - 800

- Notes:**
- Thermal or electronic overload relays may be used.
  - Combinations based on the thermal overloads relay tripping before the circuit breaker at overload currents up to the motor locked rotor current.
  - MCCBs 400 - 800 A have a Ground Fault option fitted. This will not sense small earth leakage (residual currents)
  - Refer to NHP for other device combinations.
  - The above combinations are designed for motors with an inrush of  $7 \times FLC$  for 5 seconds. The instant trip point of MCCBs must be considered when used with high inrush, high efficiency motors.

## Type 2 Short Circuit Coordination

### Terasaki ZS ELCB/Sprecher + Schuh

For DOL motor starting, 50/60 kA @ 400/415 V to AS/NZS 60947.4.1

TemBreak MCCB circuit breakers

Sprecher + Schuh Electronic overload relays with communications and earth leakage.

**TYPE 2  
50/65 KA  
415 V**

### Component Selection Table EC64.11

Motor	Circuit Breaker	Contactor	Overload Relay
Motor			
Amp			
Mo- tor Ratings @ 400/ Kw	Moulded Case Circuit Breaker 415V	Earth Fault Sensing Range	Type
0.18	0.6	ZS125GJ / 20A	30mA - 3A
0.25	0.8	ZS125GJ / 20A	30mA - 3A
0.37	1.1	ZS125GJ / 20A	30mA - 3A
0.55	1.5	ZS125GJ / 20A	30mA - 3A
0.75	1.8	ZS125GJ / 20A	30mA - 3A
1.1	2.6	ZS125GJ / 20A	30mA - 3A
1.5	3.4	ZS125GJ / 20A	30mA - 3A
2.2	4.8	ZS125GJ / 20A	30mA - 3A
3	6.5	ZS125GJ / 20A	30mA - 3A
4	8.2	ZS125GJ / 20A	30mA - 3A
5.5	11	ZS125GJ / 20A	30mA - 3A
7.5	14	ZS125GJ / 20A	30mA - 3A
10	17	ZS125GJ / 20A	30mA - 3A
11	21	ZS125GJ / 32A	30mA - 3A
15	28	ZS125GJ / 50A	30mA - 3A
18.5	34	ZS125GJ / 50A	30mA - 3A
22	40	ZS125GJ / 63A	30mA - 3A
30	55	ZS125GJ / 100A	30mA - 3A
37	66	ZS125GJ / 100A	30mA - 3A
45	80	ZS125GJ / 125A	30mA - 3A
55	100	ZS125GJ / 125A	30mA - 3A
75	130	ZS250GJ / 160A	30mA - 3A
90	155*	ZS250GJ / 250A	30mA - 3A
110	200	ZS250GJ / 250A	30mA - 3A
132	225	S400GE AG / 400A Ig = 0.2 x ln min.	CA6-115 CEP7 C3 180 140 28 - 140
150	250	S400GE AG / 400A Ig = 0.2 x ln min.	CA6-420-EI CEP7 C3 180 140 42 - 140
160	270	S400GE AG / 400A Ig = 0.2 x ln min.	CA6-420-EI CEP7 C3 420 302 60 - 302
185	325	S400GE AG / 400A Ig = 0.2 x ln min.	CA6-420-EI CEP7 C3 420 420 84 - 420
200	361	S400GE AG / 400A Ig = 0.2 x ln min.	CA6-420-EI CEP7 C3 420 420 84 - 420
220	383	S400GE AG / 400A Ig = 0.2 x ln min.	CA6-630-EI CEP7 C3 860 630 125 - 630
250	425	S630GE AG / 630A Ig = 0.2 x ln min.	CA6-860-EI CEP7 C3 860 630 125 - 630
320	538	S630GE AG / 630A Ig = 0.2 x ln min.	CA6-860-EI CEP7 C3 860 630 125 - 630
400	700	XH800SE800 LSIG Ig = 0.2 x ln min.	CA6-860-EI CEP7 C3 860 860 172 - 860

- Notes:**
- CEP7 C3 overloads include DeviceNet comms, earth fault relay, and thermistor relay.
  - The CEP7 C3 inbuilt earth fault relay senses currents from 20 mA to 5 A. An external CT is required.
  - MCCBs 400 - 800 A have a Ground Fault option fitted. This will not sense small earth leakage (residual currents)
  - Combinations based on the thermal overloads relay tripping before the circuit breaker at overload currents up to the motor locked rotor current.
  - The above combinations are designed for motors with an inrush of 7 x FLC for 5 seconds. The instant trip point of MCCBs must be considered when used with high inrush, high efficiency motors.

## Type 2 Short Circuit Coordination

**TYPE 2  
50 KA  
690 V**

### Sprecher + Schuh

For DOL motor starting, 50/60 kA @ 690 V to AS/NZS 60947.4.1

Sprecher + Schuh KTA7 motor circuit breakers/ CEP 7 electronic overload relays

### Component Selection Table C56.0

Motor Kw	Motor Amp Ratings @ 690 V AC	Circuit Breaker Type	Circuit Breaker	Contactor	Overload Relay
			MPCB/ MCCB Circuit Breaker Type		KT7 overload or separate Overload Relay
0.37	0.63	KTA 7-255-1A	CA7-9	KT7 has adjustable O/L	0.63 – 1.0
0.55	0.86	KTA 7-255-1A	CA7-9	KT7 has adjustable O/L	0.63 – 1.0
0.75	1.1	KTA 7-255-1.6A	CA7-9	KT7 has adjustable O/L	1.0 – 1.6
1.1	1.5	KTA 7-255-1.6A	CA7-9	KT7 has adjustable O/L	1.0 – 1.6
1.5	2.1	KTA 7-25H-2.5A	CA7-9	KT7 has adjustable O/L	1.6 – 2.5
2.2	2.9	KTA 7-25H-4A	CA7-9	KT7 has adjustable O/L	2.5 – 4
3	3.8	KTA 7-25H-4A	CA7-12	KT7 has adjustable O/L	2.5 – 4
4	4.9	KTA 7-25H-6.3A	CA7-12	KT7 has adjustable O/L	4.0 – 6.3
5.5	6.6	KTA 7-25H-10A	CA7-16	KT7 has adjustable O/L	6.3 – 10
7.5	8.9	KTA 7-25H-10A	CA7-23	KT7 has adjustable O/L	6.3 – 10
10	12	KTA 7-25H-16A	CA7-23	KT7 has adjustable O/L	10 – 16
11	13	KTA 7-25H-16A	CA7-30	KT7 has adjustable O/L	10 – 16
15	17	KTA 7-45H-20A	CA7-30	KT7 has adjustable O/L	14.5 – 20
18.5	21	KTA 7-45H-25A	CA7-43	KT7 has adjustable O/L	18 – 25
22	24	KTA 7-45H-32A	CA7-60	KT7 has adjustable O/L	23 – 32

## Type 2 Short Circuit Coordination

**TYPE 2  
50/65 KA  
690 V**

### Socomec switch fuses/Sprecher + Schuh

For DOL motor starting, 50/60 kA @ 690 V to AS/NZS 60947.4.1

DIN Fuse links, SOCOMEC Switch Fuses

Sprecher + Schuh KTA7 Electronic overload relays

### Component Selection Table F66D.1

Motor Kw	Motor Amp Ratings @ 690 V AC	Circuit Breaker		Contactor Type	Overload Relay	
		DIN gG Fuse Amps/Size	Switch- Fuse		Overload Relay (Elec- tronic)	Ampere Setting Range
0.18	0.35	2 / 00C	SSFDN 63	CA7-9	CEP 7 EEBB	0.2 – 1.0
0.25	0.46	2 / 00C	SSFDN 63	CA7-9	CEP 7 EEBB	0.2 – 1.0
0.37	0.63	4 / 00C	SSFDN 63	CA7-9	CEP 7 EEBB	0.2 – 1.0
0.55	0.86	4 / 00C	SSFDN 63	CA7-9	CEP 7 EEBB	0.2 – 1.0
0.75	1.1	4 / 00C	SSFDN 63	CA7-9	CEP 7 EECB	1.0 – 5.0
1.1	1.5	6 / 00C	SSFDN 63	CA7-9	CEP 7 EECB	1.0 – 5.0
1.5	2.1	6 / 00C	SSFDN 63	CA7-9	CEP 7 EECB	1.0 – 5.0
2.2	2.9	10 / 00C	SSFDN 63	CA7-9	CEP 7 EECB	1.0 – 5.0
3	3.8	10 / 00C	SSFDN 63	CA7-9	CEP 7 EECB	1.0 – 5.0
4	4.9	16 / 00C	SSFDN 63	CA7-9	CEP 7 EECB	1.0 – 5.0
5.5	6.6	20 / 00C	SSFDN 63	CA7-12	CEP 7 EEEB	5.4 – 27
7.5	8.9	25 / 00C	SSFDN 63	CA7-16	CEP 7 EEEB	5.4 – 27
10	12	32 / 00C	SSFDN 63	CA7-23	CEP 7 EEEB	5.4 – 27
11	13	35 / 00C	SSFDN 63	CA7-30	CEP 7 EEEED	5.4 – 27
15	17	50 / 00C	SSFDN 63	CA7-30	CEP 7 EEEED	5.4 – 27
18.5	21	50 / 00C	SSFDN 63	CA7-37	CEP 7 EEEED	5.4 – 27
22	24	63 / 00C	SSFDN 63	CA7-43	CEP 7 EEEED	5.4 – 27
30	32	80 / 00	SSFDN 125	CA7-60	CEP 7 EEEGE	18 – 90
37	39	100 / 00	SSFDN 125	CA7-72	CEP 7 EEEGE	18 – 90
45	47	125 / 00	SSFDN 125	CA7-85	CEP 7 EEEGE	18 – 90
55	57	125 / 00	SSFDN 125	CA6-95	CEP 7 EEEHF	30 – 150
75	78	160 / 00	SSFDN 160	CA6-1115	CEP 7 EEEHF	30 – 150
90	94	200 / 1	SSFDN 250	CA6-1110-EI	CEP 7 EEEHF	30 – 150
110	114	224 / 1	SSFDN 250	CA6-140-EI	CEP 7 EEEHF	30 – 150
132	135	250 / 1	SSFDN 250	CA6-140-EI	CEP 7 EEEHF	30 – 150
160	163	300 / 2	SSFDN 400	CA6-180-EI	CEP 7 EEJF	40 – 200
200	203	400 / 2	SSFDN 400	CA6-210-EI	CEP 7 EEKG	60 – 300
220	220	400 / 2	SSFDN 400	CA6-300-EI	CEP 7 EEKG	60 – 300
250	252	425 / 3	SSFDN 630	CA6-300-EI	CEP 7 EEKG	60 – 300
315	312	500 / 3	SSFDN 630	CA6-420-EI	CEP 7 EELG	100 – 500
355	354	630 / 3	SSFDN 630	CA6-420-EI	CEP 7 EELG	100 – 500
400	397	630 / 3	SSFDN 630	CA6-420-EI	CEP 7 EELG	100 – 500

- Notes:**
- Thermal or electronic overload relays may be used.
  - Refer to NHP for other device combinations.
  - The above combinations are designed for motors with an inrush of 7 x FLC for 5 seconds.
  - The fuse maximum inrush current must be considered when used with high inrush, high efficiency motors.

## Type 2 Short Circuit Coordination

TYPE 2  
6.5-20 kA  
1000 V

### Terasaki/Sprecher + Schuh

For DOL motor starting, 6.5-20 kA @ 1000 V to AS/NZS 60947.4.1

TemBreak 1 Moulded Case Circuit Breakers

Sprecher + Schuh Electronic overload relays

### Component Selection Table C21.0

Motor Kw	Motor Amp Ratings @ 690 V AC	Circuit Breaker MPCB/ MCCB Circuit Breaker Type	Contactor Type	Overload Relay	
				KT7 overload or separate Overload Relay	Ampere Setting Range
25	20	TL100EM403K	CA6 115 EI	CEF1-11	20 - 180
30	25	TL100EM503K	CA6 115 EI	CEF1-11	20 - 180
45	33	TL100EM603K	CA6 115 EI	CEP7 EE HF	30 - 150
55	40	TL100EM753K	CA6 105 EI	CEP7 EE HF	30 - 150
75	55	TL100EM1003K	CA6 140 EI	CEP7 EE HF	30 - 150
90	65	TL100EM1003K	CA6 170 EI	CEP7 EE HF	30 - 150
111	80	XV400NE2503K	CA6 210 EI	CEP7 EE HF	30 - 150
133	95	XV400NE2503K	CA6 250 EI	CEP7 EE HF	30 - 150
163	115	XV400NE2503K	CA6 300 EI	CEP7 EE HF	30 - 150
206	145	XV400NE2503K	CA6 420 EI	CEP7 EE JF	40 - 200
280	200	XV400NE4003K	CA5 450	CEP7 EE KG	60 - 300
355	250	XV400NE4003K	CA5 550	CEP7 EE KG	60 - 300
500	340	XV400NE4003K	CA5 700	CEP7 EE LG	100 - 500
550	380	XV630PE6303K	CA5 860	CEP7 EE LG	100 - 500

- Notes:**
- CEP7 overload add-on modules are available for Profibus, DeviceNet, Ethernet, Ground Fault, remote reset, jam protection, and a thermister protection relay. A CEP7 overload will accept one only add-on module.
  - CEF 1 CT overloads can replace CEP7 overloads if required.
  - For CEP7 C3 overload use, 1000 V rated CTs must be used.
  - Combinations based on the overload relay tripping before the circuit breaker at overload currents up to the motor locked rotor current.
  - Same 'look' handles can be used on MCCBs. Refer NHP for other device combinations.
  - The above combinations are designed for motors with an inrush of 7 x FLC for 5 seconds.

The instant trip point of MCCBs must be considered when used with high inrush, high efficiency motors.

# TEMCURVE 6 - CIRCUIT BREAKER SELECTIVITY APPLICATION SOFTWARE

**NHP**

The latest version of TemCurve 6 includes advanced new features making it a versatile application tool for use with Terasaki MCBs, MCCBs, ACBs, NHP fuses as well as generic IEC protection relay curves.

**TemCurve 6 includes:**

- Circuit line-diagrams
- Cable fault calculations
- TemCurve file sharing
- Distribution schematic
- Supply fault calculations
- Supply voltage options
- Catalogue data prints
- Time current curves
- Device photos
- User defined curves
- Motor start applications
- Internet update capability
- Energy let through curves
- Supply device type options
- Exports to AutoCad
- Circuit breaker setting detail
- Calculator

**TERASAKI**  
Innovators in Protection Technology

## Technical Reference

## **Motor circuit application table for DOL starting**

### **Breaker type and current rating (A)**

<b>Motor Rating (kW)</b>	<b>Approx. FLC (Amps)</b>	<b>Din-T C &amp; D curve</b>	<b>Safe-T</b>	<b>ZS125 E125 S125 H125 L125</b>
0.37	1.1	4	6	
0.55	1.5	4	6	20
0.75	1.8	6	6	20
1.1	2.6	10	6	20
1.5	3.4	10	10	20
2.2	4.8	16	16	20
3.0	6.5	20	16	20
4	8.2	25	20	20
4.5	9	32	25	20
5.5	11	32	32	32
7.5	14	40	40	32
10	19	50	50	50
11	21	50	50	50
15	28	63	63	63
18.5	34	100 <sup>1)</sup>	80	100
22	40	125 <sup>1)</sup>	100	100
25	46	125 <sup>1)</sup>	100	100
30	55			125
37	66			125
45	80			125
55	100			
75	135			
90	160			
110	200			
132	230			
160	270			
185	320			
200	361			
220	380			
250	430			
280	480			
300	510			
375	650			
450	750			

**Notes:** <sup>1)</sup> 80, 100 and 125 amp refers to Din-T10H type.

<sup>2)</sup> Electronic TemBreak MCCB only.

## Motor circuit application table for DOL starting

### Breaker type and current rating (A)

ZS250			ZS800	
S160			S800CJ	
H160			S800NJ	
L160	ZS400	S800 (630 A)	S800RJ	
S250	E400	ZS630	S800RE	
E250	S400	E630	H800NE	
H250	H400	S630	XS800NJ	S1000NE
L250	L400	XH630	XH800SE	S1250NE/1250
		XS630	XS800SE	XS1250SE/1000
160				
160				
160				
160	250			
250	250			
250	250			
	400	400		
	400	400		
	400	400		
	400 <sup>2)</sup>	630		
	400 <sup>2)</sup>	630		
		630	800 <sup>2)</sup>	
		630	800	
		630 <sup>2)</sup>	800	
		630 <sup>2)</sup>	800	
			800 <sup>2)</sup>	
				1000

- Notes:**
- The DOL table is based on holding 125 % FLC continuously and 600 % FLC for 10 seconds. For non-standard drives consult NHP.
  - Lower circuit breaker ratings are possible in most applications. Refer to Type '2' co-ordination tables for specific circuit breaker/overload combinations.
  - Adjustable magnetic trips set to high. Thermal magnetic TemBreak adjustable 63 % – 100 % of NRC (nominal rated current).
  - Din-T MCBs are calibrated to IEC 60898 Curve 'C' & 'D'. Selected sizes of 'D' Curve are available from stock, refer NHP.

## General motor circuit application table for reduced voltage starting

**Breaker type and current rating, star-delta, auto-transformer resistor or reactance starting**

Motor rating (kW)	Approx. FLC (Amps)	Din-T C & D curve	Safe-T	ZS125 E125 S125 H125 L125
0.37	1.1	4	6	
0.55	1.5	4	6	20
0.75	1.8	4	6	20
1.1	2.6	6	6	20
1.5	3.4	10	6	20
2.2	4.8	10	10	20
3.0	6.5	16	16	20
4	8.2	20	16	20
4.5	9	20	16	20
5.5	11	25	20	20
7.5	14	32	25	20
10	19	40	40	32
11	21	50	40	32
15	28	50	50	50
18.5	34	63	63	50
22	40	80 <sup>1)</sup>	63	63
25	46	100 <sup>1)</sup>	80	100
30	55	125 <sup>1)</sup>	100	100
37	66	125 <sup>1)</sup>		100
45	80			125
55	100			
75	135			
90	160			
110	200			
132	230			
160	270			
185	320			
200	361			
220	380			
250	430			
280	480			
300	510			
375	650			
450	750			

**Notes:** <sup>1)</sup> 80, 100 and 125 amp refers to Din-T10H type.

<sup>2)</sup> Electronic TemBreak MCCB only.

If co-ordination to IEC 60947-4-1 is required refer to co-ordination tables.

Reduced voltage table is based on holding 120 % FLC continuously and 350 % FLC for 20 seconds.

Din-T MCBs are calibrated to IEC 898 Curve 'C' & 'D'. Selected sizes of 'D' Curve are available from stock refer NHP.

## General motor circuit application table for reduced voltage starting

ZS250		S800 (630 A)	ZS800
S160			S800CJ
H160			S800NJ
L160	ZS400	ZS630	S800RJ
S250	E400	E630	S800NE
E250	S400	S630	XS800NJ
H250	H400	XH630	XS800RE
L250	L400	XS630	XS800SE
			S1000NE
			S1250NE/1250
			XS1250SE/1000

160			
160			
160	250		
160	250		
250	250		
250	250		
250	250	400	
	400	400	
	400	400	
	400	400	800 <sup>2)</sup>
	400 <sup>2)</sup>	630	800 <sup>2)</sup>
		630	800
		630	800
		630	800
		630	800
			800 <sup>2)</sup>

1000

## Motor circuit application table for DOL fire pump starting duty

### Breaker type and current rating (A)

Motor rating (kW)	Approx. FLC (Amps)	Din-T C & D curve	Safe-T	XM30PB	ZS125 E125 S125 H125 L125
0.37	1.1	4	6	3.6	
0.55	1.5	6	6	3.6	
0.75	1.8	6	6	5	20
1.1	2.6	10	6	7.4	20
1.5	3.4	16	10	10	20
2.2	4.8	20	16	12	20
3	6.5	25	20		20
4	8.2	32	25		32
4.5	9	32	32		32
5.5	11	40	40		32
7.5	14	50	50		50
10	19	63	50		50
11	21	63	63		63
15	28	100 <sup>1)</sup>	80		100
18.5	34	125 <sup>1)</sup>	100		100
22	40				125
25	46				125
30	55				
37	66				
45	80				
55	100				
75	130				
90	155				
110	200				
132	225				
160	270				
185	320				
200	361				
220	380				
250	430				
280	480				
300	510				
375	650				
450	750				

**Notes:** <sup>1)</sup> 80, 100 and 125 amp refers to Din-T10H type.

<sup>2)</sup> Electronic TemBreak MCCB only.

DOL table is based on holding 125 % FLC continuously and 600 % FLC for at least 20 seconds.

Din-T MCBs are calibrated to IEC 60898 Curve 'C' & 'D'. Selected sizes of 'D' Curve are available from stock refer NHP.

## Motor circuit application table

### for DOL fire pump starting duty

ZS250			S800CJ	
S160			S800NJ	
H160			S800RJ	
L160	ZS400	ZS630	S800NE	
S250	E400	E630	ZS800	S1000NE
E250	S400	S630	XS800NJ	S1250NE/1250
H250	H400	XH630	XH800SE	XS1250SE
L250	L400	XS630	XS800SE	/1000
160				
160				
250	250			
250	250			
400				
400				
400	630			
400	630			
400	630			
400 <sup>2)</sup>	630			
	630	800		
	630	800		
	630	800		
		800		
		800		
		800 <sup>2)</sup>	1000	
			1000	

## Motor starting table for DOL

### starting at 1000 V AC 50 Hz

Motor Size (kW)	Full Load Current Amperes (A)	MCCB	Voltage (V)
0.37-10	0.4-7.5	VS125NJ 20	1000
11.0	9.0	VS125NJ 20	1000
15-18.5	12-14.5	VS125NJ 32	1000
22-33	17-23	VS125NJ 50	1000
37-50	28-38	VS125NJ 50	1000
55-80	40-57	VS125NJ 63	1000
90-110	65-78	VS125NJ 100	1000
150	102	VS125NJ 160	1000
185-220	138-160	VS125NJ 250	1000
220-500	160-350	XV400NE/400K	1000



**Sprecher + Schuh**  
**1000 V CA 6 Contactor**  
 (Refer Part A for more information)

## Rated outputs and standard values for rated operational currents of standard squirrel-cage motors

### 3 phase 4 pole 50/60 Hz motors<sup>1) 2)</sup>

<b>kW<sup>1)</sup></b>	<b>hp</b>	<b>230 V</b>	<b>400 -415 V</b>	<b>690 V</b>	<b>1000 V</b>	<b>1100 V</b>
		<b>A</b>	<b>A</b>	<b>A</b>	<b>A</b>	<b>A</b>
0.18	0.3	1.2	0.6	0.4	0.3	0.24
0.37	0.5	1.95	1.1	0.6	0.4	0.4
0.55	0.75	2.7	1.5	0.9	0.6	0.56
0.75	1	3.2	1.8	1.2	1.0	0.7
1.1	1.5	4.6	2.6	1.6	1.1	0.92
1.5	2	6.3	3.4	2.1	1.5	1.3
2.2	3	9	4.8	2.9	2	1.85
3	4	12	6.5	4	2.7	2.5
4	5.5	15.5	8.2	5	3.4	3.2
4.5	6	17	9	5.7	4.4	3.5
5.5	7.5	20	11	6.6	6	4.3
7.5	10	27	14	9	7	5.6
10	13.5	36	19	12	7.6	7.5
11	15	39	21	13	9	8
15	20	52	28	17	12.1	10.5
18.5	25	63	34	22	15	13
22	30	75	40	25	18	15.5
25	35	83	46	28	22	18
30	40	100	55	35	23	21
37	50	122	65	40	27	25
45	60	147	80	49	34	30
55	75	180	100	59	42	37
75	100	240	130	79	54	50
90	125	290	155	95	66	60
110	150	350	200	114	80	73
132	180	410	225	135	90	85
160	220	500	270	160	117	105
185	250	570	325	185	135	120
200	270	625	361	200	150	130
220	300	675	380	220	160	142
250	340	775	430	250	200	160
280	380	830	480	280	225	180
300	410	920	505	300	235	195
315	430	980	535	315	240	200
375	500	1150	650	375	270	240
400	545	1225	665	400	290	255
475	645	1450	780	465	335	300
500	680	—	820	495	360	320
560	750	—	920	570	390	350
600	800	—	1000	610	420	390
670	900	—	1100	680	470	430
750	1000	—	1250	770	530	490
900	1200	—	1470	930	650	600

**Notes:** Refer to 9 - 46 for footnotes

## Rated outputs and standard values for rated operational currents of standard squirrel-cage motors

### Single phase motors

		<b>230 V</b>
<b>kW<sup>1)</sup></b>	<b>hp</b>	<b>A</b>
0.37	0.5	4
0.55	0.75	5
0.75	1	6.3
1.1	1.5	9
1.5	2	12
1.8	2.5	15
2.2	3	18
3	4	23
4	5	28
5.5	7.5	41
6	8	42
7.5	10	52

- Notes:**
- 1) Standard values for standard squirrel-cage motors: Rated operational currents for motors with  $n = 1500$  RPM (4 pole), possible deviation  $\pm 10\%$  depending on type and manufacturer,  $\pm 50\%$  for small motors. Deviation of rated operational currents for motors with other speeds (greater deviations for smaller motors):
    - With  $n = 3000$  rpm  
(2 pole):  $-2\% \dots -10\%$
    - With  $n = 1000$  rpm  
(6 pole):  $+2\% \dots +10\%$
    - With  $n = 750$  rpm  
(8 pole):  $+5\% \dots +20\%$
  - 2) The power factor is usually around 0.8, but this varies with the size and speed of the motor. Efficiency ranges from 85 % in small motors to 90 % and over for large motors.

## TemBreak MCCB clearance requirements at 380/415 V

Clearance requirements for MCCBs (phase to phase and earth).

When MCCBs are called upon to interrupt large short-circuits, ionised gas and arcing material is expelled from the vents, usually at the top of the MCCB.

This ionised gas is highly conductive and is also at an elevated temperature when it exits the MCCB via the arc vents. Care must be taken to avoid an arcing fault occurring due to the presence of the ionised gas.

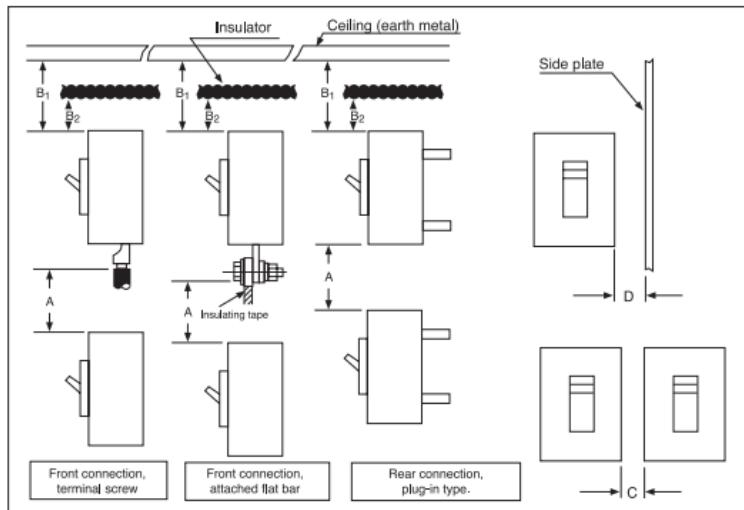
Therefore, incoming conductors must be insulated right up to the terminal opening of the MCCB. This also applies to the attached busbars supplied as a proprietary part with the MCCB.

Proprietary type interpole barriers may be used to achieve creepage and clearance requirements.

Conductors must not impede the flow of ionised gas.

### Insulating distance from Line-End for 380/415 V

When earth metal is installed within proximity of the breakers the correct insulating distance must be maintained. This distance is necessary to allow the exhausted arc gases to disperse.



#### **WARNING:**

**EXPOSED CONDUCTORS INCLUDING TERMINALS AT ATTACHED BUSBARS MUST BE INSULATED TO AVOID POSSIBLE SHORT-CIRCUITING OR EARTHING DUE TO FOREIGN MATTER COMING INTO CONTACT WITH THE CONDUCTORS.**

**Notes:** When using the terminal bar (optional), the specified insulating distance must be maintained.

All dimensions in mm.

When earthed metal is installed within proximity of the breakers the correct insulating distance must be maintained (refer to Table 1 over the page). This distance is necessary to allow the exhausted arc gases to disperse.

## TemBreak MCCB clearance requirements at 380/415 V

### Insulation distance in mm (at 440 V AC Maximum)<sup>1)</sup>

#### TemBreak 2 MCCBs

Table 1 below illustrates the minimum clearance that must be maintained

A Distance from lower breaker to open charging part of terminal on upper breaker (front connection) or the distance from lower breaker to upper breaker end (rear connection and plug-in type)

B1 Distance from breaker end to ceiling (earthing metal)

B2 Distance from breaker end to insulator

C Clearance between breakers

D Distance from breaker side to side plate (earthing metal)

Cat. No.	Type	A	B1	B2	C	D
<b>E125</b>	<b>NJ</b>	50	10	10	0	25
<b>S125</b>	<b>NF</b>	50	10	10	0	25
<b>S125</b>	<b>NJ</b>	50	10	10	0	25
<b>S125</b>	<b>GJ</b>	75	45	25	0	25
<b>ZS125</b>	<b>GJ</b>	75	45	25	0	25
<b>H125</b>	<b>NJ</b>	100	80	60	0	50
<b>L125</b>	<b>NJ</b>	100	80	60	0	50
<b>S160</b>	<b>NF</b>	50	40	30	0	25
<b>S160</b>	<b>NJ</b>	50	40	30	0	25
<b>S160</b>	<b>GJ</b>	100	80	60	0	25
<b>H160</b>	<b>NJ</b>	100	80	60	0	50
<b>L160</b>	<b>NJ</b>	100	80	60	0	50
<b>E250</b>	<b>NJ</b>	50	40	30	0	25
<b>S250</b>	<b>NJ</b>	50	40	30	0	25
<b>S250</b>	<b>GJ</b>	100	80	30	0	25
<b>ZS250</b>	<b>GJ</b>	100	80	30	0	25
<b>S250</b>	<b>PE</b>	100	80	60	0	50
<b>H250</b>	<b>NJ</b>	100	80	60	0	50
<b>H250</b>	<b>NE</b>	100	80	60	0	50
<b>L250</b>	<b>NJ</b>	100	80	60	0	50
<b>E400</b>	<b>NJ</b>	100	80	40	0	30
<b>S400</b>	<b>CJ</b>	100	80	40	0	30
<b>S400</b>	<b>NJ</b>	100	80	40	0	30
<b>S400</b>	<b>GJ</b>	100	80	40	0	30
<b>S400</b>	<b>GE/ PE</b>	100	80	40	0	30
<b>H400</b>	<b>NJ</b>	120	120	80	0	80
<b>H400</b>	<b>NE</b>	120	120	80	0	80
<b>L400</b>	<b>NJ</b>	120	120	80	0	80
<b>L400</b>	<b>NE</b>	120	120	80	0	80
<b>E630</b>	<b>NE</b>	120	100	80	0	80
<b>S630</b>	<b>CE</b>	120	100	80	0	80
<b>S630</b>	<b>GE</b>	120	100	80	0	80

**Notes:** <sup>1)</sup> Insulate the exposed conductor until it overlaps the moulded case at the terminal, or the terminal cover. All dimensions in mm.

## TemBreak MCCB clearance requirements at 380/415 V

### Insulation distance in mm (at 440 V AC Maximum)<sup>1)</sup>

This table is valid for 380/415 V – TemBreak 1 MCCBs

Table below illustrates the minimum clearance that must be maintained

- A Distance from lower breaker to open charging part of terminal on upper breaker (front connection) or the distance from lower breaker to upper breaker end (rear connection and plug-in type)
- B1 Distance from breaker end to ceiling (earthing metal)
- B2 Distance from breaker end to insulator
- C Clearance between breakers
- D Distance from breaker side to side plate (earthing metal)

MCCB type	A	B1	B2	C	D
<b>XM30PB</b>	30	10	10	0	25
<b>XH125NJ</b>	75	45	25	0	25
<b>XS250NJ</b>	80	60	30	0	25
<b>XH250NJ</b>	100	60	30	0	25
<b>XS400NJ</b> <b>XH400SE</b>	100	70	40	0	30
<b>XS630NJ</b> <b>XS630SE</b> <b>XS800NJ</b> <b>XS800SE</b>	120	70	40	0	30
<b>XH630SE</b> <b>XH800SE</b> <b>XH800PE</b>	150	80	50	0	40
<b>XS1250SE</b>	150	70	40	0	30
<b>XH630PJ</b> <b>XH800PJ</b>					
<b>XS1600SE</b> <b>XS2000NE</b> <b>XS2500NE</b>	150	150	100	0	100

**Notes:** <sup>1)</sup> Insulate the exposed conductor until it overlaps the moulded case at the terminal, or the terminal cover. All dimensions in mm.

## Electrical formulae

### – For obtaining kW, kVA, HP, and Amperes

<b>Wanted</b>	<b>Alternating Current</b>			
	<b>Single-phase</b>	<b>Two-phase Four-wire</b>	<b>Three-phase</b>	<b>Direct current</b>
Kilowatts	$I \times E \times PF$	$I \times E \times 2 \times PF$	$I \times E \times 1.73 \times PF$	$I \times E$
	1000	1000	1000	1000
kVA	$\frac{I \times E}{PF}$	$\frac{I \times E \times 2}{PF}$	$\frac{I \times E \times 1.73}{PF}$	$I \times E$
	1000	1000	1000	1000
Horse-power	$\frac{I \times E \times \% \text{ Eff.}}{\times PF}$	$\frac{I \times E \times 2 \times \% \text{ Eff.} \times PF}{746}$	$\frac{I \times E \times 1.73 \times \% \text{ Eff.} \times PF}{746}$	$\frac{I \times E \times \% \text{ Eff.}}{746}$
Amperes from kVA	$\frac{kVA \times 1000}{E}$	$\frac{kVA \times 1000}{2 \times E}$	$\frac{kVA \times 1000}{1.73 \times E}$	$\frac{kVA \times 1000}{E}$

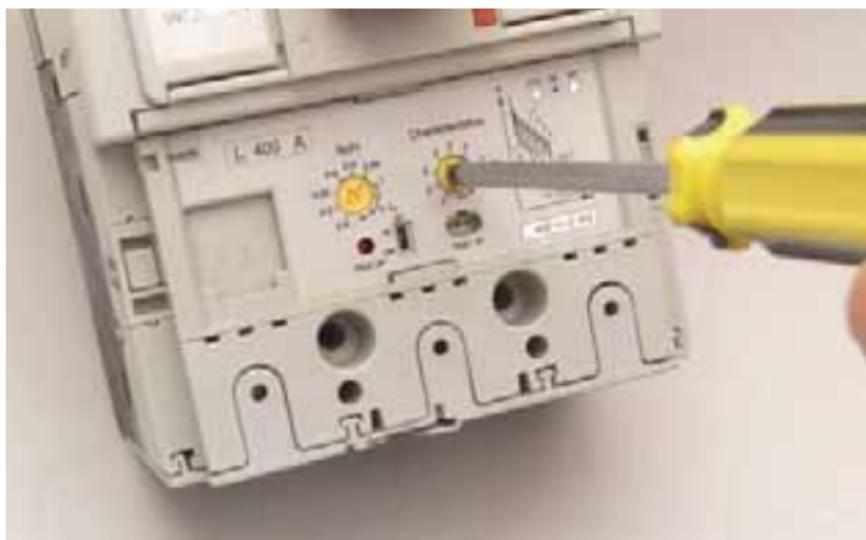
## TemBreak Electronic OCR adjustment setting

### Configuring the STANDARD Over current relay

The standard TemBreak 2 OCR can be configured allowing the user to adjust the rated current ( $I_{\text{Rated}}$ ) of the MCCB and select a predetermined tripping curve. This allows the user to tailor the MCCBs tripping characteristics to suit the requirements of the electrical load.

### Setting the rated current

The TemBreak 2 MCCB OCR rated current is adjustable from 40 % - 100 % of the nominal rated current ( $I_n$ ). The dial is adjustable in increments. It is not infinitely adjustable between setting indicators. This is a desirable feature where the demand of the protected electrical load increases over time. As the load demand increases, the rating of the breaker can be adjusted accordingly to meet the system requirements. For example, an S250PE TemBreak 2 MCCB can be configured to operate with an expected load of 125 A. The OCR can be set by rotating the rated current  $I_R$  (A) selector switch to '0.5'. This has the effect of setting the rated current of the S250PE to  $I_{\text{Rated}} = I_n$  (250 A)  $\times I_R$  (0.5) = 125 A.



**Notes:** Additional setting and options information can be found in the 2010 - 2011 Part C catalogue.

## TemBreak

### Electronic OCR adjustment setting

#### Curve selection

The predetermined curve characteristic dial on TemBreak 2 MCCBs simplifies the OCR tripping settings by reducing the number of often misunderstood variables that need to be specified. This enables users of various technical abilities to set the OCR to match the required electrical load and service application. For example if an electrical contractor was required to configure a 500 A TemBreak 2 MCCB for use in a three phase Squirrel-cage motor application, curve 5 would be the correct setting as for most applications it provides class 10 general purpose motor protection.

#### Curve types provided as standard on TemBreak 2 electronic MCCBs:

250 A and 400 A MCCBs: 7 selectable curves 16 A – 400 A

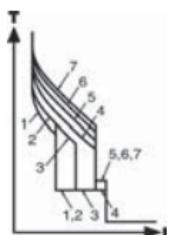
630 A: 6 selectable curves 252 A – 630 A (Curve type 7 not available)

800 - 1600 A 7 selectable curves 630 A - 1600 A.

Although each of the curves can be said to be targeted towards particular applications, the use of the curves can be extended to any other use where that curve suits. For example, curve 1 is ideal for many generator applications, though curve 1 can also be used for any other application that suits the curve.

#### General applications by curve type:

Primary Application	Short circuit (SC)/motor start type	Application 2	Application 3
Curve 1 Generator protection	Low level SC	Heating, resistive loads	Long cable runs
Curve 2 Generator protection	Low level SC	General, heating, resistive	Long cable runs
Curve 3 General distribution	Med. level SC	Long cable runs	Lighting
Curve 4 General distribution	Std. level SC	Various motor starting	Lighting
Curve 5 Motor start - standard run up time	Class 10	Transformers	Lighting
Curve 6 Motor start - longer run up time	Class 20	Capacitor switching	Lighting
Curve 7 Motor start - extra run up time	Class 30	Capacitor switching	–



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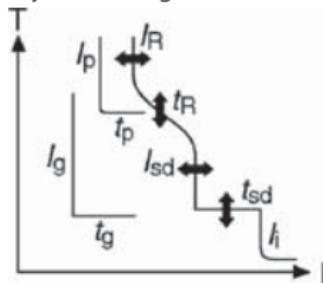
**Notes:** Curve 4 is the MCCB factory default setting for new MCCBs out of the box.

# TemBreak

## Electronic OCR adjustment setting

### Curve comparison

The predetermined curve characteristic dial on TemBreak 2 MCCBs enables easy OCR configuration to match the electrical characteristics of the load.



### Tabular representation

**Curve selection dial ONLY**

Characteristic curve selection dial position	LTD (sec)		STD Characteristics		
	200 % overload	600 % overload	$I_n < 630 \text{ A}$	$I_n \geq 630 \text{ A}$	Delay (sec)
1	11	—	$2.5 \times I_R$	$2.5 \times I_R$	0.1
2	21	—	$2.5 \times I_R$	$2.5 \times I_R$	0.1
3	21	—	$5 \times I_R$	$5 \times I_R$	0.1
4	53	5	$10 \times I_R$	$8 \times I_R$	0.1
5	108	10	$10 \times I_R$	$8 \times I_R$	0.2
6	200	19	$10 \times I_R$	$8 \times I_R$	0.2
7	308	29 (Not applicable for 630 A)	$10 \times I_R$	$8 \times I_R$	0.2

$I_R$ Selection dial position	$I_R$ Selection dial ONLY		Optional features		
	$I_n < 630 \text{ A}$	$I_n > 630 \text{ A}$	PTA Pre Trip Alarm	$I_D \times I_R$	0.8
0.40	$14 \times I_R$	$14 \times I_R$		$t_p \text{ (sec)}$	40
0.50	$14 \times I_R$	$14 \times I_R$	GFT Ground Fault Trip	$I_g \times I_n$	0.2
0.63	$14 \times I_R$	$14 \times I_R$		$t_g \text{ (sec)}$	0.2
0.80	$14 \times I_R$	$10 \times I_R$	NP Neutral protection	$I_N \times I_n$	1
0.85	$14 \times I_R$	$10 \times I_R$		$t_N \text{ (sec)}$	$t_N = t_R \cdot z_2$
0.90	$14 \times I_R$	$10 \times I_R$			
0.95	$13 \times I_R$	$10 \times I_R$			
1.00	$13 \times I_R$	$10 \times I_R$			

**Notes:** 1) The standard setting of  $I_n$  is 100 % of  $I_n$ . For any other setting, specify when ordering.

2) When neutral pole protection is installed the breaker must be set at 100 % of its  $I_n$  rating for the neutral protection to function. For other settings contact NHP.

# TemBreak

## Optional Functions

<b>Curve Application</b>	<b>Description</b>	<b>LTD</b>	<b>STD</b>
1 Generator / heating / resistive loads (LOW short cct level)	The characteristic curve features faster tripping times during overload situations & low level short circuit faults.	Fastest tripping time during an overload	Fastest tripping time during a low level short circuit
2 General distribution (LOW short cct level)	Sharing the same short circuit tripping time characteristics as curve 1, curve 2 has greater tolerance to allow for overloads caused by small inrush currents.	Intermediate tripping time during an overload	Fastest tripping time during a low level short circuit
3 General distribution (MEDIUM short cct level)	Featuring a shallower overload time trip curve and higher short circuit current protection characteristics than curve 2, curve 3 allows greater tolerance during overload and short circuit conditions.	Intermediate tripping time during an overload	Intermediate tripping time during a low level short circuit
4 General distribution (HIGH short cct level)	Featuring a shallower overload time trip curve and a higher short circuit current protection characteristic than curve 3.	Slow tripping time during an (high tolerance) overload	Slow tripping time during a low level short circuit
5 Motor Protection Class 10	Class 10 protection requires the overload detection element to trip the breaker in 10 seconds or less when a current of 600 % of its rated current is experienced. Use - general purpose motor applications, hermetic motors and submersible pumps.	Slow tripping time during an time (high tolerance) overload	Slow tripping time (high tolerance) during a low level short circuit
6 Motor Protection Class 20	Class 20 protection requires the overload detection element to trip the breaker in 20 seconds or less when a current of 600 % of its rated current is experienced. Use - motors with difficult starting conditions.	Slow tripping time during an time (high tolerance) overload	Slow tripping time (high tolerance) during a low level short circuit
7 Motor Protection Class 30	Class 30 protection requires the overload detection element to trip the breaker in 30 seconds or less when a current of 600 % of its rated current is experienced. Use - motors with difficult starting conditions that are driving high inertia loads.	Slowest tripping time during an overload	Slowest tripping time (high tolerance) during a low level short circuit

## TemBreak

### Optional functions

#### Pre-Trip Alarm (PTA)

An LED and volt-free output contact are activated after a time delay,  $t_p$ , if the load current exceeds the preset threshold,  $I_p$ . The default time delay,  $t_p$ , is set to 40 seconds and the load current threshold,  $I_p$ , is 80% of the rated current.

For example a S250PE TemBreak 2 MCCB with a  $I_{Rated}$  setting of 125 A would have a pre-trip alarm threshold of  $I_p (0.8) \times I_{Rated} (125) = 100 \text{ A}$ .

#### Ground Fault Trip (GFT)

This function trips the MCCB after a time delay,  $t_g$ , if the ground fault current exceeds the preset threshold,  $I_g$ . Ground fault protection can be enabled and disabled by operating a DIP switch on the OCR. The default time delay,  $t_g$ , is set to 0.2 seconds and the load current threshold,  $I_g$ , is 20 % of the nominal current.

For example, an S400GE TemBreak 2 MCCB with a nominal current ( $I_n$ ) 400 A would have a ground fault trip threshold of  $I_g (0.2) \times I_n (400 \text{ A}) = 80 \text{ A}$ .

When 3 pole GF MCCBs are used, a 4th neutral pole CT will be required. Refer MCCB accessories. 4 pole GF MCCBs do not require a 4th CT as the neutral pole protection CT is used. As a general note, 4 wire systems are used in Australia and New Zealand, and this is why a 4th CT is required for 3 and 4 pole applications.

The MCCB OCR facia showing GFT option below. A DIP switch allows the GFT to be switched OFF or ON, while a 'pick up' LED indicates that the 20 % of rated current activation point for GFT has been reached.



#### Neutral Protection (NP)

Neutral protection trips the MCCB after a time delay,  $t_N$ , if the current in the neutral conductor exceeds the nominal current rating,  $I_n$ , of the MCCB. The time delay characteristic is identical to that of the overload time delay characteristic, therefore  $t_N = t_R$ . The load current threshold,  $I_N$ , is 100 % of the nominal current.

For example a S250PE A TemBreak 2 MCCB with a nominal current,  $I_n$ , of 250 A would have neutral protection threshold of  $I_N (1.0) \times I_n (250) = 250 \text{ A}$ .

# TemBreak

## Optional functions

### Option ordering

Optional functions must be specified at the time of order. Options can be selected by identifying the appropriate 'code' from the table below and appending this code after the MCCB type designation. For example, to select a 4 pole, 400 A MCCB, front connect, with a nominal current ( $I_n$ ) of 250 A, featuring a Pre-Trip Alarm (P) option the correct description would be:  
 Cat. No. example: **S400GE3 AP 400 3 Pole**: with the pre-trip alarm option

### Optional Functions

$I_n$	Poles	Code	Ground Fault (GF)	Neutral Protection (NP)	Pre-Trip Alarm (PTA)
<b>250 A</b>	3	<b>AP</b>	—	—	Yes
	4	<b>AP</b>	—	—	Yes
	4	<b>AN</b>	—	Yes	—
	4	<b>APN</b>	—	Yes	Yes
<b>400 A</b>	3	<b>AP</b>	—	—	Yes
	3	<b>AG</b>	Yes	—	—
	3	<b>APG</b>	Yes	—	Yes
	4	<b>AP</b>	—	—	Yes
	4	<b>AN</b>	—	Yes	—
	4	<b>APN</b>	—	Yes	Yes
	4	<b>AGN</b>	Yes	Yes	—
	3	<b>AP</b>	—	—	Yes
<b>630 - 1600 A</b>	3	<b>AG</b>	Yes	—	—
	3	<b>APG</b>	Yes	—	Yes
	4	<b>AP</b>	—	—	Yes
	4	<b>AN</b>	—	Yes	—
	4	<b>APN</b>	—	Yes	Yes
	4	<b>AGN</b>	Yes	Yes	—

## TemBreak

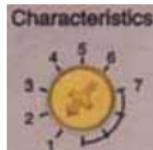
### Example 1: Generator Protection, Curve 1

Compared to a transformer, a generator has a limited short circuit capacity (say 4 times the full load rating). Therefore to avoid possible damage to the generator it is desirable to select a tripping characteristic curve that accommodates a generator's limitations.

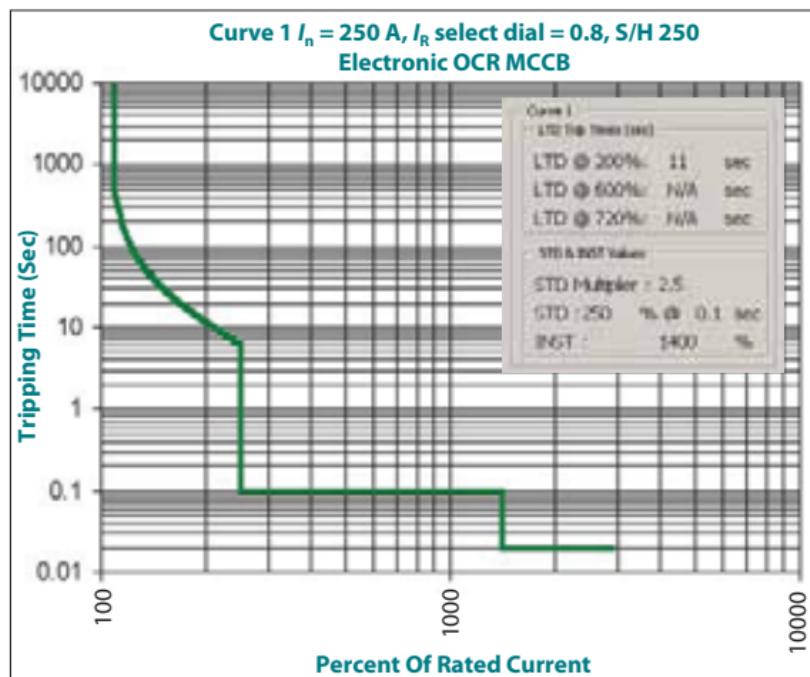
When configured for use in a generator application the characteristic curve features faster tripping times during overload situations and low level short circuit faults.

From the curve below, an S250 TemBreak 2 MCCB with a rated current of  $I_n$  (250 A)  $\times I_R$  (0.8) = 200 A features:

- Approximate trip time of 11 seconds during a 200 % of rated current (400 A) overload
- Approximate trip time of 0.1 seconds during a 250 % of rated current (500 A) low level short circuit
- Instantaneous (no intentional delay) threshold of 1400 % of rated current (2800 A).



**Generator Protection**



**Notes:** The above curves are worked examples for an electronic MCCB with a 250 A rated overcurrent relay (OCR). The same curve and setting data will also apply to TemBreak 2 MCCBs with other ampere ratings.

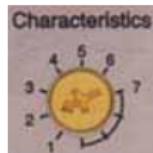
## TemBreak

### Example 2: General Feeder LOW SCP, Curve 2

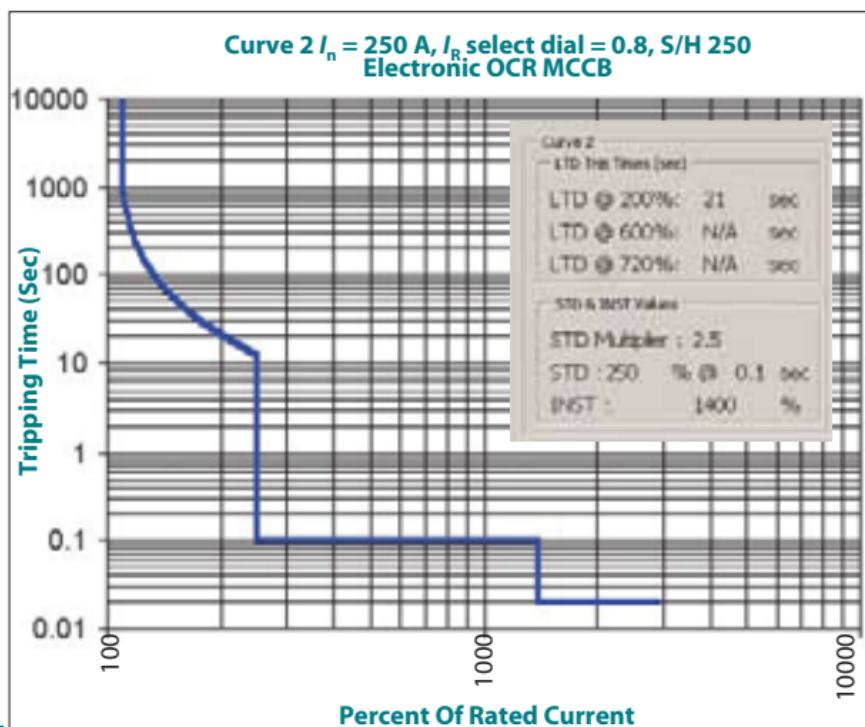
Sharing the same short circuit tripping time characteristics as the generator protection curve, the General Feeder LOW SCP curve 2 has greater tolerance to allow for overloads caused by small inrush currents.

From the curve below, an S250 TemBreak 2 MCCB with a rated current of  $I_N$  (250 A)  $\times I_R$  (0.8) = 200 A features:

- Approximate trip time of 21 seconds during a 200 % of rated current (400 A) overload
- Approximate trip time of 0.1 seconds during a 250 % of rated current (500 A) low level short circuit
- Instantaneous (no intentional delay) threshold of 1400 % of rated current (2800 A).



**General Feeder LOW SCP (SCP = Short circuit protection)**



**Notes:** The above curves are worked examples for an electronic MCCB with a 250 A rated overcurrent relay (OCR). The same curve and setting data will also apply to TemBreak 2 MCCBs with other ampere ratings.

## TemBreak

### Example 3: General Feeder MEDIUM SCP, Curve 3

Featuring a shallower overload time trip curve and higher short circuit current protection characteristics than curve 2, curve 3 allows greater tolerance during overload and short circuit conditions.

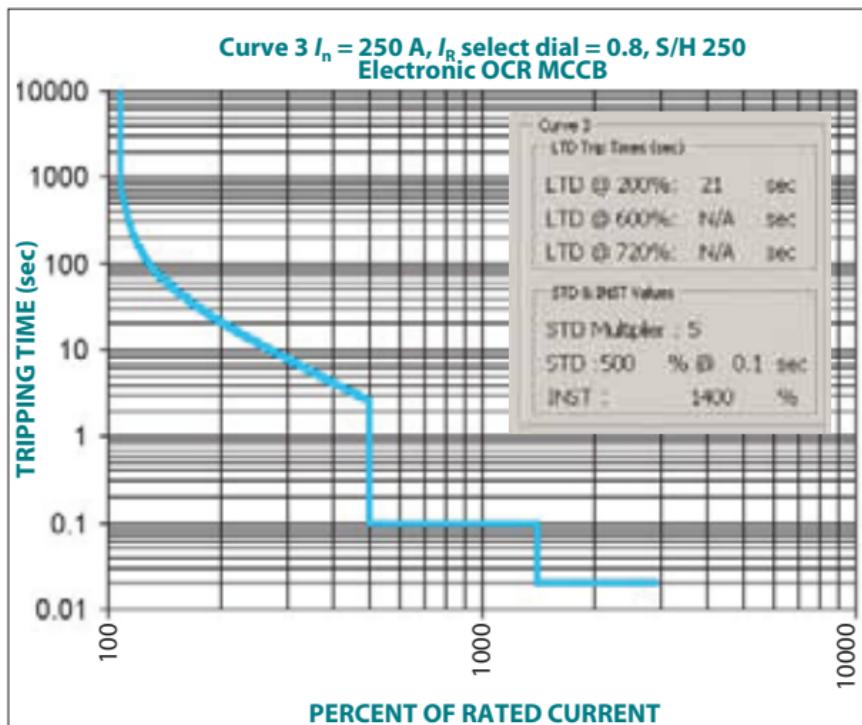
From the curve below, an S250 TemBreak 2 MCCB with a rated current of  $I_n$  (250 A)  $\times I_R$  (0.8) = 200 A features:

- Approximate trip time of 21 seconds during a 200 % of rated current (400 A) overload
- Approximate trip time of 0.1 seconds during a 500 % of rated current (1000 A) low level short circuit
- Instantaneous (no intentional delay) threshold of 1400 % of rated current (2800 A).

#### Characteristics



General Feeder MEDIUM SCP



**Notes:** The above curves are worked examples for an electronic MCCB with a 250 A rated overcurrent relay (OCR). The same curve and setting data will also apply to TemBreak 2 MCCBs with other ampere ratings.

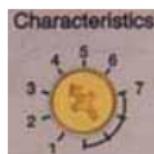
## TemBreak

### Example 4: General Feeder HIGH SCP, Curve 4

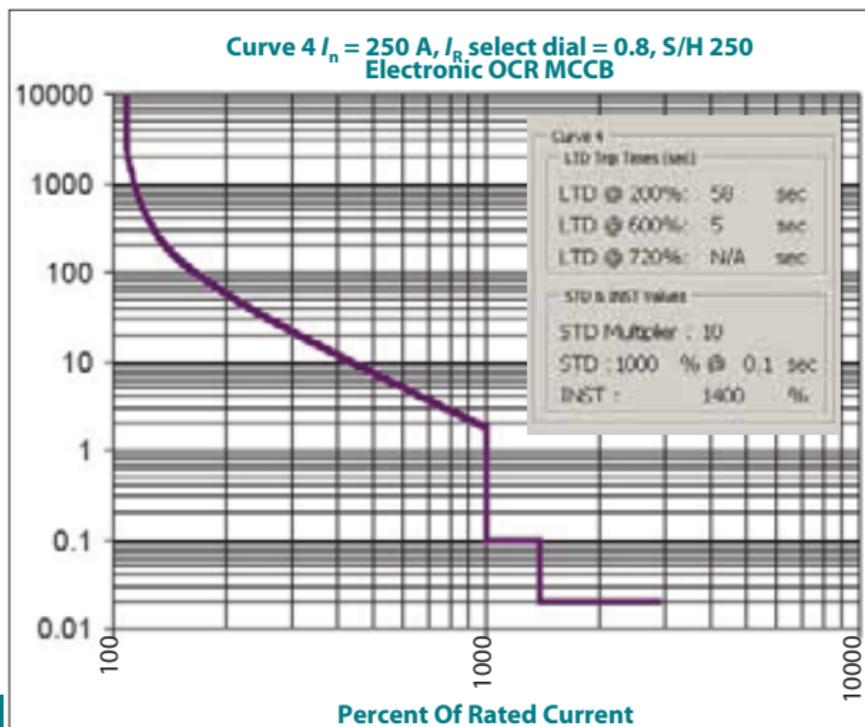
This curve contains a shallower overload time trip curve and a higher short circuit current protection characteristic compared to the previous curve 3.

From the curve below an S250 TemBreak 2 MCCB with a rated current of  $I_n$  (250 A)  $\times I_R$  (0.8) = 200 A features:

- Approximate trip time of 58 seconds during a 200 % of rated current (400 A) overload
- Approximate trip time of 5 seconds during a 600 % of rated current (1200 A) overload
- Approximate trip time of 0.1 seconds during a 1000 % of rated current (2000 A) low level short circuit
- Instantaneous (no intentional delay) threshold of 1400 % of rated current (2800 A).



**General Feeder HIGH SCP**



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**Notes:** The above curves are worked examples for an electronic MCCB with a 250 A rated overcurrent relay (OCR). The same curve and setting data will also apply to TemBreak 2 MCCBs with other ampere ratings.

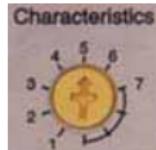
## TemBreak

### Example 5: Motor Protection Class 10, Curve 5

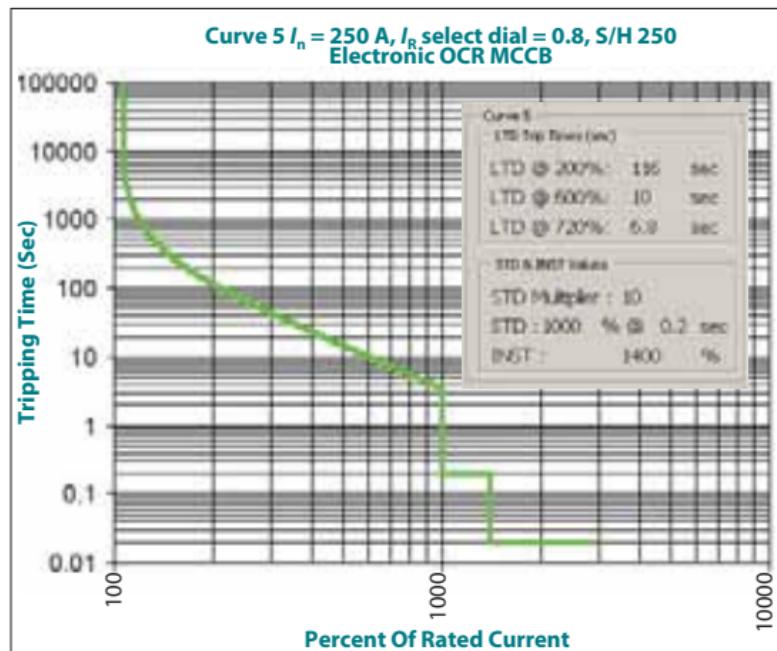
Class 10 protection requires the overload detection element to trip the breaker in 10 seconds or less when a current of 600 % of its rated current is experienced. Class 10 protection is commonly used for general purpose motor applications, hermetic motors and submersible pumps.

From the curve below an S250 TemBreak 2 MCCB with a rated current of  $I_n$  (250 A)  $\times I_R$  (0.8) = 200 A features:

- Approximate trip time of 116 seconds during a 200 % of rated current (400 A) overload
- Approximate trip time of 10 seconds during a 600 % of rated current (1200 A) overload
- Approximate trip time of 6.8 seconds during a 720 % of rated current (1440 A) overload
- Approximate trip time of 0.2 seconds during a 1000 % of rated current (2000 A) low level short circuit
- Instantaneous (no intentional delay) threshold of 1400 % of rated current (2800 A).



**Motor Protection Class 10**



**Notes:** The above curves are worked examples for an electronic MCCB with a 250 A rated overcurrent relay (OCR). The same curve and setting data will also apply to TemBreak 2 MCCBs with other ampere ratings.

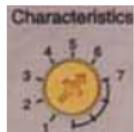
## TemBreak

### Example 6: Motor Protection Class 20, Curve 6

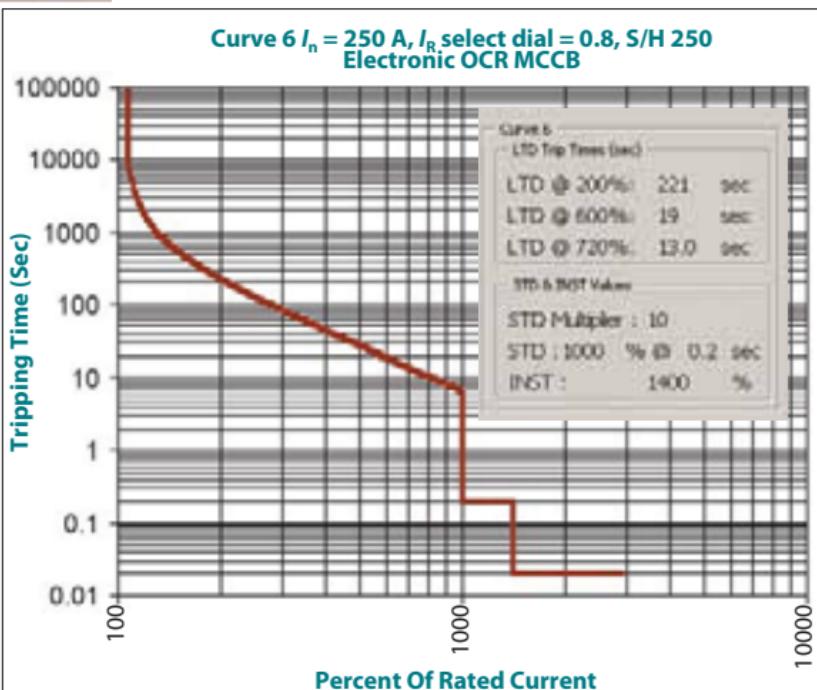
Class 20 protection requires the overload detection element to trip the breaker in 20 seconds or less when a current of 600 % of its rated current is experienced. Class 20 protection is typically reserved for motors with difficult starting conditions.

From the curve below an S250 TemBreak 2 MCCB with a rated current of  $I_n$  (250 A)  $\times I_R$  (0.8) = 200 A features:

- Approximate trip time of 221 seconds during a 200 % of rated current (400 A) overload
- Approximate trip time of 19 seconds during a 600 % of rated current (1200 A) overload
- Approximate trip time of 13 seconds during a 720 % of rated current (1440 A) overload
- Approximate trip time of 0.2 seconds during a 1000 % of rated current (2000 A) low level short circuit
- Instantaneous (no intentional delay) threshold of 1400 % of rated current (2800 A).



**Motor Protection Class 20**



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**Notes:** The above curves are worked examples for an electronic MCCB with a 250 A rated overcurrent relay (OCR). The same curve and setting data will also apply to TemBreak 2 MCCBs with other ampere ratings.

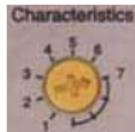
## TemBreak

### Example 7: Motor Protection Class 30, Curve 7

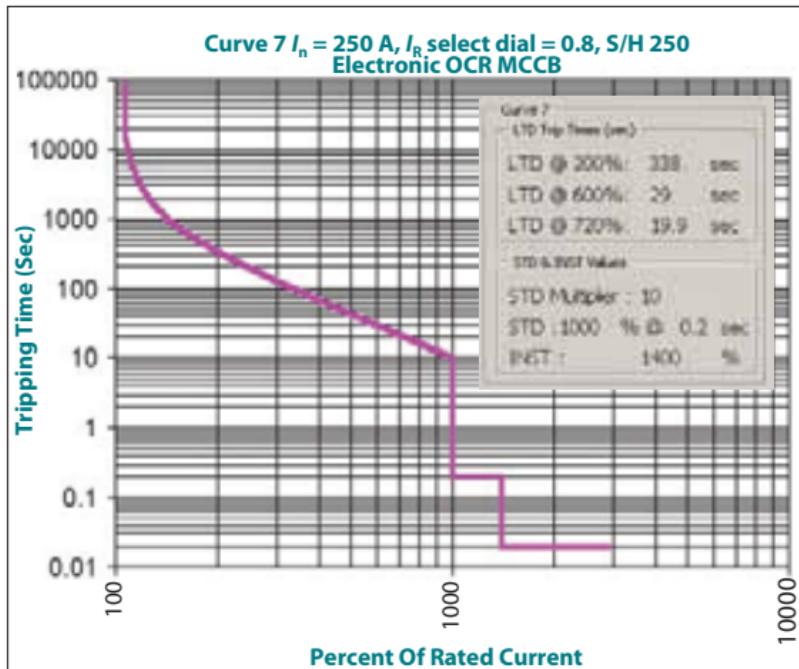
Class 30 protection requires the overload detection element to trip the breaker in 30 seconds or less when a current of 600 % of its rated current is experienced. Class 30 protection is typically reserved for motors with difficult starting conditions that are driving high inertia loads.

From the curve below an S250 TemBreak 2 MCCB with a rated current of  $I_n$  (250 A)  $\times I_R$  (0.8) = 200 A features:

- Approximate trip time of 338 seconds during a 200 % of rated current (400 A) overload
- Approximate trip time of 29 seconds during a 600 % of rated current (1200 A) overload
- Approximate trip time of 19.9 seconds during a 720 % of rated current (1440 A) overload
- Approximate trip time of 0.2 seconds during a 1000 % of rated current (2000 A) low level short circuit
- Instantaneous (no intentional delay) threshold of 1400 % of rated current (2800 A).



**Motor Protection Class 30**

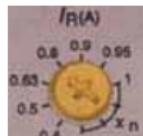


**Notes:** The above curves are worked examples for an electronic MCCB with a 250 A rated overcurrent relay (OCR). The same curve and setting data will also apply to TemBreak 2 MCCBs with other ampere ratings.

## TemBreak

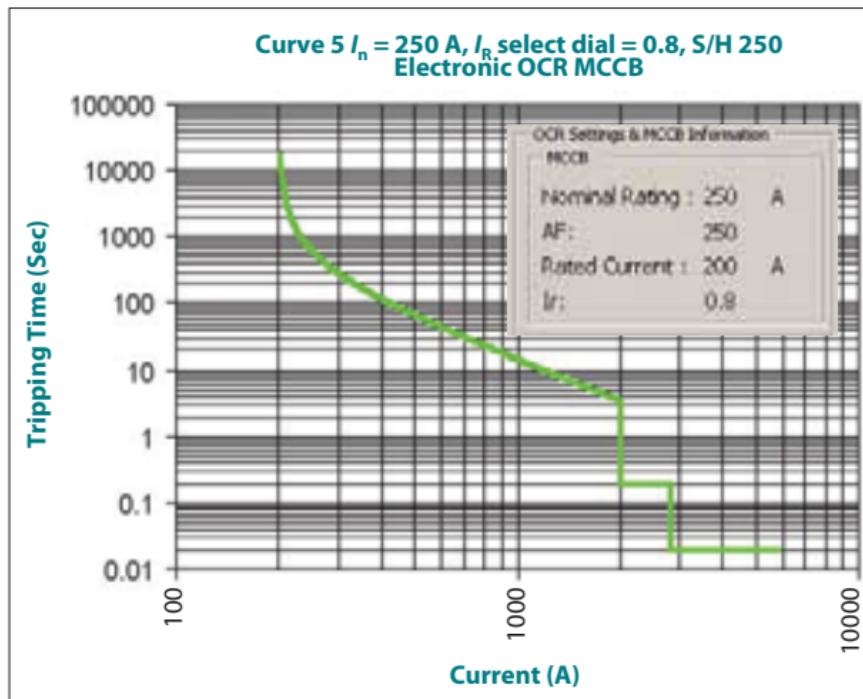
### Example 8: Setting the Rated Current IR (A) Adjustment

The rated current value of the breaker can be adjusted from 40 % to 100 % of its nominal value. In this example an S250 TemBreak 2 MCCB OCR is initially set with a rated current of  $I_n$  (250 A)  $\times I_R$  (0.8) = 200 A.



Rated Current

**Curve 5  $I_n = 250$  A,  $I_R$  select dial = 0.8, S/H 250 Electronic OCR MCCB**



9

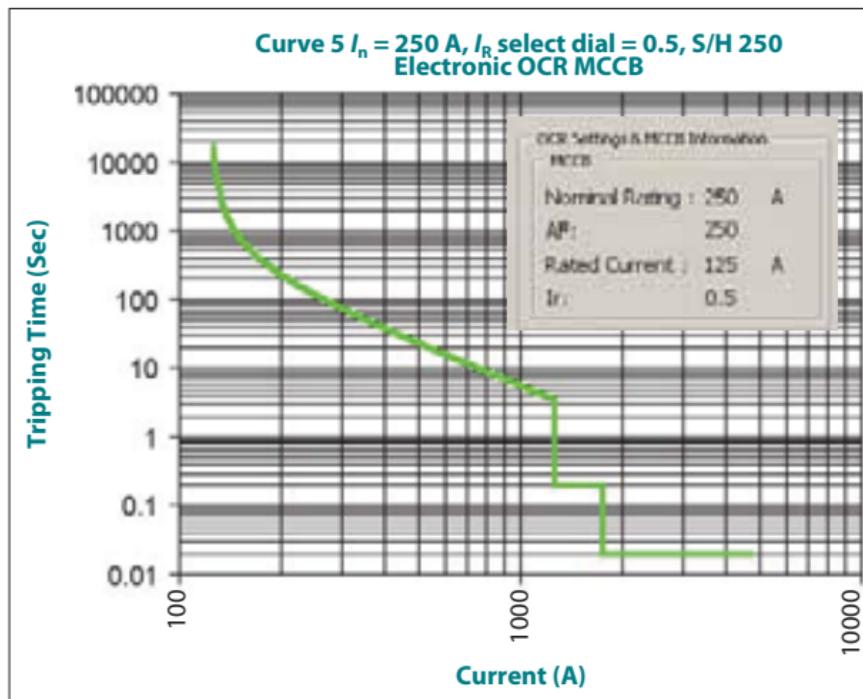
**Notes:** See also example next page.

The above curves are worked examples for an electronic MCCB with a 250 A rated overcurrent relay (OCR). The same curve and setting data will also apply to TemBreak 2 MCCBs with other ampere ratings.

## TemBreak

### Example 9: Setting the Rated Current IR (A) Adjustment

The next example shows the OCR being set at '0.5' of  $I_R$  (A). This has the effect of changing the rated current of the breaker to  $I_n$  (250 A)  $\times I_R$  (0.5) = 125 A. This change can be clearly seen in the curve movement.



**Notes:** The above curves are worked examples for an electronic MCCB with a 250 A rated overcurrent relay (OCR). The same curve and setting data will also apply to TemBreak 2 MCCBs with other ampere ratings.

# INTEGRAL EARTH LEAKAGE MCCBs

The innovative ZS earth leakage MCCB from Terasaki offers machine or personnel protection within a standard 125 A or 250 A MCCB frame size.



PP-TERASAKI-EARTH-LEAKAGE-CPB

## The ZS earth leakage MCCB offers the following features and options:

- Thermal magnetic MCCB
- 125 A or 250 A frame
- 65 kA as standard
- 3 or 4 pole types
- Adjustable thermal-curve dial
- Trip unit ratings: 12 A – 250 A
- 30, 100, 300, 500 mA, 1 A, 3 A settings
- 30 mA setting is non-adjustable, for near instant trip
- 0 sec to 700 ms selectable (100 mA – 3 A)
- Will fit existing XA, XB, XC Chassis
- Complies with AS2081:20
- Yellow TEST button
- Green 'Power ON' LED
- 'No Trip' dial setting
- Remote trip function standard
- Harmonic inhibition standard

**TemBreak**

**TERASAKI**  
Innovators in Protection Technology

REFER TO NHP FOR NEW  
400 A - 800 A ZS SIZES

## Terasaki MCCB Old Vs New cross reference

Amps	kA	TO/TG/TT MCCB	OCR type	Base current adj.	TemBreak Cat.No.	TemBreak Plus Cat.No.	2009/10 Tem-Break 2 & Tem-Break 1 combined range	400 V AC ratings kA
12.5-125	18	<b>TO100BA</b>	Adj. therm. fixed mag.	63-100 %	<b>XS125CJ</b>	-	<b>E125NJ</b>	25
12.5-125	30	<b>TO100BH</b>	Adj. therm. fixed mag.	63-100 %	<b>XS125NJ</b>	-	<b>S125NJ</b>	36
12.5-125	50	<b>TG100B</b>	Adj. therm. fixed mag.	63-100 %	<b>XH125NJ</b> <sup>1)</sup>	-	<b>S125GJ</b>	65
125-225	18	<b>TO225CB</b>	Fixed therm. fixed mag.	Fixed	<b>XE225NS</b>	-	<b>E250NJ</b>	25
100-160 160-250	35	<b>TO225BA</b>	Adj. therm. fixed mag.	63-100 %	<b>XS250NJ</b> <sup>1)</sup>	-	<b>S160NJ</b> <b>S250NJ</b>	36
100-160 160-250	50	<b>TG225B</b>	Adj. therm. fixed mag.	63-100 %	<b>XH250NJ</b> <sup>1)</sup>	-	<b>S160GJ</b> <b>S250GJ</b>	65
160-250 250-400	35	<b>TO400BA</b>	Adj. therm. fixed mag.	63-100 %	<b>XS400CJ</b>	-	<b>S400CJ</b>	36
160-250 250-400	50	<b>TG400B</b>	Adj. therm. adj. mag.	63-100 %	<b>XS400NJ</b> <sup>1)</sup>	-	<b>S400NJ</b>	50
125-250 200-400	50	<b>TTE400</b>	Electronic LSI	50-100 %	<b>XS400NE</b>	<b>XS400SE</b>	<b>S400SE</b>	50
125-250 200-400	65	<b>TTE400</b>	Electronic LSI	50-100 %	<b>XH400NE</b>	<b>XH400SE</b> <sup>1)</sup>	<b>S400GE</b>	70
250-400 400-630	45	<b>TO600BA</b>	Adj. therm. adj. mag.	63-100 %	<b>XS630CJ</b>	-	<b>XS630NJ</b>	50
250-400 400-630	65	<b>TG600B</b>	Adj. therm. adj. mag.	63-100 %	<b>XS630NJ</b> <sup>1)</sup>	-	<b>XS630NJ</b>	50
315-630	50	<b>TTE630</b>	Electronic	50-100 %	<b>XS630NE</b>	<b>XS630SE</b> <sup>1)</sup>	<b>S630CE</b>	50
315-630	65	<b>TTE630</b>	Electronic	50-100 %	<b>XH630NE</b>	<b>XH630SE</b> <sup>1)</sup>	<b>S630GE</b>	70
500-800	65	<b>TO800BA</b>	Adj. therm. adj. mag.	63-100 %	<b>XS800NJ</b> <sup>1)</sup>	-	<b>XS800NJ</b>	50
500-800	85	<b>TG800B</b>	Adj. therm. adj. mag.	63-100 %	<b>XS1250NE</b>	<b>XS1250SE</b> <sup>1)</sup>	<b>XS1250SE</b>	85
400-800	50	<b>TTE800</b>	Electronic	50-100 %	<b>XS800NE</b>	<b>XS800SE</b> <sup>1)</sup>	<b>XS800SE</b>	50
400-800	65	<b>TTE800</b>	Electronic	50-100 %	<b>XH800NE</b>	<b>XH800SE</b> <sup>1)</sup>	<b>XH800SE</b>	65
630-1250	85	<b>TO1000B</b> <b>TO1200B</b>	Electronic	50-100 %	<b>XS1250NE</b>	<b>XS1250SE</b> <sup>1)</sup>	<b>XS1250SE</b>	85
800-1600	100	<b>TO1600B</b>	Electronic	50-100 %	<b>XS1600NE</b>	<b>XS1600SE</b> <sup>1)</sup>	<b>XS1600SE</b>	100
1000-2000	100	<b>TTE2000</b> <b>TO2000</b>	Electronic	50-100 %	<b>XS2000NE</b>	- <sup>1)</sup>	<b>XS2000NE</b>	85
1250-2500	100	<b>TO2500</b>	Electronic	50-100 %	<b>XS2500NE</b>	- <sup>1)</sup>	<b>XS2500NE</b>	85
1600-3200	100	<b>TO3200</b>	Electronic	50-100 %	-	<b>2009</b>	<b>XS3200NE</b>	85
Introduction date:		<b>1982</b>	-	-	<b>1990</b>	<b>2000</b>	<b>2006/07</b>	

**Notes:** <sup>1)</sup> Stocked

## Earth Leakage Relay and Circuit Breaker based RCD device applications

Amongst the users of various earth leakage devices, there is sometimes confusion between the correct application of the more sophisticated adjustable earth leakage relays and circuit breaker RCCB or RCBO devices. It is necessary therefore to define the correct use of earth leakage devices covering the areas of general industrial equipment protection, personnel protection and their use in applications, such as in mining.

### Din-Safe Relays, TZS Relays, and the new RD Series Relay

RD3A relay



TZS relay



#### 1. Equipment Protection

Terasaki Earth Leakage relays are suitable for earth fault protection of equipment and limitation of touch voltages where automatic disconnection of supply is required.

Typically this is achieved by shunt tripping another protective device such as an upstream circuit breaker.

Earth leakage relays are used in particular where ground (earth) fault detection is required

or the Fault Loop Impedance is of such a level that the over-current device (circuit breaker) does not achieve automatic disconnection within the times prescribed in the Wiring Rules.

#### 2. Personnel Protection

Earth leakage relays are NOT suitable for personnel protection against direct contact as specified in the Wiring Rules, e.g. for socket outlets and lighting circuits. For these applications an RCD (10 mA or 30 mA) must comply with the relevant standards (AS 3190, AS/NZS 61008 or AS/NZS 61009) and be approved by the relevant authorities. Terasaki earth leakage relays are not designed to meet the requirements of this approval.

For personnel protection Safe-T and Din-T devices such as the ELR relay, SRCB, SAFETRCB6, DSRCD, DSRCB, DSRCM & DSRCBH are all suitable. These are approved devices and meet the relevant standards.

Circuit breaker based RCD devices



## Earth Leakage Relay and Circuit Breaker based RCD device applications

### 3. Mining Protection

Terasaki Earth Leakage Relays are suitable for mining applications, with the exception of coal and shale mine applications as governed by AS 2081:2011 - Electrical Equipment for coal and shale mines: "Earth Leakage protection for use on earth-fault current limited systems (IT systems)".

This is because Terasaki Earth Leakage Relays are not designed to comply with certain technical requirements of the above mining standard.

Terasaki Earth Leakage Relays that DO comply with AS 2081.3 and the DSRM72 relay.

Circuit breaker based 10 mA and 30 mA RCD devices do not need to comply with AS 2081.3, as this standard accepts devices that meet the personnel protection standards: AS 3190, AS/NZS 61008 or AS/NZS 61009. As such the following Safe-T and Din-T devices are suitable: ELR relay, SRCB, SAFETRCB6, DSRCD, DSRCB, DSRCM & DSRCBH.

ZS earth leakage MCCBs also comply with the standard AS 2081:2011.

## Protection grades against contact and foreign bodies - Ingress Protection (IP)

<b>First Number</b> <b>Protection against solid objects</b>		<b>First Number</b> <b>Protection against solid objects</b>	
<b>IP Tests</b>		<b>IP Tests</b>	
<b>0</b>	No protection.	<b>0</b>	No protection.
<b>1</b>	Protected against solid objects up to 50 mm. (e.g. accidental touch by hands).	<b>1</b>	Protected against vertical falling drops of water.
<b>2</b>	Protected against solid objects up to 12 mm (e.g. fingers).	<b>2</b>	Protected against direct sprays of water up to 15° from the vertical.
<b>3</b>	Protected against solid objects over 2.5 mm (tools + small wires).	<b>3</b>	Protected against spray of water up to 60° from the vertical.
<b>4</b>	Protected against solid objects over 1 mm (tools + small wires).	<b>4</b>	Protected against water sprayed from all directions - limited ingress permissible.
<b>5</b>	Protected against dust - limited ingress permitted (no harmful deposit).	<b>5</b>	Protected against low pressure jets of water from all directions - limited ingress permissible.
<b>6</b>	Totally protected against dust.	<b>6</b>	Protected against strong jets of water e.g. for use on shipdecks - limited ingress permissible.
<b>7</b>		<b>7</b>	Protected against the effects of immersion between 15 cm and 1 m.
<b>8</b>		<b>8</b>	Protected against long periods of immersion under pressure.

A quarterly NHP publication, the NHP technical news features a wide range of application and design criteria for the motor control, power distribution and numerous other product fields. Copies can be issued on request. NHP Technical news ranges from 4 to 8 pages.



### **Issue Technical subject**

1. Contactor control circuits, latches etc.
2. Contactors: Parallel/series connection, non standard frequencies
3. Contactors: Failure to open or close, flashover, coil burnout
4. Soft starters: Motor starting, loads, electronic soft starters
5. MCCB overcurrent relay types and applications
6. Contactors: AC and DC control
7. Fault Levels: At the point of supply and reducing factors – bars, cables etc.
8. IP ratings: Definition and applications
9. AC-1 to AC-23 (AC types only)
10. VSDs: Loads, Dynamic resistor and DC injection braking
11. Thermal and electronic overloads
12. Contactors: Operating curves and contact inspection
13. Slip ring motors, liquid resistance types and applications
14. DC contactor arc design, arcing and connection options
15. Selecting the right kind of motor starter for an application
16. AC, DC lamps, types and applications
17. Surge causes and diverters
18. PLCs: Control, mathematics, inputs and outputs
19. Conventional types and contactors with electronic coils
20. Enclosures and temperature rise
21. Electro-magnetic interference (EMI)
22. The need for safety, sensors, E stops and other devices
23. Torque and motor starters
24. Power Factor: Electricity supply degradation and solutions
25. Safety, RCD operating speed, and applications
26. Terminations: Control circuit Temp. rise, vibration, corrosion, developments
27. Switchboards: Design, venting, earthing, fault containment, control equipment
28. Electrical Equip: Ambient temp, current, voltage, impulse, ins ratings
29. Electro-magnetic compatibility, cabling and EMC sources
30. Current limiting circuit breakers: Electric arcs, applications and device types
31. MCBs, characteristic curves, fault calculation, RCD's
32. Cable ratings, overloads, faults, circuit breakers, AS standards
33. RCDs, how they work, wiring, nuisance tripping, testing.

**Issue Technical subject**

34. Derating: TemPerformance CD, enclosures, heat loss, enclosure design
35. Star-delta starters and wiring, different versions, SC protection
36. CT selection, types and applications
37. Flexible copper busbar - application
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2H4648SAB	5 - 36	NT20138	7.20
2H4650SAC	5 - 36	NT20138	7.20
2H4650SAC	5 - 36	NT20138	7.20
2H4653SAB	5 - 36	NT20138	7.20
2H4653SAB	5 - 36	NT20138	7.20
2H5153SAB	5 - 36	NT20138	7.20
2H5153SAB	5 - 36	NT20138	7.20
2H5153SAB	5 - 36	NT20138	7.20
2H5153SAB	5 - 36	NT20138	7.20
2H5153SAB	5 - 36	NT20138	7.20
2H5153SAB	5 - 36	NT20138	7.20
2H5154SAA	5 - 36	NT20138	7.20
2H5155SAA	5 - 36	NT20138	7.20
2H5161SAB	5 - 36	NT20138	7.20
2H5161SAB	5 - 36	NT20138	7.20
2H5162SAA	5 - 36	NT20138	7.20
2H5331SAA	5 - 36	NT20138	7.20
2H5364SAC	5 - 36	NT20138	7.20
2H5364SAC	5 - 36	NT20138	7.20
2H5365SAB	5 - 36	NT20138	7.20
2H5365SAB	5 - 36	NT20138	7.20
2H6198SAA	5 - 36	NT20138	7.20
I 2H6843CAB	3 - 147	NT20138	105.00
I 2H6844CAB	3 - 147	NT20138	127.00
I 2H6845CAA	3 - 147	NT20138	132.00
I 2H6846CAA	3 - 147	NT20138	167.00
I 2H6847CAA	3 - 147	NT20138	305.00
I 2H6848CAA	3 - 147	NT20138	395.00
2H6871SAA	5 - 36	NT20138	7.20
2H6872SAA	5 - 36	NT20138	7.20
2H6873SAA	5 - 36	NT20138	7.20
I 2H6940CAB	3 - 147	NT20138	220.00
I 2H6940CBA	3 - 147	NT20138	250.00
I 2H6941CAB	3 - 147	NT20138	275.00
I 2H6941CBA	3 - 147	NT20138	305.00
2H6959CAA1	3 - 120	NT20138	37.00
2H6959CAA1	3 - 146	NT20138	37.00
2H6959CBA1	3 - 120	NT20138	37.00
2H6959CBA1	3 - 146	NT20138	37.00
2H6972SAA	5 - 36	NT20138	7.20
2H6973SAA	5 - 36	NT20138	7.20
I 2H7234CAA	3 - 147	NT20138	500.00
I 2H7235CAA	3 - 147	NT20138	640.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

	CAT. NO.	PAGE	P.S.	PRICE \$
<b>3</b>				
	305.00001	2 - 50	NT40143	6.20
	392.00001	2 - 57	NT40143	46.50
	392.00002	2 - 57	NT40143	46.50
	392.35554	2 - 57	NT40143	46.50
	392.35555	2 - 57	NT40143	46.50
<b>7</b>				
	7AB 2D11B	6 - 8	NT20138	245.00
	7KB 3BA	6 - 8	NT20138	60.00
	7MB 3BA1	6 - 8	NT20138	1910.00
	7RC 2LE	6 - 8	NT20138	210.00
	7T1ST	1 - 9	NT10136	13.00
	7T 2M1	6 - 8	NT20138	110.00
	7T2ST	1 - 9	NT10136	15.60
	7UF 2D5B	6 - 8	NT20138	360.00
	7UF 2D6B	6 - 8	NT20138	360.00
	7UF 2D7B	6 - 8	NT20138	360.00
	7UF 2FD1	6 - 8	NT20138	360.00
	7UF 2FD2	6 - 8	NT20138	360.00
	7VF 2M1	6 - 8	NT20138	280.00
	7VF 2M2-B	6 - 8	NT20138	280.00
	7VF 2M6	6 - 8	NT20138	280.00
	7VF 2M7	6 - 8	NT20138	280.00
	7XA 2D31B	6 - 8	NT20138	245.00
	7XA 2D41B	6 - 8	NT20138	245.00
	7YD3	6 - 8	NT20138	55.00
<b>A</b>				
	A1000 0010	7 - 44	NB20067	550.00
	A2000 0010	7 - 44	NB20067	3030.00
	A2000 0020	7 - 44	NB20067	2000.00
	ALR	5 - 28	NT30141	465.00
	ALR	5 - 29	NT30141	465.00
	ANU1AC200	7 - 8	NZ00150	5510.00
	ARACBTRUCK	7 - 8	NZ00150	17610.00
	ARAGR21BMANUAL	7 - 6	NZ00150	10.40
	ARAGR31BMANUAL	7 - 6	NZ00150	10.40
<b>A</b>	ARB2123STD	7 - 4	NT40143	11180.00
<b>A</b>	ARB2163STD	7 - 4	NT40143	11290.00
<b>A</b>	ARB2203STD	7 - 4	NT40143	13380.00
<b>A</b>	ARB3253STD	7 - 4	NT40143	14090.00
<b>A</b>	ARB3323STD	7 - 4	NT40143	15920.00
<b>A</b>	ARB4403STD	7 - 4	NT40143	22650.00
<b>A</b>	ARC2123HHSTD	7 - 5	NT40143	4480.00
<b>A</b>	ARC2123HVSTD	7 - 5	NT40143	4480.00
<b>A</b>	ARC2123VHSTD	7 - 5	NT40143	4480.00
<b>A</b>	ARC2123WSTD	7 - 5	NT40143	4480.00
<b>A</b>	ARC2203HHSTD	7 - 5	NT40143	4950.00
<b>A</b>	ARC2203HVSTD	7 - 5	NT40143	4950.00
<b>A</b>	ARC2203VHSTD	7 - 5	NT40143	4950.00

<b>CAT. NO.</b>	<b>PAGE</b>	<b>P.S.</b>	<b>PRICE \$</b>
<b>A</b> ARC2203VVSTD	7 - 5	NT40143	4950.00
<b>A</b> ARC323HHSTD	7 - 5	NT40143	7470.00
<b>A</b> ARC323HVSTD	7 - 5	NT40143	7470.00
<b>A</b> ARC323VHSTD	7 - 5	NT40143	7470.00
<b>A</b> ARC323VVSTD	7 - 5	NT40143	7470.00
<b>A</b> ARC4403VVSTD	7 - 5	NT40143	11120.00
<b>I A</b> ARCOMMSMOD2ETH	7 - 30	NZ00150	4210.00
<b>I A</b> ARCOMMSMODDEV	7 - 30	NZ00150	4210.00
<b>I A</b> ARCOMMSMODPRO	7 - 30	NZ00150	4210.00
<b>I A</b> ARTEMPOWERRACK	7 - 33	NZ00150	POA
<b>B</b>			
<b>I A</b> BH6S633	5 - 10	NZ00150	13930.00
<b>I A</b> BH6S644	5 - 10	NZ00150	16270.00
<b>I A</b> BH8S833	5 - 10	NZ00150	15760.00
<b>I A</b> BH8S844	5 - 10	NZ00150	17410.00
<b>I A</b> BS12S1033	5 - 10	NZ00150	21580.00
<b>I A</b> BS12S1044	5 - 10	NZ00150	26460.00
<b>I A</b> BS12S1233	5 - 10	NZ00150	23850.00
<b>I A</b> BS12S1244	5 - 10	NZ00150	29440.00
<b>I A</b> BS16S1633	5 - 10	NZ00150	34800.00
<b>I A</b> BS16S1644	5 - 10	NZ00150	43930.00
<b>I A</b> BS20E2033	5 - 10	NZ00150	40870.00
<b>I A</b> BS20E2044	5 - 10	NZ00150	50940.00
<b>I A</b> BS25E2533	5 - 10	NZ00150	43260.00
<b>I A</b> BS25E2544	5 - 10	NZ00150	54130.00
<b>I A</b> BS6N433	5 - 10	NZ00150	12770.00
<b>I A</b> BS6N444	5 - 10	NZ00150	14890.00
<b>I A</b> BS6N633	5 - 10	NZ00150	12770.00
<b>I A</b> BS6N644	5 - 10	NZ00150	14890.00
<b>I A</b> BS6S633	5 - 10	NZ00150	13340.00
<b>A</b> BS8N833	5 - 10	NZ00150	14280.00
<b>I A</b> BS8N844	5 - 10	NZ00150	15220.00
<b>I A</b> BS8S833	5 - 10	NZ00150	15270.00
<b>I A</b> BS8S844	5 - 10	NZ00150	17920.00
<b>A</b> BTSS16GJ16033	5 - 7	NT20138	5900.00
<b>I A</b> BTSS16GJ16034	5 - 8	NT20138	7080.00
<b>I A</b> BTSS16GJ16044	5 - 7	NT20138	7870.00
<b>I A</b> BTSS16GJ16044	5 - 7	NT20138	7870.00
<b>I A</b> BTSS16NJ10033	5 - 7	NT20138	4580.00
<b>A</b> BTSS16NJ16033	5 - 7	NT20138	5110.00
<b>I A</b> BTSS16NJ6333	5 - 7	NT20138	3910.00
<b>I A</b> BTSS1GJ10033	5 - 7	NT20138	5100.00
<b>I A</b> BTSS1GJ10034	5 - 8	NT20138	6230.00
<b>I A</b> BTSS1GJ10044	5 - 7	NT20138	6810.00
<b>I A</b> BTSS1GJ10044	5 - 7	NT20138	6810.00
<b>A</b> BTSS1GJ12533	5 - 7	NT20138	5350.00
<b>I A</b> BTSS1GJ12534	5 - 8	NT20138	6530.00
<b>I A</b> BTSS1GJ12544	5 - 7	NT20138	7140.00
<b>I A</b> BTSS1GJ12544	5 - 7	NT20138	7140.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
I A BTSS1GJ6333	5 - 7	NT20138	4210.00
I A BTSS1GJ6344	5 - 7	NZ00150	5620.00
I A BTSS1GJ6344	5 - 7	NZ00150	5620.00
I A BTSS1NJ10033	5 - 7	NT20138	4620.00
A BTSS1NJ12533	5 - 7	NT20138	4700.00
I A BTSS1NJ6333	5 - 7	NT20138	3230.00
A BTSS2GJ25033	5 - 7	NT20138	6190.00
I A BTSS2GJ25034	5 - 8	NT20138	7350.00
I A BTSS2GJ25043	5 - 8	NT20138	7350.00
I A BTSS2GJ25044	5 - 7	NT20138	8250.00
I A BTSS2GJ25044	5 - 7	NT20138	8250.00
A BTSS2NJ25033	5 - 7	NT20138	5450.00
I A BTSS2PE12533	5 - 7	NT20138	6330.00
A BTSS2PE25033	5 - 7	NT20138	6740.00
I A BTSS2PE25044	5 - 7	NT20138	8980.00
I A BTSS4GE25033	5 - 7	NT20138	11080.00
I A BTSS4GE40033	5 - 7	NT20138	12400.00
I A BTSS4GE40044	5 - 7	NT20138	14840.00
I A BTSS4GJ25033	5 - 7	NT20138	7840.00
I A BTSS4GJ25044	5 - 7	NT20138	10450.00
A BTSS4GJ40033	5 - 7	NT20138	8180.00
I A BTSS4GJ40034	5 - 8	NT20138	9640.00
I A BTSS4GJ40043	5 - 8	NT20138	9640.00
I A BTSS4GJ40044	5 - 7	NT20138	10880.00
I A BTSS4NE25033	5 - 7	NT20138	8750.00
BTSS4NE25044	5 - 7	NT20138	POA
I A BTSS4NE40033	5 - 7	NT20138	9680.00
I A BTSS4NE40044	5 - 7	NT20138	12900.00
I A BTSS4NJ25033	5 - 7	NT20138	7080.00
I A BTSS4NJ25044	5 - 7	NT20138	9420.00
A BTSS4NJ40033	5 - 7	NT20138	7550.00
I A BTSS4NJ40034	5 - 8	NT20138	8970.00
I A BTSS4NJ40044	5 - 7	NT20138	10070.00
A BTSS6CE63033	5 - 7	NT20138	9980.00
I A BTSS6CE63034	5 - 8	NT20138	11750.00
I A BTSS6CE63044	5 - 7	NT20138	13320.00
A BTSS6GE63033	5 - 7	NT20138	12470.00
I A BTSS6GE63044	5 - 7	NT20138	16630.00
<b>C</b>			
CA81210110VAC	1 - 56	NA10007	137.00
CA81210240VAC	1 - 56	NA10007	137.00
CA8121024VAC	1 - 56	NA10007	137.00
CA81210415VAC	1 - 56	NA10007	137.00
CA8510110VAC	1 - 56	NA10007	99.50
CA8510240VAC	1 - 56	NA10007	99.50
CA851024VAC	1 - 56	NA10007	99.50
CA8510415VAC	1 - 56	NA10007	99.50
CA8910110VAC	1 - 56	NA10007	113.00
CA8910240VAC	1 - 56	NA10007	113.00

CAT. NO.	PAGE	P.S.	PRICE \$
CA891024VAC	1 - 56	NA10007	113.00
CA8910415VAC	1 - 56	NA10007	113.00
CA891048VAC	1 - 56	NA10007	113.00
CD212/183U	2 - 65	NT40143	200.00
CD218/183U	2 - 65	NT40143	225.00
CD224/183U	2 - 65	NT40143	265.00
CD230/183U	2 - 65	NT40143	310.00
CD236/183U	2 - 65	NT40143	350.00
CD242/183U	2 - 65	NT40143	380.00
CD248/183U	2 - 65	NT40143	425.00
<b>A</b> CD250CKT2	2 - 31	NT40143	280.00
<b>A</b> CD250CKT2	2 - 51	NT40143	280.00
CD250TOPC	2 - 51	NT40143	0.60
CD250TOPC	2 - 66	NT40143	0.60
CD254/183U	2 - 65	NT40143	475.00
CD260/183U	2 - 65	NT40143	495.00
CD272/183U	2 - 65	NT40143	660.00
CD278/183U	2 - 65	NT40143	780.00
CD284/183U	2 - 65	NT40143	850.00
CD296/183U	2 - 65	NT40143	990.00
<b>I</b> CD312/183U	2 - 66	NT40143	340.00
CD318/183U	2 - 66	NT40143	385.00
CD324/183U	2 - 66	NT40143	440.00
<b>I</b> CD330/183U	2 - 66	NT40143	495.00
CD336/183U	2 - 66	NT40143	530.00
CD342/183U	2 - 66	NT40143	570.00
CD348/183U	2 - 66	NT40143	650.00
<b>I</b> CD354/183U	2 - 66	NT40143	680.00
CD360/183U	2 - 66	NT40143	720.00
CD372/183U	2 - 66	NT40143	850.00
<b>I</b> CD378/183U	2 - 66	NT40143	910.00
CD384/183U	2 - 66	NT40143	1000.00
CD396/183U	2 - 66	NT40143	1130.00
<b>I A</b> CDG 24G2	2 - 24	NT40143	1550.00
<b>I A</b> CDG 24M160G2	2 - 24	NT40143	1750.00
<b>I A</b> CDG 24M160O2	2 - 25	NT40143	1750.00
CDG 24M250G2	2 - 24	NT40143	1910.00
CDG 24M250O2	2 - 25	NT40143	1910.00
<b>I A</b> CDG 24O2	2 - 25	NT40143	1550.00
<b>I A</b> CDG 36G2	2 - 24	NT40143	1750.00
<b>I A</b> CDG 36M160G2	2 - 24	NT40143	1950.00
<b>I A</b> CDG 36M160O2	2 - 25	NT40143	1950.00
<b>I A</b> CDG 36M250G2	2 - 24	NT40143	2110.00
<b>I A</b> CDG 36M250O2	2 - 25	NT40143	2110.00
<b>I A</b> CDG 36O2	2 - 25	NT40143	1750.00
<b>I A</b> CDG 48G2	2 - 24	NT40143	2010.00
<b>I A</b> CDG 48M160G2	2 - 24	NT40143	2150.00
<b>I A</b> CDG 48M160O2	2 - 25	NT40143	2150.00
<b>I A</b> CDG 48M250G2	2 - 24	NT40143	2370.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

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CAT. NO.	PAGE	P.S.	PRICE \$
<b>I A</b> CDG 48M250O2	2 - 25	NT40143	2370.00
<b>I A</b> CDG 48O2	2 - 25	NT40143	2010.00
<b>I A</b> CDG 60G2	2 - 24	NT40143	2320.00
<b>I A</b> CDG 60M160G2	2 - 24	NT40143	2480.00
CDG 60M160O2	2 - 25	NT40143	2480.00
<b>I A</b> CDG 60M250G2	2 - 24	NT40143	2680.00
<b>I A</b> CDG 60M250O2	2 - 25	NT40143	2680.00
<b>I A</b> CDG 60O2	2 - 25	NT40143	2320.00
<b>I A</b> CDG 72G2	2 - 24	NT40143	2550.00
<b>I A</b> CDG 72M250G2	2 - 24	NT40143	2850.00
<b>I A</b> CDG 72M250O2	2 - 25	NT40143	2850.00
<b>I A</b> CDG 72O2	2 - 25	NT40143	2550.00
<b>I A</b> CDG 84G2	2 - 24	NT40143	2990.00
<b>I A</b> CDG 84M250G2	2 - 24	NT40143	3350.00
<b>I A</b> CDG 84M250O2	2 - 25	NT40143	3350.00
<b>I A</b> CDG 84O2	2 - 25	NT40143	2990.00
<b>I A</b> CDG 96G2	2 - 24	NT40143	3400.00
<b>I A</b> CDG 96M250G2	2 - 24	NT40143	3750.00
CDG 96M250O2	2 - 25	NT40143	3750.00
<b>I A</b> CDG 96O2	2 - 25	NT40143	3400.00
CDH312/3027/183U	2 - 66	NT40143	640.00
CDH312/4227/183U	2 - 66	NT40143	770.00
CDH312/6027/183U	2 - 66	NT40143	950.00
CDH36/1227/183U	2 - 66	NT40143	490.00
CDH36/2427/183U	2 - 66	NT40143	550.00
CDH36/3627/183U	2 - 66	NT40143	580.00
<b>I A</b> CDM36M160G	2 - 26	NT40143	3370.00
<b>I A</b> CDM48M160G	2 - 26	NT40143	3530.00
<b>I A</b> CDM60M160G	2 - 26	NT40143	3790.00
<b>I A</b> CDM60M250G	2 - 26	NT40143	3890.00
<b>I A</b> CDM72M250G	2 - 26	NT40143	4100.00
<b>I A</b> CDM84M250G	2 - 26	NT40143	4410.00
<b>I A</b> CDM96M250G	2 - 26	NT40143	4510.00
<b>I A</b> CDMRFDM250AG6	2 - 26	NT40143	2750.00
<b>I A</b> CDMRFG	2 - 26	NT40143	1610.00
<b>I A</b> CDMRFSM250AG6	2 - 26	NT40143	2020.00
<b>A</b> CDT160MS	2 - 51	NT40143	305.00
CDT 18G2	2 - 18	NT40143	1090.00
CDT 18M160G2	2 - 18	NT40143	1340.00
<b>A</b> CDT 18M160O2	2 - 19	NT40143	1340.00
CDT 18M250G2	2 - 18	NT40143	1460.00
CDT 18M250O2	2 - 19	NT40143	1460.00
<b>A</b> CDT 18O2	2 - 19	NT40143	1090.00
CDT 24G2	2 - 18	NT40143	1190.00
CDT 24M160G2	2 - 18	NT40143	1440.00
<b>A</b> CDT 24M160O2	2 - 19	NT40143	1440.00
CDT 24M250G2	2 - 18	NT40143	1570.00
CDT 24M250O2	2 - 19	NT40143	1570.00
<b>A</b> CDT 24MCCB160G2	2 - 22	NT40143	1800.00

CAT. NO.	PAGE	P.S.	PRICE \$
A CDT 24MCCB200G2	2 - 22	NT40143	1950.00
A CDT 24O2	2 - 19	NT40143	1190.00
A CDT250MS	2 - 51	NT40143	435.00
CDT 36G2	2 - 18	NT40143	1300.00
CDT 36M160G2	2 - 18	NT40143	1550.00
A CDT 36M160O2	2 - 19	NT40143	1550.00
A CDT 36M250G2	2 - 18	NT40143	1670.00
A CDT 36M250O2	2 - 19	NT40143	1670.00
A CDT 36O2	2 - 19	NT40143	1300.00
A CDT 42MCCB160G2	2 - 22	NT40143	1990.00
A CDT 42MCCB200G2	2 - 22	NT40143	2150.00
CDT 48G2	2 - 18	NT40143	1460.00
CDT 48M160G2	2 - 18	NT40143	1710.00
A CDT 48M160O2	2 - 19	NT40143	1710.00
A CDT 48M250G2	2 - 18	NT40143	1840.00
A CDT 48M250O2	2 - 19	NT40143	1840.00
A CDT 48O2	2 - 19	NT40143	1460.00
A CDT 60G2	2 - 18	NT40143	1630.00
A CDT 60M160G2	2 - 18	NT40143	1880.00
CDT 60M160O2	2 - 19	NT40143	1880.00
A CDT 60M250G2	2 - 18	NT40143	2000.00
A CDT 60M250O2	2 - 19	NT40143	2000.00
A CDT 60MCCB160G2	2 - 22	NT40143	2200.00
A CDT 60MCCB200G2	2 - 22	NT40143	2350.00
A CDT 60O2	2 - 19	NT40143	1630.00
A CDT 72G2	2 - 18	NT40143	1780.00
A CDT 72M250G2	2 - 18	NT40143	2160.00
A CDT 72M250O2	2 - 19	NT40143	2160.00
A CDT 72O2	2 - 19	NT40143	1780.00
A CDT78MCCB160G2	2 - 22	NT40143	2600.00
A CDT78MCCB200G2	2 - 22	NT40143	2750.00
A CDT 84G2	2 - 18	NT40143	2060.00
A CDT 84M250G2	2 - 18	NT40143	2440.00
A CDT 84M250O2	2 - 19	NT40143	2440.00
A CDT 84O2	2 - 19	NT40143	2060.00
A CDT 96G2	2 - 18	NT40143	2390.00
A CDT 96M250G2	2 - 18	NT40143	2760.00
CDT 96M250O2	2 - 19	NT40143	2760.00
A CDT 96MCCB160G2	2 - 22	NT40143	2990.00
A CDT 96MCCB200G2	2 - 22	NT40143	3150.00
A CDT 96O2	2 - 19	NT40143	2390.00
A CDTE18G2	2 - 20	NT40143	1190.00
A CDTE18M160G2	2 - 20	NT40143	1440.00
A CDTE18M160O2	2 - 21	NT40143	1440.00
A CDTE18M250G2	2 - 20	NT40143	1560.00
A CDTE18M250O2	2 - 21	NT40143	1560.00
A CDTE18O2	2 - 21	NT40143	1190.00
A CDTE36G2	2 - 20	NT40143	1400.00
A CDTE36M160G2	2 - 20	NT40143	1650.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
<b>A</b> CDTE36M160O2	2 - 21	NT40143	1650.00
<b>A</b> CDTE36M250G2	2 - 20	NT40143	1770.00
<b>A</b> CDTE36M250O2	2 - 21	NT40143	1770.00
<b>A</b> CDTE36O2	2 - 21	NT40143	1400.00
<b>A</b> CDTE48G2	2 - 20	NT40143	1660.00
<b>A</b> CDTE48M160G2	2 - 20	NT40143	1910.00
<b>A</b> CDTE48M160O2	2 - 21	NT40143	1910.00
<b>A</b> CDTE48M250G2	2 - 20	NT40143	2040.00
<b>A</b> CDTE48M250O2	2 - 21	NT40143	2040.00
<b>A</b> CDTE48O2	2 - 21	NT40143	1660.00
<b>A</b> CDTE72G2	2 - 20	NT40143	1890.00
<b>A</b> CDTE72M160G2	2 - 20	NT40143	2140.00
<b>A</b> CDTE72M160O2	2 - 21	NT40143	2140.00
<b>A</b> CDTE72M250G2	2 - 20	NT40143	2260.00
<b>A</b> CDTE72M250O2	2 - 21	NT40143	2260.00
<b>A</b> CDTE72O2	2 - 21	NT40143	1890.00
<b>A</b> CDTE96G2	2 - 20	NT40143	2490.00
<b>A</b> CDTE96M160G2	2 - 20	NT40143	2740.00
<b>A</b> CDTE96M160O2	2 - 21	NT40143	2740.00
<b>A</b> CDTE96M250G2	2 - 20	NT40143	2860.00
<b>A</b> CDTE96M250O2	2 - 21	NT40143	2860.00
<b>A</b> CDTE96O2	2 - 21	NT40143	2490.00
CE4DT 14A2	1 - 42	NY80146	560.00
CE4DT 14A6	1 - 42	NY80146	640.00
CEN24	2 - 29	NT40143	88.00
CEN24	2 - 48	NT40143	88.00
CEN36	2 - 29	NT40143	95.00
CEN36	2 - 48	NT40143	95.00
CEN48	2 - 29	NT40143	118.00
CEN48	2 - 48	NT40143	118.00
CEN60	2 - 29	NT40143	144.00
CEN60	2 - 48	NT40143	144.00
CEN72	2 - 29	NT40143	158.00
CEN72	2 - 48	NT40143	158.00
CEN84	2 - 29	NT40143	193.00
CEN84	2 - 48	NT40143	193.00
CEN96	2 - 29	NT40143	215.00
CEN96	2 - 48	NT40143	215.00
CLSBB125033	5 - 34	NT30141	1840.00
<b>I</b> CLSBB125044	5 - 34	NT30141	3150.00
CLSBB63033	5 - 34	NT30141	1200.00
CLSBB63044	5 - 34	NT30141	1690.00
CLTD	5 - 28	NT30141	310.00
CLTD	5 - 29	NT30141	310.00
<b>A</b> CON 24 M160 G	2 - 15	NT40143	1190.00
<b>A</b> CON 24 M160 O	2 - 15	NT40143	1190.00
<b>A</b> CON 24 M250 G	2 - 15	NT40143	1400.00
<b>I A</b> CON 24 M250 O	2 - 15	NT40143	1400.00
<b>A</b> CON 36 M160 G	2 - 15	NT40143	1300.00

CAT. NO.	PAGE	P.S.	PRICE \$
<b>A</b> CON 36 M160 O	2 - 15	NT40143	1300.00
<b>A</b> CON 36 M250 G	2 - 15	NT40143	1500.00
<b>I A</b> CON 36 M250 O	2 - 15	NT40143	1500.00
<b>A</b> CON 48 M160 G	2 - 15	NT40143	1400.00
<b>A</b> CON 48 M160 O	2 - 15	NT40143	1400.00
<b>A</b> CON 48 M250 G	2 - 15	NT40143	1620.00
<b>I A</b> CON 48 M250 O	2 - 15	NT40143	1620.00
<b>A</b> CON 60 M160 G	2 - 15	NT40143	1540.00
<b>A</b> CON 60 M160 O	2 - 15	NT40143	1540.00
<b>A</b> CON 60 M250 G	2 - 15	NT40143	1740.00
<b>I A</b> CON 60 M250 O	2 - 15	NT40143	1740.00
CONF1	2 - 16	NT40143	285.00
CONF2	2 - 16	NT40143	285.00
<b>I</b> CONF3	2 - 16	NT40143	285.00
<b>I</b> CONF4	2 - 16	NT40143	285.00
COTD	5 - 29	NT30141	365.00
<b>A</b> CPACC24G2	2 - 29	NT40143	790.00
CPACC48G2	2 - 29	NT40143	810.00
CPACC72G2	2 - 29	NT40143	880.00
<b>A</b> CPACCS1GE2	2 - 29	NT40143	900.00
<b>A</b> CPACCS2GE2	2 - 29	NT40143	1020.00
<b>A</b> CPACCS3GE2	2 - 29	NT40143	1130.00
<b>A</b> CPACCS4GE2	2 - 29	NT40143	1320.00
<b>A</b> CPACCS5GE2	2 - 29	NT40143	1430.00
<b>A</b> CPACCS6GE2	2 - 29	NT40143	1610.00
<b>A</b> CPACSSHG2	2 - 29	NT40143	870.00
CPACSSHGE2	2 - 29	NT40143	870.00
CPACCSOG2	2 - 29	NT40143	740.00
CPACCSOGE2	2 - 29	NT40143	740.00
CPBFK1	2 - 30	NT40143	300.00
CPBFK2	2 - 30	NT40143	300.00
CPBFK3	2 - 30	NT40143	300.00
CPBFK4	2 - 30	NT40143	300.00
CPBFK5	2 - 30	NT40143	300.00
<b>I</b> CPBFK6	2 - 30	NT40143	300.00
CPBGT1	2 - 29	NT40143	46.50
CPBGT1	2 - 48	NT40143	46.50
CPBGT2	2 - 29	NT40143	67.50
CPBGT2	2 - 48	NT40143	67.50
CPBGT3	2 - 29	NT40143	88.00
CPBGT3	2 - 48	NT40143	88.00
CPBGT4	2 - 29	NT40143	145.00
CPBGT4	2 - 48	NT40143	145.00
CPBGT6	2 - 29	NT40143	230.00
CPBGT6	2 - 48	NT40143	230.00
CPBGTSH	2 - 29	NT40143	114.00
CPBGTSH	2 - 48	NT40143	114.00
CPBMN	2 - 57	NT40143	4.20
CPBS250	2 - 31	NT40143	83.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

	CAT. NO.	PAGE	P.S.	PRICE \$
<b>A</b>	CPD 18G	2 - 34	NT40143	1870.00
	CPD 18G2	2 - 40	NT40143	1870.00
	CPD 18M160G	2 - 34	NT40143	2120.00
	CPD 18M160G2	2 - 40	NT40143	2120.00
	CPD 18M1600	2 - 35	NT40143	2120.00
	CPD 18M16002	2 - 41	NT40143	2120.00
	CPD 18M160SS	2 - 36	NT40143	7160.00
	CPD 18M160SS2	2 - 42	NT40143	7160.00
	CPD 18M250G	2 - 34	NT40143	2240.00
	CPD 18M250G2	2 - 40	NT40143	2240.00
	CPD 18M2500	2 - 35	NT40143	2240.00
	CPD 18M25002	2 - 41	NT40143	2240.00
	CPD 18M250SS	2 - 36	NT40143	7310.00
	CPD 18M250SS2	2 - 42	NT40143	7310.00
<b>A</b>	CPD 18O	2 - 35	NT40143	1870.00
	CPD 18O2	2 - 41	NT40143	1870.00
<b>A</b>	CPD 18SS	2 - 36	NT40143	6850.00
	CPD 18SS2	2 - 42	NT40143	6850.00
<b>A</b>	CPD 24G	2 - 34	NT40143	1970.00
	CPD 24G2	2 - 40	NT40143	1970.00
<b>A</b>	CPD 24M160G	2 - 34	NT40143	2220.00
	CPD 24M160G2	2 - 40	NT40143	2220.00
	CPD 24M1600	2 - 35	NT40143	2220.00
	CPD 24M16002	2 - 41	NT40143	2220.00
	CPD 24M160SS	2 - 36	NT40143	7240.00
	CPD 24M160SS2	2 - 42	NT40143	7240.00
	CPD 24M250G	2 - 34	NT40143	2340.00
	CPD 24M250G2	2 - 40	NT40143	2340.00
	CPD 24M2500	2 - 35	NT40143	2340.00
	CPD 24M25002	2 - 41	NT40143	2340.00
	CPD 24M250SS	2 - 36	NT40143	7420.00
	CPD 24M250SS2	2 - 42	NT40143	7420.00
<b>A</b>	CPD 24O	2 - 35	NT40143	1970.00
	CPD 24O2	2 - 41	NT40143	1970.00
<b>A</b>	CPD 24SS	2 - 36	NT40143	6950.00
	CPD 24SS2	2 - 42	NT40143	6950.00
<b>A</b>	CPD 36G	2 - 34	NT40143	2180.00
	CPD 36G2	2 - 40	NT40143	2180.00
	CPD 36M160G	2 - 34	NT40143	2430.00
	CPD 36M160G2	2 - 40	NT40143	2430.00
	CPD 36M1600	2 - 35	NT40143	2430.00
	CPD 36M16002	2 - 41	NT40143	2430.00
	CPD 36M160SS	2 - 36	NT40143	8140.00
	CPD 36M160SS2	2 - 42	NT40143	8140.00
	CPD 36M250G	2 - 34	NT40143	2550.00
	CPD 36M250G2	2 - 40	NT40143	2550.00
	CPD 36M2500	2 - 35	NT40143	2550.00
	CPD 36M25002	2 - 41	NT40143	2550.00
	CPD 36M250SS	2 - 36	NT40143	8290.00

	<b>CAT. NO.</b>	<b>PAGE</b>	<b>P.S.</b>	<b>PRICE \$</b>
	CPD 36M250SS2	2 - 42	NT40143	8290.00
<b>A</b>	CPD 36O	2 - 35	NT40143	2180.00
	CPD 36O2	2 - 41	NT40143	2180.00
<b>A</b>	CPD 36SS	2 - 36	NT40143	7890.00
	CPD 36SS2	2 - 42	NT40143	7890.00
<b>A</b>	CPD 48G	2 - 34	NT40143	2310.00
	CPD 48G2	2 - 40	NT40143	2310.00
	CPD 48M160G	2 - 34	NT40143	2560.00
	CPD 48M160G2	2 - 40	NT40143	2560.00
	CPD 48M160O	2 - 35	NT40143	2560.00
	CPD 48M160O2	2 - 41	NT40143	2560.00
	CPD 48M160SS	2 - 36	NT40143	8290.00
	CPD 48M160SS2	2 - 42	NT40143	8290.00
<b>A</b>	CPD 48M250G	2 - 34	NT40143	2690.00
	CPD 48M250G2	2 - 40	NT40143	2690.00
	CPD 48M250O	2 - 35	NT40143	2690.00
	CPD 48M250O2	2 - 41	NT40143	2690.00
	CPD 48M250SS	2 - 36	NT40143	8460.00
	CPD 48M250SS2	2 - 42	NT40143	8460.00
<b>A</b>	CPD 48M300G	2 - 39	NT40143	3300.00
<b>A</b>	CPD 48M400G	2 - 39	NT40143	3300.00
<b>A</b>	CPD 48MCCB300G	2 - 39	NT40143	3800.00
<b>A</b>	CPD 48O	2 - 35	NT40143	2310.00
	CPD 48O2	2 - 41	NT40143	2310.00
<b>A</b>	CPD 48SS	2 - 36	NT40143	7980.00
	CPD 48SS2	2 - 42	NT40143	7980.00
<b>A</b>	CPD 60G	2 - 34	NT40143	2540.00
	CPD 60G2	2 - 40	NT40143	2540.00
	CPD 60M160G	2 - 34	NT40143	2790.00
	CPD 60M160G2	2 - 40	NT40143	2790.00
	CPD 60M160O	2 - 35	NT40143	2790.00
	CPD 60M160O2	2 - 41	NT40143	2790.00
<b>I A</b>	CPD 60M160SS	2 - 36	NT40143	9330.00
	CPD 60M160SS2	2 - 42	NT40143	9330.00
	CPD 60M250G	2 - 34	NT40143	2920.00
	CPD 60M250G2	2 - 40	NT40143	2920.00
	CPD 60M250O	2 - 35	NT40143	2920.00
	CPD 60M250O2	2 - 41	NT40143	2920.00
<b>I A</b>	CPD 60M250SS	2 - 36	NT40143	9490.00
	CPD 60M250SS2	2 - 42	NT40143	9490.00
<b>A</b>	CPD 60M300G	2 - 39	NT40143	3600.00
<b>A</b>	CPD 60M400G	2 - 39	NT40143	3600.00
<b>A</b>	CPD 60MCCB300G	2 - 39	NT40143	4100.00
<b>A</b>	CPD 60O	2 - 35	NT40143	2540.00
	CPD 60O2	2 - 41	NT40143	2540.00
<b>I A</b>	CPD 60SS	2 - 36	NT40143	9050.00
	CPD 60SS2	2 - 42	NT40143	9050.00
<b>A</b>	CPD 72G	2 - 34	NT40143	3100.00
	CPD 72G2	2 - 40	NT40143	3100.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

	CAT. NO.	PAGE	P.S.	PRICE \$
	CPD 72M250G	2 - 34	NT40143	3480.00
	CPD 72M250G2	2 - 40	NT40143	3480.00
	CPD 72M250O	2 - 35	NT40143	3480.00
	CPD 72M250O2	2 - 41	NT40143	3480.00
<b>I A</b>	CPD 72M250SS	2 - 36	NT40143	10480.00
	CPD 72M250SS2	2 - 42	NT40143	10480.00
<b>A</b>	CPD 72M300G	2 - 39	NT40143	4200.00
<b>A</b>	CPD 72M400G	2 - 39	NT40143	4200.00
<b>A</b>	CPD 72MCCB300G	2 - 39	NT40143	4700.00
<b>A</b>	CPD 72O	2 - 35	NT40143	3100.00
	CPD 72O2	2 - 41	NT40143	3100.00
<b>I A</b>	CPD 72SS	2 - 36	NT40143	10150.00
	CPD 72SS2	2 - 42	NT40143	10150.00
<b>A</b>	CPD 84G	2 - 34	NT40143	3620.00
	CPD 84G2	2 - 40	NT40143	3620.00
	CPD 84M250G	2 - 34	NT40143	3990.00
	CPD 84M250G2	2 - 40	NT40143	3990.00
	CPD 84M250O	2 - 35	NT40143	3990.00
	CPD 84M250O2	2 - 41	NT40143	3990.00
<b>I A</b>	CPD 84M250SS	2 - 36	NT40143	10690.00
	CPD 84M250SS2	2 - 42	NT40143	10690.00
<b>A</b>	CPD 84M300G	2 - 39	NT40143	4700.00
<b>A</b>	CPD 84M400G	2 - 39	NT40143	4700.00
<b>A</b>	CPD 84MCCB300G	2 - 39	NT40143	5200.00
<b>A</b>	CPD 84O	2 - 35	NT40143	3620.00
	CPD 84O2	2 - 41	NT40143	3620.00
<b>I A</b>	CPD 84SS	2 - 36	NT40143	10320.00
	CPD 84SS2	2 - 42	NT40143	10320.00
<b>A</b>	CPD 96G	2 - 34	NT40143	4250.00
	CPD 96G2	2 - 40	NT40143	4250.00
	CPD 96M250G	2 - 34	NT40143	4630.00
	CPD 96M250G2	2 - 40	NT40143	4630.00
	CPD 96M250O	2 - 35	NT40143	4630.00
	CPD 96M250O2	2 - 41	NT40143	4630.00
<b>I A</b>	CPD 96M250SS	2 - 36	NT40143	11400.00
	CPD 96M250SS2	2 - 42	NT40143	11400.00
<b>A</b>	CPD 96M300G	2 - 39	NT40143	5300.00
<b>A</b>	CPD 96M400G	2 - 39	NT40143	5300.00
<b>A</b>	CPD 96MCCB300G	2 - 39	NT40143	5800.00
<b>A</b>	CPD 96O	2 - 35	NT40143	4250.00
	CPD 96O2	2 - 41	NT40143	4250.00
<b>I A</b>	CPD 96SS	2 - 36	NT40143	11100.00
	CPD 96SS2	2 - 42	NT40143	11100.00
	CPDHANDLE92268	2 - 16	NT40143	36.50
	CPDHANDLE92268	2 - 30	NT40143	36.50
	CPDHANDLECL001	2 - 16	NT40143	36.50
	CPDHANDLECL001	2 - 30	NT40143	36.50
	CPDHANDLEELOCK	2 - 16	NT40143	290.00
	CPDHANDLEELOCK	2 - 30	NT40143	290.00

CAT. NO.	PAGE	P.S.	PRICE \$
I CPDHANDLENOLOCK	2 - 16	NT40143	36.50
I CPDHANDLENOLOCK	2 - 30	NT40143	36.50
I CPDHANDLEPADLCK	2 - 16	NT40143	78.00
I CPDHANDLEPADLCK	2 - 30	NT40143	78.00
CPDRUBBER	2 - 30	NT40143	197.00
CPECS	2 - 30	NT40143	104.00
A CPELK1	2 - 16	NT40143	430.00
A CPELK1	2 - 30	NT40143	430.00
A CPELK1	2 - 50	NT40143	430.00
A CPELK1W	2 - 16	NT40143	445.00
A CPELK1W	2 - 30	NT40143	445.00
A CPELK1W	2 - 50	NT40143	445.00
A CPELK2	2 - 16	NT40143	495.00
A CPELK2	2 - 30	NT40143	495.00
A CPELK2	2 - 50	NT40143	495.00
CPEN18	2 - 56	NT40143	88.00
CPEN18EVE	2 - 57	NT40143	98.50
CPEN18ODD	2 - 57	NT40143	98.50
CPEN24	2 - 56	NT40143	101.00
CPEN24EVE	2 - 57	NT40143	111.00
CPEN24ODD	2 - 57	NT40143	111.00
CPEN30EVE	2 - 57	NT40143	130.00
CPEN30ODD	2 - 57	NT40143	130.00
CPEN36	2 - 56	NT40143	130.00
CPEN36EVE	2 - 57	NT40143	140.00
CPEN36ODD	2 - 57	NT40143	140.00
CPEN48	2 - 56	NT40143	140.00
CPEN48EVE	2 - 57	NT40143	150.00
CPEN48ODD	2 - 57	NT40143	150.00
CPEN60	2 - 56	NT40143	171.00
CPEN72	2 - 56	NT40143	192.00
CPEN84	2 - 56	NT40143	225.00
CPEN96	2 - 56	NT40143	265.00
CPEN9EVE	2 - 57	NT40143	78.00
CPEN9ODD	2 - 57	NT40143	78.00
A CPESC	2 - 30	NT40143	50.00
CPEXTLK1	2 - 31	NT40143	395.00
CPEXTLK2	2 - 31	NT40143	710.00
CPEXTLKC	2 - 31	NT40143	300.00
I A CPG 24G	2 - 37	NT40143	2300.00
A CPG 24G2	2 - 43	NT40143	2300.00
I A CPG 24M160G	2 - 37	NT40143	2550.00
A CPG 24M160G2	2 - 43	NT40143	2550.00
CPG 24M1600	2 - 38	NT40143	2550.00
A CPG 24M160O2	2 - 44	NT40143	2550.00
CPG 24M250G	2 - 37	NT40143	2650.00
A CPG 24M250G2	2 - 43	NT40143	2650.00
CPG 24M250O	2 - 38	NT40143	2650.00
A CPG 24M250O2	2 - 44	NT40143	2650.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

	CAT. NO.	PAGE	P.S.	PRICE \$
<b>I</b>	<b>A</b> CPG 240	2 - 38	NT40143	2300.00
	<b>A</b> CPG 2402	2 - 44	NT40143	2300.00
<b>I</b>	<b>A</b> CPG 36G	2 - 37	NT40143	2600.00
	<b>A</b> CPG 36G2	2 - 43	NT40143	2600.00
	CPG 36M160G	2 - 37	NT40143	2850.00
	<b>A</b> CPG 36M160G2	2 - 43	NT40143	2850.00
	CPG 36M160O	2 - 38	NT40143	2850.00
	<b>A</b> CPG 36M160O2	2 - 44	NT40143	2850.00
	CPG 36M250G	2 - 37	NT40143	2950.00
	<b>A</b> CPG 36M250G2	2 - 43	NT40143	2950.00
	CPG 36M250O	2 - 38	NT40143	2950.00
	<b>A</b> CPG 36M250O2	2 - 44	NT40143	2950.00
<b>I</b>	<b>A</b> CPG 36O	2 - 38	NT40143	2600.00
	<b>A</b> CPG 36O2	2 - 44	NT40143	2600.00
<b>I</b>	<b>A</b> CPG 48G	2 - 37	NT40143	2850.00
	<b>A</b> CPG 48G2	2 - 43	NT40143	2850.00
	CPG 48M160G	2 - 37	NT40143	3050.00
	<b>A</b> CPG 48M160G2	2 - 43	NT40143	3050.00
	CPG 48M160O	2 - 38	NT40143	3050.00
	<b>A</b> CPG 48M160O2	2 - 44	NT40143	3050.00
<b>I</b>	<b>A</b> CPG 48M250G	2 - 37	NT40143	3200.00
	<b>A</b> CPG 48M250G2	2 - 43	NT40143	3200.00
	CPG 48M250O	2 - 38	NT40143	3200.00
	<b>A</b> CPG 48M250O2	2 - 44	NT40143	3200.00
<b>I</b>	<b>A</b> CPG 48O	2 - 38	NT40143	2850.00
	<b>A</b> CPG 48O2	2 - 44	NT40143	2850.00
<b>I</b>	<b>A</b> CPG 60G	2 - 37	NT40143	3200.00
	<b>A</b> CPG 60G2	2 - 43	NT40143	3200.00
	CPG 60M160G	2 - 37	NT40143	3450.00
	<b>A</b> CPG 60M160G2	2 - 43	NT40143	3450.00
	CPG 60M160O	2 - 38	NT40143	3450.00
	<b>A</b> CPG 60M160O2	2 - 44	NT40143	3450.00
	CPG 60M250G	2 - 37	NT40143	3550.00
	<b>A</b> CPG 60M250G2	2 - 43	NT40143	3550.00
	CPG 60M250O	2 - 38	NT40143	3550.00
	<b>A</b> CPG 60M250O2	2 - 44	NT40143	3550.00
<b>I</b>	<b>A</b> CPG 60O	2 - 38	NT40143	3200.00
	<b>A</b> CPG 60O2	2 - 44	NT40143	3200.00
<b>I</b>	<b>A</b> CPG 72G	2 - 37	NT40143	3850.00
	<b>A</b> CPG 72G2	2 - 43	NT40143	3850.00
	CPG 72M250G	2 - 37	NT40143	4200.00
	<b>A</b> CPG 72M250G2	2 - 43	NT40143	4200.00
	CPG 72M250O	2 - 38	NT40143	4200.00
	<b>A</b> CPG 72M250O2	2 - 44	NT40143	4200.00
<b>I</b>	<b>A</b> CPG 72O	2 - 38	NT40143	3850.00
	<b>A</b> CPG 72O2	2 - 44	NT40143	3850.00
<b>I</b>	<b>A</b> CPG 84G	2 - 37	NT40143	4550.00
	<b>A</b> CPG 84G2	2 - 43	NT40143	4550.00
	CPG 84M250G	2 - 37	NT40143	4900.00

CAT. NO.	PAGE	P.S.	PRICE \$
A CPG 84M250G2	2 - 43	NT40143	4900.00
CPG 84M250O	2 - 38	NT40143	4900.00
A CPG 84M250O2	2 - 44	NT40143	4900.00
I A CPG 84O	2 - 38	NT40143	4550.00
A CPG 84O2	2 - 44	NT40143	4550.00
I A CPG 96G	2 - 37	NT40143	5250.00
A CPG 96G2	2 - 43	NT40143	5250.00
CPG 96M250G	2 - 37	NT40143	5600.00
A CPG 96M250G2	2 - 43	NT40143	5600.00
CPG 96M250O	2 - 38	NT40143	5600.00
A CPG 96M250O2	2 - 44	NT40143	5600.00
I A CPG 96O	2 - 38	NT40143	5250.00
A CPG 96O2	2 - 44	NT40143	5250.00
CPGP A	2 - 30	NT40143	67.50
CPGPB	2 - 30	NT40143	220.00
CPGPS	2 - 30	NT40143	54.00
CPPIP52G	2 - 30	NT40143	210.00
A CPPACC24G	2 - 48	NT40143	1030.00
CPPACC24G2	2 - 49	NT40143	1030.00
CPPACC48G	2 - 48	NT40143	1060.00
CPPACC48G2	2 - 49	NT40143	1060.00
A CPPACCG	2 - 48	NT40143	950.00
CPPACCG2	2 - 49	NT40143	1020.00
CPPACC GE	2 - 48	NT40143	1020.00
CPPACC GE2	2 - 49	NT40143	1020.00
A CPPACCS1GE	2 - 48	NT40143	1250.00
CPPACCS1GE2	2 - 49	NT40143	1250.00
A CPPACCS2GE	2 - 48	NT40143	1450.00
CPPACCS2GE2	2 - 49	NT40143	1450.00
A CPPACCS3GE	2 - 48	NT40143	1660.00
CPPACCS3GE2	2 - 49	NT40143	1660.00
A CPPACCS4GE	2 - 48	NT40143	1970.00
CPPACCS4GE2	2 - 49	NT40143	1970.00
A CPPACCS5GE	2 - 48	NT40143	2280.00
CPPACCS5GE2	2 - 49	NT40143	2280.00
A CPPACCS6GE	2 - 48	NT40143	2590.00
CPPACCS6GE2	2 - 49	NT40143	2590.00
A CPPACCS7GE	2 - 48	NT40143	2910.00
CPPACCS7GE2	2 - 49	NT40143	2910.00
CPPBNC400GT	2 - 61	NT40143	41.50
CPPBS250	2 - 51	NT40143	83.00
CPPD92268	2 - 51	NT40143	78.00
CPPDCL001	2 - 51	NT40143	67.50
CPPES100DTL	1 - 47	NT40143	210.00
CPPES200DTL	1 - 47	NT40143	250.00
CPPES300DTL	1 - 47	NT40143	290.00
CPPES400DTL	1 - 47	NT40143	330.00
CPPES500DTL	1 - 47	NT40143	375.00
I CPPFK1	2 - 50	NT40143	300.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
CPPFK2	2 - 50	NT40143	300.00
CPPFK3	2 - 50	NT40143	300.00
CPPFK4	2 - 50	NT40143	300.00
<b>I</b> CPPFK5	2 - 50	NT40143	300.00
CPPFK6	2 - 50	NT40143	300.00
CPPFK7	2 - 50	NT40143	300.00
<b>I</b> CPPFKH	2 - 50	NT40143	300.00
CPPGPA	2 - 50	NT40143	67.50
CPPGPA6	2 - 50	NT40143	72.50
CPPGPB	2 - 50	NT40143	200.00
CPPGPB5	2 - 50	NT40143	375.00
CPPLINTH	2 - 30	NT40143	365.00
CPPLINTHD	2 - 50	NT40143	930.00
<b>I</b> CPPLINTHDSS	2 - 50	NT40143	2650.00
CPPLINTHS	2 - 50	NT40143	360.00
CPPLINTHSS	2 - 50	NT40143	1220.00
CPPWDNSW	2 - 51	NT40143	295.00
CPPWB	2 - 50	NT40143	325.00
CPPWBMS	2 - 50	NT40143	290.00
CPPWC	2 - 50	NT40143	255.00
CPPWC	2 - 50	NT40143	415.00
<b>I</b> CPPWCDS	2 - 50	NT40143	2390.00
CPPWCSS	2 - 50	NT40143	650.00
CPPWIL1	2 - 50	NT40143	150.00
CPPWIL2	2 - 50	NT40143	150.00
CPPWIL3	2 - 50	NT40143	150.00
CPPWIL4	2 - 50	NT40143	150.00
CPPWIL5	2 - 50	NT40143	150.00
CPPWIL6	2 - 50	NT40143	150.00
CPPWIL7	2 - 50	NT40143	150.00
CPPWILH	2 - 50	NT40143	150.00
<b>A</b> CPS 24G	2 - 45	NT40143	2060.00
CPS 24M160G	2 - 45	NT40143	2310.00
CPS 24M160O	2 - 46	NT40143	2310.00
CPS 24M250G	2 - 45	NT40143	2440.00
CPS 24M250O	2 - 46	NT40143	2440.00
<b>A</b> CPS 24O	2 - 46	NT40143	2060.00
<b>A</b> CPS 36G	2 - 45	NT40143	2260.00
CPS 36M160G	2 - 45	NT40143	2510.00
CPS 36M160O	2 - 46	NT40143	2510.00
CPS 36M250G	2 - 45	NT40143	2640.00
CPS 36M250O	2 - 46	NT40143	2640.00
<b>A</b> CPS 36O	2 - 46	NT40143	2260.00
<b>A</b> CPS 48G	2 - 45	NT40143	2410.00
CPS 48M160G	2 - 45	NT40143	2660.00
CPS 48M160O	2 - 46	NT40143	2660.00
CPS 48M250G	2 - 45	NT40143	2780.00
CPS 48M250O	2 - 46	NT40143	2780.00
<b>A</b> CPS 48O	2 - 46	NT40143	2410.00

CAT. NO.	PAGE	P.S.	PRICE \$
A CPS 60G	2 - 45	NT40143	2580.00
CPS 60M160G	2 - 45	NT40143	2830.00
CPS 60M160O	2 - 46	NT40143	2830.00
CPS 60M250G	2 - 45	NT40143	2960.00
CPS 60M250O	2 - 46	NT40143	2960.00
A CPS 60O	2 - 46	NT40143	2580.00
A CPS 72G	2 - 45	NT40143	3220.00
CPS 72M250G	2 - 45	NT40143	3590.00
CPS 72M250O	2 - 46	NT40143	3590.00
A CPS 72O	2 - 46	NT40143	3220.00
A CPS 84G	2 - 45	NT40143	3720.00
CPS 84M250G	2 - 45	NT40143	4100.00
A CPS 96G	2 - 45	NT40143	4360.00
CPS 96M250G	2 - 45	NT40143	4730.00
CPS 96M250O	2 - 46	NT40143	4730.00
A CPS 96O	2 - 46	NT40143	4360.00
CPSCHEDULECARD	2 - 57	NT40143	3.00
CPSCHEDULEHOLD	2 - 57	NT40143	13.00
CPTPSC1-100N	1 - 57	NE90129	530.00
CPTPSC1-12/230IR	1 - 57	NE90129	265.00
CPTPSC12-230MOD	1 - 57	NE90129	280.00
CPTPSC1-25/230IR	1 - 57	NE90129	425.00
CPTPSC1-25N	1 - 57	NE90129	265.00
CPTPSC1-50N	1 - 57	NE90129	425.00
CPTPSC2-12/230IR	1 - 57	NE90129	540.00
CPTPSC2-25/230IR	1 - 57	NE90129	990.00
CPTPSC25-230MOD	1 - 57	NE90129	475.00
CPTPSC4-12/400IR	1 - 57	NE90129	1060.00
CPTPSC4-25/400IR	1 - 57	NE90129	2150.00
CPTPSM1- 20/230 IR	1 - 59	NE90129	109.00
CPTPSM1- 20N	1 - 59	NE90129	109.00
CPTPSM1- 40/230 IR	1 - 59	NE90129	156.00
CPTPSM1- 40N	1 - 59	NE90129	156.00
CPTPSM-20-230MOD	1 - 59	NE90129	62.00
CPTPSM2- 20/230 IR	1 - 59	NE90129	270.00
CPTPSM2- 40/230 IR	1 - 59	NE90129	320.00
CPTPSM-40-230MOD	1 - 59	NE90129	72.50
CPTPSM4- 20/400 IR	1 - 59	NE90129	510.00
CPTPSM4- 40/400 IR	1 - 59	NE90129	670.00
CPWIL0	2 - 30	NT40143	83.00
CPWIL02	2 - 30	NT40143	83.00
CPWIL1	2 - 30	NT40143	83.00
CPWIL12	2 - 30	NT40143	83.00
CPWIL2	2 - 30	NT40143	83.00
CPWIL22	2 - 30	NT40143	83.00
CPWIL3	2 - 30	NT40143	125.00
CPWIL32	2 - 30	NT40143	125.00
CPWIL4	2 - 30	NT40143	135.00
CPWIL42	2 - 30	NT40143	135.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
CPWIL5	2 - 30	NT40143	145.00
CPWIL52	2 - 30	NT40143	145.00
CPWIL6	2 - 30	NT40143	156.00
CPWIL62	2 - 30	NT40143	156.00
CPWILH	2 - 30	NT40143	83.00
CPWILH2	2 - 30	NT40143	83.00
<b>A</b> CPX18G	2 - 47	NT40143	3680.00
<b>I A</b> CPX18O	2 - 47	NT40143	3680.00
<b>I A</b> CPX18SS	2 - 47	NT40143	8560.00
<b>A</b> CPX24G	2 - 47	NT40143	4100.00
<b>I A</b> CPX24O	2 - 47	NT40143	4100.00
<b>I A</b> CPX24SS	2 - 47	NT40143	8770.00
<b>A</b> CPX36G	2 - 47	NT40143	4460.00
<b>I A</b> CPX36O	2 - 47	NT40143	4460.00
<b>I A</b> CPX36SS	2 - 47	NT40143	10220.00
<b>A</b> CPX42G	2 - 47	NT40143	4880.00
<b>I A</b> CPX42O	2 - 47	NT40143	4880.00
<b>I A</b> CPX42SS	2 - 47	NT40143	11460.00
<b>I A</b> CPX48G	2 - 47	NT40143	4930.00
<b>I A</b> CPX48O	2 - 47	NT40143	4930.00
<b>I A</b> CPX48SS	2 - 47	NT40143	11670.00
<b>I A</b> CPX60G	2 - 47	NT40143	5290.00
<b>I A</b> CPX60O	2 - 47	NT40143	5290.00
<b>I A</b> CPX60SS	2 - 47	NT40143	13120.00
<b>I A</b> CPX72G	2 - 47	NT40143	5710.00
<b>I A</b> CPX72O	2 - 47	NT40143	5710.00
<b>I A</b> CPX72SS	2 - 47	NT40143	14270.00
CPXEN12	2 - 57	NT40143	140.00
CPXEN18	2 - 57	NT40143	250.00
CPXEN36	2 - 57	NT40143	320.00
CPXEN8	2 - 57	NT40143	109.00
<b>I</b> CSB08ST	2 - 4	NT30141	67.50
<b>I</b> CSB08SW	2 - 4	NT30141	67.50
CSB12FMPL	2 - 5	NT10135	37.00
CSB12FT	2 - 5	NT10135	78.00
CSB12FW	2 - 5	NT10135	78.00
CSB12ST	2 - 4	NT10135	78.00
CSB12SW	2 - 4	NT10135	78.00
CSB18FMPL	2 - 5	NT10135	37.00
CSB18FT	2 - 5	NT10135	119.00
CSB18FW	2 - 5	NT10135	119.00
CSB18ST	2 - 4	NT10135	119.00
CSB18SW	2 - 4	NT10135	119.00
CSB24FMPL	2 - 5	NT10135	42.00
CSB24FT	2 - 5	NT10135	156.00
CSB24FW	2 - 5	NT10135	156.00
CSB24ST	2 - 4	NT10135	156.00
CSB24SW	2 - 4	NT10135	156.00
CSB36FMPL	2 - 5	NT10135	42.00

CAT. NO.	PAGE	P.S.	PRICE \$
CSB36FT	2 - 5	NT10135	197.00
CSB36FW	2 - 5	NT10135	197.00
CSB36ST	2 - 4	NT10135	197.00
CSB36SW	2 - 4	NT10135	197.00
CSPC1	2 - 2	NT30141	7.30
<b>A</b> CST160MS	2 - 30	NT40143	305.00
<b>A</b> CST 24G	2 - 27	NT40143	1300.00
<b>A</b> CST 24M160G	2 - 27	NT40143	1550.00
CST 24M160O	2 - 28	NT40143	1550.00
CST 24M250G	2 - 27	NT40143	1670.00
CST 24M250O	2 - 28	NT40143	1670.00
<b>A</b> CST 24O	2 - 28	NT40143	1300.00
<b>A</b> CST250MS	2 - 30	NT40143	435.00
<b>A</b> CST 36G	2 - 27	NT40143	1410.00
<b>A</b> CST 36M160G	2 - 27	NT40143	1660.00
<b>A</b> CST 36M160O	2 - 28	NT40143	1660.00
CST 36M250G	2 - 27	NT40143	1780.00
CST 36M250O	2 - 28	NT40143	1780.00
<b>A</b> CST 36O	2 - 28	NT40143	1410.00
<b>A</b> CST 48G	2 - 27	NT40143	1550.00
<b>A</b> CST 48M160G	2 - 27	NT40143	1790.00
CST 48M250G	2 - 27	NT40143	1920.00
<b>A</b> CST 60G	2 - 27	NT40143	1710.00
<b>A</b> CST 60M160G	2 - 27	NT40143	1960.00
CST 60M160O	2 - 28	NT40143	1960.00
CST 60M250G	2 - 27	NT40143	2090.00
<b>A</b> CST 60M250O	2 - 28	NT40143	2090.00
<b>A</b> CST 60O	2 - 28	NT40143	1710.00
<b>A</b> CST 72G	2 - 27	NT40143	1860.00
CST 72M250G	2 - 27	NT40143	2230.00
CST 72M250O	2 - 28	NT40143	2230.00
<b>A</b> CST 72O	2 - 28	NT40143	1860.00
<b>I A</b> CST 96G	2 - 27	NT40143	2490.00
CST 96M250G	2 - 27	NT40143	2860.00
CST 96M250O	2 - 28	NT40143	2860.00
<b>I A</b> CST 96O	2 - 28	NT40143	2490.00
CT 212/253	2 - 67	NT40143	225.00
CT 218/253	2 - 67	NT40143	255.00
CT 224/253	2 - 67	NT40143	280.00
CT 230/253	2 - 67	NT40143	295.00
CT 236/253	2 - 67	NT40143	370.00
CT 242/253	2 - 67	NT40143	395.00
CT 248/253	2 - 67	NT40143	440.00
CT 260/253	2 - 67	NT40143	540.00
CT 272/253	2 - 67	NT40143	740.00
CT 284/253	2 - 67	NT40143	830.00
CT 296/253	2 - 67	NT40143	1020.00
<b>I</b> CT 312/253	2 - 68	NT40143	370.00
<b>I</b> CT 318/253	2 - 68	NT40143	425.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
CT 324/253	2 - 68	NT40143	495.00
<b>I</b> CT 330/253	2 - 68	NT40143	540.00
CT 336/253	2 - 68	NT40143	590.00
<b>I</b> CT 342/253	2 - 68	NT40143	680.00
CT 348/253	2 - 68	NT40143	750.00
<b>I</b> CT 360/253	2 - 68	NT40143	860.00
CT 372/253	2 - 68	NT40143	1030.00
<b>I</b> CT 384/253	2 - 68	NT40143	1120.00
CT 396/253	2 - 68	NT40143	1220.00
<b>I A</b> CTACC24HO	2 - 54	NT40143	4250.00
<b>I A</b> CTACC24O	2 - 54	NT40143	4250.00
<b>I A</b> CTACCO	2 - 54	NT40143	3990.00
<b>I A</b> CTD18O	2 - 54	NT40143	5910.00
<b>I A</b> CTD18SSO	2 - 54	NT40143	20020.00
<b>I A</b> CTD24O	2 - 54	NT40143	6230.00
<b>I A</b> CTD24SSO	2 - 54	NT40143	20230.00
<b>I A</b> CTD36O	2 - 54	NT40143	6540.00
<b>I A</b> CTD36SSO	2 - 54	NT40143	20270.00
<b>I A</b> CTD48O	2 - 54	NT40143	6740.00
<b>I A</b> CTD48SSO	2 - 54	NT40143	20580.00
<b>I A</b> CTD60O	2 - 54	NT40143	8090.00
<b>I A</b> CTD60SSO	2 - 54	NT40143	24010.00
<b>I A</b> CTD72O	2 - 54	NT40143	8510.00
<b>I A</b> CTD72SSO	2 - 54	NT40143	24320.00
<b>I A</b> CTD84O	2 - 54	NT40143	8920.00
<b>I A</b> CTD84SSO	2 - 54	NT40143	24530.00
<b>I A</b> CTD96O	2 - 54	NT40143	9230.00
<b>I A</b> CTD96SSO	2 - 54	NT40143	24730.00
CTES248RDCOLD	1 - 47	NT40143	570.00
CTES396RDCOLD	1 - 47	NT40143	670.00
<b>A</b> CTX18M4000	2 - 55	NT40143	POA
<b>I A</b> CTX18O	2 - 55	NT40143	7420.00
<b>I A</b> CTX18SSO	2 - 55	NT40143	23290.00
<b>A</b> CTX24M4000	2 - 55	NT40143	POA
<b>I A</b> CTX24O	2 - 55	NT40143	7680.00
<b>I A</b> CTX24SSO	2 - 55	NT40143	23600.00
<b>A</b> CTX36M4000	2 - 55	NT40143	POA
<b>I A</b> CTX36O	2 - 55	NT40143	8140.00
<b>I A</b> CTX36SSO	2 - 55	NT40143	24120.00
<b>A</b> CTX48M4000	2 - 55	NT40143	POA
<b>I A</b> CTX48O	2 - 55	NT40143	8660.00
<b>I A</b> CTX48SSO	2 - 55	NT40143	24590.00
<b>A</b> CTX60M4000	2 - 55	NT40143	POA
<b>I A</b> CTX60O	2 - 55	NT40143	11050.00
<b>I A</b> CTX60SSO	2 - 55	NT40143	29620.00
<b>A</b> CTX72M4000	2 - 55	NT40143	POA
<b>I A</b> CTX72O	2 - 55	NT40143	11620.00
<b>I A</b> CTX72SSO	2 - 55	NT40143	30190.00

	CAT. NO.	PAGE	P.S.	PRICE \$
<b>D</b>				
	D1000 0010	7 - 44	NB20067	5610.00
	D1000DINCLIPS	7 - 44	NB20067	11.40
	DCLD6	1 - 50	NT30141	57.00
	DINT10H1100C	1 - 22	NT10136	151.00
<b>I</b>	DINT10H1100D	1 - 22	NT10136	182.00
	DINT10H1125C	1 - 22	NT10136	189.00
	DINT10H1125D	1 - 22	NT10136	210.00
	DINT10H180C	1 - 22	NT10136	128.00
	DINT10H180D	1 - 22	NT10136	182.00
	DINT10H2100C	1 - 22	NT10136	350.00
<b>I</b>	DINT10H2100D	1 - 22	NT10136	400.00
	DINT10H2125C	1 - 22	NT10136	470.00
<b>I</b>	DINT10H2125D	1 - 22	NT10136	530.00
	DINT10H280C	1 - 22	NT10136	330.00
	DINT10H280D	1 - 22	NT10136	355.00
	DINT10H3100C	1 - 22	NT10136	400.00
	DINT10H3100D	1 - 22	NT10136	455.00
	DINT10H3125C	1 - 22	NT10136	590.00
	DINT10H3125C	2 - 31	NT10136	590.00
	DINT10H3125D	1 - 22	NT10136	650.00
	DINT10H380C	1 - 22	NT10136	400.00
	DINT10H380D	1 - 22	NT10136	455.00
	DINT10H4100C	1 - 22	NT10136	700.00
<b>I</b>	DINT10H4100D	1 - 22	NT10136	780.00
<b>I</b>	DINT10H4125C	1 - 22	NT10136	1040.00
<b>I</b>	DINT10H4125D	1 - 22	NT10136	1140.00
<b>I</b>	DINT10H480C	1 - 22	NT10136	700.00
<b>I</b>	DINT10H480D	1 - 22	NT10136	780.00
	DINT10H HS	1 - 40	NT10136	114.00
	DINT10HTC	1 - 50	NT30141	5.40
	DINTMS1001	1 - 38	NT10136	48.00
	DINTMS1002	1 - 38	NT10136	75.00
	DINTMS1003	1 - 38	NT10136	115.00
	DINTMS1003	2 - 30	NT10136	115.00
	DINTMS631	1 - 38	NT10136	42.00
	DINTMS632	1 - 38	NT10136	56.00
	DINTMS633	1 - 38	NT10136	86.50
	DINTMS801	1 - 38	NT10136	45.00
	DINTMS802	1 - 38	NT10136	67.00
	DINTMS803	1 - 38	NT10136	102.00
	DINTMS803	2 - 30	NT10136	102.00
	DINTSHT110415U	1 - 39	NT30141	164.00
	DINTSHT2460U	1 - 39	NT30141	164.00
<b>I</b>	DINTT100	2 - 64	NT40143	10.00
	DINTT100	2 - 64	NT40143	10.00
<b>A</b>	DM15036	2 - 6	NT40143	305.00
<b>A</b>	DM15054	2 - 6	NT40143	440.00
<b>A</b>	DM15072	2 - 6	NT40143	580.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
I DM150JK	2 - 6	NT40143	23.40
I DM150LD	2 - 6	NT40143	46.00
A DM150NAA	2 - 6	NT40143	39.50
I A DM150NAB	2 - 6	NT40143	72.50
A DM150NAC	2 - 6	NT40143	72.50
A DMWP12	2 - 8	NT40143	220.00
A DMWP24	2 - 8	NT40143	280.00
A DMWP36	2 - 8	NT40143	370.00
DMWPCS	2 - 8	NT40143	13.00
DMWPLD	2 - 8	NT40143	28.00
A DSLK	2 - 9	NT40143	30.50
A DSLK	2 - 10	NT40143	30.50
DSR110DEL	8 - 15	NT30141	580.00
DSR140DEL	8 - 15	NT30141	800.00
DSR210DEL	8 - 15	NT30141	960.00
DSR35DEL	8 - 15	NT30141	305.00
DSR48TD110	8 - 12	NT30141	390.00
DSR48TD240	8 - 12	NT30141	390.00
DSR80DEL	8 - 15	NT30141	375.00
DSRCB0610A	1 - 30	NT30141	285.00
DSRCB0630	1 - 30	NT30141	275.00
DSRCB0630P	1 - 31	NT30141	280.00
DSRCB10100A	1 - 30	NT30141	305.00
DSRCB1010A	1 - 30	NT30141	285.00
DSRCB1030	1 - 30	NT30141	275.00
DSRCB1030A	1 - 30	NT30141	285.00
DSRCB1030P	1 - 31	NT30141	280.00
I DSRCB16100A	1 - 30	NT30141	305.00
DSRCB1610A	1 - 30	NT30141	285.00
DSRCB1630	1 - 30	NT30141	275.00
DSRCB1630A	1 - 30	NT30141	285.00
DSRCB1630P	1 - 31	NT30141	280.00
I DSRCB20100A	1 - 30	NT30141	305.00
DSRCB2010A	1 - 30	NT30141	285.00
DSRCB2030	1 - 30	NT30141	275.00
DSRCB2030A	1 - 30	NT30141	285.00
DSRCB2030P	1 - 31	NT30141	280.00
DSRCB2530	1 - 30	NT30141	275.00
DSRCB2530A	1 - 30	NT30141	285.00
DSRCB2530P	1 - 31	NT30141	280.00
DSRCB2320	1 - 30	NT30141	275.00
DSRCB2320A	1 - 30	NT30141	285.00
DSRCB2320P	1 - 31	NT30141	280.00
DSRCB4030	1 - 30	NT30141	275.00
DSRCB4030A	1 - 30	NT30141	285.00
DSRCB4030P	1 - 31	NT30141	280.00
I DSRCBH0610A	1 - 29	NT30141	400.00
DSRCBH0630A	1 - 29	NT30141	310.00
DSRCBH1010A	1 - 29	NT30141	400.00

CAT. NO.	PAGE	P.S.	PRICE \$
DSRCBH1030A	1 - 29	NT30141	310.00
DSRCBH1610A	1 - 29	NT30141	400.00
DSRCBH1630A	1 - 29	NT30141	310.00
DSRCBH2010A	1 - 29	NT30141	400.00
DSRCBH2030A	1 - 29	NT30141	310.00
I DSRCBH2510A	1 - 29	NT30141	400.00
DSRCBH2530A	1 - 29	NT30141	310.00
I DSRCBH3210A	1 - 29	NT30141	400.00
DSRCBH3230A	1 - 29	NT30141	310.00
I DSRCBH4010A	1 - 29	NT30141	400.00
DSRCBH4030A	1 - 29	NT30141	310.00
DSRCBHTC	1 - 50	NT30141	7.50
I DSRCBS0630B	1 - 28	NT30141	320.00
DSRCBS0630C	1 - 28	NT30141	320.00
I DSRCBS1030B	1 - 28	NT30141	320.00
DSRCBS1030C	1 - 28	NT30141	320.00
I DSRCBS1630B	1 - 28	NT30141	320.00
DSRCBS1630C	1 - 28	NT30141	320.00
I DSRCBS2030B	1 - 28	NT30141	320.00
DSRCBS2030C	1 - 28	NT30141	320.00
I DSRCBS2530B	1 - 28	NT30141	320.00
DSRCBS2530C	1 - 28	NT30141	320.00
I DSRCBS3230B	1 - 28	NT30141	320.00
DSRCBS3230C	1 - 28	NT30141	320.00
DSRCBSAX	1 - 40	NT10136	102.00
DSRCBSAXAL	1 - 40	NT10136	114.00
I DSRCBSAXALG	1 - 40	NT10136	125.00
DSRCD240100	1 - 25	NT30141	290.00
I DSRCD240100A	1 - 26	NT30141	365.00
DSRCD24030	1 - 25	NT30141	240.00
DSRCD240300	1 - 25	NT30141	330.00
DSRCD24030A	1 - 26	NT30141	265.00
DSRCD24030AI	1 - 25	NT30141	290.00
DSRCD263100S	1 - 25	NT30141	365.00
DSRCD26330	1 - 25	NT30141	265.00
DSRCD263300S	1 - 25	NT30141	400.00
I DSRCD26330A	1 - 26	NT30141	340.00
DSRCD26330AI	1 - 25	NT30141	335.00
DSRCD280100	1 - 25	NT30141	355.00
I DSRCD280100A	1 - 26	NT30141	365.00
DSRCD28030	1 - 25	NT30141	295.00
I DSRCD280300	1 - 25	NT30141	370.00
I DSRCD28030A	1 - 26	NT30141	400.00
DSRCD4100100	1 - 25	NT30141	560.00
DSRCD4100100S	1 - 25	NT30141	610.00
DSRCD410030	1 - 25	NT30141	560.00
DSRCD4100300	1 - 25	NT30141	560.00
DSRCD4100300S	1 - 25	NT30141	620.00
I DSRCD410030A	1 - 26	NT30141	630.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
DSRCD4100500	1 - 25	NT30141	570.00
DSRCD4125500B	1 - 26	NT30141	2780.00
DSRCD440100	1 - 25	NT30141	340.00
DSRCD44030	1 - 25	NT30141	315.00
DSRCD440300	1 - 25	NT30141	370.00
DSRCD44030A	1 - 26	NT30141	375.00
DSRCD44030AI	1 - 25	NT30141	350.00
DSRCD463100	1 - 25	NT30141	425.00
DSRCD463100A	1 - 26	NT30141	445.00
DSRCD463100B	1 - 26	NT40143	2780.00
DSRCD463100S	1 - 25	NT30141	445.00
DSRCD46330	1 - 25	NT30141	335.00
DSRCD463300BS	1 - 26	NT40143	2780.00
DSRCD463300S	1 - 25	NT30141	510.00
DSRCD46330A	1 - 26	NT30141	395.00
DSRCD46330AI	1 - 25	NT30141	435.00
DSRCD46330B	1 - 26	NT40143	2780.00
DSRCD480100	1 - 25	NT30141	475.00
DSRCD480100A	1 - 26	NT30141	560.00
DSRCD48030	1 - 25	NT30141	375.00
DSRCDE24030	1 - 24	NT10136	250.00
DSRCDE26330	1 - 24	NT10136	285.00
DSRCDE44030	1 - 24	NT10136	335.00
DSRCDE46330	1 - 24	NT10136	360.00
DSRCM321001PN	1 - 32	NT30141	455.00
DSRCM321003PN	1 - 32	NT30141	580.00
DSRCM323001PN	1 - 32	NT30141	510.00
DSRCM323003PN	1 - 32	NT30141	580.00
DSRCM32301PN	1 - 32	NT30141	435.00
DSRCM32303PN	1 - 32	NT30141	495.00
DSRCM631001PN	1 - 32	NT30141	570.00
DSRCM631003P	1 - 32	NT30141	640.00
DSRCM631003PN	1 - 32	NT30141	640.00
DSRCM633001PN	1 - 32	NT30141	620.00
DSRCM633003PN	1 - 32	NT30141	640.00
DSRCM63301PN	1 - 32	NT30141	550.00
DSRCM63303P	1 - 32	NT30141	590.00
DSRCM63303PN	1 - 32	NT30141	580.00
DSRM110V	8 - 12	NT30141	1200.00
DSRM240V	8 - 12	NT30141	1200.00
DSRM72110	8 - 12	NT30141	980.00
DSRM7224	8 - 12	NT30141	980.00
DSRM72240	8 - 12	NT30141	980.00
DTAUXAL	1 - 40	NT10136	102.00
DTAUXALG	1 - 40	NT10136	123.00
DTC2002240	1 - 52	NT30141	151.00
DTC2011240	1 - 52	NT30141	151.00
DTC202024	1 - 52	NT30141	151.00
DTC2020240	1 - 52	NT30141	151.00

CAT. NO.	PAGE	P.S.	PRICE \$
DTC2020240L	1 - 54	NT30141	78.00
DTC202024L	1 - 54	NT30141	78.00
DTC2404240	1 - 52	NT30141	175.00
DTC244012	1 - 52	NT30141	175.00
DTC244024	1 - 52	NT30141	175.00
DTC2440240	1 - 52	NT30141	175.00
DTC2504240L	1 - 54	NT30141	98.50
DTC254012L	1 - 54	NT30141	98.50
DTC2540240L	1 - 54	NT30141	98.50
I DTC404024	1 - 52	NT30141	310.00
DTC4040240	1 - 52	NT30141	310.00
DTC4040240L	1 - 54	NT30141	235.00
I DTC634024	1 - 52	NT30141	430.00
DTC6340240	1 - 52	NT30141	430.00
DTC6340240L	1 - 54	NT30141	260.00
DTCB10 1 01C	1 - 20	NT10136	58.50
I DTCB10 1 01D	1 - 21	NT10136	66.50
DTCB10 1 02C	1 - 20	NT10136	58.50
DTCB10 1 02D	1 - 21	NT10136	66.50
DTCB10 1 04C	1 - 20	NT10136	58.50
DTCB10 1 04D	1 - 21	NT10136	66.50
DTCB10 1 05C	1 - 20	NT10136	58.50
I DTCB10 1 05D	1 - 21	NT10136	66.50
DTCB10 1 06B	1 - 19	NT10136	66.50
DTCB10 1 06C	1 - 20	NT10136	58.50
DTCB10 1 06D	1 - 21	NT10136	66.50
DTCB10 1 10B	1 - 19	NT10136	66.50
DTCB10 1 10C	1 - 20	NT10136	58.50
DTCB10 1 10D	1 - 21	NT10136	66.50
I DTCB10 1 13C	1 - 20	NT10136	58.50
I DTCB10 1 13D	1 - 21	NT10136	66.50
DTCB10 1 16B	1 - 19	NT10136	66.50
DTCB10 1 16C	1 - 20	NT10136	58.50
DTCB10 1 16D	1 - 21	NT10136	66.50
DTCB10 1 20B	1 - 19	NT10136	66.50
DTCB10 1 20C	1 - 20	NT10136	58.50
DTCB10 1 20D	1 - 21	NT10136	66.50
DTCB10 1 25B	1 - 19	NT10136	66.50
DTCB10 1 25C	1 - 20	NT10136	58.50
DTCB10 1 25D	1 - 21	NT10136	66.50
DTCB10 1 32B	1 - 19	NT10136	66.50
DTCB10 1 32C	1 - 20	NT10136	58.50
DTCB10 1 32D	1 - 21	NT10136	66.50
DTCB10 1 40B	1 - 19	NT10136	78.50
DTCB10 1 40C	1 - 20	NT10136	58.50
DTCB10 1 40D	1 - 21	NT10136	84.50
I DTCB10 1 50B	1 - 19	NT10136	91.00
DTCB10 1 50C	1 - 20	NT10136	58.50
DTCB10 1 50D	1 - 21	NT10136	109.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
I DTCB10 1 63B	1 - 19	NT10136	109.00
I DTCB10 1 63C	1 - 20	NT10136	58.50
I DTCB10 1 63D	1 - 21	NT10136	133.00
I DTCB10 2 01C	1 - 20	NT10136	179.00
I DTCB10 2 01D	1 - 21	NT10136	188.00
I DTCB10 2 02C	1 - 20	NT10136	179.00
I DTCB10 2 02D	1 - 21	NT10136	188.00
I DTCB10 2 04C	1 - 20	NT10136	179.00
I DTCB10 2 04D	1 - 21	NT10136	188.00
I DTCB10 2 05C	1 - 20	NT10136	179.00
I DTCB10 2 05D	1 - 21	NT10136	188.00
I DTCB10 2 06B	1 - 19	NT10136	188.00
I DTCB10 2 06C	1 - 20	NT10136	179.00
I DTCB10 2 06D	1 - 21	NT10136	188.00
I DTCB10 2 10B	1 - 19	NT10136	188.00
I DTCB10 2 10C	1 - 20	NT10136	179.00
I DTCB10 2 10D	1 - 21	NT10136	188.00
I DTCB10 2 13C	1 - 20	NT10136	179.00
I DTCB10 2 13D	1 - 21	NT10136	188.00
I DTCB10 2 16B	1 - 19	NT10136	188.00
I DTCB10 2 16C	1 - 20	NT10136	179.00
I DTCB10 2 16D	1 - 21	NT10136	188.00
I DTCB10 2 20B	1 - 19	NT10136	188.00
I DTCB10 2 20C	1 - 20	NT10136	179.00
I DTCB10 2 20D	1 - 21	NT10136	188.00
I DTCB10 2 25B	1 - 19	NT10136	188.00
I DTCB10 2 25C	1 - 20	NT10136	179.00
I DTCB10 2 25D	1 - 21	NT10136	188.00
I DTCB10 2 32B	1 - 19	NT10136	188.00
I DTCB10 2 32C	1 - 20	NT10136	179.00
I DTCB10 2 32D	1 - 21	NT10136	188.00
I DTCB10 2 40B	1 - 19	NT10136	194.00
I DTCB10 2 40C	1 - 20	NT10136	179.00
I DTCB10 2 40D	1 - 21	NT10136	205.00
I DTCB10 2 50B	1 - 19	NT10136	220.00
I DTCB10 2 50C	1 - 20	NT10136	179.00
I DTCB10 2 50D	1 - 21	NT10136	230.00
I DTCB10 2 63B	1 - 19	NT10136	230.00
I DTCB10 2 63C	1 - 20	NT10136	179.00
I DTCB10 2 63D	1 - 21	NT10136	255.00
I DTCB10 3 01C	1 - 20	NT10136	215.00
I DTCB10 3 01D	1 - 21	NT10136	220.00
I DTCB10 3 02C	1 - 20	NT10136	215.00
I DTCB10 3 02D	1 - 21	NT10136	220.00
I DTCB10 3 04C	1 - 20	NT10136	215.00
I DTCB10 3 04D	1 - 21	NT10136	220.00
I DTCB10 3 05C	1 - 20	NT10136	215.00
I DTCB10 3 05D	1 - 21	NT10136	220.00
I DTCB10 3 06B	1 - 19	NT10136	220.00

CAT. NO.	PAGE	P.S.	PRICE \$
DTCB10 3 06C	1 - 20	NT10136	215.00
DTCB10 3 06D	1 - 21	NT10136	220.00
DTCB10 3 10B	1 - 19	NT10136	220.00
DTCB10 3 10C	1 - 20	NT10136	215.00
DTCB10 3 10D	1 - 21	NT10136	220.00
I DTCB10 3 13C	1 - 20	NT10136	215.00
I DTCB10 3 13D	1 - 21	NT10136	220.00
DTCB10 3 16B	1 - 19	NT10136	220.00
DTCB10 3 16C	1 - 20	NT10136	215.00
DTCB10 3 16D	1 - 21	NT10136	220.00
DTCB10 3 20B	1 - 19	NT10136	220.00
DTCB10 3 20C	1 - 20	NT10136	215.00
DTCB10 3 20D	1 - 21	NT10136	220.00
DTCB10 3 25B	1 - 19	NT10136	220.00
DTCB10 3 25C	1 - 20	NT10136	215.00
DTCB10 3 25D	1 - 21	NT10136	220.00
DTCB10 3 32B	1 - 19	NT10136	220.00
DTCB10 3 32C	1 - 20	NT10136	215.00
DTCB10 3 32D	1 - 21	NT10136	220.00
DTCB10 3 40B	1 - 19	NT10136	230.00
DTCB10 3 40C	1 - 20	NT10136	215.00
DTCB10 3 40D	1 - 21	NT10136	230.00
I DTCB10 3 50B	1 - 19	NT10136	305.00
DTCB10 3 50C	1 - 20	NT10136	215.00
DTCB10 3 50D	1 - 21	NT10136	305.00
DTCB10 3 63B	1 - 19	NT10136	365.00
DTCB10 3 63C	1 - 20	NT10136	215.00
DTCB10 3 63D	1 - 21	NT10136	365.00
I DTCB10 4 01C	1 - 20	NT10136	255.00
DTCB10 4 02C	1 - 20	NT10136	255.00
I DTCB10 4 04C	1 - 20	NT10136	255.00
I DTCB10 4 04D	1 - 21	NT10136	265.00
DTCB10 4 06C	1 - 20	NT10136	255.00
I DTCB10 4 06D	1 - 21	NT10136	265.00
DTCB10 4 10C	1 - 20	NT10136	255.00
I DTCB10 4 10D	1 - 21	NT10136	265.00
I DTCB10 4 13C	1 - 20	NT10136	255.00
I DTCB10 4 13D	1 - 21	NT10136	265.00
DTCB10 4 16C	1 - 20	NT10136	255.00
I DTCB10 4 16D	1 - 21	NT10136	265.00
DTCB10 4 20C	1 - 20	NT10136	255.00
I DTCB10 4 20D	1 - 21	NT10136	265.00
DTCB10 4 25C	1 - 20	NT10136	255.00
DTCB10 4 25D	1 - 21	NT10136	265.00
DTCB10 4 32C	1 - 20	NT10136	255.00
DTCB10 4 32D	1 - 21	NT10136	265.00
DTCB10 4 40C	1 - 20	NT10136	265.00
I DTCB10 4 40D	1 - 21	NT10136	280.00
DTCB10 4 50C	1 - 20	NT10136	280.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
I DTCB10 4 50D	1 - 21	NT10136	365.00
DTCB10 4 63C	1 - 20	NT10136	290.00
DTCB10 4 63D	1 - 21	NT10136	550.00
I DTCB15 1 06C	1 - 23	NT10136	150.00
DTCB15 1 10C	1 - 23	NT10136	150.00
I DTCB15 1 13C	1 - 23	NT10136	150.00
DTCB15 1 16C	1 - 23	NT10136	150.00
DTCB15 1 20C	1 - 23	NT10136	150.00
DTCB15 1 25C	1 - 23	NT10136	150.00
DTCB15 1 32C	1 - 23	NT10136	150.00
DTCB15 1 40C	1 - 23	NT10136	150.00
DTCB15 1 50C	1 - 23	NT10136	150.00
DTCB15 1 63C	1 - 23	NT10136	150.00
I DTCB15 2 06C	1 - 23	NT10136	270.00
DTCB15 2 10C	1 - 23	NT10136	270.00
I DTCB15 2 13C	1 - 23	NT10136	270.00
DTCB15 2 16C	1 - 23	NT10136	270.00
I DTCB15 2 20C	1 - 23	NT10136	270.00
I DTCB15 2 25C	1 - 23	NT10136	270.00
I DTCB15 2 32C	1 - 23	NT10136	270.00
I DTCB15 2 40C	1 - 23	NT10136	270.00
DTCB15 2 50C	1 - 23	NT10136	270.00
I DTCB15 2 63C	1 - 23	NT10136	270.00
DTCB15 3 06C	1 - 23	NT10136	420.00
DTCB15 3 10C	1 - 23	NT10136	420.00
I DTCB15 3 13C	1 - 23	NT10136	420.00
DTCB15 3 16C	1 - 23	NT10136	420.00
DTCB15 3 20C	1 - 23	NT10136	420.00
DTCB15 3 25C	1 - 23	NT10136	420.00
DTCB15 3 32C	1 - 23	NT10136	420.00
DTCB15 3 40C	1 - 23	NT10136	420.00
DTCB15 3 50C	1 - 23	NT10136	420.00
DTCB15 3 63C	1 - 23	NT10136	420.00
I DTCB15 4 06C	1 - 23	NT10136	490.00
I DTCB15 4 10C	1 - 23	NT10136	490.00
I DTCB15 4 13C	1 - 23	NT10136	490.00
I DTCB15 4 16C	1 - 23	NT10136	490.00
I DTCB15 4 20C	1 - 23	NT10136	490.00
I DTCB15 4 25C	1 - 23	NT10136	490.00
I DTCB15 4 32C	1 - 23	NT10136	490.00
I DTCB15 4 40C	1 - 23	NT10136	490.00
I DTCB15 4 50C	1 - 23	NT10136	490.00
I DTCB15 4 63C	1 - 23	NT10136	490.00
DTCB6102C	1 - 14	NT10136	37.00
DTCB6102D	1 - 15	NT10136	51.00
DTCB6104C	1 - 14	NT10136	37.00
DTCB6104D	1 - 15	NT10136	51.00
DTCB6106C	1 - 14	NT10136	37.00
DTCB6106D	1 - 15	NT10136	51.00

CAT. NO.	PAGE	P.S.	PRICE \$
DTCB6110C	1 - 14	NT10136	37.00
DTCB6110D	1 - 15	NT10136	51.00
DTCB6113C	1 - 14	NT10136	37.00
DTCB6113D	1 - 15	NT10136	51.00
DTCB6116C	1 - 14	NT10136	37.00
DTCB6116D	1 - 15	NT10136	51.00
DTCB6120C	1 - 14	NT10136	37.00
DTCB6120D	1 - 15	NT10136	51.00
DTCB6125C	1 - 14	NT10136	37.00
DTCB6125D	1 - 15	NT10136	51.00
DTCB6132C	1 - 14	NT10136	37.00
DTCB6132D	1 - 15	NT10136	51.00
DTCB6140C	1 - 14	NT10136	37.00
DTCB6140D	1 - 15	NT10136	54.50
DTCB6150C	1 - 14	NT10136	37.00
DTCB6150D	1 - 15	NT10136	54.50
DTCB6163C	1 - 14	NT10136	37.00
DTCB6163D	1 - 15	NT10136	54.50
DTCB6202C	1 - 14	NT10136	131.00
DTCB6202D	1 - 15	NT10136	153.00
DTCB6204C	1 - 14	NT10136	131.00
DTCB6204D	1 - 15	NT10136	153.00
DTCB6206C	1 - 14	NT10136	131.00
DTCB6206D	1 - 15	NT10136	153.00
DTCB6210C	1 - 14	NT10136	131.00
DTCB6210D	1 - 15	NT10136	153.00
I DTCB6213C	1 - 14	NT10136	131.00
I DTCB6213D	1 - 15	NT10136	153.00
DTCB6216C	1 - 14	NT10136	131.00
DTCB6216D	1 - 15	NT10136	153.00
DTCB6220C	1 - 14	NT10136	131.00
DTCB6220D	1 - 15	NT10136	153.00
DTCB6225C	1 - 14	NT10136	131.00
DTCB6225D	1 - 15	NT10136	153.00
DTCB6232C	1 - 14	NT10136	131.00
DTCB6232D	1 - 15	NT10136	153.00
DTCB6240C	1 - 14	NT10136	131.00
DTCB6240D	1 - 15	NT10136	164.00
DTCB6250C	1 - 14	NT10136	131.00
DTCB6250D	1 - 15	NT10136	164.00
DTCB6263C	1 - 14	NT10136	131.00
DTCB6263D	1 - 15	NT10136	164.00
DTCB6302C	1 - 14	NT10136	166.00
DTCB6302D	1 - 15	NT10136	215.00
DTCB6304C	1 - 14	NT10136	166.00
DTCB6304D	1 - 15	NT10136	215.00
DTCB6306C	1 - 14	NT10136	166.00
DTCB6306D	1 - 15	NT10136	215.00
DTCB6310C	1 - 14	NT10136	166.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
DTCB6310D	1 - 15	NT10136	215.00
<b>I</b> DTCB6313C	1 - 14	NT10136	166.00
<b>I</b> DTCB6313D	1 - 15	NT10136	215.00
DTCB6316C	1 - 14	NT10136	166.00
DTCB6316D	1 - 15	NT10136	215.00
<b>I</b> DTCB6320C	1 - 14	NT10136	166.00
DTCB6320D	1 - 15	NT10136	215.00
DTCB6325C	1 - 14	NT10136	166.00
DTCB6325D	1 - 15	NT10136	215.00
DTCB6332C	1 - 14	NT10136	166.00
DTCB6332D	1 - 15	NT10136	215.00
DTCB6340C	1 - 14	NT10136	166.00
DTCB6340D	1 - 15	NT10136	225.00
<b>I</b> DTCB6350C	1 - 14	NT10136	166.00
DTCB6350D	1 - 15	NT10136	225.00
DTCB6363C	1 - 14	NT10136	166.00
DTCB6363D	1 - 15	NT10136	225.00
<b>I</b> DTCBD61102C	1 - 16	NT10136	182.00
<b>I</b> DTCBD61104C	1 - 16	NT10136	182.00
DTCBD61106C	1 - 16	NT10136	182.00
DTCBD61110C	1 - 16	NT10136	182.00
DTCBD61116C	1 - 16	NT10136	182.00
DTCBD61120C	1 - 16	NT10136	182.00
DTCBD6202C	1 - 16	NT10136	171.00
<b>I</b> DTCBD6204C	1 - 16	NT10136	171.00
DTCBD6206C	1 - 16	NT10136	171.00
DTCBD6210C	1 - 16	NT10136	171.00
DTCBD6216C	1 - 16	NT10136	171.00
DTCBD6220C	1 - 16	NT10136	171.00
<b>I</b> DTCBD6225C	1 - 16	NT10136	171.00
<b>I</b> DTCBD6232C	1 - 16	NT10136	171.00
<b>I</b> DTCBD6240C	1 - 16	NT10136	171.00
<b>I</b> DTCBD6302C	1 - 16	NT10136	275.00
<b>I</b> DTCBD6304C	1 - 16	NT10136	275.00
DTCBD6306C	1 - 16	NT10136	275.00
DTCBD6310C	1 - 16	NT10136	275.00
DTCBD6316C	1 - 16	NT10136	275.00
DTCBD6320C	1 - 16	NT10136	275.00
<b>I</b> DTCBD6325C	1 - 16	NT10136	275.00
<b>I</b> DTCBD6332C	1 - 16	NT10136	275.00
<b>I</b> DTCBD6340C	1 - 16	NT10136	275.00
<b>I</b> DTCBD6402C	1 - 16	NT10136	390.00
<b>I</b> DTCBD6404C	1 - 16	NT10136	390.00
DTCBD6406C	1 - 16	NT10136	390.00
DTCBD6410C	1 - 16	NT10136	390.00
DTCBD6416C	1 - 16	NT10136	390.00
DTCBD6420C	1 - 16	NT10136	390.00
<b>I</b> DTCBD6425C	1 - 16	NT10136	390.00
<b>I</b> DTCBD6432C	1 - 16	NT10136	390.00

<b>CAT. NO.</b>	<b>PAGE</b>	<b>P.S.</b>	<b>PRICE \$</b>
I DTCBD6440C	1 - 16	NT10136	390.00
DTCBDC101C	1 - 17	NT10136	126.00
DTCBDC102C	1 - 17	NT10136	126.00
DTCBDC104C	1 - 17	NT10136	126.00
I DTCBDC105C	1 - 17	NT10136	126.00
DTCBDC106C	1 - 17	NT10136	126.00
DTCBDC110C	1 - 17	NT10136	126.00
DTCBDC116C	1 - 17	NT10136	126.00
DTCBDC120C	1 - 17	NT10136	126.00
DTCBDC125C	1 - 17	NT10136	126.00
DTCBDC132C	1 - 17	NT10136	126.00
DTCBDC140C	1 - 17	NT10136	126.00
DTCBDC150C	1 - 17	NT10136	126.00
DTCBDC163C	1 - 17	NT10136	126.00
DTCBDC201C	1 - 17	NT10136	265.00
DTCBDC202C	1 - 17	NT10136	265.00
DTCBDC204C	1 - 17	NT10136	265.00
DTCBDC206C	1 - 17	NT10136	265.00
DTCBDC210C	1 - 17	NT10136	265.00
DTCBDC216C	1 - 17	NT10136	265.00
DTCBDC220C	1 - 17	NT10136	265.00
DTCBDC225C	1 - 17	NT10136	265.00
DTCBDC232C	1 - 17	NT10136	265.00
DTCBDC240C	1 - 17	NT10136	265.00
DTCBDC250C	1 - 17	NT10136	265.00
DTCBDC263C	1 - 17	NT10136	265.00
DTCBDC410B	1 - 18	NT10136	580.00
DTCBDC416B	1 - 18	NT10136	580.00
I DTCBDC420B	1 - 18	NT10136	580.00
I DTCBE6106C	1 - 24	NT10136	40.50
DTCBE6110C	1 - 24	NT10136	40.50
DTCBE6116C	1 - 24	NT10136	40.50
DTCBE6120C	1 - 24	NT10136	40.50
DTCBE6125C	1 - 24	NT10136	40.50
DTCBE6132C	1 - 24	NT10136	40.50
I DTCBE6140C	1 - 24	NT10136	40.50
I DTCBE6150C	1 - 24	NT10136	40.50
DTCBE6163C	1 - 24	NT10136	40.50
I DTCBE6306C	1 - 24	NT10136	166.00
I DTCBE6310C	1 - 24	NT10136	166.00
I DTCBE6316C	1 - 24	NT10136	166.00
I DTCBE6320C	1 - 24	NT10136	166.00
I DTCBE6325C	1 - 24	NT10136	166.00
I DTCBE6332C	1 - 24	NT10136	166.00
I DTCBE6340C	1 - 24	NT10136	166.00
I DTCBE6350C	1 - 24	NT10136	166.00
I DTCBE6363C	1 - 24	NT10136	166.00
DTCF35	1 - 50	NT30141	17.60
DTCS3212	1 - 44	NT30141	47.50

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
DTCS3213	1 - 44	NT30141	59.00
DTCS3222	1 - 44	NT30141	71.50
DTCS3223	1 - 44	NT30141	83.00
DTHR	1 - 52	NT30141	131.00
<b>I</b> DTIS1012VAC	1 - 55	NT30141	66.00
<b>I</b> DTIS1012VDC	1 - 55	NT30141	66.00
<b>I</b> DTIS10240VAC	1 - 55	NT30141	66.00
<b>I</b> DTIS1024VAC	1 - 55	NT30141	66.00
<b>I</b> DTIS1024VDC	1 - 55	NT30141	66.00
<b>I</b> DTIS1048VAC	1 - 55	NT30141	66.00
<b>I</b> DTIS1112VAC	1 - 55	NT30141	96.00
<b>I</b> DTIS1112VDC	1 - 55	NT30141	96.00
DTIS11240VAC	1 - 55	NT30141	96.00
<b>I</b> DTIS1124VAC	1 - 55	NT30141	96.00
<b>I</b> DTIS1124VDC	1 - 55	NT30141	96.00
<b>I</b> DTIS113212VDC	1 - 55	NT30141	187.00
<b>I</b> DTIS1148VAC	1 - 55	NT30141	96.00
<b>I</b> DTIS123212VDC	1 - 55	NT30141	187.00
DTIS132PWR	1 - 55	NT30141	187.00
<b>I</b> DTIS2012VAC	1 - 55	NT30141	96.00
DTIS2012VDC	1 - 55	NT30141	96.00
<b>I</b> DTIS20240VAC	1 - 55	NT30141	96.00
<b>I</b> DTIS2024VAC	1 - 55	NT30141	96.00
<b>I</b> DTIS2024VDC	1 - 55	NT30141	96.00
<b>I</b> DTIS2048VAC	1 - 55	NT30141	96.00
DTIS2CO	1 - 55	NT30141	83.00
DTIS2NO	1 - 55	NT30141	83.00
DTLCM	1 - 47	NT30141	4.70
DTLD	1 - 50	NT30141	23.00
DTLDH	1 - 50	NT40143	30.50
DTLDM	1 - 47	NT30141	12.00
DTLLA	1 - 47	NT30141	51.00
DTLLA10H	1 - 47	NT20138	61.00
DTLLAB	1 - 47	NT30141	51.00
DTLLABRH	1 - 47	NT30141	51.00
DTLLABULK	1 - 47	NT30141	570.00
DTLLARH	1 - 47	NT30141	51.00
DTLLARHBULK	1 - 47	NT30141	570.00
DTLLB	1 - 47	NT30141	12.00
DTLPF	1 - 47	NT30141	12.00
DTMD240VAC	1 - 41	NT40143	660.00
DTPB10L	1 - 44	NT30141	54.00
DTPB11	1 - 44	NT30141	35.50
DTPBS	1 - 42	NT30141	59.00
DTPC2	2 - 2	NT30141	13.00
<b>A</b> DTPC2LD	1 - 49	NT40143	19.20
<b>A</b> DTPC2LD	2 - 2	NT40143	19.20
<b>A</b> DTPC2LDCB	1 - 48	NT30141	109.00
DTPC2LDCBV	1 - 48	NT30141	109.00

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GST not included

CAT. NO.	PAGE	P.S.	PRICE \$
<b>A</b> DTPC2LDRCBO	1 - 49	NT40143	19.80
DTPC4	2 - 2	NT30141	16.80
<b>A</b> DTPC4LD	1 - 49	NT40143	23.40
<b>A</b> DTPC4LD	2 - 2	NT40143	23.40
<b>A</b> DTPC4LDCB	1 - 48	NT30141	250.00
DTPC4LDCBV	1 - 48	NT30141	540.00
DTPC6	2 - 2	NT30141	31.50
DTPC8	2 - 2	NT30141	41.00
DTPF	1 - 50	NT30141	4.30
DTPF	2 - 16	NT30141	4.30
DTPF	2 - 31	NT30141	4.30
DTPF	2 - 51	NT30141	4.30
DTPF	3 - 41	NT30141	4.30
DTPF	3 - 68	NT30141	4.30
DTPLB	1 - 44	NT30141	25.40
DTPLL24	1 - 44	NT30141	3.60
DTPLL240	1 - 44	NT30141	3.60
<b>I</b> DTPLLCL	1 - 44	NT30141	3.30
DTPLLGR	1 - 44	NT30141	3.30
DTPLLOR	1 - 44	NT30141	3.30
DTPLLRD	1 - 44	NT30141	3.30
DTSHT110415V	1 - 39	NT30141	158.00
DTSHT2460V	1 - 39	NT30141	158.00
DTSP	1 - 50	NT30141	4.40
DTTAX16PN3	1 - 50	NT30141	19.40
DTTAX25PN	1 - 50	NT30141	10.80
DTTAX25SP	1 - 50	NT30141	10.80
DTTAX50PN	1 - 50	NT30141	18.20
DTTC35	1 - 50	NT30141	16.60
DTTC5	1 - 50	NT30141	4.70
DTTLT35LPN	1 - 50	NT30141	10.80
DTTLT35PN	1 - 50	NT30141	10.80
DTTLT35SP	1 - 50	NT30141	10.80
<b>I</b> DTUVT12VDC	1 - 39	NT30141	171.00
DTUVT240VAC	1 - 39	NT30141	171.00
DTUVT24VDC	1 - 39	NT30141	171.00
<b>E</b>			
E125 NJ 3 100	3 - 24	NT20138	630.00
E125 NJ 3 125	3 - 24	NT20138	780.00
E125 NJ 3 20	3 - 24	NT20138	440.00
E125 NJ 3 32	3 - 24	NT20138	440.00
E125 NJ 3 50	3 - 24	NT20138	440.00
E125 NJ 3 63	3 - 24	NT20138	440.00
E250 NJ 3 100	3 - 47	NT20138	630.00
E250 NJ 3 125	3 - 47	NT20138	780.00
E250 NJ 3 160	3 - 47	NT20138	1030.00
E250 NJ 3 20	3 - 47	NT20138	440.00
E250 NJ 3 250	3 - 47	NT20138	1400.00
E250 NJ 3 32	3 - 47	NT20138	440.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
E250 NJ 3 50	3 - 47	NT20138	440.00
E250 NJ 3 63	3 - 47	NT20138	440.00
E400 NJ 3 400	3 - 69	NT20138	1930.00
E630 NE 3 630	3 - 86	NT20138	2700.00
EFR	5 - 28	NT30141	560.00
EFR	5 - 29	NT30141	560.00
ELR24010	1 - 11	NT10136	590.00
ELR240100	1 - 11	NT10136	590.00
ELR24030	1 - 11	NT10136	590.00
ELR240300	1 - 11	NT10136	590.00
ELR44030	1 - 11	NT10136	590.00
<b>A</b> ELTK	1 - 56	NA40037	250.00
<b>A</b> ELTS	1 - 56	NA40037	235.00
EPSR / EVSR	5 - 28	NT30141	310.00
EPSR / EVSR	5 - 29	NT30141	310.00
ERTD	5 - 28	NT30141	335.00
ERTD	5 - 29	NT30141	335.00
ESTD	5 - 28	NT30141	305.00
ESTD	5 - 29	NT30141	305.00
EVA3160H	2 - 30	NT40143	305.00
EVA3160H	2 - 51	NT40143	305.00
EVA3250H	2 - 30	NT40143	435.00
EVA3250H	2 - 51	NT40143	435.00
<b>F</b>			
FI	3 - 132	NT30141	900.00
FI	6 - 10	NT20138	900.00
FI	6 - 25	NT20138	900.00
FI	6 - 36	NT30141	900.00
FILED	3 - 132	NT30141	2050.00
FILED	6 - 10	NT20138	2050.00
FILED	6 - 36	NT30141	2050.00
<b>G</b>			
GB224184U	2 - 63	NT40143	980.00
<b>I</b> GB212183TF	2 - 62	NT40143	450.00
GB212183U	2 - 62	NT40143	560.00
<b>I</b> GB224181TF	2 - 64	NT40143	610.00
<b>I</b> GB224182TF	2 - 63	NT40143	610.00
GB224182TF	2 - 63	NT40143	610.00
<b>I</b> GB224183PNTF	2 - 63	NT40143	790.00
GB224183PNU	2 - 63	NT40143	980.00
<b>I</b> GB224183TF	2 - 62	NT40143	610.00
GB224183U	2 - 62	NT40143	720.00
<b>I</b> GB236183TF	2 - 62	NT40143	790.00
GB236183U	2 - 62	NT40143	910.00
<b>I</b> GB248181TF	2 - 64	NT40143	960.00
<b>I</b> GB248182TF	2 - 63	NT40143	960.00
GB248182TF	2 - 63	NT40143	960.00
<b>I</b> GB248183PNTF	2 - 63	NT40143	1220.00
GB248183PNU	2 - 63	NT40143	1440.00

<b>CAT. NO.</b>	<b>PAGE</b>	<b>P.S.</b>	<b>PRICE \$</b>
I GB248183TF	2 - 62	NT40143	960.00
GB248183U	2 - 62	NT40143	1080.00
GB248184U	2 - 63	NT40143	1440.00
I GB260183TF	2 - 62	NT40143	1150.00
GB260183U	2 - 62	NT40143	1270.00
I GB272181TF	2 - 64	NT40143	1350.00
I GB272182TF	2 - 63	NT40143	1350.00
GB272182TF	2 - 63	NT40143	1350.00
I GB272183PNTF	2 - 63	NT40143	1700.00
GB272183PNU	2 - 63	NT40143	1900.00
I GB272183TF	2 - 62	NT40143	1350.00
GB272183U	2 - 62	NT40143	1470.00
GB272184U	2 - 63	NT40143	1900.00
I GB284183TF	2 - 62	NT40143	1610.00
GB284183U	2 - 62	NT40143	1730.00
I GB296181TF	2 - 64	NT40143	1810.00
I GB296182TF	2 - 63	NT40143	1810.00
GB296182TF	2 - 63	NT40143	1810.00
I GB296183PNTF	2 - 63	NT40143	2250.00
GB296183PNU	2 - 63	NT40143	2450.00
I GB296183TF	2 - 62	NT40143	1810.00
GB296183U	2 - 62	NT40143	1930.00
GB296184U	2 - 63	NT40143	2450.00
GBBBC	2 - 64	NT40143	4.00
GBIC	2 - 64	NT40143	5.00
GBIB	2 - 64	NT40143	5.00
GBL148L	2 - 64	NT40143	10.00
GBL148R	2 - 64	NT40143	10.00
GBL4996L	2 - 64	NT40143	10.00
GBL4996R	2 - 64	NT40143	10.00
GBLM	2 - 64	NT40143	50.00
GBPL3P	2 - 64	NT40143	2.00
GBPL4P	2 - 64	NT40143	2.00
GBSPP3P	2 - 64	NT40143	5.00
GBSPP4P	2 - 64	NT40143	6.00
GBTOC	2 - 51	NT40143	1.50
GBTB1	2 - 64	NT40143	2.00
GBTB2	2 - 64	NT40143	2.00
GBTB3	2 - 64	NT40143	2.00
GBTB4	2 - 64	NT40143	2.00
GBTOC	2 - 64	NT40143	1.50
GBUSL	2 - 64	NT40143	2.00
<b>H</b>			
H125 NJ 3 100	3 - 30	NT20138	1110.00
H125 NJ 3 125	3 - 30	NT20138	1110.00
H125 NJ 3 20	3 - 30	NT20138	960.00
H125 NJ 3 32	3 - 30	NT20138	960.00
H125 NJ 3 50	3 - 30	NT20138	960.00
H125 NJ 3 63	3 - 30	NT20138	960.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

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CAT. NO.	PAGE	P.S.	PRICE \$
I H125 NJ 4 100	3 - 30	NT20138	1470.00
I H125 NJ 4 125	3 - 30	NT20138	1470.00
I H125 NJ 4 20	3 - 30	NT20138	1290.00
I H125 NJ 4 32	3 - 30	NT20138	1290.00
I H125 NJ 4 50	3 - 30	NT20138	1290.00
I H125 NJ 4 63	3 - 30	NT20138	1290.00
H160 NJ 3 160	3 - 45	NT20138	1650.00
I H160 NJ 4 160	3 - 45	NT20138	2210.00
H250 NE 3 125	3 - 56	NT20138	2050.00
H250 NE 3 125 AC	3 - 57	NT20138	4150.00
H250 NE 3 250	3 - 56	NT20138	2560.00
H250 NE 3 250 AC	3 - 57	NT20138	4350.00
H250 NE 3 40	3 - 56	NT20138	1670.00
H250 NE 3 40 AC	3 - 57	NT20138	3550.00
I H250 NE 3 AP 3	3 - 56	NT20138	187.00
I H250 NE 4 125	3 - 56	NT20138	3220.00
H250 NE 4 125 AC	3 - 57	NT20138	4800.00
I H250 NE 4 250	3 - 56	NT20138	3410.00
H250 NE 4 250 AC	3 - 57	NT20138	4990.00
I H250 NE 4 40	3 - 56	NT20138	3580.00
H250 NE 4 40 AC	3 - 57	NT20138	4400.00
I H250 NE 4 AN 3	3 - 56	NT20138	187.00
I H250 NE 4 AP 3	3 - 56	NT20138	187.00
I H250 NE 4 APN 3	3 - 56	NT20138	365.00
H250 NJ 3 250	3 - 53	NT20138	2020.00
I H250 NJ 4 250	3 - 53	NT20138	2700.00
H400 NE 3 250	3 - 81	NT20138	3240.00
I H400 NE 3 250 X1L	3 - 82	NT20138	5350.00
I H400 NE 3 250 X1S	3 - 82	NT20138	7150.00
H400 NE 3 400	3 - 81	NT20138	3240.00
I H400 NE 3 400 X1L	3 - 82	NT20138	5350.00
I H400 NE 3 400 X1S	3 - 82	NT20138	7150.00
I H400 NE 3 AG 400	3 - 81	NT20138	187.00
I H400 NE 3 AP +	3 - 81	NT20138	187.00
I H400 NE 3 APG 400	3 - 81	NT20138	375.00
I H400 NE 4 250	3 - 81	NT20138	4320.00
I H400 NE 4 250 X1L	3 - 82	NT20138	6540.00
I H400 NE 4 250 X1S	3 - 82	NT20138	8250.00
I H400 NE 4 400	3 - 81	NT20138	4320.00
I H400 NE 4 400 X1L	3 - 82	NT20138	6540.00
I H400 NE 4 400 X1S	3 - 82	NT20138	8250.00
I H400 NE 4 AGN 400	3 - 81	NT20138	375.00
I H400 NE 4 AN +	3 - 81	NT20138	187.00
I H400 NE 4 AP +	3 - 81	NT20138	187.00
I H400 NE 4 APN +	3 - 81	NT20138	375.00
H800 NE 3 630	3 - 109	NT20138	4230.00
H800 NE 3 800	3 - 109	NT20138	4590.00
H800 NE 3 800 X1L	3 - 110	NT20138	7150.00
H800 NE 3 800 X1S	3 - 110	NT20138	8650.00

CAT. NO.	PAGE	P.S.	PRICE \$
I H800 NE 3 AG #	3 - 109	NT20138	180.00
I H800 NE 3 AP #	3 - 109	NT20138	180.00
I H800 NE 3 APG #	3 - 109	NT20138	180.00
H800 NE 4 630	3 - 109	NT20138	4810.00
H800 NE 4 800	3 - 109	NT20138	5220.00
H800 NE 4 800 X1L	3 - 110	NT20138	8500.00
H800 NE 4 800 X1S	3 - 110	NT20138	10300.00
I H800 NE 4 AGN #	3 - 109	NT20138	360.00
I H800 NE 4 AN #	3 - 109	NT20138	180.00
I H800 NE 4 AP #	3 - 109	NT20138	180.00
I H800 NE 4 APN #	3 - 109	NT20138	360.00
HC12153	4 - 16	NT40143	1140.00
HC12183	4 - 16	NT40143	1510.00
HC12213	4 - 16	NT40143	1840.00
HC12243	4 - 16	NT40143	1930.00
HC12273	4 - 16	NT40143	2090.00
HC12303	4 - 16	NT40143	2300.00
HC12333	4 - 16	NT40143	2430.00
HC12363	4 - 16	NT40143	2620.00
HC12393	4 - 16	NT40143	2710.00
HC12423	4 - 16	NT40143	3000.00
HC12453	4 - 16	NT40143	3240.00
HC16153	4 - 16	NT40143	1710.00
HC16183	4 - 16	NT40143	2050.00
HC16213	4 - 16	NT40143	2360.00
HC16243	4 - 16	NT40143	2570.00
HC16273	4 - 16	NT40143	2850.00
HC16303	4 - 16	NT40143	3240.00
HC16333	4 - 16	NT40143	3360.00
HC16363	4 - 16	NT40143	3620.00
HC16393	4 - 16	NT40143	3800.00
HC16423	4 - 16	NT40143	3930.00
HC16453	4 - 16	NT40143	4200.00
HC22153	4 - 16	NT40143	2640.00
HC22183	4 - 16	NT40143	2840.00
HC22213	4 - 16	NT40143	3140.00
HC22243	4 - 16	NT40143	3430.00
HC22273	4 - 16	NT40143	3710.00
HC22303	4 - 16	NT40143	3980.00
HC22333	4 - 16	NT40143	4210.00
HC22363	4 - 16	NT40143	4350.00
HC22393	4 - 16	NT40143	4490.00
HC22423	4 - 16	NT40143	4680.00
HC22453	4 - 16	NT40143	4910.00
HCD250	4 - 17	NT40143	355.00
HCD250P	4 - 17	NT40143	355.00
HCD800	4 - 17	NT40143	740.00
HCDN630	4 - 17	NT40143	510.00
HCDW630	4 - 17	NT40143	510.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
HCL1250	4 - 17	NT40143	770.00
HCL1250	4 - 17	NT40143	770.00
HCL250	4 - 17	NT40143	355.00
HCL250P	4 - 17	NT40143	355.00
HCL800	4 - 17	NT40143	740.00
HCLN630	4 - 17	NT40143	510.00
HCLW630	4 - 17	NT40143	510.00
HCR1250	4 - 17	NT40143	770.00
HCR1250	4 - 17	NT40143	770.00
HCR250	4 - 17	NT40143	355.00
HCR250P	4 - 17	NT40143	355.00
HCR800	4 - 17	NT40143	740.00
HCRN630	4 - 17	NT40143	510.00
HCRW630	4 - 17	NT40143	510.00
<b>A</b> HCSTD1DS16153	4 - 15	NT40143	3990.00
<b>A</b> HCSTD2DS16243	4 - 15	NT40143	5680.00
<b>A</b> HCSTD3SSL16153	4 - 15	NT40143	3990.00
<b>A</b> HCSTD4SSR16153	4 - 15	NT40143	3990.00
<b>A</b> HCSTD5SSL16213	4 - 15	NT40143	5460.00
<b>A</b> HCSTD6SSR16213	4 - 15	NT40143	5460.00
<b>A</b> HCSTD7SSL22243	4 - 15	NT40143	7000.00
<b>A</b> HCSTD8SSR22243	4 - 15	NT40143	7000.00
<b>I</b>			
IBC108P	1 - 43	NT40143	10.60
IBC112P	1 - 43	NT40143	17.80
IBC115P	1 - 43	NT40143	21.20
IBC118P	1 - 43	NT40143	29.60
IBC121P	1 - 43	NT40143	36.00
IBC155P	1 - 43	NT40143	77.50
IBCEC1	1 - 43	NT40143	2.00
ICL102	1 - 43	NT40143	26.00
ICL123	1 - 43	NT40143	49.00
ICL153	1 - 43	NT40143	61.00
ICL183	1 - 43	NT40143	72.50
ICL213	1 - 43	NT40143	94.50
ICL561F	1 - 43	NT40143	78.00
ICL562	1 - 43	NT40143	128.00
ICL563A	1 - 43	NT40143	200.00
ICL564	1 - 43	NT40143	255.00
ICL573	1 - 43	NT40143	225.00
ICL573F	1 - 43	NT40143	230.00
ICL62	1 - 43	NT40143	18.20
ICLEC23	1 - 43	NT40143	4.00
ICLEC4	1 - 43	NT40143	4.00
ICLTOC	1 - 50	NT40143	4.60
ILC 4EN	2 - 3	NT40143	27.00
ILC 4S	2 - 3	NT40143	65.50
<b>A</b> ILC4SLD	1 - 49	NT40143	71.50
<b>A</b> ILC4SLD	2 - 3	NT40143	71.50

CAT. NO.	PAGE	P.S.	PRICE \$
<b>A</b> ILC4SLD10H	1 - 49	NT40143	77.00
<b>A</b> ILC4SLD10H	2 - 3	NT40143	77.00
ILC4SLDCB1001P	1 - 48	NT40143	365.00
ILC4SLDCB1001PD	1 - 48	NT40143	440.00
ILC4SLDCB1003P	1 - 48	NT40143	950.00
ILC4SLDCB1003PD	1 - 48	NT40143	1020.00
ILC4SLDCB1251P	1 - 48	NT40143	365.00
ILC4SLDCB1251PD	1 - 48	NT40143	440.00
ILC4SLDCB1253P	1 - 48	NT40143	950.00
ILC4SLDCB1253PD	1 - 48	NT40143	1020.00
ILC4SLDCB1P	1 - 48	NT40143	156.00
ILC4SLDCB1PD	1 - 48	NT40143	161.00
ILC4SLDCB801P	1 - 48	NT40143	365.00
ILC4SLDCB801PD	1 - 48	NT40143	440.00
ILC4SLDCB803P	1 - 48	NT40143	950.00
ILC4SLDCB803PD	1 - 48	NT40143	1020.00
ILC 8EN	2 - 3	NT40143	31.00
ILC 8S	2 - 3	NT40143	79.00
ILCSB	2 - 3	NT40143	3.60
IRC	5 - 28	NT30141	119.00
IRC	5 - 29	NT30141	119.00
ISO 3160SFH	2 - 31	NB20064	500.00
ISO 3160SFH	2 - 69	NB20064	500.00
<b>K</b>			
KEY92268	2 - 16	NT40143	7.80
KEY92268	2 - 30	NT40143	7.80
KEY92268	2 - 51	NT40143	7.80
KEYCL001	2 - 16	NT40143	7.80
KEYCL001	2 - 30	NT40143	7.80
KEYCL001	2 - 51	NT40143	7.80
<b>L</b>			
L125 NJ 3 100	3 - 31	NT20138	1170.00
L125 NJ 3 125	3 - 31	NT20138	1170.00
L125 NJ 3 20	3 - 31	NT20138	1090.00
L125 NJ 3 32	3 - 31	NT20138	1090.00
L125 NJ 3 50	3 - 31	NT20138	1090.00
L125 NJ 3 63	3 - 31	NT20138	1090.00
L125 NJ 4 100	3 - 31	NT20138	1570.00
L125 NJ 4 125	3 - 31	NT20138	1570.00
L125 NJ 4 20	3 - 31	NT20138	1440.00
L125 NJ 4 32	3 - 31	NT20138	1440.00
L125 NJ 4 50	3 - 31	NT20138	1440.00
L125 NJ 4 63	3 - 31	NT20138	1440.00
L125 PJ 3 100	3 - 29	NT20138	830.00
L125 PJ 3 125	3 - 29	NT20138	830.00
L125 PJ 3 20	3 - 29	NT20138	730.00
L125 PJ 3 32	3 - 29	NT20138	730.00
L125 PJ 3 50	3 - 29	NT20138	730.00
L125 PJ 3 63	3 - 29	NT20138	730.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
L160 NJ 3 160	3 - 46	NT20138	2030.00
I L160 NJ 4 160	3 - 46	NT20138	2710.00
I L2000KT	2 - 69	NB20064	29.60
I L250 NJ 3 250	3 - 58	NT20138	2340.00
I L250 NJ 4 250	3 - 58	NT20138	3120.00
I L400 NE 3 250	3 - 84	NT20138	3370.00
I L400 NE 3 400	3 - 84	NT20138	3370.00
I L400 NE 3 AG 400	3 - 84	NT20138	187.00
I L400 NE 3 AP +	3 - 84	NT20138	187.00
I L400 NE 3 APG 400	3 - 84	NT20138	375.00
I L400 NE 4 250	3 - 84	NT20138	4380.00
I L400 NE 4 400	3 - 84	NT20138	4380.00
I L400 NE 4 AGN 400	3 - 84	NT20138	375.00
I L400 NE 4 AN +	3 - 84	NT20138	187.00
I L400 NE 4 AP +	3 - 84	NT20138	187.00
I L400 NE 4 APN +	3 - 84	NT20138	375.00
L400 PE 3 250	3 - 77	NT20138	3240.00
L400 PE 3 400	3 - 77	NT20138	3240.00
L800 NE 3 630	3 - 111	NT20138	4520.00
L800 NE 3 800	3 - 111	NT20138	4960.00
I L800 NE 3 AG #	3 - 111	NT20138	180.00
I L800 NE 3 AP #	3 - 111	NT20138	180.00
I L800 NE 3 APG #	3 - 111	NT20138	180.00
L800 NE 4 630	3 - 111	NT20138	5350.00
L800 NE 4 800	3 - 111	NT20138	5960.00
I L800 NE 4 AGN #	3 - 111	NT20138	360.00
I L800 NE 4 AN #	3 - 111	NT20138	180.00
I L800 NE 4 AP #	3 - 111	NT20138	180.00
I L800 NE 4 APN #	3 - 111	NT20138	360.00
L800 PE 3 630	3 - 112	NT20138	5340.00
L800 PE 3 800	3 - 112	NT20138	5460.00
LABLE148DT	1 - 47	NT40143	22.80
LABLE4996DT	1 - 47	NT40143	22.80
LB18	1 - 9	NT10136	27.00
LB3PH12	1 - 9	NZ00150	153.00
LB3PH18	1 - 9	NZ00150	215.00
LD12/15	2 - 9	NT40143	78.00
LD12/15	2 - 10	NT40143	78.00
LD15/18	2 - 9	NT40143	78.00
LD18/21	2 - 9	NT40143	83.00
LD18/21	2 - 10	NT40143	83.00
LD24	2 - 9	NT40143	109.00
LD6/8	2 - 9	NT40143	67.50
LD6/8	2 - 10	NT40143	67.50
LD9/12	2 - 9	NT40143	67.50
LE 73151753	2 - 31	NA30018	1090.00
LOCTITE 480	6 - 11	NT10136	83.00
LOCTITE 480	6 - 26	NT10136	83.00
LSIG	3 - 132	NT30141	870.00

CAT. NO.	PAGE	P.S.	PRICE \$
LSIG	6 - 25	NT20138	870.00
LSIG	6 - 36	NT30141	870.00
LSIP	3 - 132	NT30141	700.00
LSIP	6 - 25	NT20138	700.00
LSIP	6 - 36	NT30141	700.00
<b>M</b>			
A M22IVS	1 - 42	NT40143	23.40
MCEPCN5MFM	2 - 7	NB20054	88.00
MCEPCN9MFM	2 - 7	NB20054	140.00
I A MH6S633	5 - 9	NZ00150	8460.00
I A MH6S644	5 - 9	NZ00150	10920.00
I A MS12S1033	5 - 9	NZ00150	15880.00
I A MS12S1044	5 - 9	NZ00150	20740.00
I A MS12S1233	5 - 9	NZ00150	18140.00
I A MS12S1244	5 - 9	NZ00150	23730.00
I A MS16S1633	5 - 9	NZ00150	29040.00
I A MS16S1644	5 - 9	NZ00150	38180.00
I A MS20E2033	5 - 9	NZ00150	32570.00
I A MS20E2044	5 - 9	NZ00150	42640.00
I A MS25E2533	5 - 9	NZ00150	34950.00
I A MS25E2544	5 - 9	NZ00150	45820.00
I A MS6N433	5 - 9	NZ00150	7300.00
I A MS6N444	5 - 9	NZ00150	7730.00
I A MS6N633	5 - 9	NZ00150	7300.00
I A MS6N644	5 - 9	NZ00150	8860.00
I A MS6S633	5 - 9	NZ00150	7850.00
I A MS6S644	5 - 9	NZ00150	10140.00
I A MS8N833	5 - 9	NZ00150	8900.00
I A MS8N844	5 - 9	NZ00150	11520.00
I A MS8S833	5 - 9	NZ00150	9670.00
I A MS8S844	5 - 9	NZ00150	12510.00
MST	5 - 28	NT30141	210.00
MST	5 - 29	NT30141	210.00
<b>N</b>			
NC212/183U	2 - 58	NT40143	200.00
NC218/183U	2 - 58	NT40143	225.00
NC224182U	2 - 60	NT40143	280.00
NC224183PNU	2 - 59	NT40143	430.00
NC224/183U	2 - 58	NT40143	280.00
NC224/184U	2 - 59	NT40143	430.00
NC230/183U	2 - 58	NT40143	310.00
NC236182U	2 - 60	NT40143	350.00
NC236/183U	2 - 58	NT40143	350.00
NC236/184U	2 - 59	NT40143	520.00
NC242/183U	2 - 58	NT40143	380.00
NC248182U	2 - 60	NT40143	425.00
NC248183PNU	2 - 59	NT40143	630.00
NC248/183U	2 - 58	NT40143	425.00
NC248/184U	2 - 59	NT40143	630.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
NC250HTOPC	2 - 61	NT40143	0.75
NC250TOPC	2 - 51	NT40143	0.80
NC250TOPC	2 - 61	NT40143	0.80
NC254/183U	2 - 58	NT40143	475.00
NC260182U	2 - 60	NT40143	495.00
NC260/183U	2 - 58	NT40143	495.00
NC260/184U	2 - 59	NT40143	750.00
<b>I</b> NC272183PNU	2 - 59	NT40143	980.00
NC272/183U	2 - 58	NT40143	660.00
NC272/184U	2 - 59	NT40143	980.00
NC278/183U	2 - 58	NT40143	780.00
NC284/183U	2 - 58	NT40143	850.00
<b>I</b> NC296183PNU	2 - 59	NT40143	1330.00
NC296/183U	2 - 58	NT40143	990.00
NC4108/183TF	2 - 59	NT40143	1380.00
NC412/183U	2 - 59	NT40143	375.00
NC418/183U	2 - 59	NT40143	425.00
NC424/183U	2 - 59	NT40143	480.00
NC430/183U	2 - 59	NT40143	540.00
NC436/183U	2 - 59	NT40143	580.00
NC442/183U	2 - 59	NT40143	620.00
NC448/183U	2 - 59	NT40143	710.00
NC454/183U	2 - 59	NT40143	750.00
NC460/183U	2 - 59	NT40143	790.00
NC472/183U	2 - 59	NT40143	930.00
NC478/183U	2 - 59	NT40143	1000.00
NC484/183U	2 - 59	NT40143	1090.00
NC496/183U	2 - 59	NT40143	1250.00
NCBBC	2 - 61	NT40143	5.70
NCBC	2 - 61	NT40143	10.80
NCBC4	2 - 61	NT40143	16.00
<b>A</b> NCCK200	2 - 61	NT40143	135.00
NCCK200CP	2 - 31	NT40143	182.00
NCCK200CPP	2 - 51	NT40143	187.00
<b>A</b> NCCK250	2 - 61	NT40143	355.00
NCCK250CP	2 - 31	NT40143	490.00
NCCK250CPP	2 - 51	NT40143	500.00
<b>A</b> NCCK400	2 - 61	NT40143	510.00
<b>A</b> NCCK4002	2 - 61	NT40143	720.00
NCCK4002CPP	2 - 51	NT40143	820.00
NCCK400CPP	2 - 51	NT40143	590.00
NCH123	2 - 61	NT40143	15.00
NCH412/273U	2 - 60	NT40143	560.00
NCH412/3027/183U	2 - 60	NT40143	660.00
NCH412/4227/183U	2 - 60	NT40143	790.00
NCH412/6027/183U	2 - 60	NT40143	980.00
NCH418/273U	2 - 60	NT40143	760.00
NCH424/273U	2 - 60	NT40143	920.00
NCH46/1227/183U	2 - 60	NT40143	500.00

CAT. NO.	PAGE	P.S.	PRICE \$
NCH46/2427/183U	2 - 60	NT40143	560.00
NCH46/273U	2 - 60	NT40143	385.00
NCH46/3627/183U	2 - 60	NT40143	590.00
NCH46/4827/183U	2 - 60	NT40143	630.00
NCL243	2 - 61	NT40143	16.60
NCL24C	2 - 61	NT40143	16.60
NCS250GT	2 - 61	NT40143	78.00
NEB185	1 - 50	NT40143	88.00
NEB185	2 - 57	NT40143	88.00
NEB33S	2 - 57	NT40143	88.00
NLC12FE	2 - 9	NT40143	35.50
NLC12S	2 - 9	NT40143	164.00
NLC15FE	2 - 9	NT40143	35.50
NLC15S	2 - 9	NT40143	187.00
NLC18FE	2 - 9	NT40143	41.50
NLC18S	2 - 9	NT40143	205.00
NLC21FE	2 - 9	NT40143	45.50
NLC21S	2 - 9	NT40143	215.00
NLC24S	2 - 9	NT40143	275.00
NLC8FE	2 - 9	NT40143	27.40
NLC8S	2 - 9	NT40143	141.00
<b>P</b>			
PRE-TRIP ALARM	6 - 10	NT20138	770.00
PXB80012U	4 - 4	NT40143	590.00
PXB80018U	4 - 4	NT40143	810.00
PXB80024U	4 - 4	NT40143	1040.00
PXB80030U	4 - 4	NT40143	1230.00
PXB80036U	4 - 4	NT40143	1600.00
PXB80042U	4 - 4	NT40143	1850.00
PXB80048U	4 - 4	NT40143	2120.00
PXB80060U	4 - 4	NT40143	2540.00
PXB8006U	4 - 4	NT40143	510.00
PXB80072U	4 - 4	NT40143	3250.00
<b>R</b>			
RD1B212	8 - 5	NT30141	1080.00
RD1B214	8 - 5	NT30141	1080.00
RD1B215	8 - 5	NT30141	1080.00
RD1B21H	8 - 5	NT30141	1080.00
RD1DF12	8 - 6	NT30141	520.00
RD1DF14	8 - 6	NT30141	520.00
RD1DF15	8 - 6	NT30141	520.00
RD1EP212	8 - 7	NT30141	910.00
RD1EP214	8 - 7	NT30141	910.00
RD1EP215	8 - 7	NT30141	910.00
RD1EP21H	8 - 7	NT30141	910.00
RD1G212	8 - 10	NT30141	1000.00
RD1G214	8 - 10	NT30141	1000.00
RD1G215	8 - 10	NT30141	1000.00
RD3AF12 (110V AC)	8 - 4	NT30141	910.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
RD3AF14 (240 V AC)	8 - 4	NT30141	910.00
RD3AF15 (415 V AC)	8 - 4	NT30141	910.00
RD3AF1H (24-150 V DC)	8 - 4	NT30141	910.00
RD3AF1N (24 V AC)	8 - 4	NT30141	910.00
RD3E212B	8 - 8	NT30141	1510.00
RD3E217B	8 - 8	NT30141	1510.00
RD3E218B	8 - 8	NT30141	1510.00
RD3E21HB	8 - 8	NT30141	1510.00
<b>I</b> RD4848C	8 - 15	NT30141	200.00
<b>I</b> RD7272C	8 - 15	NT30141	200.00
RD7296A	8 - 15	NT30141	88.00
<b>I</b> RD9696C	8 - 15	NT30141	255.00
<b>S</b>			
S1000 NE 3 1000	3 - 113	NT20138	6850.00
S1000 NE 3 1000 X1L	3 - 114	NT20138	7750.00
S1000 NE 3 1000 X1S	3 - 114	NT20138	9450.00
<b>I</b> S1000 NE 3 AG #	3 - 113	NT20138	180.00
<b>I</b> S1000 NE 3 AP #	3 - 113	NT20138	180.00
<b>I</b> S1000 NE 3 APG #	3 - 113	NT20138	360.00
S1000 NE 4 1000	3 - 113	NT20138	4812.00
S1000 NE 4 1000 X1L	3 - 114	NT20138	9300.00
S1000 NE 4 1000 X1S	3 - 114	NT20138	11340.00
<b>I</b> S1000 NE 4 AGN #	3 - 113	NT20138	360.00
<b>I</b> S1000 NE 4 AN #	3 - 113	NT20138	180.00
<b>I</b> S1000 NE 4 AP #	3 - 113	NT20138	180.00
<b>I</b> S1000 NE 4 APN #	3 - 113	NT20138	360.00
<b>I</b> S100 GF 2 100	3 - 26	NT20138	430.00
<b>I</b> S100 GF 2 15	3 - 26	NT20138	315.00
S100 GF 2 20	3 - 26	NT20138	315.00
S100 GF 2 30	3 - 26	NT20138	315.00
S100 GF 2 40	3 - 26	NT20138	315.00
S100 GF 2 50	3 - 26	NT20138	315.00
S100 GF 2 60	3 - 26	NT20138	315.00
S100 GF 2 75	3 - 26	NT20138	355.00
S1250 GE 3 1250	3 - 121	NT20138	8650.00
<b>I</b> S1250 GE 3 AG #	3 - 121	NT20138	180.00
<b>I</b> S1250 GE 3 AP #	3 - 121	NT20138	180.00
<b>I</b> S1250 GE 3 APG #	3 - 121	NT20138	180.00
S1250 GE 4 1250	3 - 121	NT20138	10250.00
<b>I</b> S1250 GE 4 AGN #	3 - 121	NT20138	360.00
<b>I</b> S1250 GE 4 AN #	3 - 121	NT20138	180.00
<b>I</b> S1250 GE 4 AP #	3 - 121	NT20138	180.00
<b>I</b> S1250 GE 4 APN #	3 - 121	NT20138	360.00
S1250NN3	3 - 142	NT20138	7600.00
S1250NN4	3 - 142	NT20138	8950.00
S125 GJ 3 100	3 - 28	NT20138	900.00
S125 GJ 3 100PM	3 - 146	NT20138	1050.00
S125 GJ 3 125	3 - 28	NT20138	1000.00
S125 GJ 3 125PM	3 - 146	NT20138	1210.00

CAT. NO.	PAGE	P.S.	PRICE \$
S125 GJ 3 20	3 - 28	NT20138	750.00
S125 GJ 3 32	3 - 28	NT20138	750.00
S125 GJ 3 50	3 - 28	NT20138	750.00
I S125 GJ 3 50PM	3 - 146	NT20138	850.00
S125 GJ 3 63	3 - 28	NT20138	750.00
S125 GJ 3 63PM	3 - 146	NT20138	850.00
S125 GJ 4 100	3 - 28	NT20138	1210.00
S125 GJ 4 125	3 - 28	NT20138	1330.00
S125 GJ 4 20	3 - 28	NT20138	990.00
S125 GJ 4 32	3 - 28	NT20138	990.00
S125 GJ 4 50	3 - 28	NT20138	990.00
S125 GJ 4 63	3 - 28	NT20138	990.00
I S125ND3	3 - 143	NT20138	POA
I S125ND4	3 - 143	NT20138	POA
S125 NF 1 100	3 - 25	NT20138	310.00
S125 NF 1 125	3 - 25	NT20138	310.00
S125 NF 1 16	3 - 25	NT20138	165.00
S125 NF 1 20	3 - 25	NT20138	165.00
S125 NF 1 25	3 - 25	NT20138	165.00
S125 NF 1 32	3 - 25	NT20138	165.00
S125 NF 1 40	3 - 25	NT20138	165.00
S125 NF 1 50	3 - 25	NT20138	165.00
S125 NF 1 63	3 - 25	NT20138	165.00
S125 NF 1 80	3 - 25	NT20138	235.00
S125 NJ 3 100	3 - 27	NT20138	680.00
S125 NJ 3 125	3 - 27	NT20138	810.00
S125 NJ 3 20	3 - 27	NT20138	480.00
S125 NJ 3 20PM	3 - 146	NT20138	850.00
S125 NJ 3 32	3 - 27	NT20138	480.00
S125 NJ 3 32PM	3 - 146	NT20138	850.00
S125 NJ 3 50	3 - 27	NT20138	480.00
S125 NJ 3 63	3 - 27	NT20138	480.00
S125NN3	3 - 142	NT20138	430.00
I S125NN4	3 - 142	NT20138	570.00
S1600 NE 3 1250	3 - 122	NT20138	9820.00
I S1600 NE 3 AG #	3 - 122	NT20138	180.00
I S1600 NE 3 AP #	3 - 122	NT20138	180.00
I S1600 NE 3 APG #	3 - 122	NT20138	180.00
S1600 NE 4 1250	3 - 122	NT20138	11500.00
I S1600 NE 4 AGN #	3 - 122	NT20138	360.00
I S1600 NE 4 AN #	3 - 122	NT20138	180.00
I S1600 NE 4 AP #	3 - 122	NT20138	180.00
I S1600 NE 4 APN #	3 - 122	NT20138	360.00
S1600NN3	3 - 142	NT20138	8700.00
S1600NN4	3 - 142	NT20138	9900.00
S160 GJ 3 100	3 - 44	NT20138	900.00
S160 GJ 3 125	3 - 44	NT20138	1000.00
S160 GJ 3 160	3 - 44	NT20138	1210.00
S160 GJ 3 160PM	3 - 146	NT20138	1440.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
S160 GJ 3 50	3 - 44	NT20138	750.00
S160 GJ 3 63	3 - 44	NT20138	750.00
<b>I</b> S160 GJ 4 100	3 - 44	NT20138	1210.00
S160 GJ 4 125	3 - 44	NT20138	1330.00
S160 GJ 4 160	3 - 44	NT20138	1620.00
<b>I</b> S160 GJ 4 50	3 - 44	NT20138	950.00
<b>I</b> S160 GJ 4 63	3 - 44	NT20138	990.00
<b>I</b> S160ND3	3 - 143	NT20138	POA
<b>I</b> S160ND4	3 - 143	NT20138	POA
S160 NF 1 100	3 - 42	NT20138	310.00
S160 NF 1 125	3 - 42	NT20138	310.00
S160 NF 1 16	3 - 42	NT20138	165.00
S160 NF 1 160	3 - 42	NT20138	340.00
S160 NF 1 20	3 - 42	NT20138	165.00
S160 NF 1 25	3 - 42	NT20138	165.00
S160 NF 1 32	3 - 42	NT20138	165.00
S160 NF 1 40	3 - 42	NT20138	165.00
S160 NF 1 50	3 - 42	NT20138	165.00
S160 NF 1 63	3 - 42	NT20138	165.00
S160 NF 1 80	3 - 42	NT20138	220.00
S160 NJ 3 100	3 - 43	NT20138	680.00
S160 NJ 3 125	3 - 43	NT20138	810.00
S160 NJ 3 160	2 - 31	NT20138	1080.00
S160 NJ 3 160	3 - 43	NT20138	1080.00
S160 NJ 3 20	3 - 43	NT20138	480.00
S160 NJ 3 32	3 - 43	NT20138	480.00
S160 NJ 3 50	3 - 43	NT20138	480.00
S160 NJ 3 63	3 - 43	NT20138	480.00
S160 NJ 4 100	3 - 43	NT20138	900.00
S160 NJ 4 125	3 - 43	NT20138	1090.00
S160 NJ 4 160	3 - 43	NT20138	1425.00
S160 NJ 4 20	3 - 43	NT20138	630.00
<b>I</b> S160 NJ 4 32	3 - 43	NT20138	630.00
S160 NJ 4 50	3 - 43	NT20138	630.00
S160 NJ 4 63	3 - 43	NT20138	630.00
S160NN3	3 - 142	NT20138	500.00
S160NN4	3 - 142	NT20138	670.00
S250 GJ 3 250	3 - 49	NT20138	1680.00
<b>I</b> S250 GJ 3 250M1000	3 - 49	NT20138	1870.00
<b>I A</b> S250 GJ 3 250MAG	3 - 49	NT20138	1910.00
S250 GJ 3 250PM	3 - 146	NT20138	1780.00
S250 GJ 3 SO23160	3 - 49	NT20138	1780.00
S250 GJ 4 250	3 - 49	NT20138	2240.00
<b>I</b> S250ND3	3 - 143	NT20138	POA
<b>I</b> S250ND4	3 - 143	NT20138	POA
S250NJ	2 - 31	NT20138	1480.00
S250 NJ 3 250	3 - 48	NT20138	1480.00
S250 NJ 4 250	3 - 48	NT20138	1860.00
S250NN3	2 - 31	NT20138	500.00

CAT. NO.	PAGE	P.S.	PRICE \$
S250NN3	3 - 142	NT20138	500.00
S250NN4	3 - 142	NT20138	670.00
S250 PE 3 125	3 - 52	NT20138	1730.00
S250 PE 3 125 AC	3 - 54	NT20138	3760.00
S250 PE 3 250	3 - 52	NT20138	2100.00
S250 PE 3 250 AC	3 - 54	NT20138	3970.00
S250 PE 3 40 AC	3 - 54	NT20138	3560.00
S250 PE 3 AP 3	3 - 52	NT20138	187.00
S250 PE 4 125	3 - 52	NT20138	2430.00
S250 PE 4 125 AC	3 - 54	NT20138	4500.00
S250 PE 4 250	3 - 52	NT20138	2790.00
S250 PE 4 250 AC	3 - 54	NT20138	4760.00
S250 PE 4 40 AC	3 - 54	NT20138	4270.00
S250 PE 4 AN 4	3 - 52	NT20138	187.00
S250 PE 4 AP 4	3 - 52	NT20138	187.00
S250 PE 4 APN 4	3 - 52	NT20138	365.00
S400 CJ 3 250	3 - 70	NT20138	1930.00
S400 CJ 3 400	3 - 70	NT20138	1970.00
S400 GE 3 250	3 - 75	NT20138	2550.00
S400 GE 3 250 X1L	3 - 76	NT20138	4650.00
S400 GE 3 250 X1S	3 - 76	NT20138	6550.00
S400 GE 3 400	3 - 75	NT20138	2550.00
S400 GE 3 400PM	3 - 146	NT20138	3010.00
S400 GE 3 400 X1L	3 - 76	NT20138	4900.00
S400 GE 3 400 X1S	3 - 76	NT20138	6800.00
S400 GE 3 AG 400	3 - 75	NT20138	2720.00
S400 GE 3 AP 400	3 - 75	NT20138	2750.00
S400 GE 3 APG 400	3 - 75	NT20138	2930.00
S400 GE 4 250	3 - 75	NT20138	3380.00
S400 GE 4 250 X1L	3 - 76	NT20138	5690.00
S400 GE 4 250 X1S	3 - 76	NT20138	7750.00
S400 GE 4 400	3 - 75	NT20138	3400.00
S400 GE 4 400 X1L	3 - 76	NT20138	5880.00
S400 GE 4 400 X1S	3 - 76	NT20138	8160.00
S400 GE 4 AGN 400	3 - 75	NT20138	3780.00
S400 GE 4 AN 400	3 - 75	NT20138	3590.00
S400 GE 4 AP 400	3 - 75	NT20138	3590.00
S400 GE 4 APN 400	3 - 75	NT20138	3780.00
S400 GJ 3 250	3 - 73	NT20138	2310.00
S400 GJ 3 400	3 - 73	NT20138	2310.00
S400 GJ 4 250	3 - 73	NT20138	3080.00
S400 GJ 4 400	3 - 73	NT20138	3080.00
S400ND3	3 - 143	NT20138	POA
S400 NE 3 250	3 - 72	NT20138	2180.00
S400 NE 3 400	3 - 72	NT20138	2180.00
S400 NE 4 250	3 - 72	NT20138	2180.00
S400 NE 4 400	3 - 72	NT20138	2890.00
S400 NJ 3 250	3 - 71	NT20138	2020.00
S400 NJ 3 400	3 - 71	NT20138	2020.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
S400 NJ 4 250	3 - 71	NT20138	2700.00
S400 NJ 4 400	3 - 71	NT20138	2700.00
S400NN3	2 - 31	NT20138	1650.00
S400NN3	3 - 142	NT20138	1650.00
S400NN4	3 - 142	NT20138	2200.00
<b>I</b> S400 PE 3 250	3 - 79	NT20138	2780.00
S400 PE 3 400	3 - 79	NT20138	2780.00
<b>I</b> S400 PE 3 AG 400	3 - 79	NT20138	187.00
<b>I</b> S400 PE 3 AP +	3 - 79	NT20138	187.00
<b>I</b> S400 PE 3 APG 400	3 - 79	NT20138	375.00
<b>I</b> S400 PE 4 250	3 - 79	NT20138	3480.00
<b>I</b> S400 PE 4 400	3 - 79	NT20138	3480.00
<b>I</b> S400 PE 4 AGN 400	3 - 79	NT20138	375.00
<b>I</b> S400 PE 4 AN +	3 - 79	NT20138	187.00
<b>I</b> S400 PE 4 AP +	3 - 79	NT20138	187.00
<b>I</b> S400 PE 4 APN +	3 - 79	NT20138	375.00
S630 CE 3 630	3 - 87	NT20138	2920.00
S630 CE 4 630	3 - 87	NT20138	3880.00
S630 GE 3 630	3 - 90	NT20138	3130.00
S630 GE 3 630PM	3 - 146	NT20138	3600.00
S630 GE 3 630 X1L	3 - 91	NT20138	5500.00
S630 GE 3 630 X1S	3 - 91	NT20138	7340.00
S630 GE 3 AG 630	3 - 90	NT20138	3330.00
<b>I</b> S630 GE 3 AP 630	3 - 90	NT20138	3330.00
<b>I</b> S630 GE 3 APG 630	3 - 90	NT20138	3530.00
S630 GE 4 630	3 - 90	NT20138	4180.00
<b>I</b> S630 GE 4 630 X1L	3 - 91	NT20138	6600.00
<b>I</b> S630 GE 4 630 X1S	3 - 91	NT20138	8800.00
S630 GE 4 AGN 630	3 - 90	NT20138	4570.00
<b>I</b> S630 GE 4 AN 630	3 - 90	NT20138	4370.00
<b>I</b> S630 GE 4 AP 630	3 - 90	NT20138	4370.00
<b>I</b> S630 GE 4 APN 630	3 - 90	NT20138	4570.00
S630NN3	3 - 142	NT20138	2490.00
S630NN4	3 - 142	NT20138	3320.00
S800 CJ 3 630	3 - 103	NT20138	2500.00
S800 CJ 3 800	3 - 103	NT20138	2550.00
<b>I</b> S800ND4	3 - 143	NT20138	POA
S800 NE 3 630	3 - 106	NT20138	3250.00
S800 NE 3 800	3 - 106	NT20138	3990.00
S800 NE 4 630	3 - 106	NT20138	3740.00
S800 NE 4 800	3 - 106	NT20138	4560.00
S800 NJ 3 630	3 - 104	NT20138	2900.00
S800 NJ 3 800	3 - 104	NT20138	3150.00
S800NN3	3 - 142	NT20138	3150.00
S800NN4	3 - 142	NT20138	3990.00
S800 RE 3 630	3 - 107	NT20138	3150.00
S800 RE 3 800	3 - 107	NT20138	4200.00
S800 RE 3 800 X1L	3 - 108	NT20138	6450.00
S800 RE 3 800 X1S	3 - 108	NT20138	7900.00

CAT. NO.	PAGE	P.S.	PRICE \$
S800 RE 3 AG #	3 - 107	NT20138	180.00
S800 RE 3 AP #	3 - 107	NT20138	180.00
S800 RE 3 APG #	3 - 107	NT20138	360.00
S800 RE 4 630	3 - 107	NT20138	3810.00
S800 RE 4 800	3 - 107	NT20138	4850.00
S800 RE 4 800 X1L	3 - 108	NT20138	7740.00
S800 RE 4 800 X1S	3 - 108	NT20138	9480.00
S800 RE 4 AGN #	3 - 107	NT20138	360.00
S800 RE 4 AN #	3 - 107	NT20138	180.00
S800 RE 4 AP #	3 - 107	NT20138	180.00
S800 RE 4 APN #	3 - 107	NT20138	360.00
S800 RJ 3 630	3 - 105	NT20138	3910.00
S800 RJ 3 800	3 - 105	NT20138	4500.00
S800 RJ 4 630	3 - 105	NT20138	4350.00
S800 RJ 4 800	3 - 105	NT20138	4950.00
SAFET6106	1 - 7	NT10136	61.50
SAFET6106SHT	1 - 8	NT10136	190.00
SAFET6110	1 - 7	NT10136	61.50
SAFET61100	1 - 7	NT10136	138.00
SAFET61100NA	1 - 7	NT10136	103.00
SAFET61100NASHT	1 - 8	NT10136	225.00
SAFET61100SHT	1 - 8	NT10136	270.00
SAFET6110SHT	1 - 8	NT10136	190.00
SAFET6116	1 - 7	NT10136	61.50
SAFET6116SHT	1 - 8	NT10136	190.00
SAFET6120	1 - 7	NT10136	61.50
SAFET6120SHT	1 - 8	NT10136	190.00
SAFET6125	1 - 7	NT10136	61.50
SAFET6125SHT	1 - 8	NT10136	190.00
SAFET6132	1 - 7	NT10136	61.50
SAFET6132SHT	1 - 8	NT10136	190.00
SAFET6140	1 - 7	NT10136	61.50
SAFET6140SHT	1 - 8	NT10136	190.00
SAFET6150	1 - 7	NT10136	61.50
SAFET6150SHT	1 - 8	NT10136	190.00
SAFET6163	1 - 7	NT10136	61.50
SAFET6163NA	1 - 7	NT10136	65.50
SAFET6163NASHT	1 - 8	NT10136	184.00
SAFET6163SHT	1 - 8	NT10136	190.00
SAFET6180	1 - 7	NT10136	138.00
SAFET6180SHT	1 - 8	NT10136	270.00
SAFET6206	1 - 7	NT10136	190.00
SAFET6206SHT	1 - 8	NT10136	325.00
SAFET6210	1 - 7	NT10136	190.00
SAFET62100	1 - 7	NT10136	355.00
SAFET62100NA	1 - 7	NT10136	220.00
SAFET62100NASHT	1 - 8	NT10136	350.00
SAFET62100SHT	1 - 8	NT10136	475.00
SAFET6210SHT	1 - 8	NT10136	325.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
SAFET6216	1 - 7	NT10136	190.00
<b>I</b> SAFET6216SHT	1 - 8	NT10136	325.00
SAFET6220	1 - 7	NT10136	190.00
<b>I</b> SAFET6220SHT	1 - 8	NT10136	325.00
<b>I</b> SAFET6225	1 - 7	NT10136	190.00
<b>I</b> SAFET6225SHT	1 - 8	NT10136	325.00
SAFET6232	1 - 7	NT10136	190.00
<b>I</b> SAFET6232SHT	1 - 8	NT10136	325.00
SAFET6240	1 - 7	NT10136	190.00
<b>I</b> SAFET6240SHT	1 - 8	NT10136	325.00
SAFET6250	1 - 7	NT10136	190.00
<b>I</b> SAFET6250SHT	1 - 8	NT10136	325.00
SAFET6263	1 - 7	NT10136	190.00
<b>I</b> SAFET6263NA	1 - 7	NT10136	164.00
<b>I</b> SAFET6263NASHT	1 - 8	NT10136	285.00
<b>I</b> SAFET6263SHT	1 - 8	NT10136	325.00
SAFET6280	1 - 7	NT10136	355.00
<b>I</b> SAFET6280SHT	1 - 8	NT10136	475.00
SAFET6306	1 - 7	NT10136	225.00
<b>I</b> SAFET6306SHT	1 - 8	NT10136	350.00
SAFET6310	1 - 7	NT10136	225.00
<b>I</b> SAFET63100	1 - 7	NT10136	405.00
SAFET63100NA	1 - 7	NT10136	285.00
SAFET63100NA	2 - 30	NT10136	285.00
SAFET63100NASHT	1 - 8	NT10136	425.00
SAFET63100SHT	1 - 8	NT10136	540.00
SAFET6310SHT	1 - 8	NT10136	350.00
SAFET6316	1 - 7	NT10136	225.00
SAFET6316SHT	1 - 8	NT10136	350.00
SAFET6320	1 - 7	NT10136	225.00
SAFET6320SHT	1 - 8	NT10136	350.00
SAFET6325	1 - 7	NT10136	225.00
SAFET6325SHT	1 - 8	NT10136	350.00
SAFET6332	1 - 7	NT10136	225.00
SAFET6332SHT	1 - 8	NT10136	350.00
SAFET6340	1 - 7	NT10136	225.00
SAFET6340SHT	1 - 8	NT10136	350.00
SAFET6350	1 - 7	NT10136	225.00
SAFET6350SHT	1 - 8	NT10136	350.00
SAFET6363	1 - 7	NT10136	225.00
SAFET6363NA	1 - 7	NT10136	200.00
SAFET6363NASHT	1 - 8	NT10136	335.00
SAFET6363SHT	1 - 8	NT10136	350.00
SAFET6380	1 - 7	NT10136	405.00
SAFET6380SHT	1 - 8	NT10136	540.00
<b>I</b> SAFET6406	1 - 7	NT10136	315.00
<b>I</b> SAFET6406SHT	1 - 8	NT10136	440.00
<b>I</b> SAFET6410	1 - 7	NT10136	315.00
<b>I</b> SAFET64100	1 - 7	NT10136	495.00

CAT. NO.	PAGE	P.S.	PRICE \$
SAFET64100NA	1 - 7	NT10136	440.00
SAFET64100NASHT	1 - 8	NT10136	560.00
SAFET64100SHT	1 - 8	NT10136	630.00
SAFET6410SHT	1 - 8	NT10136	440.00
SAFET6416	1 - 7	NT10136	315.00
SAFET6416SHT	1 - 8	NT10136	440.00
SAFET6420	1 - 7	NT10136	315.00
SAFET6420SHT	1 - 8	NT10136	440.00
SAFET6425	1 - 7	NT10136	315.00
SAFET6425SHT	1 - 8	NT10136	440.00
SAFET6432	1 - 7	NT10136	315.00
SAFET6432SHT	1 - 8	NT10136	440.00
SAFET6440	1 - 7	NT10136	315.00
SAFET6440SHT	1 - 8	NT10136	440.00
SAFET6450	1 - 7	NT10136	315.00
SAFET6450SHT	1 - 8	NT10136	440.00
SAFET6463	1 - 7	NT10136	315.00
SAFET6463NA	1 - 7	NT10136	285.00
SAFET6463NASHT	1 - 8	NT10136	425.00
SAFET6463SHT	1 - 8	NT10136	440.00
SAFET6480	1 - 7	NT10136	495.00
SAFET6480SHT	1 - 8	NT10136	630.00
SAFETLCK 12	1 - 9	NT10136	159.00
SAFETLCK 24	1 - 9	NT10136	210.00
SAFE-TPC1	2 - 2	NT10136	18.20
SAFE-TPC23	2 - 2	NT10136	32.50
SAFETPF	1 - 9	NT10136	1.80
SAFETPF	2 - 10	NT10136	1.80
SAFETPF	2 - 31	NT10136	1.80
SAFETPF	2 - 51	NT10136	1.80
SPD1	5 - 28	NT30141	210.00
SPD1	5 - 29	NT30141	210.00
SPD3	5 - 28	NT30141	280.00
SPD3	5 - 29	NT30141	280.00
SRCB 1010	1 - 10	NT10136	360.00
SRCB 1030	1 - 10	NT10136	325.00
SRCB 1610	1 - 10	NT10136	360.00
SRCB 1630	1 - 10	NT10136	325.00
SRCB 2010	1 - 10	NT10136	360.00
SRCB 2030	1 - 10	NT10136	325.00
SRCBHA	1 - 10	NT10136	26.40
SRCBLCK 12	1 - 10	NT10136	275.00
SRCBLCK 24	1 - 10	NT10136	450.00
SRCBWA	1 - 10	NT10136	26.40
SSW2	5 - 28	NB20052	390.00
SSW2	5 - 29	NB20052	390.00
SSW3	5 - 28	NB20052	405.00
SSW3	5 - 29	NB20052	405.00
STK250ND/TH	2 - 31	NT40143	119.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
STK250NDTH	2 - 51	NT40143	119.00
STK250ND/TH	2 - 68	NT40143	119.00
STK300TH	2 - 31	NT40143	119.00
STK300TH	2 - 51	NT40143	119.00
STKCD	2 - 16	NT40143	119.00
STKCD	2 - 51	NT40143	119.00
STKCD	2 - 66	NT40143	119.00
<b>T</b>			
T12CAPLAB	3 - 33	NZ00150	3.50
T12CAPLAB	3 - 34	NZ00150	3.50
T12CAPLAB	3 - 34	NZ00150	3.50
T12CAPLAB	3 - 34	NZ00150	3.50
T12CAPLAB	3 - 35	NZ00150	3.50
T12CAPLAB	3 - 35	NZ00150	3.50
T12CAPLAB	3 - 36	NZ00150	3.50
T12CAPLAB	3 - 36	NZ00150	3.50
T12CAPLAB	5 - 36	NZ00150	3.50
T1HP03R6BNA4	3 - 22	NT20138	141.00
<b>A</b> T1HP30PALK	3 - 22	NT10136	44.50
<b>A</b> T1HP40PALK	6 - 11	NT10136	44.50
T1HP40R6BNA4	6 - 11	NT20138	355.00
<b>A</b> T1HP80PALK	6 - 26	NT10136	49.50
T1HP80R6BNA4	6 - 26	NT20138	480.00
<b>A</b> T1HPX6PALK	6 - 37	NT10136	49.50
T1HPX6R6BNA4	6 - 37	NT20138	570.00
T1HS03R5GM	3 - 22	NT20138	240.00
T1HS40R5GM	6 - 11	NT20138	415.00
<b>A</b> T1HS80R5GM	6 - 26	NT20138	490.00
<b>A</b> T1HSX6R5GM	6 - 37	NT20138	570.00
T25CAPLAB	3 - 60	NZ00150	3.50
T25CAPLAB	3 - 61	NZ00150	3.50
T25CAPLAB	3 - 61	NZ00150	3.50
T25CAPLAB	3 - 62	NZ00150	3.50
T25CAPLAB	3 - 63	NZ00150	3.50
T25CAPLAB	5 - 36	NZ00150	3.50
T2AL00B1STA	3 - 32	NT20138	146.00
T2AL00B1STA	3 - 59	NT20138	146.00
T2AL00B1STA	3 - 92	NT20138	146.00
T2AL00B1STA	3 - 115	NT20138	146.00
T2AL00B1STA	3 - 123	NT20138	146.00
T2AL00B2STA	3 - 32	NT20138	146.00
T2AL00B2STA	3 - 59	NT20138	146.00
T2AL00B2STA	3 - 92	NT20138	146.00
T2AL00B2STA	3 - 115	NT20138	146.00
T2AL00B2STA	3 - 123	NT20138	146.00
T2AL00M3RTA	3 - 32	NT20138	187.00
T2AL00M3RTA	3 - 59	NT20138	187.00
T2AL00M3RTA	3 - 92	NT20138	187.00
T2AL00M3RTA	3 - 115	NT20138	187.00

CAT. NO.	PAGE	P.S.	PRICE \$
T2AL00M3RTA	3 - 123	NT20138	187.00
T2AL00M3STA	3 - 32	NT20138	134.00
T2AL00M3STA	3 - 59	NT20138	134.00
T2AL00M3STA	3 - 92	NT20138	134.00
T2AL00M3SWA	3 - 32	NT20138	146.00
T2AL00M3SWA	3 - 59	NT20138	146.00
T2AL00M3SWA	3 - 92	NT20138	146.00
T2AL00M4STA	3 - 115	NT20138	129.00
T2AL00M4STA	3 - 123	NT20138	129.00
T2AL00M5SWA	3 - 115	NT20138	141.00
T2AL00M5SWA	3 - 123	NT20138	141.00
T2AX00B1STA	3 - 32	NT20138	146.00
T2AX00B1STA	3 - 59	NT20138	146.00
T2AX00B1STA	3 - 92	NT20138	146.00
T2AX00B1STA	3 - 115	NT20138	146.00
T2AX00B1STA	3 - 123	NT20138	146.00
T2AX00B2STA	3 - 32	NT20138	146.00
T2AX00B2STA	3 - 59	NT20138	146.00
T2AX00B2STA	3 - 92	NT20138	146.00
T2AX00B2STA	3 - 115	NT20138	146.00
T2AX00B2STA	3 - 123	NT20138	146.00
T2AX00M3RTA	3 - 32	NT20138	187.00
T2AX00M3RTA	3 - 59	NT20138	187.00
T2AX00M3RTA	3 - 92	NT20138	187.00
T2AX00M3RTA	3 - 115	NT20138	187.00
T2AX00M3RTA	3 - 123	NT20138	187.00
T2AX00M3STA	3 - 32	NT20138	134.00
T2AX00M3STA	3 - 59	NT20138	134.00
T2AX00M3STA	3 - 92	NT20138	134.00
T2AX00M3STA	3 - 115	NT20138	134.00
T2AX00M3STA	3 - 123	NT20138	134.00
T2AX00M3SWA	3 - 32	NT20138	146.00
T2AX00M3SWA	3 - 59	NT20138	146.00
T2AX00M3SWA	3 - 92	NT20138	146.00
T2AX00M3SWA	3 - 115	NT20138	146.00
T2AX00M3SWA	3 - 123	NT20138	146.00
T2AX00M4SWA	3 - 115	NT20138	146.00
T2AX00M4SWA	3 - 123	NT20138	146.00
I T2AX00M5SWA	3 - 115	NT20138	146.00
I T2AX00M5SWA	3 - 123	NT20138	146.00
T2BA123SHA	3 - 38	NT20138	17.40
T2BA123SHA	4 - 14	NT20138	17.40
T2BA253LHA	3 - 38	NT20138	20.00
T2BA253LHA	3 - 65	NT20138	20.00
T2BA253LHA	4 - 14	NT20138	20.00
T2BA253SHA	3 - 65	NT20138	20.00
T2BA253SHA	4 - 14	NT20138	20.00
I T2BA403LHA	3 - 98	NT20138	POA
T2BA403SHA	3 - 98	NT20138	21.60

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
T2BA403SHA	4 - 14	NT20138	21.60
T2BA803LHA	3 - 118	NT20138	10.00
T2BA803SHA	3 - 118	NT20138	10.00
T2BAX63LHA	3 - 126	NT20138	10.00
T2CB803GHNA	3 - 118	NT20138	170.00
T2CB804GHNA	3 - 118	NT20138	210.00
T2CF00L	3 - 38	NT20138	9.10
T2CF00L	3 - 65	NT20138	9.10
T2CF00L	3 - 98	NT20138	9.10
T2CF00L	4 - 14	NT20138	9.10
T2CF00LA	3 - 118	NT20138	8.80
T2CF00LA	3 - 126	NT20138	8.80
T2CF121SLNG	3 - 37	NT20138	35.00
T2CF121SLNG	4 - 13	NT20138	35.00
T2CF122SLNG	3 - 37	NT20138	49.50
T2CF123SLNG	3 - 37	NT20138	64.50
T2CF123SLNG	4 - 13	NT20138	64.50
I T2CF123SSNBA	3 - 37	NT20138	60.50
I T2CF123SSNBA	4 - 13	NT20138	60.50
T2CF124SLNG	3 - 37	NT30141	73.00
T2CF124SLNG	4 - 13	NT30141	73.00
I T2CF124SSNBA	3 - 37	NT20138	71.00
I T2CF124SSNBA	4 - 13	NT20138	71.00
T2CF161SLNG	3 - 64	NT20138	40.00
T2CF161SLNG	4 - 13	NT20138	40.00
T2CF253LLNG	3 - 37	NT20138	71.00
T2CF253LLNG	3 - 64	NT20138	71.00
T2CF253LLNG	4 - 13	NT20138	71.00
T2CF253SLNG	3 - 64	NT20138	67.00
T2CF253SLNG	4 - 13	NT20138	67.00
T2CF253SSNBA	3 - 64	NT20138	67.00
T2CF253SSNBA	4 - 13	NT20138	67.00
T2CF254LLNG	3 - 37	NT20138	77.50
T2CF254LLNG	3 - 64	NT20138	77.50
T2CF254LLNG	4 - 13	NT20138	77.50
T2CF254SLNG	3 - 64	NT20138	77.50
T2CF254SLNG	4 - 13	NT20138	77.50
T2CF254SSNBA	3 - 64	NT20138	77.50
T2CF254SSNBA	4 - 13	NT20138	77.50
T2CF403SLNG	3 - 97	NT20138	190.00
T2CF403SLNG	4 - 13	NT20138	190.00
T2CF403SWNG	3 - 97	NT30141	190.00
T2CF403SWNG	4 - 13	NT30141	190.00
T2CF404SLNG	3 - 97	NT20138	205.00
T2CF404SWNG	3 - 97	NT20138	205.00
T2CF803SLHGA	3 - 118	NT20138	205.00
T2CF804SLHGA	3 - 118	NT20138	260.00
T2CFX33SLHGA	3 - 126	NT20138	225.00
T2CFX34SLHGA	3 - 126	NT20138	280.00

	CAT. NO.	PAGE	P.S.	PRICE \$
	T2CLSBB25033	5 - 34	NT30141	550.00
I	T2CLSBB25043	5 - 34	NT30141	760.00
	T2CLSBB25044	5 - 34	NT30141	760.00
	T2CLSBB40033	5 - 34	NT30141	650.00
I	T2CLSBB40043	5 - 34	NT30141	740.00
	T2CLSBB40044	5 - 34	NT30141	880.00
	T2CLSBB63033	5 - 34	NT30141	1180.00
	T2CLSBB63043	5 - 34	NT30141	1400.00
	T2CLSBB63044	5 - 34	NT30141	1540.00
	T2CR123SG	3 - 38	NT20138	44.00
	T2CR123SG	4 - 14	NT20138	44.00
	T2CR124SG	3 - 38	NT20138	55.00
	T2CR124SG	4 - 14	NT20138	55.00
	T2CR253SG	3 - 38	NT20138	54.00
	T2CR253SG	3 - 65	NT20138	54.00
	T2CR253SG	4 - 14	NT20138	54.00
	T2CR254SG	3 - 38	NT20138	60.50
	T2CR254SG	3 - 65	NT20138	60.50
	T2CR254SG	4 - 14	NT20138	60.50
	T2CR403SG	3 - 98	NT20138	93.50
	T2CR403SG	4 - 13	NT20138	93.50
	T2CR403SG	4 - 14	NT20138	93.50
	T2CR404SG	3 - 98	NT20138	111.00
	T2CR404SG	4 - 13	NT20138	111.00
	T2CR803LHGA	3 - 118	NT20138	210.00
	T2CR803SHGA	3 - 118	NT20138	170.00
	T2CR804LHGA	3 - 118	NT20138	240.00
	T2CR804SHGA	3 - 118	NT20138	210.00
	T2CS121SG	3 - 37	NT20138	10.60
	T2CS121SG	4 - 13	NT20138	10.60
	T2CS122SG	4 - 13	NT40143	12.00
	T2CS123SG	3 - 37	NT20138	44.00
	T2CS123SG	4 - 13	NT20138	44.00
	T2CS124SG	3 - 37	NT20138	55.00
	T2CS124SG	4 - 13	NT20138	55.00
	T2CS251SG	3 - 64	NT20138	10.00
	T2CS251SG	4 - 13	NT40143	10.00
	T2CS253SG	3 - 37	NT20138	54.00
	T2CS253SG	3 - 64	NT20138	54.00
	T2CS253SG	4 - 13	NT20138	54.00
	T2CS254SG	3 - 37	NT20138	60.50
	T2CS254SG	3 - 64	NT20138	60.50
	T2CS254SG	4 - 13	NT20138	60.50
	T2DA12A	3 - 41	NT20138	63.00
I	T2DF25A	3 - 41	NT20138	127.00
I	T2DF25A	3 - 68	NT20138	127.00
I	T2DF40A	3 - 101	NT20138	132.00
I	T2DM25A	3 - 41	NT20138	215.00
I	T2DM25A	3 - 68	NT20138	215.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
I T2DM40A	3 - 101	NT20138	260.00
I T2FB123BA	3 - 39	NT20138	77.50
I T2FB124BA	3 - 39	NT20138	103.00
I T2FB251BA	3 - 39	NT20138	26.80
I T2FB251BA	3 - 39	NT20138	26.80
I T2FB251BA	3 - 66	NT20138	26.80
T2FB253BA	3 - 39	NT20138	77.50
T2FB253BA	3 - 66	NT20138	77.50
T2FB254BA	3 - 39	NT20138	103.00
T2FB254BA	3 - 66	NT20138	103.00
T2FB463BA	3 - 99	NT20138	240.00
T2FB464BA	3 - 99	NT20138	305.00
I T2FP12S3B	3 - 41	NT20138	82.50
I T2FP12S4A	3 - 41	NT20138	POA
I T2FP25S3B	3 - 68	NT20138	82.50
I T2FP25S4A	3 - 68	NT20138	POA
I T2FP40S3A	3 - 101	NT20138	280.00
I T2FP40S4A	3 - 101	NT20138	POA
T2FW12S3A	3 - 39	NT20138	107.00
I T2FW12S4A	3 - 39	NT20138	141.00
T2FW25L3B	3 - 39	NT20138	173.00
T2FW25L3B	3 - 66	NT20138	173.00
I T2FW25L4B	3 - 39	NT20138	240.00
I T2FW25L4B	3 - 66	NT20138	240.00
T2FW40L3A	3 - 99	NT20138	415.00
T2FW40L3A	3 - 119	NT20138	415.00
I T2FW40L4A	3 - 99	NT20138	560.00
I T2FW40L4A	3 - 119	NT20138	560.00
T2GB40N04A	3 - 100	NT20138	290.00
T2GB40N06A	3 - 100	NT20138	440.00
T2GBX6N12A	3 - 116	NT20138	430.00
T2GBX6N12A	3 - 126	NT20138	430.00
T2GBX6N16A	3 - 116	NT20138	430.00
T2GBX6N16A	3 - 126	NT20138	430.00
T2HB12UR5BN	3 - 34	NT20138	175.00
T2HB12UR5RN	3 - 34	NT20138	199.00
T2HB25UR5BN	3 - 34	NT20138	189.00
T2HB25UR5BN	3 - 61	NT20138	189.00
T2HB25UR5RN	3 - 34	NT20138	210.00
T2HB25UR5RN	3 - 61	NT20138	210.00
T2HB40UR5BN	3 - 94	NT20138	240.00
T2HB40UR5RN	3 - 94	NT20138	265.00
T2HB80UR5BN	3 - 116	NT20138	495.00
T2HB80UR5RN	3 - 116	NT20138	495.00
T2HBX6UR5BN	3 - 124	NT20138	560.00
T2HBX6UR5RN	3 - 124	NT20138	560.00
<b>A</b> T2HL12CAP	3 - 38	NT20138	33.50
T2HL25B	3 - 38	NT20138	31.50
T2HL25B	3 - 65	NT20138	31.50

CAT. NO.	PAGE	P.S.	PRICE \$
A T2HL25CAP	3 - 38	NT20138	33.50
A T2HL25CAP	3 - 65	NT20138	33.50
T2HL40A	3 - 99	NT20138	73.00
T2HL40A	3 - 119	NT20138	73.00
A T2HL40CAP	3 - 99	NT20138	73.00
T2HL80CAP	3 - 119	NT20138	125.00
A T2HLS125NFCAP	3 - 38	NT30141	92.00
A T2HLS160NFCAP	3 - 65	NT30141	92.00
T2HLX6A	3 - 127	NT20138	77.00
T2HLX6CAP	3 - 127	NT20138	165.00
T2HP12R6BN	3 - 34	NT20138	290.00
T2HP12R6RN	3 - 34	NT20138	300.00
A T2HP25PALK	3 - 34	NT30141	49.50
A T2HP25PALK	3 - 34	NT30141	49.50
A T2HP25PALK	3 - 61	NT30141	49.50
T2HP25R6BN	3 - 34	NT20138	290.00
T2HP25R6BN	3 - 61	NT20138	290.00
T2HP25R6RN	3 - 34	NT20138	300.00
T2HP25R6RN	3 - 61	NT20138	300.00
A T2HP40PALK	3 - 94	NT30141	49.50
T2HP40R6BN	3 - 94	NT20138	315.00
T2HP40R6RN	3 - 94	NT20138	330.00
T2HP80PALK	3 - 116	NT20138	47.50
T2HP80R6BN	3 - 116	NT20138	470.00
T2HP80R6ME	3 - 116	NT20138	690.00
T2HP80R6RN	3 - 116	NT20138	470.00
T2HPX6PALK	3 - 124	NT20138	85.00
T2HPX6R6BN	3 - 124	NT20138	550.00
T2HPX6R6ME	3 - 124	NT20138	830.00
T2HPX6R6RN	3 - 124	NT20138	550.00
A T2HS12R5GM	3 - 34	NT20138	280.00
T2HS12R5RM	3 - 34	NT20138	290.00
T2HS250SHAFT	3 - 22	NT20138	47.00
T2HS250SHAFT	3 - 34	NT20138	47.00
T2HS250SHAFT	3 - 34	NT20138	47.00
T2HS250SHAFT	3 - 61	NT20138	47.00
A T2HS25R5GM	3 - 34	NT20138	280.00
A T2HS25R5GM	3 - 61	NT20138	280.00
A T2HS25R5RM	3 - 34	NT20138	290.00
A T2HS25R5RM	3 - 61	NT20138	290.00
T2HS400SHAFT	3 - 94	NT20138	47.00
T2HS400SHAFT	3 - 116	NT20138	47.00
T2HS400SHAFT	3 - 124	NT20138	47.00
T2HS400SHAFT	6 - 11	NT20138	47.00
T2HS400SHAFT	6 - 26	NT20138	47.00
T2HS400SHAFT	6 - 37	NT20138	47.00
A T2HS40R5GM	3 - 94	NT20138	370.00
A T2HS40R5RM	3 - 94	NT20138	315.00
T2HS80R6GM	3 - 116	NT20138	470.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
T2HS80R6RM	3 - 116	NT20138	470.00
T2HSESC100	3 - 22	NZ00150	18.20
T2HSESC100	3 - 34	NZ00150	18.20
T2HSESC100	3 - 34	NZ00150	18.20
T2HSESC100	3 - 61	NZ00150	18.20
T2HSESC100	3 - 94	NZ00150	18.20
T2HSESC100	3 - 116	NZ00150	18.20
T2HSESC100	3 - 124	NZ00150	18.20
T2HSESC100	6 - 11	NZ00150	18.20
T2HSESC100	6 - 26	NZ00150	18.20
T2HSESC100	6 - 37	NZ00150	18.20
T2HSX6R6GM	3 - 124	NT20138	550.00
T2HSX6R6RM	3 - 124	NT20138	550.00
T2MBX33P	3 - 125	NT20138	850.00
T2MBX34P	3 - 125	NT20138	1130.00
T2MBX63P	3 - 125	NT20138	850.00
T2MBX64P	3 - 125	NT20138	1130.00
T2MC12A10NB	3 - 33	NT20138	1200.00
T2MC12A24NB	3 - 33	NT20138	1200.00
T2MC12D02NB	3 - 33	NT20138	1200.00
I T2MC12D04NB	3 - 33	NT20138	1150.00
I T2MC12D10NB	3 - 33	NT20138	1200.00
I T2MC25A10NB	3 - 33	NT20138	1620.00
I T2MC25A10NB	3 - 60	NT20138	1620.00
T2MC25A24NB	3 - 33	NT20138	1630.00
T2MC25A24NB	3 - 60	NT20138	1630.00
T2MC25D02NB	3 - 33	NT20138	1630.00
T2MC25D02NB	3 - 60	NT20138	1630.00
I T2MC25D04NB	3 - 33	NT20138	1620.00
I T2MC25D04NB	3 - 60	NT20138	1620.00
I T2MC25D10NB	3 - 33	NT20138	1620.00
I T2MC25D10NB	3 - 60	NT20138	1620.00
T2MC40A10NB	3 - 93	NT20138	2420.00
T2MC40D02NB	3 - 93	NT20138	2420.00
I T2MC40D10NB	3 - 93	NT20138	2420.00
T2MC80A10NA	3 - 119	NT20138	2570.00
T2MC80D10NA	3 - 119	NT20138	2570.00
T2MCX6A10NA	3 - 127	NT20138	3150.00
T2MCX6A24NA	3 - 127	NT20138	3150.00
T2MCX6D02NA	3 - 127	NT20138	3150.00
T2ML12L3A	3 - 35	NT20138	127.00
T2ML12L4A	3 - 35	NT20138	127.00
T2ML12RA	3 - 35	NT20138	113.00
T2ML25L3A	3 - 35	NT20138	127.00
T2ML25L3A	3 - 62	NT20138	127.00
T2ML25L4A	3 - 35	NT20138	127.00
T2ML25L4A	3 - 62	NT20138	127.00
T2ML25RA	3 - 35	NT20138	113.00
T2ML25RA	3 - 62	NT20138	113.00

CAT. NO.	PAGE	P.S.	PRICE \$
T2ML40L3B	3 - 95	NT20138	133.00
T2ML40L4B	3 - 95	NT20138	133.00
T2ML40RB	3 - 95	NT20138	350.00
T2ML80L3A	3 - 117	NT20138	140.00
T2ML80L4A	3 - 117	NT20138	140.00
T2ML80RA	3 - 117	NT20138	365.00
I A T2MLH40L3B	3 - 95	NT20138	133.00
I A T2MLH40L4B	3 - 95	NT20138	133.00
I A T2MLH40RB	3 - 95	NT20138	350.00
T2MM25L05A	3 - 33	NT20138	60.50
T2MM25L05A	3 - 60	NT20138	60.50
T2MM25L15A	3 - 33	NT20138	73.00
T2MM25L15A	3 - 60	NT20138	73.00
T2MM40L06A	3 - 93	NT20138	60.50
T2MM40L06A	3 - 119	NT20138	60.50
T2MM40L21A	3 - 93	NT20138	80.00
T2MM40L21A	3 - 119	NT20138	80.00
T2MM40S06A	3 - 119	NT20138	58.50
T2MM40S21A	3 - 119	NT20138	70.50
I T2MS123SFA	3 - 36	NT20138	120.00
I T2MS124SFA	3 - 36	NT20138	134.00
T2MS253LFA	3 - 36	NT20138	120.00
T2MS253LFA	3 - 63	NT20138	120.00
I T2MS253SFA	3 - 63	NT20138	120.00
T2MS254LFA	3 - 36	NT20138	134.00
T2MS254LFA	3 - 63	NT20138	134.00
I T2MS254SFA	3 - 63	NT20138	134.00
I T2MS403SFA	3 - 96	NT20138	220.00
I T2MS404SFA	3 - 96	NT20138	210.00
T2MS803LFA	3 - 117	NT20138	260.00
T2MS803SFA	3 - 117	NT20138	240.00
T2MS804LFA	3 - 117	NT20138	280.00
T2MS804SFA	3 - 117	NT20138	260.00
T2MSX63SFA	3 - 125	NT20138	360.00
T2MSX64SFA	3 - 125	NT20138	450.00
T2MW00L	3 - 125	NT20138	70.50
T2MW00LA	3 - 36	NT20138	73.00
T2MW00LA	3 - 63	NT20138	73.00
T2MW00LA	3 - 96	NT20138	73.00
T2MW00LA	3 - 117	NT20138	73.00
T2MW00S	3 - 125	NT20138	60.50
T2MW00SA	3 - 36	NT20138	63.00
T2MW00SA	3 - 63	NT20138	63.00
T2MW00SA	3 - 96	NT20138	63.00
T2MW00SA	3 - 117	NT20138	63.00
T2MW12CA	3 - 36	NT20138	265.00
T2MW25CA	3 - 36	NT20138	275.00
T2MW25CA	3 - 63	NT20138	275.00
T2MW40CB	3 - 96	NT20138	330.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

	CAT. NO.	PAGE	P.S.	PRICE \$
	T2MW80CA	3 - 117	NT20138	335.00
<b>I A</b>	T2MWH40CB	3 - 96	NT20138	330.00
	T2MWX6CA	3 - 125	NT20138	445.00
	T2PF123BA	3 - 147	NT40143	34.00
<b>I</b>	T2PF124BA	3 - 147	NT20138	46.00
	T2PF253BA	3 - 147	NT20138	71.00
	T2PF254BA	3 - 147	NT20138	94.00
	T2PF403BA	3 - 147	NT20138	215.00
	T2PF404BA	3 - 147	NT20138	280.00
	T2PF803HA	3 - 120	NT20138	235.00
	T2PF804HA	3 - 120	NT20138	290.00
	T2PM12A3A	3 - 146	NT20138	159.00
<b>I</b>	T2PM12A4A	3 - 146	NT20138	200.00
	T2PM25A3A	3 - 146	NT20138	178.00
<b>I</b>	T2PM25A4A	3 - 146	NT20138	235.00
	T2PM40A3A	3 - 146	NT20138	380.00
<b>I</b>	T2PM40A4A	3 - 146	NT20138	510.00
	T2PM80A3A	3 - 120	NT20138	485.00
	T2PM80A4A	3 - 120	NT20138	640.00
	T2RP123SA	3 - 40	NT20138	200.00
	T2RP124SA	3 - 40	NT20138	270.00
	T2RP253LA	3 - 40	NT20138	390.00
	T2RP253LA	3 - 67	NT20138	390.00
	T2RP253SB	3 - 67	NT20138	375.00
	T2RP254LA	3 - 40	NT20138	540.00
	T2RP254LA	3 - 67	NT20138	540.00
	T2RP254SB	3 - 67	NT20138	480.00
<b>I</b>	T2RP403LA	3 - 100	NT20138	670.00
	T2RP403SA	3 - 100	NT20138	650.00
<b>I</b>	T2RP404LA	3 - 100	NT20138	940.00
	T2RP404SA	3 - 100	NT20138	870.00
	T2RP463SA	3 - 100	NT20138	740.00
	T2RP464SA	3 - 100	NT20138	980.00
	T2RP803HA	3 - 119	NT20138	1150.00
	T2RP803MA	3 - 119	NT20138	780.00
	T2RP803NA	3 - 119	NT20138	780.00
	T2RP804HA	3 - 119	NT20138	1440.00
	T2RP804MA	3 - 119	NT20138	840.00
	T2RP804NA	3 - 119	NT20138	840.00
	T2RPX03HA	3 - 119	NT20138	1420.00
	T2RPX04HA	3 - 119	NT20138	1830.00
	T2RPX335B	3 - 127	NT20138	1350.00
	T2RPX345B	3 - 127	NT20138	1940.00
	T2RPX635B	3 - 127	NT20138	1730.00
	T2RPX645B	3 - 127	NT20138	2250.00
	T2SF25NEA	3 - 67	NT20138	26.80
	T2SF25NTA	3 - 40	NT20138	26.80
	T2SF25NTA	3 - 67	NT20138	26.80
	T2SH00A10TA	3 - 32	NT20138	255.00

CAT. NO.	PAGE	P.S.	PRICE \$
T2SH00A10TA	3 - 59	NT20138	255.00
T2SH00A10TA	3 - 92	NT20138	255.00
T2SH00A10TA	3 - 115	NT20138	255.00
T2SH00A10TA	3 - 123	NT20138	255.00
T2SH00A20TA	3 - 32	NT20138	255.00
T2SH00A20TA	3 - 59	NT20138	255.00
T2SH00A20TA	3 - 92	NT20138	255.00
T2SH00A20TA	3 - 115	NT20138	255.00
T2SH00A20TA	3 - 123	NT20138	255.00
T2SH00A40TA	3 - 32	NT20138	255.00
T2SH00A40TA	3 - 59	NT20138	255.00
T2SH00A40TA	3 - 92	NT20138	255.00
T2SH00A40TA	3 - 115	NT20138	255.00
T2SH00A40TA	3 - 123	NT20138	255.00
I T2SH00D01TA	3 - 115	NT20138	255.00
I T2SH00D01TA	3 - 123	NT20138	255.00
T2SH00D02TA	3 - 32	NT20138	255.00
T2SH00D02TA	3 - 59	NT20138	255.00
T2SH00D02TA	3 - 92	NT20138	255.00
T2SH00D02TA	3 - 115	NT20138	255.00
T2SH00D02TA	3 - 123	NT20138	255.00
T2SH00D04TA	3 - 32	NT20138	255.00
T2SH00D04TA	3 - 59	NT20138	255.00
T2SH00D04TA	3 - 92	NT20138	255.00
T2SH00D04TA	3 - 115	NT20138	255.00
T2SH00D04TA	3 - 123	NT20138	255.00
T2SH00D10TA	3 - 32	NT20138	255.00
T2SH00D10TA	3 - 59	NT20138	255.00
T2SH00D10TA	3 - 92	NT20138	255.00
T2SH00D10TA	3 - 115	NT20138	255.00
T2SH00D10TA	3 - 123	NT20138	255.00
T2SH00D20TA	3 - 32	NT20138	255.00
T2SH00D20TA	3 - 59	NT20138	255.00
T2SH00D20TA	3 - 92	NT20138	255.00
T2SH00D20TA	3 - 115	NT20138	255.00
T2SH00D20TA	3 - 123	NT20138	255.00
T2SH16A10WA	3 - 59	NT20138	255.00
T2SH16A20WA	3 - 59	NT20138	255.00
T2SH16D02WA	3 - 59	NT20138	255.00
T2SH16D10WA	3 - 59	NT20138	250.00
T2SH16D20WA	3 - 59	NT20138	250.00
A T2SW3P1251255K	3 - 20	NT20138	900.00
A T2SW3P125TC	3 - 20	NT20138	55.00
A T2SW3P2501505K	3 - 20	NT20138	940.00
A T2SW3P2502505K	3 - 20	NT20138	940.00
A T2SW3P250TC	3 - 20	NT20138	110.00
A T2SW3P250TC	3 - 20	NT20138	110.00
A T2SW3P6304005K	3 - 20	NT20138	1230.00
A T2SW3P6306005K	3 - 20	NT20138	1230.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
<b>A</b> T2SW3P630TC	3 - 20	NT20138	110.00
<b>A</b> T2SW3P630TC	3 - 20	NT20138	110.00
<b>I A</b> T2SW4P1251255K	3 - 20	NT20138	1190.00
<b>I A</b> T2SW4P125TC	3 - 20	NT20138	66.50
<b>I A</b> T2SW4P2501505K	3 - 20	NT20138	1230.00
<b>I A</b> T2SW4P2502505K	3 - 20	NT20138	1230.00
<b>I A</b> T2SW4P250TC	3 - 20	NT20138	148.00
<b>I A</b> T2SW4P250TC	3 - 20	NT20138	148.00
<b>I A</b> T2SW4P6304005K	3 - 20	NT20138	1630.00
<b>I A</b> T2SW4P6306005K	3 - 20	NT20138	1630.00
<b>I A</b> T2SW4P630TC	3 - 20	NT20138	160.00
<b>I A</b> T2SW4P630TC	3 - 20	NT20138	160.00
<b>I</b> T2TF25LGA	3 - 41	NT20138	189.00
<b>I</b> T2TF25LGA	3 - 68	NT20138	189.00
<b>I</b> T2TF25RGA	3 - 41	NT20138	189.00
<b>I</b> T2TF25RGA	3 - 68	NT20138	189.00
<b>I</b> T2TF40LGA	3 - 101	NT20138	189.00
<b>I</b> T2TF40LGA	3 - 119	NT20138	189.00
<b>I</b> T2TF40RGA	3 - 101	NT20138	189.00
<b>I</b> T2TF40RGA	3 - 119	NT20138	189.00
T2TP003A	3 - 120	NT20138	37.00
T2TP003A	3 - 146	NT20138	37.00
T2UPX31000	3 - 120	NT20138	950.00
T2UPX3125	3 - 40	NT20138	305.00
T2UPX3250	3 - 67	NT20138	330.00
T2UPX3400	3 - 100	NT20138	405.00
T2UPX3630	3 - 100	NT20138	770.00
T2UPX3800	3 - 120	NT20138	690.00
T2UPXE3250	3 - 40	NT20138	350.00
T2UPXE3250	3 - 67	NT20138	350.00
T2UV00A10NTA	3 - 32	NT20138	270.00
T2UV00A10NTA	3 - 59	NT20138	270.00
T2UV00A10NTA	3 - 92	NT20138	270.00
T2UV80A10NTA	3 - 115	NT20138	270.00
T2UV80A10NTA	3 - 123	NT20138	270.00
T2UV00A20NTA	3 - 32	NT20138	270.00
T2UV00A20NTA	3 - 59	NT20138	270.00
T2UV00A20NTA	3 - 92	NT20138	270.00
T2UV80A20NTA	3 - 115	NT20138	270.00
T2UV80A20NTA	3 - 123	NT20138	270.00
T2UV00A40NTA	3 - 32	NT20138	270.00
T2UV00A40NTA	3 - 59	NT20138	270.00
T2UV00A40NTA	3 - 92	NT20138	270.00
T2UV80A40NTA	3 - 115	NT20138	270.00
T2UV80A40NTA	3 - 123	NT20138	270.00
T2UV00D02NTA	3 - 32	NT20138	270.00
T2UV00D02NTA	3 - 59	NT20138	270.00
T2UV00D02NTA	3 - 92	NT20138	270.00
T2UV80D02NTA	3 - 115	NT20138	270.00

CAT. NO.	PAGE	P.S.	PRICE \$
T2UV80D02NTA	3 - 123	NT20138	270.00
T2UV00D10NTA	3 - 32	NT20138	270.00
T2UV00D10NTA	3 - 59	NT20138	270.00
T2UV00D10NTA	3 - 92	NT20138	270.00
T2UV80D10NTA	3 - 115	NT20138	270.00
T2UV80D10NTA	3 - 123	NT20138	270.00
I T2UV00D20NTA	3 - 32	NT20138	270.00
I T2UV00D20NTA	3 - 59	NT20138	270.00
I T2UV00D20NTA	3 - 92	NT20138	270.00
I T2UV80D20NTA	3 - 115	NT20138	270.00
I T2UV80D20NTA	3 - 123	NT20138	270.00
T40CAPLAB	3 - 93	NZ00150	3.50
T40CAPLAB	3 - 94	NZ00150	3.50
T40CAPLAB	3 - 94	NZ00150	3.50
T40CAPLAB	3 - 95	NZ00150	3.50
T40CAPLAB	3 - 95	NZ00150	3.50
T40CAPLAB	3 - 96	NZ00150	3.50
T40CAPLAB	5 - 36	NZ00150	3.50
T80CAPLAB	3 - 116	NT20138	3.50
TAASLY	1 - 9	NT10136	3.30
TAL111	1 - 68	NB30088	105.00
TAL111MINI	1 - 68	NB30088	102.00
TAL171	1 - 68	NB30088	148.00
TAL211	1 - 68	NB30088	200.00
TAL211MINI	1 - 68	NB30088	151.00
TAL271	1 - 68	NB30088	215.00
TAL371MP240VAC	1 - 68	NB30088	145.00
TAL371PRO	1 - 68	NB30088	210.00
TAL372PRO	1 - 68	NB30088	330.00
TAL471PRO	1 - 68	NB30088	270.00
TAL472PRO	1 - 68	NB30088	390.00
TAL791PRO	1 - 68	NB30088	430.00
TAL892PLUSTOP	1 - 68	NB30088	760.00
TAL892PLUSTOP	1 - 68	NB30088	760.00
TALCEPLUSTOP	1 - 68	NB30088	365.00
I TDAA2	8 - 14	NT30141	1000.00
I TDAB2	8 - 14	NT30141	1310.00
TDAC2	8 - 14	NT30141	2130.00
TDB50SG12	1 - 9	NT10136	20.20
I TDGA2	8 - 14	NT30141	225.00
TDGB2	8 - 14	NT30141	300.00
TDGC2	8 - 14	NT30141	375.00
TDGD2	8 - 14	NT30141	570.00
TDGE2	8 - 14	NT30141	790.00
TDGF2	8 - 14	NT30141	950.00
TDGH2	8 - 14	NT30141	325.00
TEMRELAY	7 - 32	NT40143	POA
TEMVISIONMAX	7 - 32	NT40143	POA
I A TEMVISIONPRO	7 - 32	NT40143	POA

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
TFH 22D	6 - 8	NT20138	335.00
TFJ21PB	3 - 22	NT20138	235.00
TFJ22LU	6 - 8	NT20138	355.00
TFJ34XU	6 - 11	NT20138	415.00
TFJ36XU	6 - 26	NT20138	510.00
TFJ38XU	6 - 37	NT20138	610.00
TGPEN181S	2 - 56	NT40143	55.00
TGPEN182S	2 - 56	NT40143	57.00
TGPEN182SEVE	2 - 56	NT40143	62.50
TGPEN182SODD	2 - 56	NT40143	62.50
TGPEN241S	2 - 56	NT40143	65.50
TGPEN242S	2 - 56	NT40143	67.50
TGPEN242SEVE	2 - 56	NT40143	72.50
TGPEN242SODD	2 - 56	NT40143	72.50
TGPEN302S	2 - 56	NT40143	83.00
TGPEN302SEVE	2 - 56	NT40143	88.00
TGPEN302SODD	2 - 56	NT40143	88.00
TGPEN362S	2 - 56	NT40143	93.50
TGPEN362SEVE	2 - 56	NT40143	104.00
TGPEN362SODD	2 - 56	NT40143	104.00
TGPEN422S	2 - 56	NT40143	93.50
TGPEN422SEVE	2 - 56	NT40143	114.00
TGPEN422SODD	2 - 56	NT40143	114.00
TGPEN482S	2 - 56	NT40143	98.50
TGPEN482SEVE	2 - 56	NT40143	125.00
TGPEN482SODD	2 - 56	NT40143	125.00
TGPEN602S	2 - 56	NT40143	135.00
TGPEN722S	2 - 56	NT40143	161.00
TGPEN842S	2 - 56	NT40143	197.00
TGPEN92SEVE	2 - 56	NT40143	41.50
TGPEN92SODD	2 - 56	NT40143	41.50
TGPEN962S	2 - 56	NT40143	235.00
TGPINS	2 - 57	NT40143	8.90
TH250TOPC	1 - 9	NT10136	0.60
TH250TOPC	2 - 51	NT10136	0.60
TH250TOPC	2 - 68	NT10136	0.60
TKB50SGL	1 - 9	NT10136	21.20
TKC50SG	1 - 9	NT10136	21.20
TKNHP0A	2 - 22	NB20071	520.00
TKNHP0A	3 - 39	NB20071	520.00
TKNHP0A	3 - 66	NB20071	520.00
TKNHP0A	3 - 99	NB20071	520.00
TKNHP0A	6 - 27	NB20071	520.00
TKNHP0A	6 - 37	NB20071	520.00
TKNHP0B	2 - 22	NB20071	520.00
TKNHP0B	3 - 39	NB20071	520.00
TKNHP0B	3 - 66	NB20071	520.00
TKNHP0B	3 - 99	NB20071	520.00
TKNHP0B	6 - 27	NB20071	520.00

CAT. NO.	PAGE	P.S.	PRICE \$
TKNHP0B	6 - 37	NB20071	520.00
TKNHP0C	2 - 22	NB20071	520.00
TKNHP0C	3 - 39	NB20071	520.00
TKNHP0C	3 - 66	NB20071	520.00
TKNHP0C	3 - 99	NB20071	520.00
TKNHP0C	6 - 27	NB20071	520.00
TKNHP0C	6 - 37	NB20071	520.00
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TKNHP0D	3 - 66	NB20071	520.00
TKNHP0D	3 - 99	NB20071	520.00
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TKNHP0E	3 - 39	NB20071	520.00
TKNHP0E	3 - 66	NB20071	520.00
TKNHP0E	3 - 99	NB20071	520.00
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TKNHP0E	6 - 37	NB20071	520.00
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TKNHP0F	3 - 99	NB20071	520.00
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TKNHP0F	6 - 37	NB20071	520.00
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TKNHP0G	3 - 99	NB20071	520.00
TKNHP0G	6 - 27	NB20071	520.00
TKNHP0G	6 - 37	NB20071	520.00
TKNHP0H	2 - 22	NB20071	520.00
TKNHP0H	3 - 39	NB20071	520.00
TKNHP0H	3 - 66	NB20071	520.00
TKNHP0H	3 - 99	NB20071	520.00
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TKNHP0I	3 - 66	NB20071	520.00
TKNHP0I	3 - 99	NB20071	520.00
TKNHP0I	6 - 27	NB20071	520.00
TKNHP0I	6 - 37	NB20071	520.00
TKNHP0J	2 - 22	NB20071	520.00
TKNHP0J	3 - 39	NB20071	520.00
TKNHP0J	3 - 66	NB20071	520.00
TKNHP0J	3 - 99	NB20071	520.00
TKNHP0J	6 - 27	NB20071	520.00
TKNHP0J	6 - 37	NB20071	520.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
TKNHPOK	2 - 22	NB20071	520.00
TKNHPOK	3 - 39	NB20071	520.00
TKNHPOK	3 - 66	NB20071	520.00
TKNHPOK	3 - 99	NB20071	520.00
TKNHPOK	6 - 27	NB20071	520.00
TKNHPOK	6 - 37	NB20071	520.00
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TKNHPOM	3 - 66	NB20071	520.00
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TKNHPON	6 - 37	NB20071	520.00
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TKNHPOO	6 - 37	NB20071	520.00
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TKNHPOP	3 - 66	NB20071	520.00
TKNHPOP	3 - 99	NB20071	520.00
TKNHPOP	6 - 27	NB20071	520.00
TKNHPOP	6 - 37	NB20071	520.00
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TKNHPOR	6 - 37	NB20071	520.00
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TKNHPOS	6 - 27	NB20071	520.00
TKNHPOS	6 - 37	NB20071	520.00
TKNHPOT	2 - 22	NB20071	520.00

CAT. NO.	PAGE	P.S.	PRICE \$
TKNHPOT	3 - 39	NB20071	520.00
TKNHPOT	3 - 66	NB20071	520.00
TKNHPOT	3 - 99	NB20071	520.00
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TKNHPKEYOF	3 - 99	NB20071	130.00
TKNHPKEYOF	6 - 27	NB20071	130.00
TKNHPKEYOF	6 - 37	NB20071	130.00
TKNHPKEYOG	2 - 22	NB20071	130.00
TKNHPKEYOG	3 - 39	NB20071	130.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
TKNHPKEY0G	3 - 66	NB20071	130.00
TKNHPKEY0G	3 - 99	NB20071	130.00
TKNHPKEY0G	6 - 27	NB20071	130.00
TKNHPKEY0G	6 - 37	NB20071	130.00
TKNHPKEY0H	2 - 22	NB20071	130.00
TKNHPKEY0H	3 - 39	NB20071	130.00
TKNHPKEY0H	3 - 66	NB20071	130.00
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TKNHPKEY0I	6 - 37	NB20071	130.00
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TKNHPKEYOO	2 - 22	NB20071	130.00
TKNHPKEYOO	3 - 39	NB20071	130.00
TKNHPKEYOO	3 - 66	NB20071	130.00

CAT. NO.	PAGE	P.S.	PRICE \$
TKNHPKEY0O	3 - 99	NB20071	130.00
TKNHPKEY0O	6 - 27	NB20071	130.00
TKNHPKEY0O	6 - 37	NB20071	130.00
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TKNHPKEY0P	3 - 66	NB20071	130.00
TKNHPKEY0P	3 - 99	NB20071	130.00
TKNHPKEY0P	6 - 27	NB20071	130.00
TKNHPKEY0P	6 - 37	NB20071	130.00
TKNHPKEY0Q	2 - 22	NB20071	130.00
TKNHPKEY0Q	3 - 39	NB20071	130.00
TKNHPKEY0Q	3 - 66	NB20071	130.00
TKNHPKEY0Q	3 - 99	NB20071	130.00
TKNHPKEY0Q	6 - 27	NB20071	130.00
TKNHPKEY0Q	6 - 37	NB20071	130.00
TKNHPKEY0R	2 - 22	NB20071	130.00
TKNHPKEY0R	3 - 39	NB20071	130.00
TKNHPKEY0R	3 - 66	NB20071	130.00
TKNHPKEY0R	3 - 99	NB20071	130.00
TKNHPKEY0R	6 - 27	NB20071	130.00
TKNHPKEY0R	6 - 37	NB20071	130.00
TKNHPKEY0S	2 - 22	NB20071	130.00
TKNHPKEY0S	3 - 39	NB20071	130.00
TKNHPKEY0S	3 - 66	NB20071	130.00
TKNHPKEY0S	3 - 99	NB20071	130.00
TKNHPKEY0S	6 - 27	NB20071	130.00
TKNHPKEY0S	6 - 37	NB20071	130.00
TKNHPKEYOT	2 - 22	NB20071	130.00
TKNHPKEYOT	3 - 39	NB20071	130.00
TKNHPKEYOT	3 - 66	NB20071	130.00
TKNHPKEYOT	3 - 99	NB20071	130.00
TKNHPKEYOT	6 - 27	NB20071	130.00
TKNHPKEYOT	6 - 37	NB20071	130.00
<b>A</b> TL100EM 100 3K	6 - 7	NT20138	2330.00
<b>A</b> TL100EM 15 3K	6 - 7	NT20138	2330.00
<b>A</b> TL100EM 20 3K	6 - 7	NT20138	2330.00
<b>A</b> TL100EM 30 3K	6 - 7	NT20138	2330.00
<b>A</b> TL100EM 40 3K	6 - 7	NT20138	2330.00
<b>A</b> TL100EM 50 3K	6 - 7	NT20138	2330.00
<b>A</b> TL100EM 60 3K	6 - 7	NT20138	2330.00
<b>A</b> TL100EM 75 3K	6 - 7	NT20138	2330.00
TL100EMR5GM	6 - 8	NT20138	390.00
<b>A</b> TL100EMR6BN	6 - 8	NT20138	280.00
TL101240V	5 - 31	NT30141	1900.00
<b>A</b> TL101CIP	5 - 31	NT30141	2990.00
<b>I</b> TL1250NE 1000 3 FC	6 - 34	NT20138	11690.00
<b>I</b> TL1250NE 1000 3 LG	6 - 34	NT30141	12420.00
<b>I</b> TL1250NE 1250 3 FC	6 - 34	NT20138	13080.00
<b>I</b> TL1250NE 1250 3 LG	6 - 34	NT30141	13810.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
TL630NE3LSIG	6 - 32	NT20138	5010.00
<b>I</b> TL630NE 630 3	6 - 32	NT20138	4280.00
TL800NE3LSIG	6 - 33	NT20138	9580.00
<b>I</b> TL800NE 800 3	6 - 33	NT20138	8850.00
TLC12S	2 - 10	NT40143	164.00
TLC18S	2 - 10	NT40143	205.00
TLC6S	2 - 10	NT40143	126.00
TLCDMA	2 - 10	NT40143	33.00
<b>A</b> TLP1	5 - 29	NT30141	2250.00
<b>A</b> TLP2	5 - 28	NT30141	2250.00
<b>I A</b> TLP2L1CABLE10	5 - 32	NT30141	125.00
<b>I A</b> TLP2L1CABLE15	5 - 32	NT30141	140.00
<b>I A</b> TLP2L1CABLE20	5 - 32	NT30141	156.00
<b>I A</b> TLP2L1CABLE25	5 - 32	NT30141	176.00
<b>I A</b> TLP2L1CABLE30	5 - 32	NT30141	197.00
<b>A</b> TLP2L1LCABLE	5 - 31	NT30141	114.00
<b>A</b> TLP2L1LCABLE	5 - 32	NT30141	114.00
<b>I</b> TNS2	3 - 67	NT20138	6590.00
<b>I</b> TNS2110V	3 - 100	NT20138	POA
<b>I</b> TNS2240V	3 - 100	NT20138	POA
TPD OSZ	8 - 2	NT20138	102.00
TX6CAPLAB	3 - 124	NT20138	3.50
<b>I</b> TXBD0009A	3 - 22	NT20138	36.50
TXJD0050B	3 - 66	NT20138	75.50
<b>I</b> TXLD0005A	6 - 26	NT20138	385.00
<b>I</b> TXLD0006A	6 - 26	NT20138	495.00
TXLD0012A	6 - 27	NT20138	340.00
<b>I</b> TXLD0013A	6 - 27	NT20138	425.00
<b>I</b> TXLD0016A	6 - 27	NT20138	26.80
<b>I</b> TXLD0016A	6 - 27	NT20138	26.80
TXRD0003A	3 - 132	NT30141	2030.00
TXRD0004A	3 - 132	NT30141	2810.00
TXRD0005A	3 - 132	NT20138	210.00
TZS-100	8 - 2	NT30141	1610.00
TZS-15	8 - 2	NT30141	113.00
TZS-24	8 - 2	NT30141	340.00
TZS-40	8 - 2	NT30141	630.00
TZS-68	8 - 2	NT30141	1050.00
TZS AD120240V	8 - 2	NT30141	680.00
TZS AD24VAC	8 - 2	NT30141	680.00
TZS AD415440V	8 - 2	NT30141	680.00
<b>U</b>			
UPX330PB	3 - 22	NT30141	270.00
UPX3440	6 - 12	NT30141	355.00
UPX3800	6 - 27	NT30141	660.00
UXHB0001B	3 - 132	NT30141	195.00
UXKB0001A	3 - 132	NT30141	79.00
UXKB0002A	6 - 26	NT20138	60.50
UXKB0002A	6 - 26	NT20138	60.50

	<b>CAT. NO.</b>	<b>PAGE</b>	<b>P.S.</b>	<b>PRICE \$</b>
	UXKB0003A	6 - 37	NT30141	80.00
	UXKB0013A	3 - 38	NT20138	61.00
I	UXKC0001B	6 - 11	NT20138	560.00
	UXKC0002B	6 - 11	NT20138	560.00
I	UXKC0003B	6 - 11	NT20138	840.00
	UXKC0004A	6 - 26	NT20138	360.00
	UXKC0005A	6 - 26	NT20138	520.00
	UXKC0006D	6 - 36	NT30141	880.00
	UXKC0007D	6 - 36	NT30141	1170.00
	UXKC0012A	3 - 132	NT30141	2090.00
I	UXKC0013A	3 - 132	NT30141	3120.00
	UXKC0020A	3 - 132	NT20138	83.00
	UXKC0020A	6 - 11	NT20138	83.00
	UXKC0020A	6 - 26	NT20138	83.00
	UXKC0020A	6 - 36	NT20138	83.00
	UXKC0021B	6 - 11	NT20138	220.00
	UXKC0022B	6 - 26	NT20138	310.00
	UXKC0023B	6 - 36	NT30141	460.00
	UXKC0024B	6 - 36	NT30141	460.00
	UXKC0025B	3 - 132	NT30141	650.00
	UXKC0026C	6 - 36	NT30141	880.00
I	UXKC0027C	6 - 36	NT30141	1170.00
	UXKE0030A	6 - 8	NT20138	2.20
I	UXLB0006C	3 - 22	NT20138	84.00
I	UXLB0008C	3 - 22	NT20138	120.00
	UXLB0009D	6 - 10	NT20138	178.00
	UXLB0010D	6 - 25	NT20138	181.00
	UXLB0011D	6 - 35	NT30141	315.00
I	UXLB0012C	3 - 131	NT30141	445.00
	UXLB0013D	6 - 10	NT20138	189.00
	UXLB0014D	6 - 10	NT20138	220.00
	UXLB0015D	6 - 25	NT20138	195.00
	UXLB0016D	6 - 25	NT20138	225.00
	UXLB0017D	6 - 35	NT30141	385.00
	UXLB0018D	6 - 35	NT30141	460.00
I	UXLB0019D	3 - 131	NT30141	510.00
	UXLB0020C	3 - 131	NT30141	580.00
I	UXLB0021C	3 - 131	NT30141	670.00
I	UXLB0023C	3 - 131	NT20138	790.00
I	UXLB0024D	6 - 35	NT20138	315.00
	UXLB0025D	6 - 35	NT20138	385.00
	UXLB0026D	6 - 35	NT20138	460.00
I	UXMB0006B	3 - 132	NT30141	3820.00
	UXMB0008B	3 - 132	NT30141	3820.00
	UXMB0009B	3 - 132	NT30141	3820.00
I	UXMC0001B	6 - 11	NT20138	2780.00
I	UXMC0003B	6 - 11	NT20138	2780.00
I	UXMC0004B	6 - 11	NT20138	2780.00
	UXMC0005B	6 - 11	NT20138	2780.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
UXMC0006B	6 - 26	NT20138	3550.00
<b>I</b> UXMC0008B	6 - 26	NT20138	3550.00
<b>I</b> UXMC0009B	6 - 26	NT20138	3550.00
UXMC0010B	6 - 26	NT20138	3550.00
UXMD0001B	6 - 11	NT20138	47.00
UXMD0002B	6 - 26	NT20138	47.00
UXOY0001A	6 - 25	NT20138	425.00
UXOY0002A	6 - 25	NT20138	425.00
UXOY0003A	6 - 36	NT30141	445.00
UXOY0004A	6 - 36	NT30141	445.00
UXOY0005A	6 - 36	NT30141	445.00
UXOY0006A	3 - 132	NT30141	720.00
<b>I</b> UXOY0007A	3 - 132	NT30141	880.00
UXPD0011B	6 - 12	NT20138	190.00
UXPD0012A	6 - 12	NT20138	245.00
UXPD0013C	4 - 14	NT20138	220.00
UXPD0013C	6 - 27	NT20138	220.00
<b>I</b> UXPD0014B	6 - 27	NT20138	270.00
UXQH0004B	4 - 14	NT20138	10.40
UXQH0004B	6 - 12	NT20138	10.40
UXQH0004B	6 - 27	NT20138	10.40
UXQH0004B	6 - 37	NT20138	10.40
UXRC0006C	6 - 11	NT20138	810.00
<b>I</b> UXRC0007C	6 - 11	NT20138	1090.00
UXRC0008B	6 - 26	NT20138	1460.00
<b>I</b> UXRC0009B	6 - 26	NT20138	2040.00
UXUB0013B	3 - 131	NT20138	113.00
UXUB0013B	6 - 10	NT20138	113.00
UXUB0013B	6 - 25	NT20138	113.00
UXUB0013B	6 - 35	NT20138	113.00
UXUB0014B	3 - 131	NT20138	113.00
UXUB0014B	6 - 10	NT20138	113.00
UXUB0014B	6 - 25	NT20138	113.00
UXUB0014B	6 - 35	NT20138	113.00
UXUB0015B	3 - 131	NT20138	113.00
UXUB0015B	6 - 10	NT20138	113.00
UXUB0015B	6 - 25	NT20138	113.00
UXUB0015B	6 - 35	NT20138	113.00
<b>I</b> UXUB0016B	3 - 131	NT20138	220.00
<b>I</b> UXUB0016B	6 - 10	NT20138	220.00
<b>I</b> UXUB0016B	6 - 25	NT20138	220.00
<b>I</b> UXUB0016B	6 - 35	NT20138	220.00
UXUB0017B	3 - 131	NT20138	220.00
UXUB0017B	6 - 10	NT20138	220.00
UXUB0017B	6 - 25	NT20138	220.00
UXUB0017B	6 - 35	NT20138	220.00
<b>I</b> UXUB0018B	3 - 131	NT20138	215.00
<b>I</b> UXUB0018B	6 - 10	NT20138	215.00
<b>I</b> UXUB0018B	6 - 25	NT20138	215.00

	CAT. NO.	PAGE	P.S.	PRICE \$
I	UXUB0018B	6 - 35	NT20138	215.00
I	UXUB0038B	3 - 131	NT20138	113.00
I	UXUB0038B	6 - 10	NT20138	113.00
I	UXUB0038B	6 - 25	NT20138	113.00
I	UXUB0038B	6 - 35	NT20138	113.00
	UXXB0001D	3 - 22	NT20138	86.50
	UXXB0003C	3 - 22	NT20138	127.00
	UXXB0004D	6 - 10	NT20138	169.00
	UXXB0005D	6 - 10	NT20138	220.00
	UXXB0006D	6 - 10	NT20138	255.00
	UXXB0007D	6 - 25	NT20138	169.00
	UXXB0008D	6 - 25	NT20138	200.00
	UXXB0009D	6 - 25	NT20138	240.00
	UXXB0010D	6 - 35	NT30141	335.00
	UXXB0011D	6 - 35	NT30141	415.00
	UXXB0012D	6 - 35	NT30141	490.00
	UXXB0013C	3 - 131	NT30141	350.00
	UXXB0014C	3 - 131	NT30141	400.00
I	UXXB0015C	3 - 131	NT30141	465.00
I	UXXB0016C	3 - 131	NT30141	540.00
I	UXXB0017C	3 - 131	NT30141	590.00
I	UXXB0018C	3 - 131	NT30141	640.00
I	UXXB0023D	6 - 35	NT20138	335.00
	UXXB0024D	6 - 35	NT20138	415.00
I	UXXB0025D	6 - 35	NT20138	490.00
I	UXYB0004A	6 - 27	NT20138	54.00
I	UXYB0004A	6 - 27	NT20138	54.00
I	UXYC0005A	6 - 27	NT20138	54.00
I	UXYC0005A	6 - 27	NT20138	54.00
	UXYD0001A	3 - 132	NT20138	26.80
	UXYD0001A	6 - 12	NT20138	26.80
	UXYD0001A	6 - 27	NT20138	26.80
	UXYD0001A	6 - 37	NT20138	26.80
	UXYD0002A	3 - 132	NT20138	2.20
	UXYD0002A	6 - 12	NT20138	2.20
	UXYD0002A	6 - 27	NT20138	2.20
	UXYD0002A	6 - 37	NT20138	2.20
<b>V</b>				
	VS125NJ3100	6 - 5	NT20138	1250.00
	VS125NJ3125	6 - 5	NT20138	1450.00
	VS125NJ320	6 - 5	NT20138	1250.00
	VS125NJ332	6 - 5	NT20138	1250.00
	VS125NJ350	6 - 5	NT20138	1250.00
	VS125NJ363	6 - 5	NT20138	1250.00
	VS250NJ3160	6 - 6	NT20138	1750.00
	VS250NJ3250	6 - 6	NT20138	1850.00
<b>X</b>				
	XA63012U	4 - 3	NT40143	390.00
I	XA63016U4POLE	4 - 5	NT40143	910.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
XA63018U	4 - 3	NT40143	500.00
XA63024U	4 - 3	NT40143	670.00
<b>I</b> XA63024U4POLE	4 - 5	NT40143	1320.00
XA63030U	4 - 3	NT40143	750.00
<b>I</b> XA63032U4POLE	4 - 5	NT40143	1680.00
XA63036U	4 - 3	NT40143	900.00
<b>I</b> XA63040U4POLE	4 - 5	NT40143	2010.00
XA63042U	4 - 3	NT40143	1020.00
XA63048U	4 - 3	NT40143	1130.00
<b>I</b> XA63048U4POLE	4 - 5	NT40143	2360.00
<b>I</b> XA63056U4POLE	4 - 5	NT40143	2920.00
XA63060U	4 - 3	NT40143	1380.00
<b>I</b> XA63064U4POLE	4 - 5	NT40143	3110.00
XA6306U	4 - 3	NT40143	275.00
XA63072U	4 - 3	NT40143	1650.00
<b>I</b> XA6308U4POLE	4 - 5	NT40143	760.00
XA80012U	4 - 3	NT40143	400.00
<b>I</b> XA80016U4POLE	4 - 5	NT40143	940.00
XA80018U	4 - 3	NT40143	540.00
XA80024U	4 - 3	NT40143	670.00
<b>I</b> XA80024U4POLE	4 - 5	NT40143	1380.00
XA80030U	4 - 3	NT40143	800.00
<b>I</b> XA80032U4POLE	4 - 5	NT40143	1780.00
XA80036U	4 - 3	NT40143	960.00
XA80040U4POLE	4 - 5	NT40143	2170.00
XA80042U	4 - 3	NT40143	1090.00
XA80048U	4 - 3	NT40143	1180.00
XA80048U4POLE	4 - 5	NT40143	2600.00
XA80056U4POLE	4 - 5	NT40143	3020.00
XA80060U	4 - 3	NT40143	1450.00
XA80064U4POLE	4 - 5	NT40143	3370.00
XA8006U	4 - 3	NT40143	285.00
XA80072U	4 - 3	NT40143	1730.00
XA8008U4POLE	4 - 5	NT40143	840.00
XAB2	2 - 51	NT20138	3.80
XAB2	3 - 41	NT20138	3.80
XAB3	2 - 51	NT20138	3.80
XAB3	3 - 68	NT20138	3.80
XB80012U	4 - 3	NT40143	540.00
<b>I</b> XB80016U4POLE	4 - 6	NT40143	1170.00
XB80018U	4 - 3	NT40143	740.00
XB80024U	4 - 3	NT40143	930.00
<b>I</b> XB80024U4POLE	4 - 6	NT40143	1630.00
XB80030U	4 - 3	NT40143	1120.00
<b>I</b> XB80032U4POLE	4 - 6	NT40143	2100.00
XB80036U	4 - 3	NT40143	1330.00
<b>I</b> XB80040U4POLE	4 - 6	NT40143	2540.00
XB80042U	4 - 3	NT40143	1540.00
XB80048U	4 - 3	NT40143	1760.00

Q-Pulse Id: A7MS130729201627 of 1633  
GST not included

	CAT. NO.	PAGE	P.S.	PRICE \$
I	XB80048U4POLE	4 - 6	NT40143	3060.00
	XB80060U	4 - 3	NT40143	2130.00
	XB8006U	4 - 3	NT40143	455.00
	XB80072U	4 - 3	NT40143	2710.00
I	XB8008U4POLE	4 - 6	NT40143	930.00
	XBSSL 800 12U	4 - 7	NT40143	750.00
	XBSSL 800 15U	4 - 7	NT40143	890.00
	XBSSL 800 18U	4 - 7	NT40143	1080.00
	XBSSL 800 21U	4 - 7	NT40143	1220.00
	XBSSL 800 24U	4 - 7	NT40143	1760.00
	XBSSL 800 30U	4 - 7	NT40143	2130.00
	XBSSL 800 36U	4 - 7	NT40143	2710.00
I	XBSSL 800 3U	4 - 7	NT40143	370.00
	XBSSL 800 6U	4 - 7	NT40143	440.00
	XBSSL 800 9U	4 - 7	NT40143	590.00
	XBSSR 800 12U	4 - 8	NT40143	750.00
	XBSSR 800 15U	4 - 8	NT40143	890.00
	XBSSR 800 18U	4 - 8	NT40143	1080.00
	XBSSR 800 21U	4 - 8	NT40143	1220.00
	XBSSR 800 24U	4 - 8	NT40143	1760.00
	XBSSR 800 30U	4 - 8	NT40143	2130.00
	XBSSR 800 36U	4 - 8	NT40143	2710.00
I	XBSSR 800 3U	4 - 8	NT40143	370.00
	XBSSR 800 6U	4 - 8	NT40143	440.00
	XBSSR 800 9U	4 - 8	NT40143	590.00
	XC100012U	4 - 9	NT40143	800.00
	XC100018U	4 - 9	NT40143	1110.00
	XC10001X4R12U	4 - 10	NT40143	1490.00
	XC10001X4R24U	4 - 10	NT40143	2100.00
	XC10001X4R36U	4 - 10	NT40143	2800.00
	XC100024U	4 - 9	NT40143	1430.00
	XC10002X4R12U	4 - 10	NT40143	2320.00
	XC10002X4R24U	4 - 10	NT40143	2930.00
	XC10002X4R36U	4 - 10	NT40143	3630.00
	XC100030U	4 - 9	NT40143	1660.00
	XC100036U	4 - 9	NT40143	1980.00
	XC100042U	4 - 9	NT40143	2340.00
I	XC100048U	4 - 9	NT40143	2580.00
	XC10006U	4 - 9	NT40143	710.00
	XCW0840LS13	7 - 6	NZ00150	330.00
	XCW0840LS16	7 - 6	NZ00150	330.00
I	XDM6-3	6 - 27	NT20138	880.00
I	XDM6-4	6 - 27	NT20138	980.00
	XECA640LS20	7 - 6	NZ00150	330.00
	XECA640LS25	7 - 6	NZ00150	650.00
	XECA640LS32	7 - 6	NZ00150	650.00
	XECA640LS40	7 - 6	NZ00150	1240.00
	XFE10	3 - 132	NT20138	1690.00
I	XH630PJ 400 3	6 - 15	NT20138	4350.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

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	CAT. NO.	PAGE	P.S.	PRICE \$
	XH630PJ 630 3	6 - 15	NT20138	4810.00
	XH630SE 630 3	6 - 17	NT20138	3260.00
<b>I A</b>	XH630SE 630 3LSIG	6 - 17	NT20138	4110.00
	XH630SE 630 4	6 - 17	NT20138	4350.00
<b>I</b>	XH630SE 630 4LSIG	6 - 17	NT20138	6420.00
<b>I</b>	XH800PE 800 3	6 - 23	NT20138	4700.00
<b>I</b>	XH800PE 800 4	6 - 23	NT20138	8500.00
	XH800PJ 800 3P	6 - 20	NT20138	4810.00
<b>I</b>	XH800PJ 800 4P	6 - 20	NT20138	6750.00
	XH800SE 800 3	6 - 22	NT20138	4360.00
<b>I A</b>	XH800SE 800 3LSIG	6 - 22	NT20138	5080.00
<b>I</b>	XH800SE 800 4	6 - 22	NT20138	6750.00
<b>I</b>	XH800SE 800 4LSIG	6 - 22	NT20138	7480.00
	XKA4	6 - 11	NT20138	47.00
	XKA6	6 - 26	NT20138	60.50
	XM30PB0.7 3P	3 - 21	NT20138	500.00
	XM30PB10 3P	3 - 21	NT20138	500.00
	XM30PB12 3P	3 - 21	NT20138	500.00
	XM30PB1.4 3P	3 - 21	NT20138	500.00
	XM30PB2.0 3P	3 - 21	NT20138	500.00
	XM30PB2.6 3P	3 - 21	NT20138	500.00
	XM30PB4 3P	3 - 21	NT20138	500.00
	XM30PB5 3P	3 - 21	NT20138	500.00
	XM30PB8 3P	3 - 21	NT20138	500.00
	XM30TSC	3 - 22	NT20138	21.80
<b>I</b>	XS1000ND10003FC	3 - 145	NT20138	9630.00
	XS1250ND12503FC	3 - 145	NT30141	10160.00
<b>A</b>	XS1250OCR SK	6 - 37	NT20138	40.00
<b>I A</b>	XS1250SE 10003LG	6 - 29	NT30141	7870.00
<b>I A</b>	XS1250SE 10004LG	6 - 29	NT30141	8940.00
	XS1250SE 1000 FC3	6 - 29	NT30141	7010.00
	XS1250SE 1000 FC4	6 - 29	NT30141	9220.00
	XS1250SE 12503LG	6 - 29	NT30141	9490.00
<b>I A</b>	XS1250SE 12504LG	6 - 29	NT30141	12230.00
	XS1250SE 1250 FC3	6 - 29	NT30141	8770.00
	XS1250SE 1250 FC4	6 - 29	NT30141	11680.00
<b>I</b>	XS1600ND16003FC	3 - 145	NT30141	16750.00
	XS1600SE 16003LG	6 - 31	NT30141	10780.00
	XS1600SE 16004LG	6 - 31	NT30141	14120.00
	XS1600SE 1600 FC3	6 - 31	NT30141	10050.00
	XS1600SE 1600 FC4	6 - 31	NT30141	13390.00
<b>I</b>	XS2000ND20003RC	3 - 145	NT30141	18460.00
<b>I A</b>	XS2000NE 20003L	3 - 128	NT30141	18250.00
	XS2000NE 20003 RC	3 - 128	NT30141	17400.00
<b>I</b>	XS2000NE 20004L	3 - 128	NT20138	24160.00
<b>I</b>	XS2000NE 20004RC	3 - 128	NT30141	23310.00
	XS2000NN3RC	3 - 142	NT30141	15610.00
<b>I</b>	XS2000NN4RC	3 - 142	NT30141	20820.00
<b>I A</b>	XS2000OCR SK	3 - 132	NT20138	60.50

	CAT. NO.	PAGE	P.S.	PRICE \$
I	XS2500ND25003RC	3 - 145	NT30141	20710.00
	XS2500NE 2500 RC3	3 - 129	NT20138	19410.00
I	XS2500NE 2500 RC4	3 - 129	NT20138	25880.00
I	XS2500NN3RC	3 - 142	NT30141	15990.00
	XS2500NN4FC	3 - 142	NT20138	23660.00
	XS2500SE 25003L	3 - 129	NT20138	20280.00
I	XS2500SE 25004L	3 - 129	NT20138	26750.00
	XS3200NE32003 RC	3 - 130	NT30141	23810.00
A	XS4000CRSK	6 - 12	NT20138	54.00
	XS630NJ 400 3	6 - 14	NT20138	2990.00
	XS630NJ 630 3	6 - 14	NT20138	2990.00
A	XS6300CRSK	6 - 27	NT20138	54.00
	XS630SE 630 3	6 - 16	NT20138	3100.00
A	XS630SE 6303LSIG	6 - 16	NT20138	3960.00
	XS630SE 630 4	6 - 16	NT20138	4130.00
I A	XS630SE 6304LSIG	6 - 16	NT20138	6280.00
	XS800NJ 800 3	6 - 19	NT20138	3850.00
	XS800NJ 800 4	6 - 19	NT20138	5130.00
	XS800NN3	6 - 13	NT20138	3450.00
	XS800SE 800 3	6 - 21	NT20138	4140.00
A	XS800SE 800 3LSIG	6 - 21	NT20138	4990.00
	XS800SE 800 4	6 - 21	NT20138	5520.00
I A	XS800SE 800 4LSIG	6 - 21	NT20138	6370.00
A	XV1250NE1000 3 K	6 - 30	NT20138	10620.00
A	XV1250NE1250 3 K	6 - 30	NT20138	13630.00
I A	XV1250NE 400 3 K	6 - 30	NT20138	10030.00
A	XV1250NE 800 3 K	6 - 30	NT20138	10030.00
A	XV400NE 160 3K	6 - 9	NT20138	3860.00
A	XV400NE 250 3K	6 - 9	NT20138	3860.00
A	XV400NE 400 3K	6 - 9	NT20138	4080.00
A	XV630PE 400 3K	6 - 24	NT20138	4270.00
A	XV630PE 630 3K	6 - 24	NT20138	5440.00
A	XV800PE 800 3K	6 - 24	NT20138	8240.00
Y				
A	YASD22D	6 - 8	NT20138	445.00
A	YASD34	6 - 11	NT20138	700.00
Z				
	ZS125 GJ 3 100	3 - 135	NT20138	2230.00
	ZS125 GJ 3 125	3 - 135	NT20138	2380.00
	ZS125 GJ 3 20	3 - 135	NT20138	2000.00
	ZS125 GJ 3 32	3 - 135	NT20138	2000.00
	ZS125 GJ 3 50	3 - 135	NT20138	2000.00
	ZS125 GJ 3 63	3 - 135	NT20138	2000.00
	ZS125 GJ 4 100	3 - 135	NT20138	2560.00
	ZS125 GJ 4 100 SN	3 - 135	NT20138	2560.00
	ZS125 GJ 4 125	3 - 135	NT20138	2750.00
	ZS125 GJ 4 125 SN	3 - 135	NT20138	2750.00
	ZS125 GJ 4 20	3 - 135	NT20138	2200.00
	ZS125 GJ 4 20 SN	3 - 135	NT20138	2200.00

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Ma

**I** Available on indent only.

**A** Assembled to order.

CAT. NO.	PAGE	P.S.	PRICE \$
ZS125 GJ 4 32	3 - 135	NT20138	2200.00
ZS125 GJ 4 32 SN	3 - 135	NT20138	2200.00
ZS125 GJ 4 50	3 - 135	NT20138	2200.00
ZS125 GJ 4 50 SN	3 - 135	NT20138	2200.00
ZS125 GJ 4 63	3 - 135	NT20138	2200.00
ZS125 GJ 4 63 SN	3 - 135	NT20138	2200.00
ZS250 GJ 3 160	3 - 136	NT20138	2490.00
ZS250 GJ 3 250	3 - 136	NT20138	2780.00
ZS250 GJ 4 160	3 - 136	NT20138	2890.00
ZS250 GJ 4 160 SN	3 - 136	NT20138	2890.00
ZS250 GJ 4 250	3 - 136	NT20138	3110.00
ZS250 GJ 4 250 SN	3 - 136	NT20138	3110.00
ZS400 GF 3 250	3 - 140	NT20138	3900.00
ZS400 GF 3 300	3 - 140	NT20138	3900.00
ZS400 GF 3 350	3 - 140	NT20138	4150.00
ZS400 GF 3 400	3 - 140	NT20138	4300.00
ZS400 GF 4 250	3 - 140	NT20138	4600.00
ZS400 GF 4 300	3 - 140	NT20138	4600.00
ZS400 GF 4 350	3 - 140	NT20138	4800.00
ZS400 GF 4 400	3 - 140	NT20138	4950.00
ZS630 GF 3 250	3 - 141	NT20138	1640.00
ZS630 GF 3 300	3 - 141	NT20138	1640.00
ZS630 GF 3 350	3 - 141	NT20138	1640.00
ZS800 GF 3 350	3 - 141	NT20138	1640.00
ZS800 GF 3 400	3 - 141	NT20138	1640.00



## 24/7 protection for your plant and equipment.



CORP-NHP SERVICE-CPB

### Field support services

NHP Service provides a comprehensive range of value add services that support and enhance the reliability and performance of NHP products. Our team of proficiently qualified technicians are available for a variety of lifecycle services, including:

- Product repairs and service
- On-site emergency breakdown service
- Preventative maintenance, and
- Commissioning

### Product repairs and service

Our National Service Headquarters is based in Melbourne. For over 40 years, we have supported all NHP products, from motor starters to circuit breakers. Traditionally, products are returned to our National service centre for maintenance and repair. When this is not possible, we deploy our field service technicians to complete the tasks at customer sites.

Products covered by NHP Service:

1. NHP variable speed drives
2. NHP soft starters
3. NHP auto transformer starters
4. NHP liquid resistance starters
5. Terasaki ACBs, MCCBs
6. NHP power factor correction panels and power quality products

### Emergency breakdown assistance

Modern facility managers demand consistency and efficiency of performance. In industrial applications, production is paramount.

In the case of commercial installations, continuity of service is equally important. In either case, disruption can result in costly losses and consequential damages. You want action, and you want it fast! NHP service offers 24/7 protection to ensure that your plant and equipment continues to work for you. Our service technicians are on call and are equipped to minimise downtime.

### Charge out fees\*

Onsite: Standard hourly rate = \$125/hr

Normal business hours:

8.00am - 5.00pm, Monday to Friday

All site work is subject to minimum four hours (includes travel and organisation time).

- Minimum charge normal business hours  
= 4 hours (\$500), thereafter = \$125/hr
- Minimum charge after hours  
= 4 hours (\$750), thereafter = \$187.50/hr
- Minimum charge public holidays  
= 4 hours (\$1000), thereafter = \$250/hr

Return to base: Standard hourly rate = \$95/hr

All return to base work incurs a minimum evaluation charge starting from \$150, and thereafter a quote is issued for the repair/service work to be completed on the item. This quote will cover both labour and parts.

### Overtime on request:

- Hourly rate after hours = \$125/hr
- Hourly rate for public holidays = \$250/hr

### Special service quotes:

The service sales team can also create special service quotes for scheduled work or maintenance contracts.

### Payment:

Customers that do not have an account with NHP can use NHP's secure VISA and MasterCard credit card facilities.

Products and/or service offered for sale in this pocket book are subject to our Standard Conditions of Sale, applicable at the date the order is placed. NHP standard Conditions of Sale can be viewed on our website at:

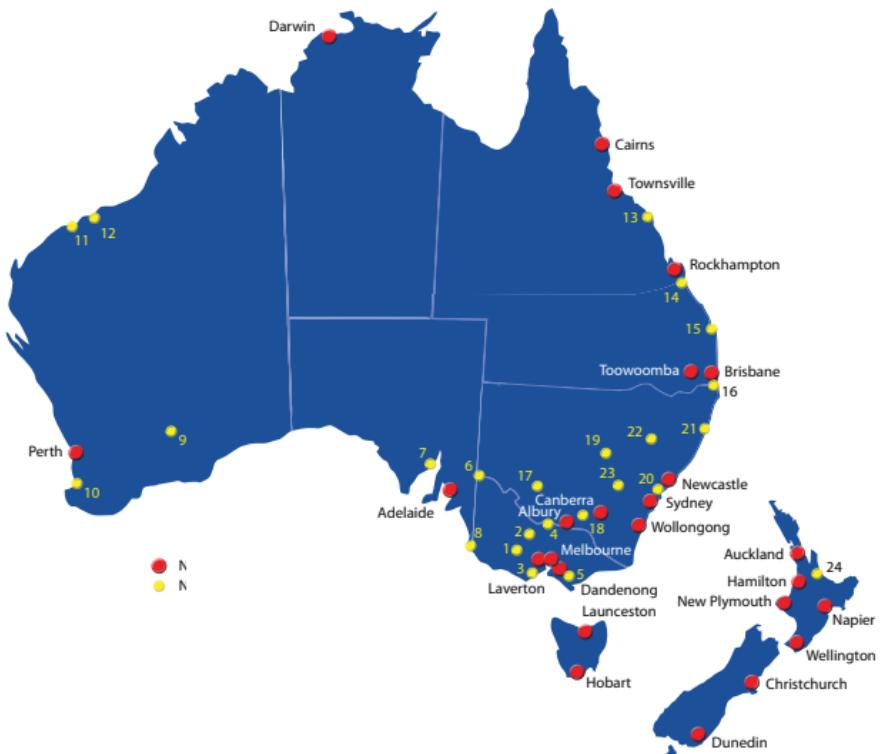
<http://ecat.nhp.com.au> or by requesting a copy for any of our offices.

### Contacts

Normal business hours: contact your local NHP branch.

After hours: phone 1300 NHP NHP, where your after hours service request will be answered by technically trained NHP customer service staff, who will assess the level of service support required and arrange for the work to be completed.

# 33 Adam Street Wynnum North SPS - Electrical Installation OM Map



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Dandenong  
Albury / Wodonga

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Launceston

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**South Australia**  
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1 Ballarat	13 Mackay
2 Bendigo	14 Gladstone
3 Geelong	15 Sunshine Coast
4 Shepparton	
5 Gippsland	16 Gold Coast
6 Mildura	17 Griffith
7 Whyalla	18 Wagga Wagga
8 Mt Gambier	19 Dubbo
9 Kalgoorlie	20 Gosford
10 Bunbury	21 Coffs Harbour
11 Karratha	22 Tamworth
12 Port Hedland	23 Lithgow

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● New Zealand Regional Representation

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### 1300 NHP NHP

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3026  
Tel +61 3 9368 2901

### Albury / Wodonga

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Tel +61 2 6049 0600

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North  
Silverwater NSW 2128  
Tel +61 2 9748 3444

### Newcastle

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Mayfield West NSW  
2304  
Tel +61 2 4960 2220

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NHP

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Tel +61 7 4927 2277

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Cnr Carroll Street and  
Struan Court  
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Tel +61 7 4634 4799

## Cairns

2/1 Bramp Close  
Portsmith QLD 4870  
Tel +61 7 4035 6888

## ACT

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1/187 Gladstone  
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Fyshwick ACT 2609  
Tel +61 2 6280 9888

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38 Belmont Ave  
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Hamilton 3204  
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30 Fox Street  
South Dunedin 9012  
Tel 0800 NHP NHP

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# **TECHNICAL DATA SHEET**

**Equipment Type:** Phase Failure Relay

**Location:** Power Distribution

**Model Numbers:** DPB 01CM48W4

**Manufacturer:** Carlo Gavazzi

**Supplier:** NHP Pty Ltd

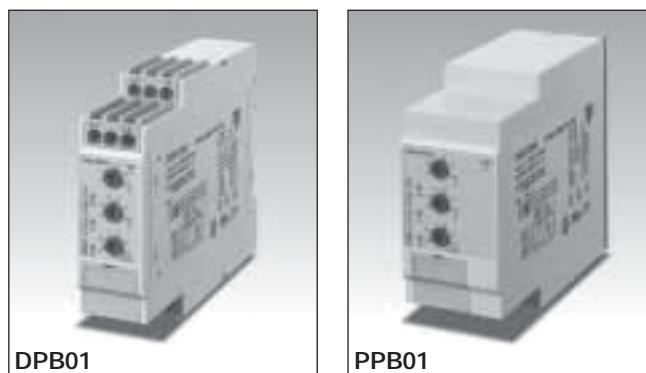
16 Riverview Place  
Murarrie  
(07) 3909 4999

# Monitoring Relays

## True RMS 3-Phase, 3-Phase+N, Multi-function

### Types DPB01, PPB01

CARLO GAVAZZI



- TRMS 3-phase over and under voltage, phase sequence and phase loss monitoring relays
- Detect when all 3 phases are present and have the correct phase sequence (except for N versions)
- Available versions (W4) supplied between phase and neutral
- Detect if all the 3-phase-phase or phase-neutral voltages are within the set limits
- Upper and lower limits separately adjustable
- Measure on own power supply
- Selection of measuring range by DIP-switches
- Adjustable voltage on relative scale
- Adjustable delay function (0.1 to 30 s)
- Output: 8 A SPDT relay N.E.
- For mounting on DIN-rail in accordance with DIN/EN 50 022 (DPB01) or plug-in module (PPB01)
- 22.5 mm Euronorm housing (DPB01) or 36 mm plug-in module (PPB01)
- LED indication for relay, alarm and power supply ON

### Product Description

3-phase or 3-phase+neutral line voltage monitoring relay for phase sequence, phase loss, over and under voltage (separately adjustable set points) with built-in time delay function. Supply ranges from 208 to 480 VAC covered by two multivoltage relays.

### Ordering Key

**DPB 01 C M23**

Housing	<input type="text"/>
Function	<input type="text"/>
Type	<input type="text"/>
Item number	<input type="text"/>
Output	<input type="text"/>
Power supply	<input type="text"/>

### Type Selection

Mounting	Phase sequence detection	Output	Supply: 208 to 240 VAC	Supply: 380 to 415 VAC	Supply: 380 to 480 VAC
DIN-rail	yes	SPDT	DPB 01 C M23	DPB 01 C M48 W4	DPB 01 C M48
Plug-in	yes	SPDT	PPB 01 C M23	PPB 01 C M48 W4	
Plug-in	yes	SPDT		PPB 01 C M48	
DIN-rail	no	SPDT	DPB 01 C M23 N	DPB 01 C M48 N W4	DPB 01 C M48 N
Plug-in	no	SPDT	PPB 01 C M23 N	PPB 01 C M48 N W4	
Plug-in	no	SPDT		PPB 01 C M48 N	

### Input Specifications

<b>Input</b> L1, L2, L3, N	DPB01: Terminals L1, L2, L3, N PPB01: Terminals 5, 6, 7, 11 Measure on own supply	<b>Ranges</b> Upper level Lower level	+2 to +22% of the nominal voltage -22 to -2% of the nominal voltage
Note: Connect the neutral only if it is intrinsically at the star centre		<b>Note:</b> The input voltage must not exceed the maximum rated voltage or drop below the minimum rated voltage reported above.	
<b>Measuring ranges</b> 208 to 240 VAC 380 to 415 VAC 380 to 480 VAC	177 to 275 V <sub>L-L</sub> AC M23 versions 323 to 475 V <sub>L-L</sub> AC PPB01CM48 PPB01CM48N D/P PB01CM48W4 D/P PB01CM48NW4 323 to 550 V <sub>L-L</sub> AC DPB01CM48 DPB01CM48N	<b>Hysteresis</b> Set points from 2 to 5% Set points from 5 to 22%	1% 2%

## Output Specifications

<b>Output</b>	SPDT relay
Rated insulation voltage	250 VAC
<b>Contact ratings (AgSnO<sub>2</sub>)</b>	μ
Resistive loads AC 1	8 A @ 250 VAC
DC 12	5 A @ 24 VDC
Small inductive loads AC 15	2.5 A @ 250 VAC
DC 13	2.5 A @ 24 VDC
<b>Mechanical life</b>	≥ 30 x 10 <sup>6</sup> operations
Electrical life	≥ 10 <sup>5</sup> operations (at 8 A, 250 V, cos φ = 1)
Operating frequency	≤ 7200 operations/h
Dielectric strength	
Dielectric voltage	2 kVAC (rms)
Rated impulse withstand volt.	4 kV (1.2/50 μs)

## General Specifications

<b>Power ON delay</b>	1 s ± 0.5 s or 6 s ± 0.5 s	
<b>Reaction time</b>		
Incorrect phase sequence or total phase loss	< 200 ms (input signal variation from -20% to +20% or from +20% to -20% of set value)	
Voltage level	< 200 ms (delay < 0.1 s) < 200 ms (delay < 0.1 s)	
Alarm ON delay		
Alarm OFF delay		
<b>Accuracy</b>	(15 min warm-up time) ± 1000 ppm/°C ± 10% on set value ± 50 ms ± 0.5% on full-scale	
Temperature drift		
Delay ON alarm		
Repeatability		
<b>Indication for</b>		
Power supply ON	LED, green	
Alarm ON	LED, red (flashing 2 Hz during delay time)	
Output relay ON	LED, yellow	
<b>Environment</b>		
Degree of protection	IP 20	
Pollution degree	3 (DPB01), 2 (PPB01)	
Operating temperature	-20 to 60°C, R.H. < 95%	
@ Max. voltage, 50 Hz	-20 to 50°C, R.H. < 95%	
@ Max. voltage, 60 Hz		
Storage temperature	-30 to 80°C, R.H. < 95%	
<b>Housing</b>		
Dimensions	DPB01	22.5 x 80 x 99.5 mm
	PPB01	36 x 80 x 94 mm
<b>Weight</b>	Approx. 120 g	
<b>Screw terminals</b>		
Tightening torque	Max. 0.5 Nm according to IEC 60947	
<b>Approvals</b>	UL, CSA (except for W4 versions)	
<b>CE Marking</b>	Yes	
<b>EMC</b>	Electromagnetic Compatibility Immunity According to EN 61000-6-2 Emissions According to EN 61000-6-3	

## Mode of Operation

Connected to the 3 phases (and neutral) DPB01 and PPB01 operate when all 3 phases are present at the same time, the phase sequence is correct (not N versions) and the phase-phase (or phase-neutral) voltage levels are within set limits.

If one or more phase-phase or phase-neutral voltages exceeds the upper set level or drops below the lower set level, the red LED starts

flashing 2 Hz and the output relay releases after the set time period. In any case if phase-neutral measurement is selected both phase-phase and phase-neutral voltages are monitored. If the phase sequence is wrong or one phase is lost, the output relay releases immediately.

Only 200 ms delay occurs. The failure is indicated by the red LED flashing 5 Hz during the alarm condition.

### Example 1 (mains network monitoring)

The relay monitors over and under voltage, phase loss and correct phase sequence. In case of N versions, the relay monitors over and under voltage.

### Example 2 (load monitoring)

The relay releases in case of interruption of one or more phases, when one or more voltages drop below the lower set level or exceed the upper set level.



## Function/Range/Level and Time Delay Setting

Adjust the input range setting the DIP switches 3 and 4 as shown below.

Select the desired function setting the DIP switches 1 and 2 as shown below.

To access the DIP switches open the grey plastic cover as shown below

**Selection of level and time delay:**

**Upper knob:**

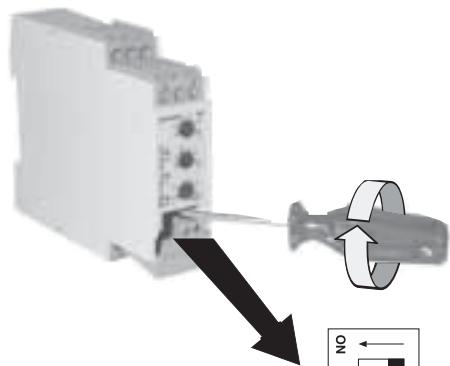
Setting of lower level on relative scale.

**Centre knob:**

Setting of upper level on relative scale.

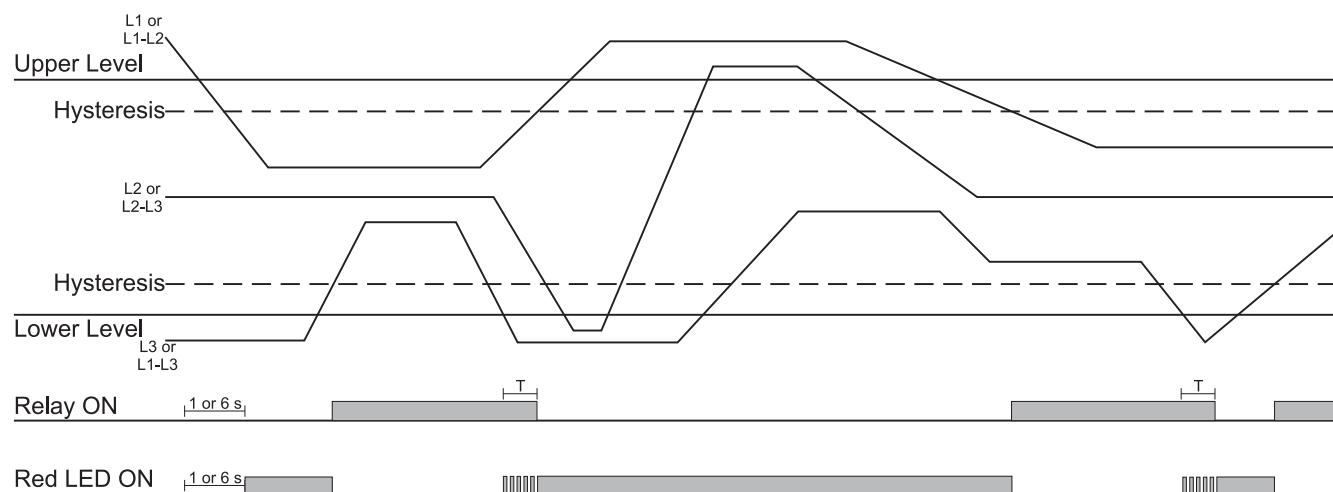
**Lower knob:**

Setting of delay on alarm time on absolute scale (0.1 to 30 s).



<b>Power ON delay</b> ON: $6 \text{ s} \pm 0.5 \text{ s}$ OFF: $1 \text{ s} \pm 0.5 \text{ s}$				
<b>Monitored voltage</b> ON: Phase-Neutral OFF: Phase-Phase				
<b>Measuring range</b>				
SW3	ON	ON	OFF	OFF
SW4	ON	OFF	ON	OFF
M23 Ph-Ph Voltage	208 VAC	220 VAC	230 VAC	240 VAC
M48 Ph-Ph Voltage	380 VAC	400 VAC	415 VAC	480 VAC DPB01CM48, DPB01CM48N only
M48 Ph-N Voltage	220 VAC	230 VAC	240 VAC	277 VAC DPB01CM48, DPB01CM48N only

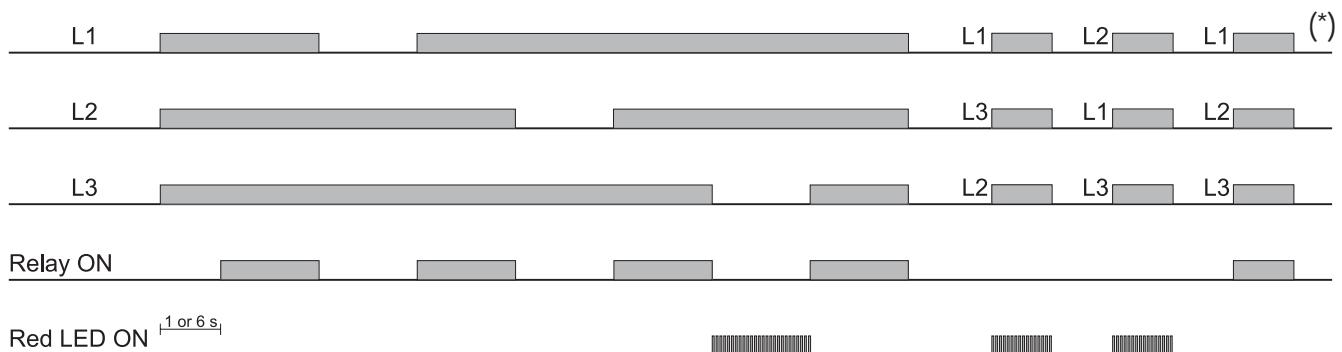
## Operation Diagrams



DPB01, PPB01

**CARLO GAVAZZI**

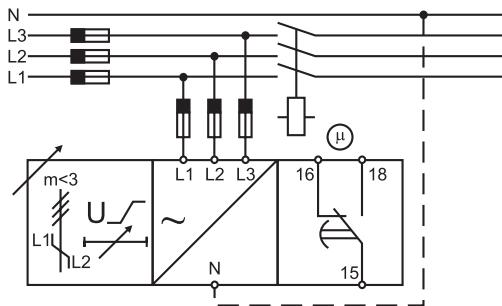
## Operation Diagrams (cont.)



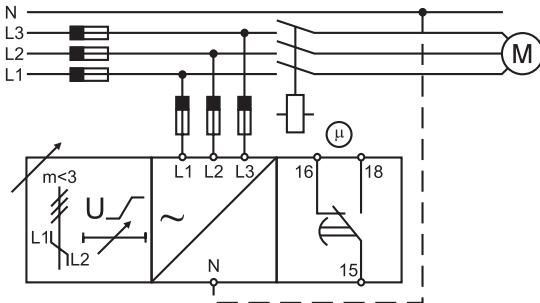
(\*) N versions don't detect incorrect phase sequence.

## Wiring Diagrams

Example 1

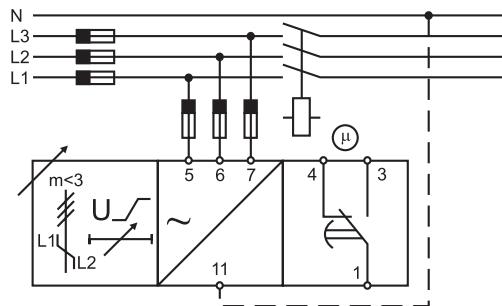


Example 2

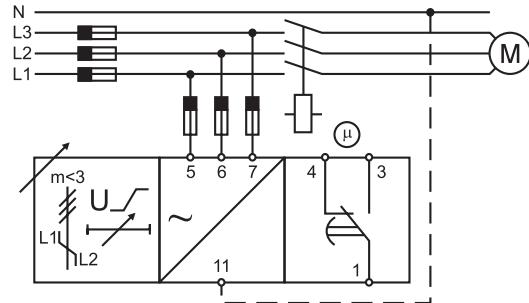


DPB01

Example 1



Example 2



PPB01

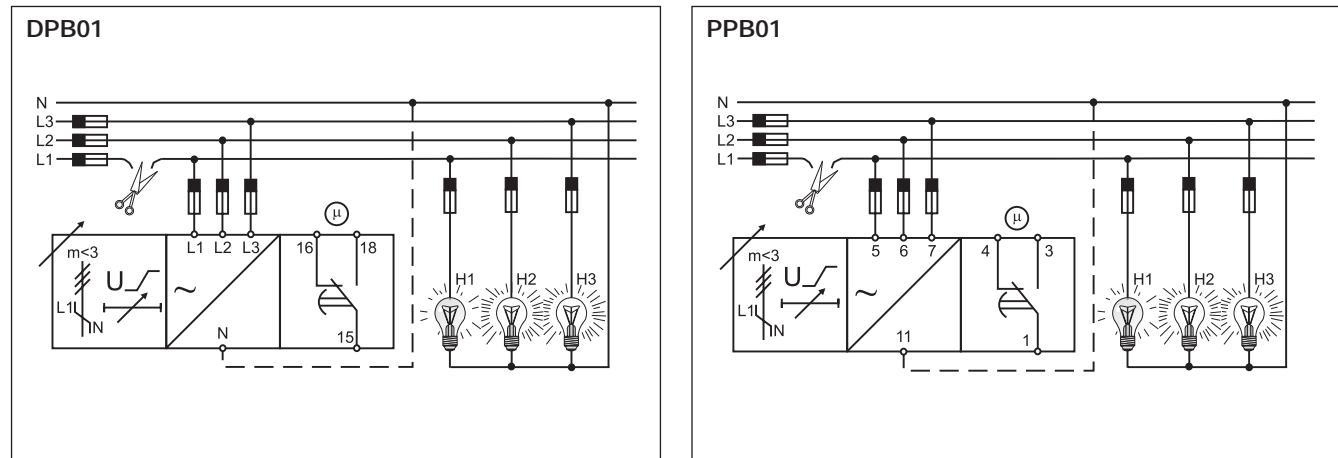
DPB01, PPB01



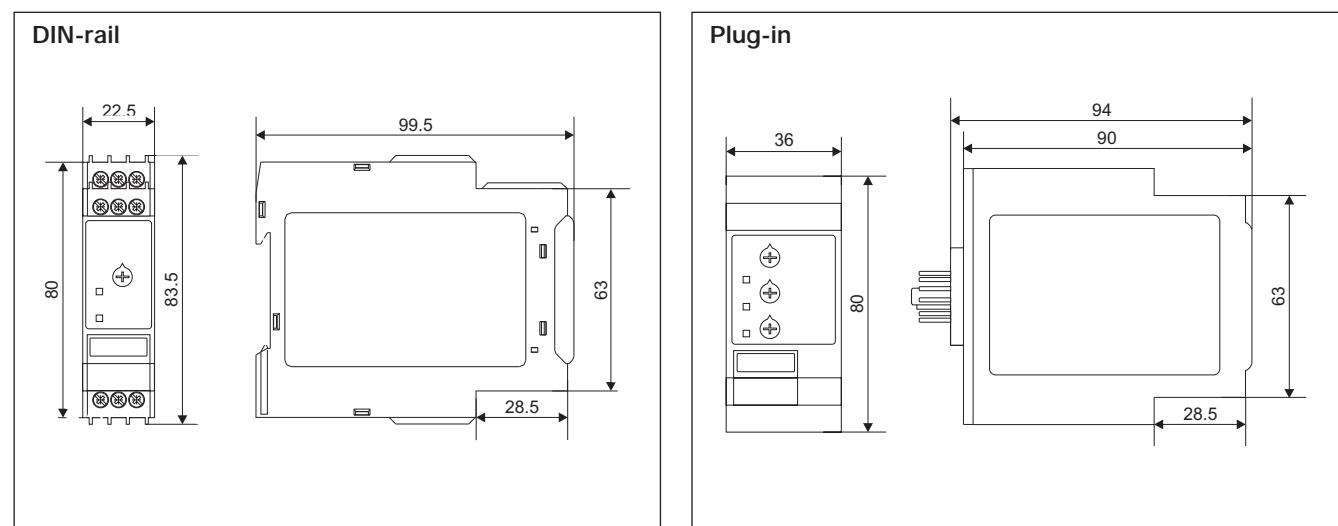
## Note

When DPB01 or PPB01 is used with phase indicator lamps (see examples in the following diagrams), the lamp H1 or H2 might be dimly lit when there is a phase loss in L1 or L2. This might happen if the lamps used are the typical low power indicator lamps, and there are no other loads present.

This fact can be avoided by using W4 models. Note that the neutral must be always connected to the device.



## Dimensions



## **TECHNICAL DATA SHEET**

**Equipment Type:** Standard load break switches

**Location:** Power Distribution

**Model Numbers:** various

**Manufacturer:** Socomec

**Supplier:** NHP Pty Ltd

16 Riverview Place  
Murarrie  
(07) 3909 4999

## SLB Standard load-break switches

### COMO M 20 to 100 A




SLB 20...40

The COMO M range of load-break switches offer compact IP 20 finger safe solutions for switching up to and including 100 A. They are ideal for the arduous switching of motors.

Standard mounting is by DIN rail or base mount with screws.

The COMO M comes complete with direct mount handle, or pistol handles and shaft. Fourth pole and auxiliary switching can also be achieved with easy clip-on modules - refer accessories.

#### Front operated surface mount (Supplied with direct or external handle)

	AC 22 400 V (A)	AC 23 400 V (A)	AC 23 400 V (kW)	Handle type	Cat. No.
<b>20 A</b>	20	20	9	Direct	SLB 20D 3P
				Pistol	SLB 20P 3P
<b>25 A</b>	25	25	11	Direct	SLB 25D 3P
				Pistol	SLB 25P 3P
<b>32 A</b>	32	32	15	Direct	SLB 32D 3P
				Pistol	SLB 32P 3P
<b>40 A</b>	40	40	18.5	Direct	SLB 40D 3P
				Pistol	SLB 40P 3P
<b>63 A</b>	63	63	30	Direct	SLB 63D 3P
				Pistol	SLB 63P 3P
<b>80 A</b>	80	80	40	Direct	SLB 80D 3P
				Pistol	SLB 80P 3P
<b>100 A</b>	100	80	40	Direct	SLB 100D 3P
				Pistol	SLB 100P 3P

FRAME SIZE M1



SLB 63...100

## SLB Standard load-break switches

### SIRCO 125 to 4000 A




SLB 125...630

The SIRCO range of load-break switches offer compact solutions for switching from 125 A to 4000 A. Base mounting is standard.

The SIRCO range are a proven, reliable design that more than suit harsh Australian conditions.

The switches come complete with extended shaft and door mountable pistol grip handle.

Available in three and four pole versions with a large range of accessories to choose from.

#### Front operated surface mount (Supplied with external handle and shaft)

	AC 21 400 V (A)	AC 23 400 V (A)	AC 23 400 V (kW)	No. of poles <sup>1)</sup>	Cat. No.
<b>125 A</b>	125	125	63	3	<b>SLB 125 3P</b>
				4	<b>SLB 125 4P</b>
<b>160 A</b>	160	160	80	3	<b>SLB 160 3P</b>
				4	<b>SLB 160 4P</b>
<b>200 A</b>	200	200	100	3	<b>SLB 200 3P</b>
				4	<b>SLB 200 4P</b>
<b>250 A</b>	250	250	132	3	<b>SLB 250 3P</b>
				4	<b>SLB 250 4P</b>
<b>315 A</b>	315	315	160	3	<b>SLB 315 3P</b>
				4	<b>SLB 315 4P</b>
<b>400 A</b>	400	400	220	3	<b>SLB 400 3P</b>
				4	<b>SLB 400 4P</b>
<b>500 A</b>	500	400	280	3	<b>SLB 500 3P</b>
				4	<b>SLB 500 4P</b>
<b>630 A</b>	630	500	280	3	<b>SLB 630 3P</b>
				4	<b>SLB 630 4P</b>
<b>800 A</b>	800	800	450	3	<b>SLB 800 3P</b>
				4	<b>SLB 800 4P</b>

**Notes:** <sup>1)</sup> 6 and 8 pole switches available on indent. Refer NHP.

 Available on indent only.



SLB 800...3150

## SLB Standard load-break switches

### SIRCO 125 to 4000 A (cont'd)



SLB 800...3150

#### Front operated surface mount (Supplied with external handle and shaft)

	AC 21 400 V (A)	AC 23 400 V (A)	AC 23 400 V (kW)	No. of poles <sup>1)</sup>	Cat. No.
<b>1000 A</b>	1000	1000	560	3	SLB 1000 3P
				4	SLB 1000 4P
<b>1250 A</b>	1250	1000	560	3	SLB 1250 3P
				4	SLB 1250 4P
<b>1600 A</b>	1600	1000	560	3	SLB 1600 3P
				4	SLB 1600 4P
<b>1800 A</b>	1800	1000	560	3	SLB 1800 3P
				4	SLB 1800 4P
<b>2000 A</b>	2000	1250	710	3	SLB 2000 3P
				4	SLB 2000 4P
<b>2500 A</b>	2500	1250	710	3	SLB 2500 3P
				4	SLB 2500 4P
<b>3150 A</b>	3150	1250	710	3	SLB 3150 3P
				4	SLB 3150 4P
<b>4000 A</b>	4000	1250	710	3	SLB 4000 3P <sup>2)</sup>
				4	SLB 4000 4P <sup>2)</sup>

**Notes:** <sup>1)</sup> 6 and 8 pole switches available on indent. Refer NHP.

<sup>2)</sup> Supplied with 2 N/O and 2 N/C auxiliaries as standard.

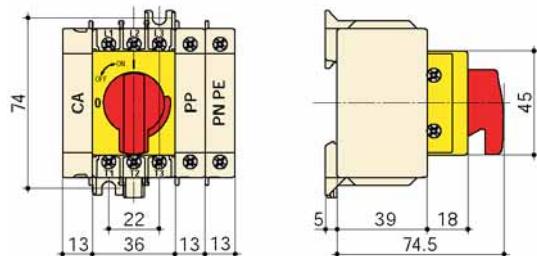
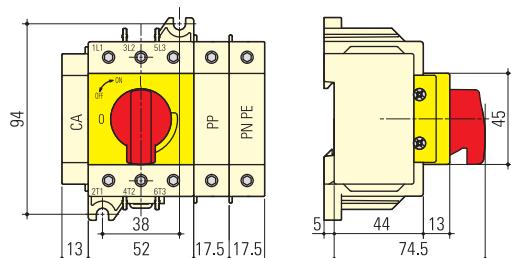
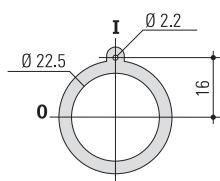
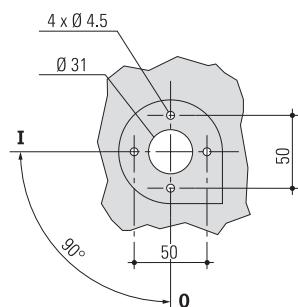
Available on indent only.



SLB 4000

## Technical data and dimensions (mm)

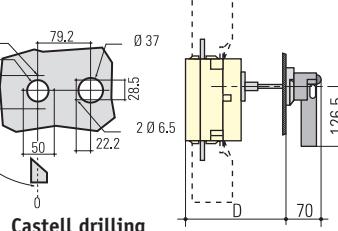
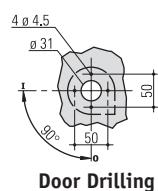
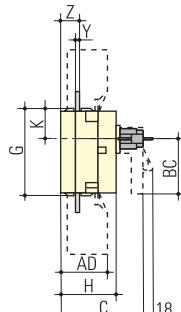
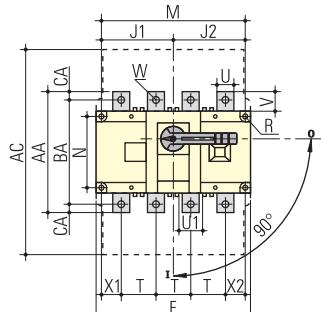
### COMO M SLB 20 to 100 A

**COMO M 20 to 40 A****COMO M 63 to 100 A****COMO M Selector handle door drilling****COMO M Pistol handle door drilling**

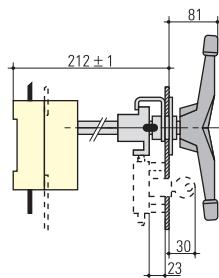
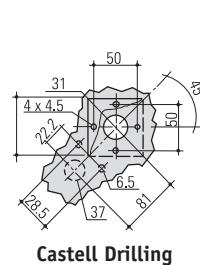
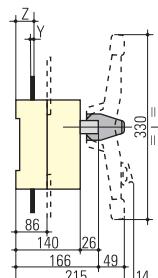
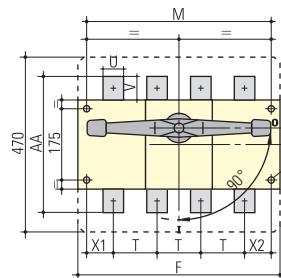
## Technical data and dimensions (mm)

### SIRCO SLB 125 to 2500 A

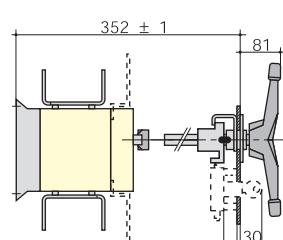
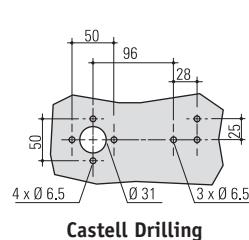
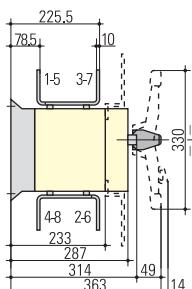
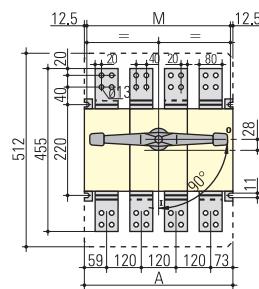
#### SIRCO 125 to 2500 A



Rating A	Overall dimensions			Terminal shrouds		Switch body				Switch mounting				Connection terminals																
	C	D	AC	AC	AD	F 3p	F 4p	G	H	J1 3p	J1 4p	J2	K	BC	M 3p	M 4p	N	R	T	U	U1	V	W 3p	X1 4p	X1	X2	Y	Z	AA	BA
125	120	124...354	235	50	140	170	93	65	45	75	75	31.5	80	120	150	65	5.5	36	20	20.5	25	9	28	22	20	3.5	20.5	135	115	10
160	120	124...354	235	50	140	170	93	65	45	75	75	31.5	80	120	150	65	5.5	36	20	20.5	25	9	28	22	20	3.5	20.5	135	115	10
200	130	135...365	290	60	180	230	108	75	55	105	105	34	115	160	210	80	5.5	50	25	25.5	30	11	33	33	27	3.5	22.5	160	130	15
250	130	135...365	290	60	180	230	108	75	55	105	105	34	115	160	210	80	5.5	50	25	25.5	30	11	33	33	27	3.5	22.5	160	130	15
315	165	167...397	401	89	230	290	170	110	75	135	135	55	115	210	270	140	7	65	32	45.5	37.5	11	42.5	37.5	37.5	5	36	235	205	15
400	165	167...397	401	89	230	290	170	110	75	135	135	55	115	210	270	140	7	65	32	45.5	37.5	11	42.5	37.5	37.5	5	36	235	205	15
500	165	167...397	401	89	230	290	170	110	75	135	135	55	115	210	270	140	7	65	32	45.5	37.5	13	42.5	37.5	37.5	5	36	235	205	15
630	165	167...397	400	89	230	290	170	110	75	135	135	55	115	210	270	140	7	65	45	45.5	50	13	42.5	37.5	37.5	5	36	260	220	20



Rating A	Switch body		Switch mounting		Connection terminals							
	F 3p	F 4p	M 3p	M 4p	T	U	V	Y	X1	X2	Z	AA
800	280	360	255	335	80	50	60.5	7	47.5	47.5	46.5	321
1000	280	360	255	335	80	50	60.5	7	47.5	47.5	46.5	321
1250	372	492	347	467	120	90	44	8	53.5	53.5	47.5	288
1600	372	492	347	467	120	90	44	8	53.5	53.5	47.5	288
1800	372	492	347	467	120	90	44	8	53.5	53.5	47.5	288

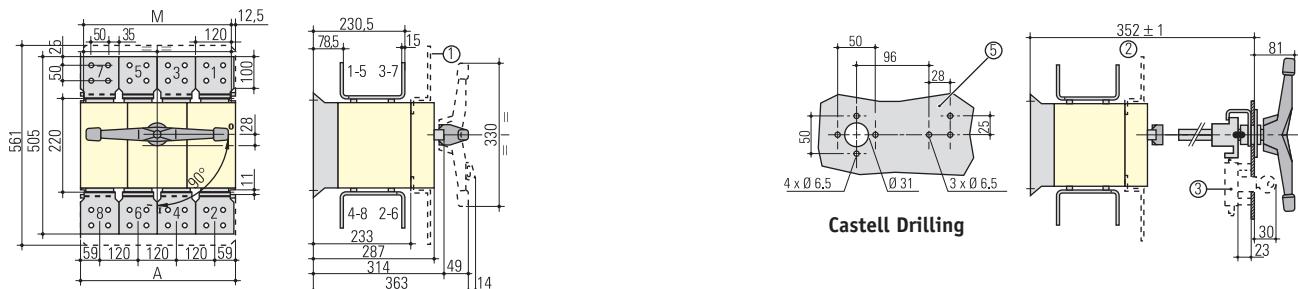


Rating A	Overall dimensions		Switch mounting	
	A 3p	A 4p	M 3p	M 4p
2000	372	492	347	467
2500	372	492	347	467

## Technical data and dimensions (mm)

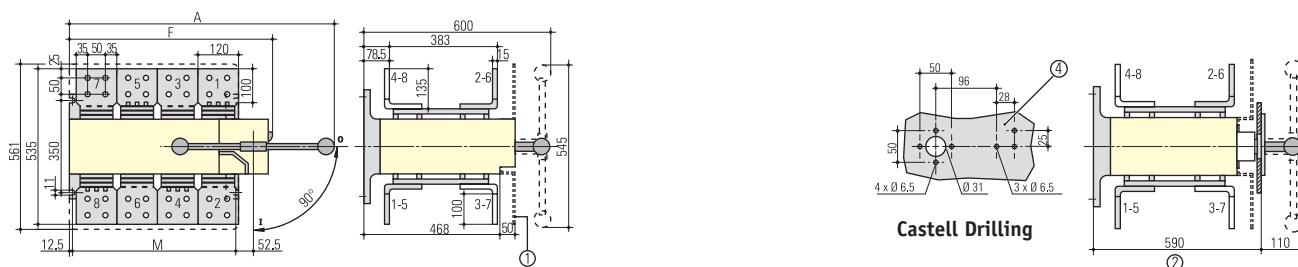
### SIRCO SLB 3150 to 4000 A

#### SIRCO 3150 A



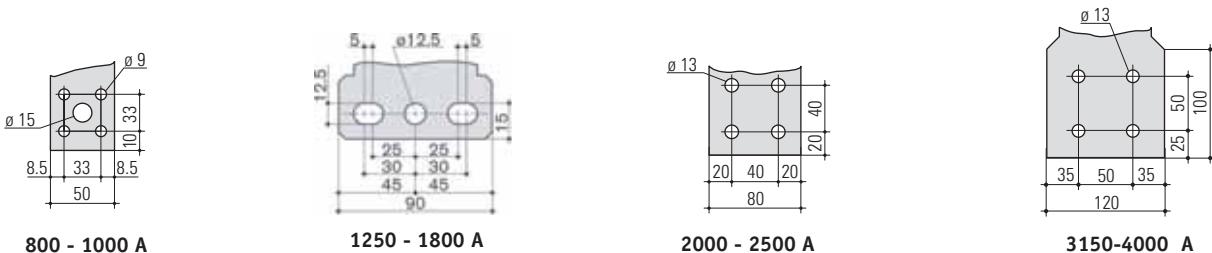
Rating	Overall dimensions		Switch mounting	
	A 3p	A 4p	M 3p	M 4p
3150	372	492	347	467

#### SIRCO 4000 A



Rating	Overall dimensions		Switch body		Switch mounting	
	A 3p	A 4p	F 3p	F 4p	M 3p	M 4p
4000	684	804	470	590	347	467

#### SIRCO Connection terminals - 800 to 4000 A



## Technical data and ratings chart

### COMO M SLB 20 to 100 A

#### Ratings to AS 3947-3 and IEC 60947-3

			20 A	25 A	32 A	40 A	63 A	80 A	100 A
Rated insulation voltage and rated operation voltage AC 20/DC 20	V		800	800	800	800	800	800	800
Rated impulse withstand voltage	kV		8	8	8	8	8	8	8
Rated operational current									
AC 21A	400 V	A	20	25	32	40	63	80	100
	500 V	A	20	25	32	40	63	80	100
	690 V	A	20	25	32	40	63	80	100
AC 22A	400 V	A	20	25	32	40	63	80	100
	500 V	A	20	25	32	40	63	80	100
	690 V	A	20	25	32	40	63	80	100
AC23A	400 V	A	20	25	32	40	63	80	80
	500 V	A	16	20	25	32	50	63	63
	690 V	A	16	20	20	20	50	50	50
Rated operational current									
DC 21A	400 V	A							
	500 V	A							
DC 22A	400 V	A							
	500 V	A							
DC 23A	400 V	A							
	500 V	A							
Operational power									
AC 23A	400 V	kW	9	11	15	18.5	30	40	40
	500 V	kW	9	11	15	18.5	33	40	40
	690 V	kW	11	15	15	15	45	45	45
Overload capacity									
Short time withstand current Icw (RMS 1s) 690 V		kA	1.26	1.26	1.26	1.26	1.5	1.5	1.5
Breaking capacity	400 V	A	160	200	256	320	504	640	640
AC 23A									
Fuse protected short circuit withstand. (kA RMS prospective)	400 V AC	kA	50	50	50	50	25	25	25
	Fuse	A	20	25	32	40	63	80	100
Mechanical endurance		Ops	100000	100000	100000	100000	30000	30000	30000
Weight (3 pole)		Kg	0.13	0.13	0.13	0.13	0.25	0.25	0.25
Min. tightening torque		Nm	2	2	2	2	4	4	4
Connection cable size		mm <sup>2</sup>	2.5/16	2.5/16	4/16	6/16	16/50	16/50	25/50

Refer NHP

Note: 240/415 V ratings suitable for use on 230/400 V in accordance with AS 60038 : 2000.

## Technical data and ratings chart

### SIRCO SLB 125 to 630 A

#### Ratings to AS 3947-3 and IEC 60947-3

		<b>125 A</b>	<b>160 A</b>	<b>200 A</b>	<b>250 A</b>	<b>315 A</b>	<b>400 A</b>	<b>500 A</b>	<b>630 A</b>
Rated insulation voltage and rated operation voltage AC 20/DC 20	V	800	800	800	800	1000	1000	1000	1000
Rated impulse withstand voltage	kV	8	8	8	8	12	12	12	12
Rated operational current									
AC 21A	400 V A	125	160	200	250	315	400	500	630
	500 V A	125	160	200	250	315	400	500	630
	690 V A	125	160	200	250	315	400	500	500
AC 22A	400 V A	125	160	200	250	315	400	500	630
	500 V A	125	125	200	250	315	400	500	500
	690 V A	-	-	-	125	250	250	250	315
AC23A	400 V A	125	160	200	250	315	400	500	500
	500 V A	100	100	160	200	315	315	315	315
	690 V A	-	-	-	100	160	160	160	160
Rated operational current									
DC 21A	400 V A	125	160	160	250	315	400	400	630
	500 V A	125	125	160	200	315	400	400	500
DC 22A	400 V A	125	160	160	200	315	400	400	500
	500 V A	125	125	160	200	315	315	315	500
DC 23A	400 V A	125	125	160	200	315	400	400	500
	500 V A	125	125	160	200	315	400	400	500
Operational power									
AC 23A	400 V kW	63	80	100	132	160	220	280	280
	500 V kW	63	63	110	140	220	220	220	220
	690 V kW	55	55	75	90	150	150	150	150
Overload capacity									
Short time withstand current Icw (RMS 1s) 690 V	kA	7	7	9	9	13	13	13	13
Breaking capacity	400 V A	1000	1280	1600	2000	2520	3200	4000	4000
AC 23A									
Fuse protected short circuit withstand. (kA RMS prospective)	400 V AC kA	100	100	80	50	100	100	100	70
	Fuse A	125	160	200	250	315	400	500	630
Rated capacitor power	kVar	55	75	90	115	145	185	230	290
Mechanical endurance	Ops	10000	10000	10000	10000	5000	5000	5000	5000
Weight (3 pole)	Kg	1	1.5	2	2	3.5	3.5	3.5	3.5
Min. tightening torque	Nm	6.5	6.5	10	10	15.4	14.5	14.5	14.5
Connection cable size	mm <sup>2</sup>	35/50	50/95	70/95	95/150	150/240	185/240	240/240	2 (150/300)

Note: 240/415 V ratings suitable for use on 230/400 V in accordance with AS 60038 : 2000.

## Technical data and ratings chart

### SIRCO SLB 800 to 4000 A

#### Ratings to AS 3947-3 and IEC 60947-3

		<b>800 A</b>	<b>1000 A</b>	<b>1250 A</b>	<b>1600 A</b>	<b>1800 A</b>	<b>2000 A</b>	<b>2500 A</b>	<b>3150 A</b>	<b>4000 A</b>
Rated insulation voltage and rated operation voltage AC 20/DC 20	V	1000	1000	1000	1000	1000	1000	1000	1000	1000
Rated impulse withstand voltage	kV	12	12	12	12	12	12	12	12	12
Rated operational current										
AC 21A	400 V A	800	1000	1250	1600	1600	2000	2500	3150	3150
	500 V A	800	1000	1250	1600	1600	2000	2500	3150	3150
	690 V A	800	1000	1000	1600	1600	2000	2000	2000	2000
AC 22A	400 V A	800	1000	1250	1250	1250	2000	2000	2500	2500
	500 V A	800	1000	1000	1250	1250	1600	1600	2000	2000
	690 V A	800	630	630	800	800	1000	1000	1000	1000
AC 23A	400 V A	800	1000	1000	1000	1000	1250	1250	1250	1250
	500 V A	630	800	800	1000	1000	1000	1000	1000	1000
	690 V A	200	400	400	500	500	800	800	800	800
Rated operational current										
DC 21A	400 V A	800	1000	1250	1600	1600	2000	2000	2000	2000
	500 V A	630	1000	1250	1250	1250	1250	1250	1250	1250
DC 22A	400 V A	800	1000	1250	1250	1250	1250	1250	1250	1250
	500 V A	800	1000	1250	1250	1250	1250	1250	1250	1250
DC 23A	400 V A	800	1000	1000	1000	1000	1000	1000	1000	1000
	500 V A	800	1000	1000	1000	1000	1000	1000	1000	1000
Operational power										
AC 23A	400 V kW	450	560	560	560	560	710	710	710	710
	500 V kW	450	560	560	710	710	710	710	710	710
	690 V kW	185	400	400	475	475	750	750	750	750
Overload capacity										
Short time withstand current	kA	26	35 <sup>1)</sup>	50	50	50	50	50	55	70
Icw (RMS 1s) 690 V										
Breaking capacity	400 V A	6400	8000	8000	8000	8000	10000	10000	10000	10000
AC 23A										
Fuse protected short circuit withstand. (kA RMS prospective)	400 V AC kA	50	100	100	100	100	100	100	-	-
	Fuse A	800	1000	1250	2x800	2x800	2x1000	2x1000	-	-
Rated capacitor power	kVar	365	460	575	-	-	-	-	-	-
Mechanical endurance	Ops	4000	4000	4000	3000	3000	3000	2500	2500	2500
Weight (3 pole)	Kg	8	10.5	10.5	16	17	31	32	42	90
Min. tightening torque	Nm	37	37	37	50	50	60	60	60	110
Connection cable size	mm <sup>2</sup>	2 <sup>(185/300)</sup>	2 240/4 185	4 185 max	6 240 max	-	-	-	-	-

**Notes:** <sup>1)</sup> 50 kA switch available in larger frame size. Refer NHP.  
240/415 V ratings suitable for use on 230/400 V in accordance with AS 60038 : 2000.

## **TECHNICAL DATA SHEET**

**Equipment Type:** Power Supply

**Location:** Power Distribution

**Model Numbers:** CP M SNT 120W 24V 5A

**Manufacturer:** Weidmuller

**Supplier:** Ramelec

2/5 Breene Place  
Morningside  
Qld 4170

Ph: 07 3899 1322

**Data sheet...****CP M SNT 120W 24V 5A**

**Weidmüller Interface GmbH & Co. KG**  
 Klingenbergsstraße 16  
 D-32758 Detmold  
 Germany  
 Fon: +49 5231 14-0  
 Fax: +49 5231 14-292083  
[www.weidmueller.com](http://www.weidmueller.com)

**PRO-M = Power-Reliable-Optimized**

The perfectly reliable power supply for automation technology.

The ten different versions for the 24V-DC power supply all feature a solid but thin metal housing which enables them to be installed without any side gaps. This results in less space required on the mounting rail. Wide range of AC/DC inputs and a wide temperature range enable them to be used anywhere. Because of its high efficiency, resistance to overloads and high power reserves, the PRO-M is a trusted power supply for use in any application.

The three-phase PRO-M power supply modules continue to function reliably when one phase fails (i.e., in two-phase mode).

**General ordering data**

Type	CP M SNT 120W 24V 5A
Order No.	<a href="#">8951340000</a>
Version	Power supply, switch-mode power supply unit
GTIN (EAN)	4032248742554
Qty.	1 pc(s).

**Data sheet...****CP M SNT 120W 24V 5A**

**Weidmüller Interface GmbH & Co. KG**  
 Klingenbergsstraße 16  
 D-32758 Detmold  
 Germany  
 Fon: +49 5231 14-0  
 Fax: +49 5231 14-292083  
[www.weidmueller.com](http://www.weidmueller.com)

**Technical data****Dimensions and weights**

Width	40 mm	Height	130 mm
Depth	125 mm	Weight	0.7 kg
Net weight	724.3 g		

**Temperatures**

Operating temperature	-25 °C...+70 °C	Storage temperature	-40 °C...+85 °C
-----------------------	-----------------	---------------------	-----------------

**Input**

AC current consumption	1.1 A @ 230 V AC / 2.0 A @ 115 V AC	DC current consumption	0.4 A @ 370 V DC / 1.2 A @ 120 V DC
DC input voltage range	80...370 V DC (Derating @ 120 V DC)	Frequency range AC	47...63 Hz
Input fuse	Yes	Input fuse (internal)	Yes
Input voltage range AC	85...264 V AC (Derating @ 100 V AC)	Inrush current	max. 40 A
Recommended back-up fuse	4 A / DI, safety fuse 6 A, Char. B, circuit breaker 3...5 A, Char. C, circuit breaker	Wire connection method	Screw connection
rated input voltage	100...240 V AC (wide-range input)		

**output**

Output current	5 A	Output power	120 W
Output voltage type	DC	Output voltage, max.	29.5 V
Output voltage, min.	22.5 V	Output voltage, note	(adjustable via potentiometer on front)
Overload protection	Yes	Parallel connection option	yes, max. 5
Powerboost @ 24 V DC, 60 °C	6 A for 1 min, ED = 5 %	Rated (nominal) output current @ U <sub>Nom</sub>	5 A @ 60 °C
Wire connection method	Screw connection	continous output current @ 24 V DC	6.0 A @ 45 °C, 5.3 A @ 55 °C, 3.8 A @ 70 °C
rated output voltage	24 V DC ± 1 %	residual ripple, breaking spikes	< 50 mV <sub>SS</sub> @ 24 V DC, I <sub>N</sub>

**General data**

AC failure bridging time @ I <sub>Nom</sub>	> 100 ms @ 230 V AC / > 20 ms @ 115 V AC	Current limiting	> 120 % I <sub>N</sub>
Degree of efficiency	90 % @ 230 V AC / 88 % @ 115 V AC	Housing version	Metal, corrosion resistant
Indication	Operation, green LED	MTBF	> 500,000 h acc. to IEC 1709 (SN29500)
Mounting position, installation notice	Horizontal on TS35 mounting rail, with 50 mm of clearance at top and bottom for air circulation. Can be mounted side by side with no space in between.	Operating temperature	-25 °C...+70 °C
Power factor (approx.)	> 0.5 @ 230 V AC / > 0.6 @ 115 V AC	Protection against over-heating	Yes
Protection against reverse voltages from the load	30...35 V DC	Short-circuit protection	Yes
Weight	0.7 kg		

**Data sheet...****CP M SNT 120W 24V 5A**

**Weidmüller Interface GmbH & Co. KG**  
 Klingenbergsstraße 16  
 D-32758 Detmold  
 Germany  
 Fon: +49 5231 14-0  
 Fax: +49 5231 14-292083  
[www.weidmueller.com](http://www.weidmueller.com)

**Technical data****EMC / shock / vibration**

Limiting of mains voltage harmonic currents	in accordance with EN 61000-3-2	Noise emission acc. to EN55022	Class B
Interference immunity test acc. to	EN 61000-4-2 (ESD)  EN 61000-4-3 and EN 61000-4-8 (fields) EN 61000-4-4 (burst) EN 61000-4-5 (surge) EN 61000-4-6 (conducted)  EN 61000-4-11 (dips)	Shock resistance IEC 60068-2-27	
			30 g in all directions

**Insulation coordination**

Class of protection	I, with PE connection	Insulation voltage	3 kV input/output; 2 kV input/earth; 0.5 kV output/earth
Pollution severity	2	electrical isolation, input-earth	2 kV
electrical isolation, input-output	3 kV	electrical isolation, output-earth	0.5 kV

**Electrical safety (applied standards)**

Electrical machine equipment	Acc. to EN60204	For use with electronic equipment	Acc. to EN50178 / VDE0160
Protection against dangerous shock currents	Acc. to VDE0106-101	Protective separation protection against electrical shock	VDE0100-4-10 / acc. to DIN57100-4-10
Safety extra-low voltage	SELV acc. to EN60950, PELV acc. to EN60204	Safety transformers for switch-mode power supplies	Acc. to EN 61558-2-17

**Connection data (input)**

Conductor cross-section, AWGcmil , max.	12	Conductor cross-section, AWGcmil , min.	26
Conductor cross-section, flexible , min.	0.5 mm <sup>2</sup>	Conductor cross-section, rigid , max.	6 mm <sup>2</sup>
Conductor cross-section, rigid , min.	0.5 mm <sup>2</sup>	Number of terminals [Input]	3 for L/N/PE
Tightening torque, max.	0.6 Nm	Tightening torque, min.	0.5 Nm
Wire connection cross section, flexible (input), max.	2.5 mm <sup>2</sup>		

**Connection data (output)**

Conductor cross-section, AWGcmil , max.	12	Conductor cross-section, AWGcmil , min.	26
Conductor cross-section, flexible , max.	2.5 mm <sup>2</sup>	Conductor cross-section, flexible , min.	0.5 mm <sup>2</sup>
Conductor cross-section, rigid , max.	6 mm <sup>2</sup>	Conductor cross-section, rigid , min.	0.5 mm <sup>2</sup>
Number of terminals [Output]	5 (++ / -)	Tightening torque, max.	0.6 Nm
Tightening torque, min.	0.5 Nm		

**Data sheet...****CP M SNT 120W 24V 5A**

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 Germany  
 Fon: +49 5231 14-0  
 Fax: +49 5231 14-292083  
[www.weidmueller.com](http://www.weidmueller.com)

**Technical data****Approvals**

Institute (GERMLLOYD)



Certificate No. (GERMLLOYD)

94767-10

Institute (cULus)



Certificate no. (cULus)

Institute (cURus)



Certificate No. (cURus)

E258476VOL1SEC22

E255651VOLX3A13

**Classifications**

ETIM 3.0

EC001039

eClass 5.1

27-04-90-02

eClass 6.2

27-04-90-04

eClass 7.1

27-04-90-04

**Approvals**

Approvals



ROHS

Conform

**Downloads**Package insert [Operating instructions](#)Declaration of Conformity [K469\\_12\\_11.pdf](#)PDF [Warranty information](#)EPLAN [8951340000.ema](#)

3-D model

**Data sheet...****CP M SNT 120W 24V 5A**

**Weidmüller Interface GmbH & Co. KG**  
Klingenbergsstraße 16  
D-32758 Detmold  
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Fon: +49 5231 14-0  
Fax: +49 5231 14-292083  
[www.weidmueller.com](http://www.weidmueller.com)

**Drawings****Electric symbol**

With DC connection, note polarity

## **TECHNICAL DATA SHEET**

**Equipment Type:** Surge Reduction Filter

**Location:** Power Distribution

**Model Numbers:** DAR-275V

**Manufacturer:** Critec

**Supplier:** Energy Correction Options  
PO Box 431  
Kelvin Grove, QLD 4059

Ph: 07 3356 0577  
Fax: 07 3356 1432  
Web: [www.ecoptions.com.au](http://www.ecoptions.com.au)

## INSTALLATION INSTRUCTIONS



**MODEL NUMBER**  
**DAR 275V**

### 1. PREPARATION

**DANGER:** *Electrical shock or burn hazard. Installation of this device should only be made by qualified personnel. Failure to lockout electrical power during installation or maintenance can result in fatal electrocution or severe burns. Before making any connections be sure that power has been removed from all associated wiring, electrical panels, and other electrical equipment.*



#### CAUTION NOTES:

1. *The installation of this device should follow all applicable electrical codes, such as the National Electrical Code.*
2. *Check to make sure line voltage does not exceed DAR275V voltage ratings.*
3. *Follow all instructions to ensure correct and safe operation.*
4. *Do not attempt to open or tamper with the DAR in any way as this may compromise performance and will void warranty. No user serviceable parts are contained.*

### 2. INTRODUCTION

Selected DSD, TDS & TDF DINLINE Surge Protection Devices include status monitoring circuits which provide visual status display of device capacity. They may also provide a low voltage opto-coupler alarm output circuit that can be connect to the DAR to provide potential free (Form C) change-over contacts. The DAR alarm contacts may be used to provide output to external alarm systems or remote monitoring circuits.

One DAR can be used per DSD/TDS/TDF opto-coupler alarm or up to 16 DSD opto-coupler alarms can be connected in series to the one DAR to provide a common output. It is recommended that the DAR be powered from the same power circuit that feeds the device(s) being monitored, however the DAR can be powered from other circuits. This allows for example, one DAR unit to be connected to separate SPDs that are protecting a three phase circuit.

Note. Depending upon the usage of the DAR output contacts, failure of power to the DAR may be interpreted as a failure of one or more of the SPDs being monitored. Visual inspection of the DAR and SPDs status displays would determine this.

### 3. MOUNTING

The DAR is designed to clip to 35mm (top hat) DIN rails (standard EN50022). Unless otherwise mechanically restrained, use horizontal DIN rails with the DAR module spring clips to the bottom and the label text the correct way up.

**NOTE:** The DAR must be installed in an enclosure or panel that:

- *prevents the DAR temperature from exceeding 131°F (55°C)*
- *provides adequate electrical and safety protection*
- *prevents the ingress of moisture and water*
- *allows DAR status indicators to be inspected*

### 4. ELECTRICAL CONNECTION

The interconnecting wiring should:

- *be of size #10 to #14 AWG (2.5mm<sup>2</sup> to 6mm<sup>2</sup>) solid or stranded conductor.*
- *The wire insulation should be stripped back 5/16" (8mm).*
- *NOTE: Do not use greater than 9inlbs (1Nm) of torque when tightening the terminals.*

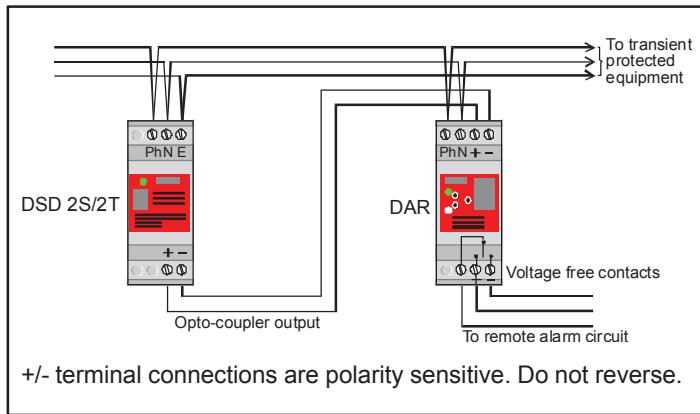
### CONNECTION TO TELECOMMUNICATIONS NETWORKS

The DAR is approved for use in Australia where the alarm contacts may be connected to private lines or building cabling associated with the telecommunications network. NO direct connection to the public switched network should be made.

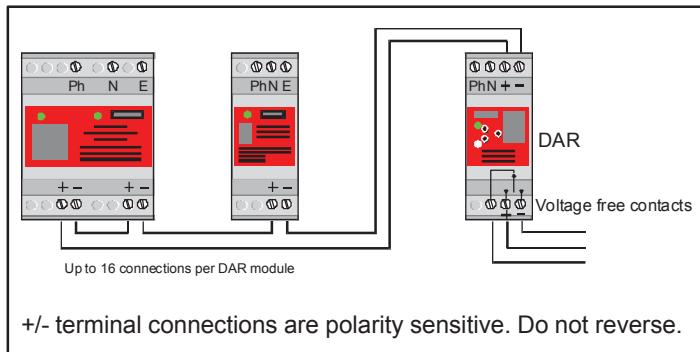
## INSTALLATION INSTRUCTIONS

### 5. INTERCONNECTION

When connecting the DAR to a single opto-coupler output the + terminal of the SPD should connect to the + terminal on the DAR. The – terminal should connect to the -- terminal.



When connecting the DAR to multiple opto-couplers the opto-couplers should be connected in series with + terminal of one connected to the – terminal of the next. The DAR + terminal should connect to + SPD terminal at one end of the series connection and the – DAR terminal connect to the – SPD terminal at the other end of the series connection.



### 5. STATUS INDICATION

STATUS	Protection Operational	Protection Alarm	Fault Mode
DISPLAY	Normal  Fault 	Normal  Fault 	Normal  Fault 
EXPLANATION	Normal operation Normal (green) indicator ON Red indicator OFF Relay is energised Power is supplied	DSD in alarm mode or power to DSD has been removed Normal (green) indicator OFF Red indicator ON Relay is de-energised Power is supplied	Power to DAR removed Protection status unknown Normal (green) indicator OFF Red indicator OFF Relay is de-energised Power is OFF

### 6. FUSING AND ISOLATION

Overcurrent protection must be installed in the upstream circuit of the power supply to the DAR to provide protection to the unit itself and the wiring in case of fault conditions.

The fuse rating should be based on the wiring size used to connect to the DAR Ph & N terminals. Australian regulations AS3000-1991, Table B2 specifies the following upstream protection for single phase circuits, unenclosed in air.

Cable Size	HRC Fuse or	CB Rewirable Fuse
1.5mm <sup>2</sup>	16A	12A
2.5mm <sup>2</sup>	20A	16A
4mm <sup>2</sup>	25A	20A
6mm <sup>2</sup>	32A	25A

Where overcurrent protection of the appropriate rating or smaller is already fitted in the upstream circuit, overcurrent protection at the DAR will not be required

### 6. MAINTENANCE & TESTING

Before removing a DAR unit from service, ensure that the power has been removed. Maintenance, testing and replacement should only be undertaken by qualified personnel.

Testing of a DAR unit which is connected to a fully functional DSD unit can be accomplished by removing power to the DSD only. The DAR Status indication and output contacts should alter from the Normal to Fault condition.

Testing of the DAR unit alone may be accomplished by disconnecting the + / -connections to the unit. When power is applied the DAR "Fault" Status Indicator should be illuminated. By connecting the + / - terminals together, the "Normal" Status Indicator should be illuminated. The output contacts should alter to the appropriate state.

### 7. USE OF OTHER INTERFACES

Only DAR units are recommended for the interfacing of equipment to the DSD, TDS & TDF opto-coupler alarm output circuit(s). The direct connection of other equipment to these opto-coupler alarm outputs may not provide sufficient isolation or exceed the opto-coupler specifications. This may damage the SPD and/or the connected equipment. Warranty may be voided under such circumstances.

**NOTE:** In connecting to the SPD opto-coupler alarm output(s), do not reverse the +/- connections as damage may occur.

## **TECHNICAL DATA SHEET**

**Equipment Type:** Surge Filter Alarm Relay

**Location:** Power Distribution

**Model Numbers:** TDF-10A-240V

**Manufacturer:** Critec

**Supplier:** Energy Correction Options  
PO Box 431  
Kelvin Grove, QLD 4059

Ph: 07 3356 0577  
Fax: 07 3356 1432  
Web: [www.ecoptions.com.au](http://www.ecoptions.com.au)

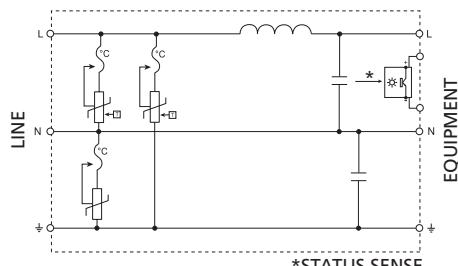
## Features

- CRITEC® Transient Discriminating (TD) Technology provides increased service life
- In-line series protection
- High efficiency low pass sine wave filtering – ideal for the protection of switched mode power supplies
- Three modes of protection: L-N, L-PE & N-PE
- 35 mm DIN rail mount – simple installation
- LED status indication and opto-isolated output – for remote status monitoring
- CE, UL® 1449 Ed. 3 Listed

## CRITEC® Transient Discriminating Filter

The TDF series has been specifically designed for process control applications to protect the switched mode power supply units on devices such as PLC controllers, SCADA systems and motor controllers. Units are UL® Recognized and available for 3A, 10A and 20A loads and suitable for 110-120V ac/dc and 220-240Vac circuits.

The TDF is a series connected, single phase surge filter providing an aggregate surge capacity of 50kA (8/20 $\mu$ s) across L-N, L-PE, and N-PE. The low pass filter provides up to 65dB of attenuation to voltage transients. Not only does this reduce the residual let-through voltage, but it also helps further reduce the steep voltage rate-of-rise providing superior protection for sensitive electronic equipment.



Model	TDF3A120V	TDF3A240V	TDF10A120V	TDF10A240V	TDF20A120V	TDF20A240V
Item Number for Europe	700001	700002	700003	700004	700005	700006
Nominal Voltage, U <sub>n</sub>	110-120 V	220-240 V	110-120 V	220-240 V	110-120 V	220-240 V
Distribution System	TN-C-S, TN-S					
Max Cont. Operating Voltage, U <sub>c</sub>	170VAC	340VAC	170VAC	340VAC	170VAC	340VAC
Stand-off Voltage	240V	400V	240V	400V	240V	400V
Frequency	0-60Hz	50/60Hz	0-60Hz			50/60Hz
Max Line Current, I <sub>L</sub>	3 A		10 A		20 A	
Operating Current @ U <sub>n</sub>	135 mA	250 mA	240 mA	480 mA	240 mA	480 mA
Max Discharge Current, I <sub>max</sub>	10kA 8/20 $\mu$ s N-PE 20kA 8/20 $\mu$ s L-N 20kA 8/20 $\mu$ s L-PE					
Protection Modes	All modes protected					
Technology	In-line series low pass sine wave filter TD Technology					
Voltage Protection Level, U <sub>p</sub>	500V @ 500A 250V @ 3kA	700V @ 500A 600V @ 3kA	500V @ 500A 250V @ 3kA	700V @ 500A 600V @ 3kA	500V @ 500A 250V @ 3kA	700V @ 500A 600V @ 3kA
Filtering	-62dB @ 100kHz		-65dB @ 100kHz		-53dB @ 100kHz	
Status	Green LED. On=Ok. Isolated opto-coupler output					
Dimensions H x D x W: mm (in)	90 x 68 x 72 (3.54 x 2.68 x 2.83)		90 x 68 x 144 (3.54 x 2.68 x 5.67)			
Module Width	4 M		8 M			
Weight: kg (lbs)	0.7 (1.54)		1.48 (3.25)		1.57 (3.46)	
Enclosure	DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA®-1)					
Connection	1 mm <sup>2</sup> to 6 mm <sup>2</sup> (#18AWG to #10)					
Mounting	35 mm top hat DIN rail					
Back-up Overcurrent Protection	3A		10A		20A	
Temperature	-35°C to 55°C (-31°F to 131°F)					
Humidity	0% to 90%					
Approvals	C-Tick, CE (NOM 3A, 120V), CSA 22.2, UL® 1283, UL® 1449 Ed 3 Recognized Component Type 2					
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B, Cat C					

(1) Opto-coupler output can be connected to DINLINE Alarm Relay (DAR275V) to provide Form C dry contacts.

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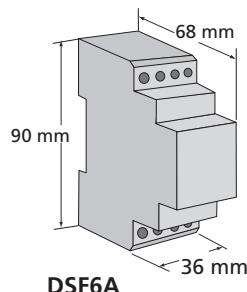
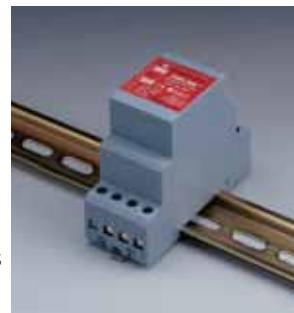
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## Features

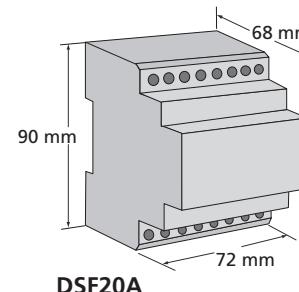
- In-line series protection
- EMI/RFI noise filtering – protects against industrial electrical noise
- Compact design – fits into motor control and equipment panels
- Three modes of protection: L-N, L-PE & N-PE
- 35 mm DIN rail mount – simple installation
- LED power indicator

The “two port” DSF series has been specifically designed for process control applications to protect the switched mode power supply units on devices such as PLC controllers, SCADA systems and motor controllers. The 30V unit is suitable for 12V and 24Vac/dc signaling and control systems.

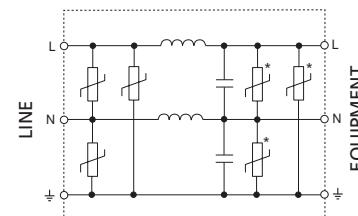
The 6A DSF series incorporates a space efficient, low pass, series filter which provides attenuation to high frequency interference. The larger 20A model provides status indication and a higher surge rating, making this ideal for the protection of higher risk equipment.



DSF6A



DSF20A



\*DSF20A275V only

Model	DSF6A30V	DSF6A150V	DSF6A275V	DSF20A275V
Item Number for Europe	702090	701000	701030	701020
Nominal Voltage, $U_n$	24	110-120 V	220-240 V	
Distribution System	1Ph 2W+G			
System Compatibility	TN-S, TN-C-S			
Max Cont. Operating Voltage, $U_c$	30VAC, 38VDC	150VAC	275VAC	
Frequency	0-60Hz	50/60Hz		
Max Line Current, $I_L$	6 A		20 A	
Operating Current @ $U_n$	7 mA			
Max Discharge Current, $I_{max}$	4kA 8/20μs	16kA 8/20μs		15kA 8/20μs L-N 15kA 8/20μs L-PE 25kA 8/20μs N-PE
Protection Modes	All modes protected			
Technology	In-line series filter MOV			
Voltage Protection Level, $U_p$	110V @ 3kA	400V @ 3kA	750V @ 3kA	710V @ 3kA
Filtering	-3dB @ 300kHz			-3dB @ 62kHz
Status	LED power indicator			Status indicator
Dimensions H x D x W: mm (in)	90 x 68 x 36 (3.54 x 2.68 x 1.42)			90 x 68 x 72 (3.54 x 2.68 x 2.83)
Module Width	2 M			4 M
Weight: kg (lb)	0.2 (0.441)			0.7 (1.543)
Enclosure	DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA-1)			
Connection	1 mm <sup>2</sup> to 6 mm <sup>2</sup> (#18AWG to #10AWG)			
Mounting	35 mm top hat DIN rail			
Back-up Overcurrent Protection	6A		20A	
Temperature	-35°C to 55°C (-31°F to 131°F)			
Humidity	0% to 90%			
Approvals	C-Tick, CE, NOM, UL® 1449 Ed 3 Recognized Component Type 2	C-Tick, CE		
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B			

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E817S-WWEN 580017071WWEN 008291M18



Q-Pulse Id: TMS1407

Active: 30/09/2015

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# TECHNICAL DATA SHEET

**Equipment Type:** Surge Diverter

**Location:** Power Distribution

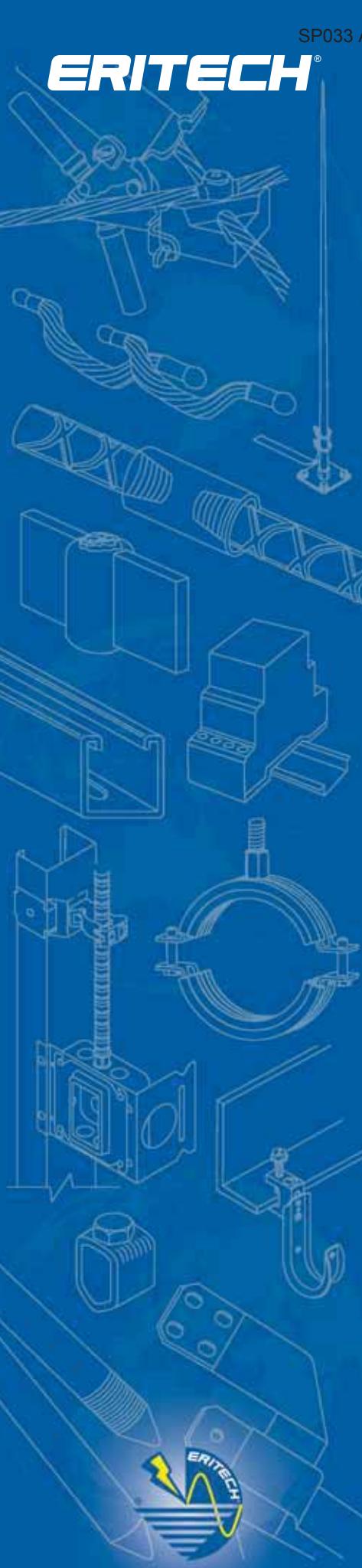
**Model Numbers:** TDS1100-2SR-277

**Manufacturer:** Critec

**Supplier:**  
Energy Correction Options  
PO Box 431  
Kelvin Grove, QLD 4059

Ph: 07 3356 0577  
Fax: 07 3356 1432  
Web: [www.ecoptions.com.au](http://www.ecoptions.com.au)

## CRITEC® Transient Discriminating Surge Diverters



Q-Pulse Id: TMS1407

Active: 30/09/2015

**ERICO®**

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# Surge Protection And Surge Ratings

The stress, which an SPD will experience under surge conditions, is a function of many complex and interrelated parameters. These include:

- Location of the SPD(s) within the structure – are they located at the main distribution board or within the facility at secondary board, or even in front of the end-user equipment?
- Method of coupling the lightning strike to the facility – for example, is this via a direct strike to the structures LPS, or via induction onto building wiring due to a nearby strike?
- Distribution of lightning currents within the structure – for example, what portion of the lightning current enters the earthing system and what remaining portion seeks a path to remote grounds via the power distribution system and equipotential bonding SPDs?
- Type of power distribution system – the distribution of lightning current on a power distribution system is strongly influenced by the grounding practice for the neutral conductor. For example, in the TN-C system with its multiple earthed neutral, a more direct and lower impedance path to ground is provided for lightning currents than in a TT system.
- Additional conductive services connected to the facility – these will carry a portion of the direct lightning current and therefore reduce the portion which flows through the power distribution system via the lightning equipotential bonding SPD.
- Type of waveshape – it is not possible to simply consider the peak current which the SPD will have to conduct, one also has to consider the waveshape of this surge. It is also not possible to simply equate the areas under the current-time curves (also referred to as the action integral) for SPDs under different waveshapes.

Many attempts have been made to quantify the electrical environment and "threat level" which an SPD will experience at different locations within a facility. The new IEC<sup>SM</sup> standard on lightning protection, IEC 62305-4 "Protection against lightning - Part 4: Electrical and electronic systems within structures" has sought to address this issue by considering the highest surge magnitude which may be presented to an SPD based on the lightning protection level (LPL) being considered. For example, this standard postulates that under a LPL I the magnitude of a direct strike to the structure's LPS may be as high as 200kA 10/350. While this level is possible, its statistical probability of occurrence is approximately 1%. In other words, 99% of discharges will be less than this postulated 200 kA peak current level.

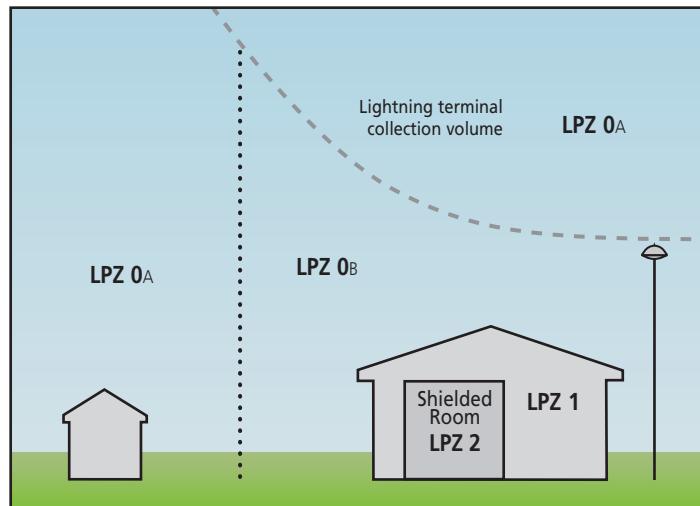
An assumption is made that 50% of this current is conducted via the building's earthing system, and 50% returns via the equipotential bonding SPDs connected to

a three wire plus neutral power distribution system. It is also assumed that no additional conductive service exists. This implies that the portion of the initial 200 kA discharge experienced by each SPD is 25 kA.

Simplified assumptions of current dispersion are useful in considering the possible threat level, which the SPD(s) may experience, but it is important to keep in context the assumptions being made. In the example above, a lightning discharge of 200kA has been considered. It follows that the threat level to the equipotential bonding SPDs will be less than 25kA for 99% of the time. In addition, it has been assumed that the waveshape of this current component through the SPD(s) will be of the same waveshape as the initial discharge, namely 10/350, while in reality the waveshape have been altered by the impedance of building wiring, etc.

Many standards have sought to base their considerations on field experience collected overtime. For example, the IEEE® guide to the environment C62.41.1 and the recommended practice C62.41.2 present two scenarios of lightning discharge and different exposure levels under each of these depending on the location where the SPD is installed. In this standard, Scenario II depicts a direct strike to the structure, while Scenario I depicts a nearby strike and the subsequent conducted current into a structure via power and data lines. The highest surge exposure considered feasible to an SPD installed at the service entrance to a facility under Scenario I is 10kA 8/20, while under Scenario II it is considered to be 10kA 10/350 (exposure Level 3).

From the above, it is apparent that the selection of the appropriate surge rating for an SPD depends on many complex and interconnected parameters. When addressing such complexities, one needs to keep in mind that one of the more important parameters in selecting an SPD is its limiting voltage performance during the expected surge event, and not the energy withstand which it can handle.



Protection zones defined by specific product application.

# Advanced Technologies – The ERICO® Advantage

## Transient Discriminating Technology

To meet the fundamental requirements of performance, longer service life and greater safety under real world conditions, ERICO has developed Transient Discriminating (TD) Technology.

This quantum leap in technology adds a level of "intelligence" to the Surge Protection Device enabling it to discriminate between sustained abnormal over-voltage conditions and true transient or surge events. Not only does this help ensure safe operation under practical application, but it also prolongs the life of the protector since permanent disconnects are not required as a means of achieving internal over-voltage protection.

### Traditional Technologies

Conventional SPD technologies utilize metal oxide varistors and/or silicon avalanche diodes to clamp or limit transient events. However, these devices are susceptible to sustained 50/60Hz mains over-voltage conditions which often occur during faults to the utility system. Such occurrences present a significant safety hazard when the suppression device attempts to clamp the peak of each half cycle on the mains over-voltage. This condition can cause the device to rapidly accumulate heat and in turn fail with the possibility of inducing a fire hazard.

### The Core of TD Technology

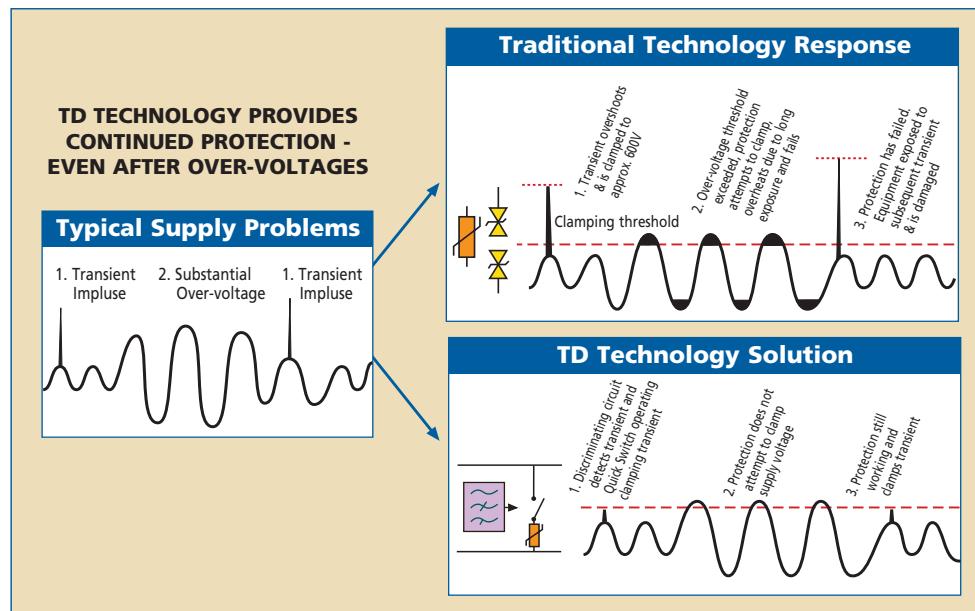
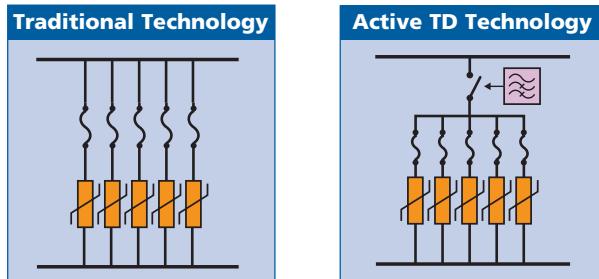
The secret to ERICO's Transient Discriminating Technology is its *active frequency discrimination* circuit. This patented device can discriminate between a temporary over-voltage (TOV) condition

and a very fast transient, which is associated with lightning or switching-induced surges. When the transient frequencies are detected, the patented Quick-Switch within TD activates to allow the robust protection to limit the incoming transient. The frequency discriminating circuit that controls the Quick-Switch helps ensure that the SPD device is immune to the effects of a sustained 50 or 60Hz TOV. This allows the device to keep operating, in order to help provide safe and reliable transient protection, even after an abnormal over-voltage condition has occurred.

### Meeting & Exceeding UL® Standards

The CRITEC® range of surge protection devices from ERICO® employing TD Technology has been specifically designed to meet and exceed the new safety requirements of UL 1449 Edition 3. To meet the abnormal over-voltage testing of UL 1449 Edition 3, many manufacturers of SPD devices have incorporated fuse or thermal disconnect devices which permanently disconnect all protection from the circuit during an over-voltage event. Transient Discriminating Technology on the other hand will allow the SPD device to experience an abnormal over-voltage up to twice its nominal operating voltage and still remain operational even after this event! This allows the device to help provide safe, reliable and continuous protection to your sensitive electronic equipment. TD Technology is especially recommended for any site where sustained over-voltages are known to occur, and where failure of traditional SPD technologies cannot be tolerated.

The UL 1449 testing standard addresses the safety of an SPD device under temporary and abnormal overvoltage conditions, but does not specifically mandate a design that will give a reliable, long length of service in the real world. Specifically, UL 1449 tests that the SPD remains operational at 10% above nominal supply voltage, allowing SPD manufacturers to design products that permanently disconnect just above that. Most reputable manufacturer's designs allow for up to a 25% overvoltage, while ERICO's TD Technology gives even greater overhead.



## CRITEC® TDS Surge Diverter - TDS130 Series

### Features

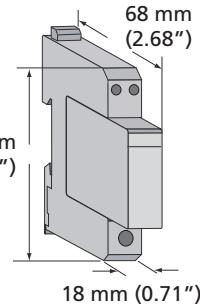
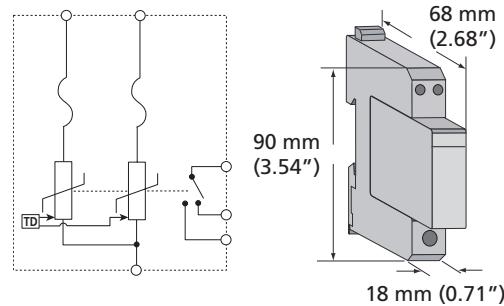
- CRITEC TD Technology with thermal disconnect protection
- Compact package, modular DIN rail mounting for limited space requirements
- Three modes of protection: L-N, L-PE & N-PE
- Indication flags and voltage-free contacts provide remote status monitoring
- Separate plug and base design facilitates replacement of a failed surge module
- 15kA 8/20 $\mu$ s surge rating per mode
- CE, UL® 1449 Edition 3 Listed

Surges and voltage transients are a major cause of expensive electronic equipment failure and business disruption. Damage may result in the loss of capital outlays, such as computers and communications equipment, as well as consequential loss of revenue and profits due to unscheduled system down-time.

The TDS130 series of surge suppressors provide economical and reliable protection from voltage transients on power distribution systems. The TDS130 is specifically designed for the protection of single phase power supplies within instrumentation and control applications. They are conveniently packaged for easy installation on 35 mm DIN rail within control panels.

CRITEC® TD technology helps ensure reliable and continued operation during sustained and abnormal over-voltage events. Internal thermal disconnect devices help ensure safe behavior at end-of life. A visual indicator flag provides user-feedback in the event of such operation. The TDS130 provides a set of optional voltage-free contacts for remote signaling that maintenance is required.

The convenient plug-in module and separate base design facilitates replacement of a failed surge module without needing to undo installation wiring.



Model	TDS1301TR150	TDS1301TR240
Item Number for Europe	702421	702422
Nominal Voltage, $U_n$	120-150 VAC	220-240 VAC
Max Cont. Operating Voltage, $U_c$	170VAC	275VAC
Stand-off Voltage	230VAC	440VAC
Frequency	0-100Hz	
Nominal Discharge Current, $I_n$	8kA 8/20 $\mu$ s per mode	
Max Discharge Current, $I_{max}$	15kA 8/20 $\mu$ s L-N 15kA 8/20 $\mu$ s L-PE	
Protection Modes	L-G, L-N, N-G	
Technology	TD Technology with thermal disconnect	
Short Circuit Current Rating, $I_{sc}$	200kAIC	
Back-up Overcurrent Protection	63AqL, if supply > 63A	
Voltage Protection Level, $U_p$	500V @ 3kA (L+N-G) 800V @ 3kA (L-N)	800V @ 3kA (L+N-G) 1500V @ 3kA (L-N)
Status	N/O, N/C Change-over contact, 250V~/0.5A, max 1.5 mm² (#14AWG) terminals Mechanical flag / remote contacts (R model only)	
Module Width	1 M	
Dimensions H x D x W: mm (in)	90 x 68 x 18 (3.54 x 2.68 x 0.71)	
Weight: kg (lbs)	0.12 (0.26)	
Enclosure	DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA-1)	
Connection	1 mm² to 6 mm² (#18AWG to #10AWG) Line and Neutral Terminals ≤25 mm² (#4AWG) stranded ≤35 mm² (#2AWG) solid PE Terminal	
Mounting	35 mm top hat DIN rail	
Temperature	-40°C to 80°C (-40°F to 176°F)	
Humidity	0% to 90%	
Approvals	CE, IEC® 61643-1, UL® 1449 Ed 3 Recognized Component Type 2	
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B IEC 61643-1 Class II UL® 1449 Ed3 In 3kA mode	
Replacement Module	TDS130M150	TDS130M240
Replacement Module (Europe)	702432	702424

## CRITEC® TDS Surge Diverter - TDS150 Series

### Features

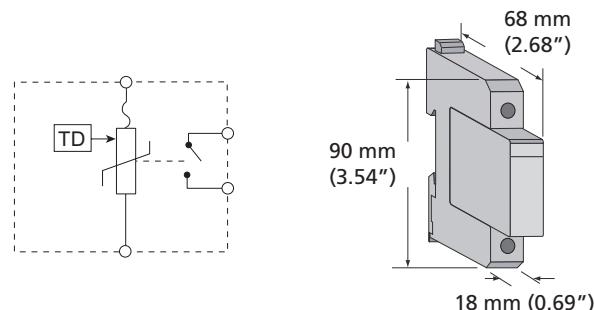
- CRITEC® TD Technology with thermal disconnect protection
- Compact design fits into DIN distribution panel boards and motor control centers
- 35 mm DIN rail mount – DIN 43 880 profile matches common circuit breakers
- Indication flags and voltage-free contacts provide remote status monitoring
- Separate plug and base design facilitates replacement of a failed surge module
- 50kA 8/20 $\mu$ s maximum surge rating provides protection suitable for sub-distribution panels and a long operational life
- Available in various operating voltages to suit most common power distribution systems
- CE, UL® 1449 Edition 3 Listed

Surges and voltage transients are a major cause of expensive electronic equipment failure and business disruption. Damage may result in the loss of capital outlays, such as computers and communications equipment, as well as consequential loss of revenue and profits due to unscheduled system down-time.

The TDS150 series of surge suppressors provide economical and reliable protection from voltage transients on power distribution systems. They are conveniently packaged for easy installation on 35 mm DIN rail within main distribution panelboards.

CRITEC® TD technology helps ensure reliable and continued operation during sustained and abnormal over-voltage events. Internal thermal disconnect devices help ensure safe behavior at end-of-life. A visual indicator flag provides user-feedback in the event of such operation. As standard, the TDS150 provides a set of voltage-free contacts for remote signaling that maintenance is required.

The convenient plug-in module and separate base design facilitates replacement of a failed surge module without needing to undo installation wiring.



Model	TDS1501SR150	TDS1501SR240	TDS1501SR277	TDS1501SR560
Item Number for Europe	702404	702406	702407	702408
Nominal Voltage, U <sub>n</sub>	120-150 VAC	220-240 VAC	240-277 VAC	480-560 VAC
Max Cont. Operating Voltage, U <sub>c</sub>	170VAC	275VAC	320VAC	610VAC
Stand-off Voltage	240VAC	440VAC	480VAC	700VAC
Frequency	0-100Hz			
Short Circuit Current Rating, I <sub>sc</sub>	200KAIC			
Back-up Overcurrent Protection	125AgL, if supply > 100A			
Technology	TD with thermal disconnect			
Max Discharge Current, I <sub>max</sub>	50kA 8/20 $\mu$ s			
Nominal Discharge Current, I <sub>n</sub>	25kA 8/20 $\mu$ s	20kA 8/20		
Protection Modes	Single mode (L-G, L-N or N-G)			
Voltage Protection Level U <sub>p</sub>	400V @ 3kA 1.0kV @ In	700V @ 3kA 1.2kV @ In	800V @ 3kA 1.6kV @ In	1.8kV @ 3kA 2.4kV @ In
Status	N/O, N/C Change-over contact, 250V~/0.5A, max 1.5 mm <sup>2</sup> (#14AWG) Mechanical flag / remote contacts (R model only)			
Dimensions H x D x W: mm (in)	90 x 68 x 18 (3.54 x 2.68 x 0.69)			
Module Width	1 M			
Weight: kg (lbs)	0.12 (0.26)			
Enclosure	DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA-1)			
Connection	$\leq$ 25 mm <sup>2</sup> (#4AWG) stranded $\leq$ 35 mm <sup>2</sup> (#2AWG) solid			
Mounting	35 mm top hat DIN rail			
Temperature	-40°C to 80°C (-40°F to 176°F)			
Humidity	0% to 90%			
Approvals	CE, IEC® 61643-1, UL® 1449 Ed 3 Recognized Component Type 2			
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B, Cat C ANSI®/IEEE® C62.41.2 Scenario II, Exposure 2, 50kA 8/20 $\mu$ s IEC 61643-1 Class II UL® 1449 Ed3 In 20kA mode			
Replacement Module	TDS150M150	TDS150M240	TDS150M277	TDS150M560

## CRITEC® TDS Surge Diverter - TDS1100 Series

### Features

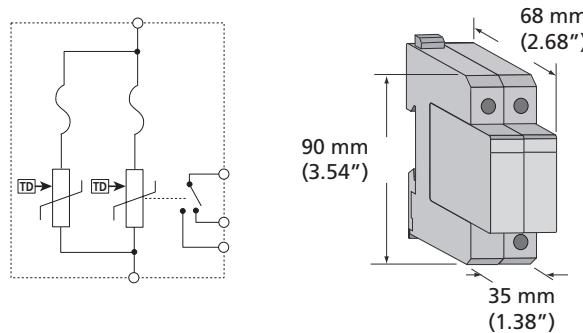
- CRITEC® TD Technology with thermal disconnect protection
- Compact design fits into DIN distribution panel boards and motor control centers
- 35 mm DIN rail mount – DIN 43 880 profile matches common circuit breakers
- Indication flags and voltage-free contacts provide remote status monitoring
- Separate plug and base design facilitates replacement of a failed surge module
- 100kA 8/20 $\mu$ s maximum surge rating provides protection suitable for sub-distribution panels and a long operational life
- Available in various operating voltages to suit most common power distribution systems
- CE, UL® 1449 Edition 3 Listed

Surges and voltage transients are a major cause of expensive electronic equipment failure and business disruption. Damage may result in the loss of capital outlays, such as computers and communications equipment, as well as consequential loss of revenue and profits due to unscheduled system down-time.

The TDS1100 series of surge suppressors provide economical and reliable protection from voltage transients on power distribution systems. They are conveniently packaged for easy installation on 35 mm DIN rail within main distribution panelboards.

CRITEC® TD technology helps ensure reliable and continued operation during sustained and abnormal over-voltage events. Internal thermal disconnect devices help ensure safe behavior at end-of-life. A visual indicator flag provides user-feedback in the event of such operation. As standard, the TDS1100 provides a set of voltage-free contacts for remote signaling that maintenance is due.

The convenient plug-in module and separate base design facilitates replacement of a failed surge module without needing to undo installation wiring.



Model	TDS11002SR150	TDS11002SR240	TDS11002SR277	TDS11002SR560
Item Number for Europe	702409	702411	702412	702413
Nominal Voltage, $U_n$	120-150 VAC	220-240 VAC	240-277 VAC	480-560 VAC
Max Cont. Operating Voltage, $U_c$	170VAC	275VAC	320VAC	610VAC
Stand-off Voltage	240VAC	440VAC	480VAC	700VAC
Frequency	0-100Hz			
Short Circuit Current Rating, $I_{sc}$	200kAIC			
Back-up Overcurrent Protection	125AgL, if supply > 100A			
Technology	TD with thermal disconnect			
Max Discharge Current, $I_{max}$	100kA 8/20 $\mu$ s			
Impulse Current, $I_{imp}$	12.5kA 10/350 $\mu$ s			
Nominal Discharge Current, $I_n$	50kA 8/20 $\mu$ s	40kA 8/20 $\mu$ s		
Protection Modes	Single mode (L-G, L-N or N-G)			
Voltage Protection Level, $U_p$	400V @ 3kA 1.0kV @ 20kA	700V @ 3kA 1.2kV @ 20kA	800V @ 3kA 1.6kV @ 20kA	1.8kV @ 3kA 2.4kV @ 20kA
Status	N/O, N/C Change-over contact, 250V~/0.5A, max 1.5 mm² (#14AWG) terminals Mechanical flag / remote contacts (R model only)			
Dimensions H x D x W: mm (in)	90 x 68 x 35 (3.54 x 2.68 x 1.38)			
Module Width	2 M			
Weight: kg (lbs)	0.24 (0.53)			
Enclosure	DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA-1)			
Connection	$\leq 25$ mm² (#4AWG) stranded $\leq 35$ mm² (#2AWG) solid			
Mounting	35 mm top hat DIN rail			
Temperature	-40°C to 80°C (-40°F to 176°F)			
Humidity	0% to 90%			
Approvals	CE, IEC® 61643-1, UL® 1449 Ed 3 Recognized Component Type 2			
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B, Cat C ANSI®/IEEE® C62.41.2 Scenario II, Exposure 3, 100kA 8/20 $\mu$ s, 10kA 10/350 $\mu$ s IEC 61643-1 Class I and Class II UL® 1449 Ed 3 In 20kA mode			
Replacement MOV Module	TDS150M150	TDS150M240	TDS150M277	TDS150M560

## CRITEC® TDS Surge Diverter - TDS350 Series

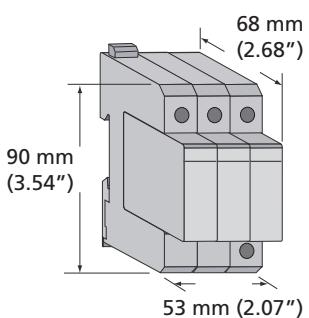
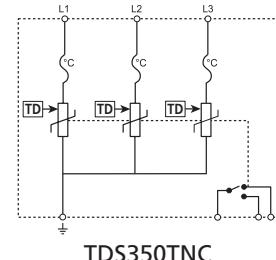
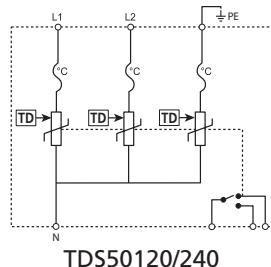
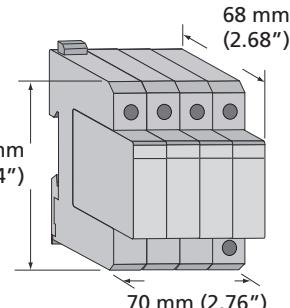
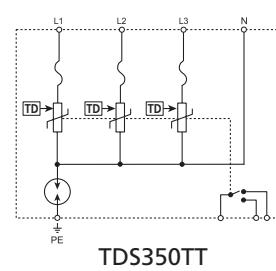
### Features

- CRITEC® TD Technology with thermal disconnect protection
- Compact design fits into DIN distribution panel boards and motor control centers
- 35 mm DIN rail mount – DIN 43 880 profile matches common circuit breakers
- Indication flags and voltage-free contacts provide remote status monitoring
- Separate plug and base design facilitates replacement of a failed surge module
- 50kA 8/20 $\mu$ s maximum surge rating provides protection suitable for sub-distribution panels and a long operational life
- Available in various operating voltages to suit most common power distribution systems
- CE, UL® 1449 Edition 3 Listed

Surges and voltage transients are a major cause of expensive electronic equipment failure and business disruption. Damage may result in the loss of capital outlays, such as computers and communications equipment, as well as consequential loss of revenue and profits due to unscheduled system down-time.

CRITEC® TD technology helps ensure reliable and continued operation during sustained and abnormal over-voltage events. Internal thermal disconnect devices help ensure safe behavior at end-of-life. A visual indicator flag provides user-feedback in the event of such operation. As standard, the TDS provides a set of voltage-free contacts for remote signaling that maintenance is due.

The convenient plug-in module and separate base design facilitates replacement of a failed surge module without needing to undo installation wiring.



Model	TDS350TNC150	TDS50120240	TDS350TNC277	TDS350TT150	TDS350TT277
Item Number for Europe	702414	702419	702417	702416	702418
Nominal Voltage, $U_n$	120-150 VAC	240-277 VAC	120-150 VAC	240-277 VAC	
Max Cont. Operating Voltage, $U_c$	170/295VAC	240/480VAC	320/536VAC	170/295VAC	320/536VAC
Stand-off Voltage	240/415VAC	240/480VAC	480/813VAC	240/415VAC	480/813VAC
Frequency	0-100Hz				
Short Circuit Current Rating, $I_{sc}$	200kAIC				
Back-up Overcurrent Protection	125A $\text{gL}$ , if supply > 100A				
Technology	TD with thermal disconnect				
Max Discharge Current, $I_{max}$	50kA 8/20 $\mu$ s			12.5kA 10/350 $\mu$ s N-PE 50kA 8/20 $\mu$ s	
Nominal Discharge Current, $I_n$	25kA 8/20 $\mu$ s	20kA 8/20	25kA 8/20 $\mu$ s	20kA 8/20	
Protection Modes	L-N	L-N, N-PE	L-N	L-N, N-PE	
Voltage Protection Level, $U_p$	400V @ 3kA 1.0kV @ $I_n$	800V @ 3kA 1.6kV @ $I_n$	400V @ 3kA 1.0kV @ $I_n$	800V @ 3kA 1.6kV @ $I_n$	
Status	N/O, N/C Change-over contact, 250V~/0.5A, max 1.5 mm <sup>2</sup> (#14AWG) terminals Mechanical flag / remote contacts				
Dimensions H x D x W: mm (in)	90 x 68 x 53 (3.54 x 2.68 x 2.07)			90 x 68 x 70 (3.54 x 2.68 x 2.76)	
Module Width	3 M			4 M	
Weight: kg (lbs)	0.36 (0.79)			0.5 (1.10)	
Enclosure	DIN 43 880, UL94V-0 thermoplastic, IP 20 (NEMA-1)				
Connection	$\leq$ 25 mm <sup>2</sup> (#4AWG) stranded $\leq$ 35 mm <sup>2</sup> (#2AWG) solid				
Mounting	35 mm top hat DIN rail				
Temperature	-40°C to 80°C (-40°F to 176°F)				
Humidity	0% to 90%				
Approvals	CE, IEC® 61643-1, UL® 1449 Ed 3 Recognized Component Type 2				
Surge Rated to Meet	ANSI®/IEEE® C62.41.2 Cat A, Cat B, Cat C ANSI®/IEEE® C62.41.2 Scenario II, Exposure 2, 50kA 8/20 $\mu$ s IEC 61643-1 Class II UL® 1449 Ed3 In 20kA mode				
Replacement MOV Module	TDS150M150		TDS150M277	TDS150M150	TDS150M277
Replacement GDT Module	-			SGD112M	
Replacement GDT Module (Europe)	-			702403	



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#### WARNING

ERICO products shall be installed and used only as indicated in ERICO's product instruction sheets and training materials. Instruction sheets are available at [www.erico.com](http://www.erico.com) and from your ERICO customer service representative. Improper installation, misuse, misapplication or other failure to completely follow ERICO's instructions and warnings may cause product malfunction, property damage, serious bodily injury and death.

# TECHNICAL DATA SHEET

**Equipment Type:** Radio

**Location:** RTU Section

**Model Numbers:** DR900

**Manufacturer:** Trio

**Supplier:** Schneider

80 Schneider Rd Taylor Pl  
Eagle Farm  
1300 369 233

# D Series

## Data Radio Modem

### DR900 - Digital Radios

*Trio DataCom's D Series are high performance cost effective data radio modems designed as an alternative to hard wired data transport. Transmit your data over radio with a fully integrated data radio modem designed for fixed point-to-point and point-to-multipoint applications.*

The **D Series** is available as either a half duplex or a full duplex\* 853-929 MHz +/- 5MHz radio, including a fully integrated 4800 / 9600 bps data modem. These units operate equally well in either a stand-alone configuration, or as part of a large communication system.

This complete package forms an attractively priced product for the transmission of data over radio in fixed applications thus providing a viable alternative to costly networks of buried media.



#### Features:

- ❖ Fully integrated half and full duplex\* radio and modem
- ❖ Transparent and non-intrusive remote diagnostic facilities (Optional)
- ❖ Inbuilt data routing and multiplexing capabilities, multi-port operation
- ❖ Simultaneous delivery of multiple protocols using Trio DataCom's unique MultiStream™ technology
- ❖ Digital Signal Processing (DSP) modem
- ❖ Selectable 300-19,200 bps asynchronous RS232 user interface
- ❖ Built-in antenna diplexer\*
- ❖ Integrated supervisory data channel
- ❖ Unique collision avoidance facility, for unsolicited report-by-exception
- ❖ Software selectable configuration parameters
- ❖ Internal repeater operation
- ❖ Housed in an attractive yet robust metal enclosure
- ❖ Range of ancillary equipment - full duplex base / repeater stations and hot-standby base station

#### Radio

The **D Series** radio has been designed to meet worldwide regulatory guidelines, including FCC, and has adjustable power output up to 5 Watts. This fully synthesised radio is programmable in 6.25/7.5 kHz increments to accommodate various worldwide channel spacings. The receiver section has a wide tuning range with an excellent signal-to-noise ratio. Exceptional frequency stability is achieved by intelligent microprocessor controlled temperature compensation. An extended operating temperature range of -30 to 60°C makes the unit ideal for commercial and industrial applications.

#### Modem

The in-built modem includes a custom DSP developed for data communications over narrow band radio systems.

This system offers minimum occupied bandwidth and optimal data integrity (using the standard HDLC protocol with CCITT CRC error detection) inhibiting the transfer of any rogue unwanted data caused by interference or squelch headers / tails.

The Trio DataCom DSP provides:

- the interface between the asynchronous RS232 user communication and the synchronous radio link layer.
- an inbuilt multiplexer / router which allows for simultaneous transportation of multiple protocols over the one radio network.

#### Applications

The **D Series** is ideal for use in a variety of sophisticated and critical SCADA and Distributed Information Systems, where complex routing of multiple data protocols and remote diagnostics and wireless network management are important factors.

Remote units and a number of full duplex base station / repeater models, suitable for a variety of requirements, make up the **D Series**. At the top of the range, the DH model is a genuine, duplicated hot standby base for systems where nothing short of ultra reliability is acceptable.

**Telemetry Systems** - Utilities (Gas, Water, Electricity), Railways, Mining, Telecommunications, Industry. Where network status, system control, data collection and fault conditions are required.

**Transaction Processing** - Point of Sale Credit Terminals, Stock Control, Direct Order, Banks, Building Societies, Stock Brokers, Gambling Organizations, etc, where Point of Sale, inventory, credit, or transaction data requires collection and distribution.

**Common Carrier Data Services** - The high speed, low cost and spectrum efficiency of this device make it well suited to all forms of common carrier data networking.

**Alarm Monitoring** - Fire, Power, Intrusion & Essential Services Alarm Reporting.

## D Series - Data Radio Modem

### DR900 - Digital Radios

#### Configuration

Configuration using Trio's **D Series** programming software (DRProg) is completely Windows® based for all parameters, such as; frequency, transmitter power, digital mute level, PTT timer, system configurations, port settings.

#### Network Management & Diagnostic (Optional)

A large distributed network, or even a simple point-to-point link, requires comprehensive fault reporting and diagnostics to ensure a high level of availability. Trio **D Series** data radio modem products offer sophisticated in-built diagnostics using the optional **TView™** software. This capability allows the customer to remotely monitor and maintain their system, minimising the likelihood of failures, by pointing out component degradation and decreasing the time to diagnose and repair. There is no necessity to visit the master station or interfere with the host data integrity, other than additional data transfer. For further details, consult the **TView** data sheet.

#### Specifications:

RADIO	
Frequency Range**	853-929 MHz +/- 5MHz
Channel Selection	Fully programmable
Frequency Splits	76 MHz Tx/Rx frequency split available including simplex
Frequency Stability	$\pm 1\text{ppm}$ (-10 to 60°C ambient, opt. -30 to 70°C) Higher frequency stability options are available due to intelligent processor controlled temperature compensation
Aging	$\leq 1\text{ppm}/\text{annum}$
Half / Full Duplex	half duplex or full duplex*
Data Rate (rf)	4800 / 9600 bps
Configuration	All configuration via Windows software
TRANSMITTER	
Tx Power	5 W (+37 dBm) or 1 W* (+30 dBm) (software programmable)
Modulation	Narrow band digital filtering binary GMSK
Occupied Bandwidth	Meets various international regulatory guidelines for point-to-point and point-to-multipoint
Tx Attach Time	< 1 mSecond
Timeout Timer	Programmable 1-255 seconds
Tx Spurious	$\leq -65 \text{ dBm}$
RECEIVER	
Sensitivity	-115 dBm for 12 dB SINAB
Blocking	> 75 dB (EIA)
Intermodulation	$\leq 70 \text{ dB}$ (EIA)
Spurious Response	$\leq 70 \text{ dB}$ (EIA)
Select. and Desense	70 dB (EIA)
AFC Tracking	$\pm 3 \text{ kHz}$ tracking @ -90 dBm/attack time <10 mS
Mute	Programmable digital mute
CONNECTIONS	
User Data Port	2 x DB9 RS232 female ports
Antenna	SMA female bulkhead (optional N)
Power	2 pin locking. Mating connector supplied
MODEM	
Data Serial Port #1	Full duplex, DB9 RS232, DCE (modem), 300-19,200 bps asynchronous, hardware/software handshaking
Data Serial Port #2	Full duplex, DB9 RS232, 300-9600 bps asynchronous, software handshaking
Data Storage	On-board RAM
Channel Data Rate	4800 / 9600 bps, full duplex
Bit Error Rate	$< 1 \times 10^{-6}$ @ -108 dBm (4800 bps) $< 1 \times 10^{-6}$ @ -105 dBm (9600 bps)
Collision Avoidance	Trio DataCom's unique supervisory channel C/DSMA collision avoidance system
MultiStream™	Trio DataCom's unique simultaneous delivery of multiple data streams (protocols)
GENERAL	
Power Supply	13.8 Vdc nominal (11-16 Vdc)
Transmit Current	600 mA max. @ 1 W 1700 mA max. @ 5 W
Receive Current	175 mA
Dimensions	260 x 161 x 65 mm (robust metal enclosure)
Weight	1.3 kg

\* Available for DR900 full duplex 1 W version (853 ± 5 MHz / 929 ± 5 MHz)

\*\* Various sub-frequency bands available.

Note: Model codes previously known as xxxDR are now depicted as DRxxx.

Local regulatory conditions may determine the suitability of individual versions in different countries. It is the responsibility of the buyer to confirm these regulatory conditions.

Performance data indicates typical values related to the described unit.  
Information subject to change without notice.

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# designs products & solutions

# TECHNICAL DATA SHEET

**Equipment Type:** 3 Phase inlet

**Location:** External

**Model Numbers:** 3658 and 40787

**Manufacturer:** Mennekes

**Supplier:** DKSH

03 9554 666

# Industrial plugs and receptacles



International  
Wiring  
Devices

# Global focus

Well known  
internationally  
and certified.



MENNEKES plugs and receptacles are well known all over the world – and comply with the relevant national and international standards.

More than half of our products are destined for international markets.

This is why MENNEKES also has a global presence, with subsidiaries and agencies in more than 90 countries.

When plugs and receptacles are being tested by independent testing authorities, such as the VDE Testing and Certification Institute, the test reports are compiled according to CCA or CB-II procedures. They then serve as the basis for approvals in other countries, such as those whose national test marks are shown below.

For plugs and receptacles for USA and Canada please contact us.



Argentina



Austria



Belgium



Canada



Croatia

Czech  
Republic

Denmark



Finland



France



Germany

Great  
Britain

Hungary

Italy  
Q-Pulse Id: TMS1407

Netherlands



Norway



PR China



Poland

Russia  
Active: 30/09/2015

Slovakia



Spain

South  
Africa

Sweden



Switzer-



USA

# Family business

MENNEKES is a family-run business - like most of our customers' companies.

Perhaps this is also the reason behind our legendary customer focus. At MENNEKES, an 800-strong global workforce produces plugs and receptacles for international markets. From its headquarters in Kirchhundem, Germany and its Neudorf plant in the Erzgebirge. In addition, a production plant in Nanjing supplies the Chinese market exclusively.

The North American market is serviced by MENNEKES Electrical Products headquartered in Fairfield, NJ.



Neudorf plant

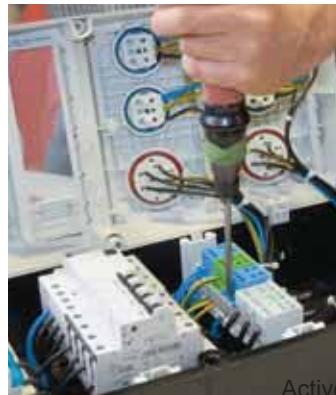


Kirchhundem headquarters

When a MENNEKES product leaves our factory, it has already survived the harshest testing. In our test lab it is exposed to cold, heat, dust and water over and over again. Only the products that withstand these tests are worthy of the name MENNEKES. Our products are of course certified to national and international standards by renowned institutions.



C-Pulse Id: TMS1407



Active: 30/09/2015



Only the combination of first-class raw materials and advanced manufacturing processes guarantees a premium product. This is why we use only first-grade granules which are processed by a highly skilled workforce in state-of-the-art production facilities to create certified MENNEKES products.

# CEE receptacles 16A up to 125A

63A: SoftCONTACT, 125A: TorsionSpringCONTACT

Other voltages and frequencies available on request.

## Wall mounted receptacles



⚠ IP 44

A	P	110V	230V	400V
16	3	1177	<b>1178</b>	—
16	4	—	1267	<b>1268</b>
16	5	—	—	1
32	3	1368	<b>1369</b>	—
32	4	1371	1372	<b>1373</b>
32	5	—	—	2

## Wall mounted receptacles



⚠ IP 44

A	P	110V	230V	400V
16	3	—	—	—
16	4	3030	3034	<b>1418</b>
16	5	3041	3045	<b>1419</b>
32	3	1420	<b>1421</b>	1422
32	4	1423	1424	<b>1425</b>
32	5	1555	1556	<b>1557</b>

## Wall mounted receptacles



⚠ IP 67

A	P	110V	230V	400V
16	3	1193	<b>1192</b>	1211
16	4	1194	1195	<b>1196</b>
16	5	1198	1199	<b>1200</b>
32	3	1201	<b>1202</b>	1203
32	4	1204	1205	<b>1206</b>
32	5	1208	1209	<b>1210</b>

## Wall mounted receptacles



⚠ IP 67

A	P	110V	230V	400V
63	3	—	—	—
63	4	—	—	—
63	5	—	—	—
125	3	—	—	—
125	4	137	138	<b>139</b>
125	5	141	142	<b>143</b>

## Panel mounted receptacles



straight

⚠ IP 44

A	P	110V	230V	400V
16	3	1365	<b>1366</b>	1367
16	4	1388	1389	<b>1390</b>
16	5	1384	1386	<b>1385</b>
32	3	1394	<b>1395</b>	1396
32	4	1397	1398	<b>1399</b>
32	5	3449	3454	<b>3451</b>

## Panel mounted receptacles



angled 20°

⚠ IP 44

A	P	110V	230V	400V
16	3	1462	<b>1463</b>	1464
16	4	1465	1466	<b>1467</b>
16	5	1471	1472	<b>1473</b>
32	3	1491	<b>1492</b>	1493
32	4	1494	1495	<b>1496</b>
32	5	1498	1499	<b>1500</b>

## Panel mounted receptacles



straight

⚠ IP 44

A	P	110V	230V	400V
63	3	1260	<b>1261</b>	1262
63	4	1246	1247	<b>1248</b>
63	5	1250	1251	<b>1252</b>
125	3	—	—	—
125	4	—	—	—
125	5	—	—	—

## Panel mounted receptacles



angled 20°

⚠ IP 44

A	P	110V	230V	400V
63	3	1146	<b>1147</b>	1148
63	4	1149	1150	<b>1151</b>
63	5	1153	1154	<b>1155</b>
125	3	—	—	—
125	4	—	—	—
125	5	—	—	—

## Panel mounted receptacles with standard flange dimensions



angled 20°,  
flange:  
85 x 85 mm,  
fixing hole spacing:  
70 x 70 mm

Q-Pulse Id: TMS1407

A	P	110V	230V	400V
16	3	3031	<b>3036</b>	—
16	4	—	—	<b>3072</b>
16	5	—	—	<b>3093</b>
32	3	3110	<b>3112</b>	—
32	4	—	—	<b>3136</b>
32	5	—	—	<b>3153</b>

## Wall mounted receptacles



⚠ IP 44

A	P	110V	230V	400V
16	3	100	<b>101</b>	102
16	4	103	104	<b>105</b>
16	5	109	110	<b>111</b>
32	3	—	—	—
32	4	—	—	—
32	5	—	—	—

## Wall mounted receptacles



⚠ IP 44

A	P	110V	230V	400V
63	3	1136	<b>1137</b>	1138
63	4	1139	1140	<b>1141</b>
63	5	1143	1144	<b>1145</b>
125	3	—	—	—
125	4	—	—	—
125	5	—	—	—

## Wall mounted receptacles



⚠ IP 67

A	P	110V	230V	400V
63	3	856	<b>128</b>	129
63	4	130	131	<b>132</b>
63	5	134	135	<b>136</b>
125	3	—	—	—
125	4	—	—	—
125	5	—	—	<b>2162</b>

## Wall mounted receptacles



⚠ IP 67

A	P	110V	230V	400V
16	3	217	<b>218</b>	219
16	4	220	221	<b>222</b>
16	5	226	227	<b>228</b>
32	3	229	<b>230</b>	231
32	4	232	233	<b>234</b>
32	5	238	239	<b>240</b>

## Panel mounted receptacles



⚠ IP 67

A	P	110V	230V	400V
63	3	1474	<b>1475</b>	1476
16	4	1477	1478	<b>1479</b>
16	5	1483	1484	<b>1485</b>
32	3	1501	<b>1502</b>	1503
32	4	1504	1505	<b>1506</b>
32	5	1489	1490	<b>1551</b>

## Panel mounted receptacles



⚠ IP 67

A	P	110V	230V	400V
63	3	1263	<b>1264</b>	1265
63	4	1122	1123	<b>1124</b>
63	5	1126	1127	<b>1128</b>
125	3	—	—	<b>3380</b>
125	4	1455	1456	<b>1457</b>
125	5	1459	1460	<b>1461</b>

## Panel mounted receptacles



⚠ IP 67

A	P	110V	230V	400V
63	3	2179	<b>2180</b>	2181
63	4	203	204	<b>205</b>
63	5	207	208	<b>209</b>
125	3	—	—	<b>3575</b>
125	4	210	211	<b>212</b>
125	5	2		

# CEE receptacles 16A and 32A, screwless connection technique

Other voltages and frequencies available on request.

## Wall mounted receptacles with TwinCONTACT



	screwless spring terminals	A	P	110V	230V	400V
16	3	1340		1341		—
16	4	—		1342	1343	
16	5	—		—	31	
32	3	1345		1346		—
32	4	—		1347	1348	
32	5	—		—	32	

▲ IP 44

## Wall mounted receptacles with TwinCONTACT



	screwless spring terminals	A	P	110V	230V	400V
16	3	—		—	—	—
16	4	1750		1751	418	
16	5	1755		1756	419	
32	3	1851		420	1852	
32	4	1855		1856	421	
32	5	1860		1861	422	

▲ IP 44

## Panel mounted receptacles with TwinCONTACT



	screwless spring terminals, straight	A	P	110V	230V	400V
16	3	1667		1668	1669	
16	4	1672		1673	1674	
16	5	1678		1679	3385	
32	3	1786		1787	1788	
32	4	1789		1790	1791	
32	5	1795		1796	1797	

▲ IP 44

## Panel mounted receptacles with TwinCONTACT



	screwless spring terminals, angled 20°	A	P	110V	230V	400V
16	3	1631		1632	1633	
16	4	1636		1637	1638	
16	5	1642		1643	3473	
32	3	1733		1734	1735	
32	4	1738		1739	1740	
32	5	1744		1745	1746	

▲ IP 44

## Panel mounted receptacles RAPIDO with TwinCONTACT



	screwless spring terminals, central fixing, 61 mm Ø mounting hole	A	P	110V	230V	400V
16	3	1132		997	—	—
16	4	—		—	—	—
16	5	—		—	—	—
32	3	—		—	—	—
32	4	—		—	—	—
32	5	—		—	—	—

▲ IP 44

## Wall mounted receptacles with TwinCONTACT



	screwless spring terminals	A	P	110V	230V	400V
16	3	1719		1720	1721	
16	4	—		1723	1724	
16	5	—		1730	3331	
32	3	—		—	—	—
32	4	—		—	—	—
32	5	—		—	—	—

▲ IP 44

## Wall mounted receptacles with TwinCONTACT



	screwless spring terminals	A	P	110V	230V	400V
16	3	1867		241	1868	
16	4	1870		1871	242	
16	5	1875		1876	200	
32	3	1877		243	1878	
32	4	1879		1880	244	
32	5	1884		1885	245	

♦♦ IP 67

## Panel mounted receptacles with TwinCONTACT



	screwless spring terminals, straight	A	P	110V	230V	400V
16	3	1707		1708	1709	
16	4	1710		1711	1712	
16	5	1716		1717	1131	
32	3	1809		1810	1811	
32	4	1812		1813	1814	
32	5	1818		1819	1820	

♦♦ IP 67

## Panel mounted receptacles RAPIDO with TwinCONTACT



	screwless spring terminals, angled 20°	A	P	110V	230V	400V
16	3	1700		1701	1702	
16	4	—		1703	1704	
16	5	—		—	3485	
32	3	1801		1802	1803	
32	4	—		1804	1805	
32	5	—		—	1808	

▲ IP 44

## RAPIDO

RAPIDO receptacles are available with screw terminals or with screwless TwinCONTACT.

16A, 3p:

for mounting holes 61 mm diam. and wall thickness from 2 up to 5 mm.

16A, 4p + 5p and 32A:

for mounting holes 70 mm diam. and wall thickness from 2 up to 9 mm.

## TwinCONTACT Screwless connection technique

without screws, double terminal with split spring for throughwiring.



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Active: 30/09/2015



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# CEE plugs and inlets 16A up to 125A

Other voltages and frequencies available on request.

## Plugs AM-TOP



single part body, screw terminals

A	P	110V	230V	400V
16	3	247	<b>248</b>	249
16	4	250	251	<b>252</b>
16	5	256	257	<b>3</b>
32	3	259	<b>260</b>	261
32	4	262	263	<b>264</b>
32	5	268	269	<b>4</b>

⚠ IP 44

## Plugs StarTOP with SafeCONTACT



screwless with insulation displacement technique

A	P	110V	230V	400V
16	3	947	<b>948</b>	—
16	4	—	951	<b>952</b>
16	5	—	—	<b>33</b>
32	3	711	<b>712</b>	—
32	4	—	717	<b>719</b>
32	5	—	—	<b>34</b>

⚠ IP 44

## Plugs AM-TOP



single part body, screw terminals

A	P	110V	230V	400V
16	3	277	<b>278</b>	279
16	4	280	281	<b>282</b>
16	5	286	287	<b>288</b>
32	3	289	<b>290</b>	291
32	4	292	293	<b>294</b>
32	5	298	299	<b>300</b>

⚠ IP 67

## Plugs PowerTOP Xtra



with rubberized grip area, for toughest conditions

A	P	110V	230V	400V
63	3	13201	<b>13202</b>	13203
63	4	13204	13205	<b>13206</b>
63	5	13210	13211	<b>13212</b>
125	3	13215	<b>13216</b>	—
125	4	13217	13218	<b>13219</b>
125	5	13223	13224	<b>13225</b>

⚠ IP 67

## Panel mounted inlets RAPIDO



with screw terminals, central fixing, 61 mm Ø mounting hole

A	P	110V	230V	400V
16	3	919	<b>924</b>	—
16	4	—	—	<b>931</b>
16	5	—	—	<b>949</b>
32	3	—	—	—
32	4	—	—	—
32	5	—	—	—

⚠ IP 44

## Wall mounted appliance inlets



⚠ IP 44

A	P	110V	230V	400V
16	3	843	<b>844</b>	—
16	4	—	—	<b>800</b>
16	5	—	—	<b>801</b>
32	3	—	<b>802</b>	—
32	4	—	—	<b>803</b>
32	5	—	—	<b>804</b>

## Panel mounted appliance inlets



with hinged lid

A	P	110V	230V	400V
16	3	—	—	—
16	4	392	393	<b>394</b>
16	5	398	399	<b>400</b>
32	3	401	<b>402</b>	403
32	4	404	405	<b>406</b>
32	5	410	411	<b>412</b>

⚠ IP 44

## Panel mounted inlets



⚠ IP 44

A	P	110V	230V	400V
16	3	810	<b>812</b>	—
16	4	—	837	<b>813</b>
16	5	—	—	<b>815</b>
32	3	816	<b>817</b>	—
32	4	—	838	<b>819</b>
32	5	—	—	<b>821</b>

## Panel mounted inlets



Q-Pulse Id: TMS1407

## Plugs ProTOP



split body, screw terminals

A	P	110V	230V	400V
16	3	147	<b>148</b>	149
16	4	—	151	<b>152</b>
16	5	—	—	<b>13</b>
32	3	159	<b>160</b>	—
32	4	—	163	<b>164</b>
32	5	—	—	<b>14</b>

⚠ IP 44

## Plugs PowerTOP Xtra



with rubberized grip area, for toughest conditions

A	P	110V	230V	400V
63	3	13101	<b>13102</b>	—
63	4	—	13105	<b>13106</b>
63	5	—	13111	<b>13112</b>
125	3	—	—	—
125	4	—	—	—
125	5	—	—	—

⚠ IP 44

## Plugs PowerTOP



with external strain relief

A	P	110V	230V	400V
16	3	3794	<b>3796</b>	3799
16	4	3807	3811	<b>3809</b>
16	5	3819	3823	<b>3821</b>
32	3	3829	<b>3830</b>	3832
32	4	3839	3844	<b>3841</b>
32	5	3851	3855	<b>3853</b>

⚠ IP 67

## Angled plugs



\*VarioTOP

A	P	110V	230V	400V
16	3	1410	<b>1411</b>	—
16	4	—	891	<b>315</b>
16	5	3312	3981*	<b>3980*</b>
32	3	—	<b>3306</b>	—
32	4	—	3646	<b>3987</b>
32	5	—	3424	<b>3266</b>

⚠ IP 44

## Panel mounted inlets RAPIDO



with screw terminals, central fixing, 70 mm Ø mounting hole

A	P	110V	230V	400V
16	3	—	—	—
16	4	—	932	<b>933</b>
16	5	—	—	<b>972</b>
32	3	935	<b>938</b>	—
32	4	—	939	<b>942</b>
32	5	—	—	<b>945</b>

⚠ IP 44

## Wall mounted appliance inlets



⚠ IP 44

A	P	110V	230V	400V
16	3	331	<b>332</b>	333
16	4	334	335	<b>336</b>
16	5	340	341	<b>342</b>
32	3	343	<b>344</b>	345
32	4	346	347	<b>348</b>
32	5	352	353	<b>354</b>

⚠ IP 44

## Wall mounted appliance inlets



⚠ IP 44

A	P	110V	230V	400V
63	3	1216	<b>1107</b>	1217
63	4	355	356	<b>357</b>
63	5	359	360	<b>361</b>
125	3	—	—	—
125	4	362	363	<b>364</b>
125	5	366	367	<b>368</b>

⚠ IP 67

## Panel mounted inlets



⚠ IP 44

A	P	110V

**CEE connectors 16A up to 125A**

63A: SoftCONTACT, 125A: TorsionSpringCONTACT

Other voltages and frequencies available on request.



Plugs for the world

**Connectors AM-TOP**single part  
body, screw  
terminals

A	P	110V	230V	400V
16	3	509	<b>510</b>	511
16	4	512	513	<b>514</b>
16	5	518	519	<b>5</b>
32	3	521	<b>522</b>	523
32	4	524	525	<b>526</b>
32	5	530	531	<b>6</b>

▲ IP 44

**Connectors StarTOP with SafeCONTACT**screwless with  
insulation  
displacement  
technique

A	P	110V	230V	400V
16	3	979	<b>980</b>	—
16	4	—	993	<b>994</b>
16	5	—	—	<b>35</b>
32	3	725	<b>731</b>	—
32	4	—	761	<b>763</b>
32	5	—	—	<b>36</b>

▲ IP 44

**Connectors AM-TOP**single part  
body, screw  
terminals

A	P	110V	230V	400V
16	3	539	<b>540</b>	541
16	4	542	543	<b>544</b>
16	5	548	549	<b>550</b>
32	3	551	<b>552</b>	553
32	4	554	555	<b>556</b>
32	5	560	561	<b>562</b>

♦♦ IP 67

**Connectors PowerTOP Xtra**with rubberized  
grip area,  
for toughest  
conditions

A	P	110V	230V	400V
63	3	14201	<b>14202</b>	14203
63	4	14204	14205	<b>14206</b>
63	5	14210	14211	<b>14212</b>
125	3	14215	<b>14216</b>	—
125	4	14217	14218	<b>14219</b>
125	5	14223	14224	<b>14225</b>

♦♦ IP 67

**Connectors ProTOP**split body,  
screw  
terminals

A	P	110V	230V	400V
16	3	179	<b>180</b>	181
16	4	—	193	<b>194</b>
16	5	—	—	<b>15</b>
32	3	121	<b>122</b>	—
32	4	—	125	<b>126</b>
32	5	—	—	<b>16</b>

▲ IP 44

**Connectors PowerTOP Xtra**with rubberized  
grip area,  
for toughest  
conditions

A	P	110V	230V	400V
63	3	14101	<b>14102</b>	—
63	4	—	14105	<b>14106</b>
63	5	—	14111	<b>14112</b>
125	3	—	—	—
125	4	—	—	—
125	5	—	—	—

▲ IP 44

**Connectors PowerTOP**with external  
strain relief

A	P	110V	230V	400V
16	3	3859	<b>3860</b>	3862
16	4	3869	3873	<b>3871</b>
16	5	3879	3883	<b>3881</b>
32	3	3887	<b>3888</b>	3891
32	4	3896	3899	<b>3897</b>
32	5	3905	3909	<b>3907</b>

▲ IP 67

**Angled connector**

▲ IP 44

A	P	110V	230V	400V
16	3	—	<b>1438</b>	—
16	4	—	—	—
16	5	—	—	—
32	3	—	—	—
32	4	—	—	—
32	5	—	—	—

**PowerTOP Xtra**

**PowerTOP Xtra** is rubberized for the best grip. Improved impact resistance even under humid conditions. Highly heat-resistant contact carrier, frame terminals, cable gland and sealing, strain relief and protection against kinking. Enclosure with thread lock, two safety slides and plugs with nickel-plated contacts. Connectors 63A with **SoftCONTACT** and 125A with **TorsionSpringCONTACT**.

**SoftCONTACT****TorsionSpringCONTACT****StarTOP**

with SafeCONTACT, screwless with insulation displacement technique, cable gland with sealing, strain relief and protection against kinking, 2-part enclosure with thread and locking slider.

ACTIVE: 30/09/2015

Q-Pulse ID: FMS1407



# CEE receptacles switched, interlocked, 16A up to 125A

63A: SoftCONTACT, 125A: TorsionSpringCONTACT. CEE receptacles with DUO-interlock can be padlocked.

Other voltages and frequencies available on request.

## Wall mounted receptacles with mechanical DUO-interlock



⚠ IP 44

A	P	110V	230V	400V
16	3	7010	<b>7002</b>	—
16	4	5457	5099	<b>5100</b>
16	5	5459	5102	<b>5103</b>
32	3	5743	<b>5696</b>	—
32	4	5460	5104	<b>5105</b>
32	5	5462	5107	<b>5108</b>

## Wall mounted receptacles with mechanical DUO-interlock



⚠ IP 67

A	P	110V	230V	400V
16	3	7011	<b>7012</b>	—
16	4	—	5599	<b>5600</b>
16	5	—	5602	<b>5603</b>
32	3	5924	<b>5793</b>	—
32	4	—	5604	<b>5605</b>
32	5	—	5607	<b>5608</b>

## Wall mounted receptacles with mechanical DUO-interlock



⚠ IP 44

A	P	110V	230V	400V
63	3	6569	<b>6571</b>	—
63	4	—	5955	<b>5956</b>
63	5	—	—	<b>5959</b>
125	3	—	—	—
125	4	—	—	—
125	5	—	—	—

## Wall mounted receptacles with mechanical DUO-interlock



⚠ IP 44

A	P	110V	230V	400V
16	3	7602	<b>7603</b>	—
16	4	—	7604	<b>7605</b>
16	5	—	—	<b>7607</b>
32	3	7611	<b>7612</b>	—
32	4	—	7613	<b>7614</b>
32	5	—	—	<b>7616</b>

## Panel mounted receptacles with mechanical DUO-interlock



⚠ IP 44

A	P	110V	230V	400V
16	3	7502	<b>7503</b>	—
16	4	—	7504	<b>7505</b>
16	5	—	—	<b>7507</b>
32	3	7511	<b>7512</b>	—
32	4	—	7513	<b>7514</b>
32	5	—	—	<b>7516</b>

## Wall mounted receptacles with mechanical DUO-interlock



⚠ IP 44

fused,  
DIN-rail

A	P	110V	230V	400V
16	3	—	<b>7213</b>	—
16	4	—	—	<b>5610</b>
16	5	—	—	<b>5613</b>
32	4	—	—	<b>5615</b>
32	5	—	—	<b>5618</b>
63	4	—	—	<b>6059</b>
63	5	—	—	<b>6062</b>

## Wall mounted receptacles with mechanical DUO-interlock



⚠ IP 44

fused,  
MCB

A	P	110V	230V	400V
16	3	—	<b>7216</b>	—
16	4	—	—	<b>7217</b>
16	5	—	—	<b>7218</b>
32	4	—	—	<b>7219</b>
32	5	—	—	<b>7220</b>
63	4	—	—	<b>7221</b>
63	5	—	—	<b>7222</b>

## Wall mounted receptacles with mechanical DUO-interlock



⚠ IP 67

A	P	110V	230V	400V
63	3	5925	<b>5911</b>	—
63	4	—	—	<b>5109</b>
63	5	—	—	<b>5112</b>
125	3	7060	<b>7000</b>	—
125	4	—	5887	<b>5691</b>
125	5	—	5888	<b>5692</b>

## Wall mounted receptacles with mechanical DUO-interlock



⚠ IP 67

A	P	110V	230V	400V
16	3	7620	<b>7621</b>	—
16	4	—	7623	<b>7624</b>
16	5	—	—	<b>7626</b>
32	3	7628	<b>7629</b>	—
32	4	—	7633	<b>7634</b>
32	5	—	—	<b>7636</b>

## Panel mounted receptacles with mechanical DUO-interlock



⚠ IP 67

A	P	110V	230V	400V
16	3	7520	<b>7521</b>	—
16	4	—	7523	<b>7524</b>
16	5	—	—	<b>7526</b>
32	3	7530	<b>7531</b>	—
32	4	—	7533	<b>7534</b>
32	5	—	—	<b>7536</b>

## Wall mounted receptacles with mechanical DUO-interlock



⚠ IP 67

A	P	110V	230V	400V
16	3	—	<b>7050</b>	—
16	4	—	—	<b>5630</b>
16	5	—	—	<b>5633</b>
32	4	—	—	<b>5635</b>
32	5	—	—	<b>5638</b>
63	4	—	—	<b>5640</b>
63	5	—	—	<b>5643</b>

## Wall mounted receptacles with mechanical DUO-interlock



⚠ IP 67

A	P	110V	230V	400V
16	3	—	<b>7238</b>	—
16	4	—	—	<b>7239</b>
16	5	—	—	<b>7240</b>
32	4	—	—	<b>7241</b>
32	5	—	—	<b>7242</b>
63	4	—	—	<b>7243</b>
63	5	—	—	<b>7244</b>

## Mechanical DUO-interlock



Q-Pulse Id: TMS1407

Active: 30/09/2015

After insertion and switching on, the plug is interlocked in the ON-position.  
After switching off and withdrawing, the switch is locked in the OFF-position.



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# Phase inverter plugs/inlets 16A and 32A

## Plugs and receptacles for low voltage

Other voltages and frequencies available on request.

### Phase inverter plugs AM-TOP



single part  
body, screw  
terminals

A	P	110V	230V	400V
16	3	—	—	—
16	4	—	338	339
16	5	—	318	319
32	3	—	—	—
32	4	—	396	397
32	5	—	321	322

▲ IP 44

### Phase inverter plugs ProTOP



split body,  
screw  
terminals

A	P	110V	230V	400V
16	3	—	—	—
16	4	—	—	—
16	5	—	—	3319
32	3	—	—	—
32	4	—	—	—
32	5	—	—	3322

▲ IP 44

### Wall mounted phase inverter inlets



▲ IP 44

A	P	110V	230V	400V
16	3	—	—	—
16	4	—	—	—
16	5	—	—	3517
32	3	—	—	—
32	4	—	—	—
32	5	—	—	3523

### Panel mounted phase inverter inlets



▲ IP 44

A	P	110V	230V	400V
16	3	—	—	—
16	4	—	3348	3350
16	5	—	—	20970
32	3	—	—	—
32	4	—	3355	3356
32	5	—	3717	21241

### Panel mounted phase inverter inlet



▲ IP 44

A	P	110V	230V	400V
16	3	—	—	—
16	4	—	—	—
16	5	—	—	854
32	3	—	—	—
32	4	—	—	—
32	5	—	—	—

### Wall mounted receptacles for low voltage



▲ IP 44

A	P	20-25V 50 a. 60 Hz	40-50V 50 a. 60 Hz	20-25V/ 40-50V 100-200 Hz
16	2	1825	1831	—
16	3	1832	1837	1835
32	2	1838	1844	—
32	3	1845	1850	1848

### Panel mounted receptacles for low voltage



▲ IP 44

A	P	20-25V 50 a. 60 Hz	40-50V 50 a. 60 Hz	20-25V/ 40-50V 100-200 Hz
16	2	603	604	—
16	3	610	611	612
32	2	616	617	—
32	3	623	624	625

### Plugs for low voltage



▲ IP 44

A	P	20-25V 50 a. 60 Hz	40-50V 50 a. 60 Hz	20-25V/ 40-50V 100-200 Hz
16	2	629	630	—
16	3	636	637	638
32	2	642	643	—
32	3	649	650	651

### Connectors for low voltage



Q-Pulse Id TMS1407

A	P	20-25V 50 a. 60 Hz	40-50V 50 a. 60 Hz	20-25V/ 40-50V 100-200 Hz
16	2	681	682	—
16	3	688	689	690
32	2	694	695	—
32	3	701	702	703

### Phase inverter plugs AM-TOP



single part  
body, screw  
terminals

A	P	110V	230V	400V
16	3	—	—	—
16	4	—	3338	3339
16	5	—	—	325
32	3	—	—	—
32	4	—	3340	3341
32	5	—	327	328

▲ IP 67

### Phase inverter plug VarioTOP



single part  
body, screw  
terminals

A	P	110V	230V	400V
16	3	—	—	—
16	4	—	—	—
16	5	—	—	859
32	3	—	—	—
32	4	—	—	—
32	5	—	—	—

▲ IP 44

### Wall mounted phase inverter inlets



single part  
body, screw  
terminals

A	P	110V	230V	400V
16	3	—	—	—
16	4	—	3342	3343
16	5	—	—	2511
32	3	—	—	—
32	4	—	3345	3346
32	5	—	3347	2478

▲ IP 44

### Wall mounted receptacles for low voltage



single part  
body, screw  
terminals

A	P	20-25V 50 a. 60 Hz	40-50V 50 a. 60 Hz	20-25V/ 40-50V 100-200 Hz
16	2	577	578	—
16	3	584	585	586
32	2	590	591	—
32	3	597	598	599

### Panel mounted receptacles for low voltage



single part  
body, screw  
terminals

A	P	20-25V 50 a. 60 Hz	40-50V 50 a. 60 Hz	20-25V/ 40-50V 100-200 Hz
16	2	1270	2855	—
16	3	2845	1272	2860
32	2	1271	2864	—
32	3	2870	1273	2852

▲ IP 44

### Wall mounted appliance inlets for low voltage



single part  
body, screw  
terminals

A	P	20-25V 50 a. 60 Hz	40-50V 50 a. 60 Hz	20-25V/ 40-50V 100-200 Hz
16	2	1955	1961	—
16	3	1962	1967	1965
32	2	1968	1974	—
32	3	1975	1980	1978

▲ IP 44



# Plugs and receptacles 7 pole

Other voltages and frequencies available on request.

## Wall mounted receptacles



▲ IP 44

A	P	230V	400V	500V
16	7	733	734	1035
32	7	735	736	1040

## Panel mounted receptacles



angled 20°

▲ IP 44

A	P	230V	400V	500V
16	7	737	738	1045
32	7	739	740	1050

## Plugs AM-TOP



single part body, screw terminals

▲ IP 44

A	P	230V	400V	500V
16	7	741	742	1055
32	7	743	744	1060

## Wall mounted inlets



▲ IP 44

A	P	230V	400V	500V
16	7	—	2166	—
32	7	—	2167	—

## Connectors AM-TOP



single part body, screw terminals

▲ IP 44

A	P	230V	400V	500V
16	7	745	746	1065
32	7	747	748	1070

## Wall mounted receptacles with mechanical DUO-interlock



3 pole switch, can be padlocked

▲ IP 44

A	P	230V	400V	500V
16	7	—	5536	—
32	7	—	7061	—

## Wall mounted receptacles



♦♦ IP 67

A	P	230V	400V	500V
16	7	3240	2746	3262
32	7	2818	2648	2782

## Panel mounted receptacles



angled 20°

A	P	230V	400V	500V
16	7	2883	2459	2296
32	7	—	2317	2212

♦♦ IP 67

## Plugs AM-TOP



single part body, screw terminals

♦♦ IP 67

A	P	230V	400V	500V
16	7	3776	3777	3913
32	7	2405	2324	2213

## Panel mounted inlets



▲ IP 44

A	P	230V	400V	500V
16	7	749	750	1075
32	7	751	752	1080

## Connectors AM-TOP



single part body, screw terminals

♦♦ IP 67

A	P	230V	400V	500V
16	7	3783	3916	3784
32	7	2406	2255	2460

## Wall mounted receptacles with mechanical DUO-interlock



3 pole switch, can be padlocked

♦♦ IP 67

A	P	230V	400V	500V
16	7	—	5785	—
32	7	—	6106	—

# Plugs and receptacles 7 pole for multi functional applications

These plugs and receptacles provide solutions where there are multi functional requirements in industry, farming and commerce.

This number of poles provides solutions in the following fields:

- Star-delta start-up
- Closed loop control
- Open loop control
- Monitoring
- Detection and alarms
- Clearing alarms
- Electrical interlocking



**CEE receptacles Cepex**

Other voltages and frequencies available on request.



Plugs for the world

**Wall mounted receptacles**grey  
▲ IP 44

A	P	110V	230V	400V
16	3	4101	<b>4102</b>	—
16	4	—	4254	<b>4103</b>
16	5	—	—	<b>4105</b>
32	3	4106	<b>4107</b>	—
32	4	—	—	<b>4108</b>
32	5	—	—	<b>4110</b>
		SCHUKO	<b>4970</b>	

**Wall mounted receptacles**grey, with  
labeling field  
▲ IP 44

A	P	110V	230V	400V
16	3	—	<b>4132</b>	—
16	4	—	—	<b>4133</b>
16	5	—	—	<b>4135</b>
32	3	—	<b>4137</b>	—
32	4	—	—	<b>4138</b>
32	5	—	—	<b>4140</b>
		SCHUKO	<b>4973</b>	

**Wall mounted receptacles**grey, with  
labeling field  
and lockable  
cover  
▲ IP 44

A	P	110V	230V	400V
16	3	—	<b>4162</b>	—
16	4	—	—	<b>4163</b>
16	5	—	—	<b>4165</b>
32	3	—	<b>4167</b>	—
32	4	—	—	<b>4168</b>
32	5	—	—	<b>4170</b>
		SCHUKO	<b>4976</b>	

**Panel mounted receptacles**alpine white  
▲ IP 44

A	P	110V	230V	400V
16	3	—	—	—
16	4	—	—	—
16	5	—	—	<b>4262</b>
32	3	—	—	—
32	4	—	—	—
32	5	—	—	<b>4263</b>
		SCHUKO	<b>4979</b>	

**Flush mounted receptacles**pearl white  
▲ IP 44

A	P	110V	230V	400V
16	3	—	<b>4122</b>	—
16	4	—	—	—
16	5	—	—	<b>4125</b>
32	3	—	<b>4127</b>	—
32	4	—	—	—
32	5	—	—	<b>4130</b>
		SCHUKO	<b>4972</b>	

**Flush mounted installation box**

for Cepex CEE receptacles 16A and 32A and Cepex SCHUKO receptacles

Part no. 41404

**Perfect in every detail - one fits another****Anything goes.**

Covers, current rating and colors may be optionally combined: neutral cover, with labeling field, with labeling field and lock, 3 pole, 5 pole and SCHUKO.



Q-Pulse Id: TMS1407

**Panel mounted receptacles**pearl white  
▲ IP 44

A	P	110V	230V	400V
16	3	4111	<b>4112</b>	—
16	4	—	4233	<b>4113</b>
16	5	—	—	<b>4115</b>
32	3	4116	<b>4117</b>	—
32	4	—	—	<b>4118</b>
32	5	—	—	<b>4120</b>
		SCHUKO	<b>4971</b>	

**Panel mounted receptacles**pearl white,  
with labeling  
field  
▲ IP 44

A	P	110V	230V	400V
16	3	4141	<b>4142</b>	—
16	4	—	—	<b>4143</b>
16	5	—	—	<b>4145</b>
32	3	4146	<b>4147</b>	—
32	4	—	—	<b>4148</b>
32	5	—	—	<b>4150</b>
		SCHUKO	<b>4974</b>	

**Panel mounted receptacles**pearl white,  
with labeling  
field and  
lockable  
cover  
▲ IP 44

A	P	110V	230V	400V
16	3	4171	<b>4172</b>	—
16	4	—	—	<b>4173</b>
16	5	—	—	<b>4175</b>
32	3	—	<b>4177</b>	—
32	4	—	—	<b>4178</b>
32	5	—	—	<b>4180</b>
		SCHUKO	<b>4977</b>	

**Panel mounted receptacles**alpine white,  
with labeling  
field  
▲ IP 44

A	P	110V	230V	400V
16	3	—	<b>4247</b>	—
16	4	—	—	<b>4273</b>
16	5	—	—	<b>4237</b>
32	3	—	<b>4274</b>	—
32	4	—	—	<b>4275</b>
32	5	—	—	<b>4238</b>
		SCHUKO	<b>4980</b>	

**Cepex modular system**

Some versions of Cepex panel mounted receptacles are shown on the left.  
Further versions you can create using Cepex panel receptacles, shown above, in combination with the installation box 41404.



Cepex SCHUKO panel mounted receptacle with labeling field

4145

+ flush mounted installation box

41404

= flush mounted receptacle

**Resistant to ball rebound.**

All Cepex receptacles with neutral covers meet DIN 18032 standards for ball rebound and are suitable for use in

Active: 30/09/2015 facilities and comparable environments

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# Plugs and receptacles 200A up to 400A

Plugs and receptacles are available in seawater resistant design on request.

Other voltages and frequencies available on request.

## Receptacles



	A	P	230V	400V	500V	690V	1000V	weight
	200	4	75220	<b>75221</b>	75222	75223	75224	5580
	200	5	75225	<b>75226</b>	75227	75228	75229	5780
	250	4	75020	<b>75021</b>	75022	75023	75024	10510
	250	5	75110	<b>75111</b>	75112	75113	75114	11020
	400	4	75025	<b>75026</b>	75027	75028	75029	10510
	400	5	75115	<b>75116</b>	75117	75118	75119	11020

## Panel mounted receptacles



	A	P	230V	400V	500V	690V	1000V	weight
	200	4	75240	<b>75241</b>	75242	75243	75244	3200
	200	5	75245	<b>75246</b>	75247	75248	75249	3450
	250	4	75040	<b>75041</b>	75042	75043	75044	6800
	250	5	75130	<b>75131</b>	75132	75133	75134	7300
	400	4	75045	<b>75046</b>	75047	75048	75049	6800
	400	5	75135	<b>75136</b>	75137	75138	75139	7300

## Receptacles, switched and interlocked



	A	P	230V	400V	500V	690V	1000V	weight
	200	4	75230	<b>75231</b>	75232	75233	75234	25100
	200	5	75235	<b>75236</b>	75237	75238	75279	25300
	250	4	75030	<b>75031</b>	75032	75033	75034	45000
	250	5	75120	<b>75121</b>	75122	75123	75124	46500
	400	4	75035	<b>75036</b>	75037	75038	75039	43900
	400	5	75125	<b>75126</b>	75127	75128	75129	45400

## Plugs



	A	P	230V	400V	500V	690V	1000V	weight
	200	4	75200	<b>75201</b>	75202	75203	75204	3000
	200	5	75205	<b>75206</b>	75207	75208	75274	3200
	250	4	75000	<b>75001</b>	75002	75003	75004	8290
	250	5	75090	<b>75091</b>	75092	75093	75094	8610
	400	4	75005	<b>75006</b>	75007	75008	75009	8290
	400	5	75095	<b>75096</b>	75097	75098	75099	8610

## Connectors



	A	P	230V	400V	500V	690V	1000V	weight
	200	4	75210	<b>75211</b>	75212	75213	75214	3730
	200	5	75215	<b>75216</b>	75217	75218	75219	3980
	250	4	75010	<b>75011</b>	75012	75013	75014	9160
	250	5	75100	<b>75101</b>	75102	75103	75104	9670
	400	4	75015	<b>75016</b>	75017	75018	75019	9160
	400	5	75105	<b>75106</b>	75107	75108	75109	9670

## Heavy duty versions for industry



Mechanical interlocking. For mobile consumers of rated current > 125A we have included a heavy duty range with 200A, 250A and 400A in our program. This can be supplied for rated voltages of 230V to 1000V and in seawater resistant version.

The heavy duty range is suitable for use in very harsh conditions, e.g. building sites:

- drilling rigs
- tunnel constructions
- gravel pits
- strip mining
- container terminals and crane connections in harbours
- for versatile power supply at large-scale indoor and outdoor events
- power supply to market places
- airports
- quarries

**SCHUKO and grounding-type receptacles**

SCHUKO and French/Belgian standard 16A, 230V, 2p + E. British standard 13A, 230V, 2p + E.

Other variations on request.



Plugs for the world

**SCHUKO panel mounted receptacles**

with plug-in terminals or screw-terminals, without shutter  
 △ IP 54

Color	plug-in terminals	screw terminals
grey	11010	11030
blue	11011	11031
black	11012	11032
red	11013	11033

**Grounding-type panel mounted receptacles French/Belgian standard**

with plug-in terminals, without shutter  
 △ IP 44

Color	plug-in terminals	screw terminals
grey	11110	—
blue	11111	—
black	—	—
red	—	—

**SCHUKO wall mounted receptacles**

with plug-in terminals, without shutter  
 △ IP 44

Color	plug-in terminals	screw terminals
grey	10081	—
blue	10082	—
black	10083	—
red	—	—

**Base for wall mounted receptacles**

with cable entry and screws

Part no.	grey	10714
Part no.	blue	10715
Part no.	black	10716

**SCHUKO panel mounted receptacles**

with plug-in terminals or screw-terminals, without shutter  
 IP 20

Color	plug-in terminals	screw terminals
grey	—	—
blue	11511	11531
black	11512	11532
red	—	—

**Grounding-type panel mounted receptacle British standard**

with screw-terminals, with shutter and matching frame and seal  
 △ IP 44

Color	plug-in terminals	screw terminals
grey	—	—
blue	—	—
black	—	10713
red	—	—

**SCHUKO plugs with grommet**

combined PE-conductor acc. to German and French/Belgian standards.

Color
grey
black
orange
blue
red
yellow
green

**SCHUKO panel mounted receptacles**

with plug-in terminals or screw-terminals, with shutter  
 △ IP 54

Color	plug-in terminals	screw terminals
grey	11060	—
blue	11061	11081
black	—	—
red	—	—

**Grounding-type panel mounted receptacles French/Belgian standard**

with plug-in terminals or screw-terminals, with shutter  
 △ IP 44

Color	plug-in terminals	screw terminals
grey	11160	11180
blue	11161	11181
black	11162	11182
red	11163	11183

**Grounding-type wall mounted receptacle French/Belgian standard**

with plug-in terminals, with shutter  
 △ IP 44

Color	plug-in terminals	screw terminals
grey	—	—
blue	10092	—
black	—	—
red	—	—

**Modular system for wall mounted receptacle**

The combination of the base with one of the panel mounted receptacles shown above, gives a wall mounted receptacle.

**Grounding-type panel mounted receptacles French/Belgian standard**

with plug-in terminals or screw-terminals, without shutter  
 IP 20

Color	plug-in terminals	screw terminals
grey	—	—
blue	11611	11631
black	—	—
red	—	—

**Grounding-type panel mounted receptacle British standard**

with screw-terminals, with shutter and seal  
 △ IP 44

Color	plug-in terminals	screw terminals
grey	—	—
blue	—	10718
black	—	—
red	—	—

**SCHUKO connectors with grommet**

Color
grey
black
orange
blue
red
yellow
green

# AMAXX® receptacle combinations

## Success in series

Extensively configurable receptacle combinations in six different sizes – the AMAXX® range by MENNEKES. With an appealing and unique design in many variations for almost all applications. With our extended program, you now have three good extra reasons to opt for AMAXX® receptacle combinations.

# AMAXX®

by MENNEKES



- Protection types: IP 44 and IP 67.
- Enclosure materials: AMAPLAST and especially chemical-resistant AMELAN.
- Colors: bottom part black, top part grey, silver (IP 44), yellow or red.
- Equipped with: CEE receptacles from 16A, 3-poles up to 63A, 5-poles, grounding-type receptacles in accordance with many national standards, DUO receptacles switched and interlocked from 16A, 3p to 32A, 5p as well as fuse elements.

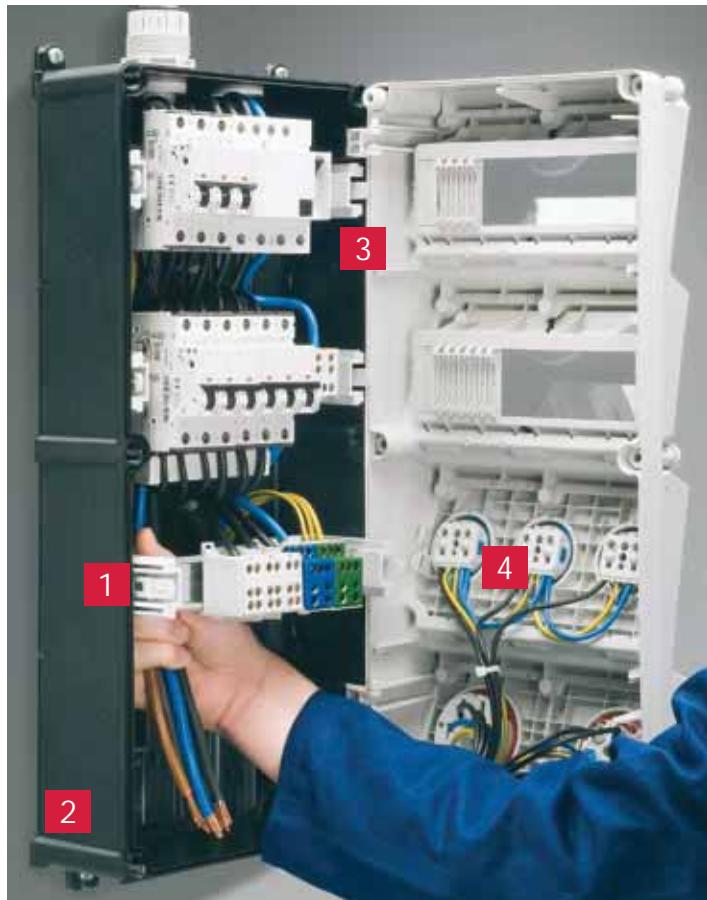
## International



AMAXX® receptacle combinations are also perfectly suited for the international market with many different standards. For example: British, French, Bulgarian, DMS1407, Swiss standard as well as the NEMA (since 30/09/2015) and Canada). Contact us.

Page 689 of 1633

## Features and benefits



**1 Liftable DIN Rails**

Liftable DIN rails and a large, smooth wiring space significantly ease the insertion as well as connection of large cables.

**2 One-man installation**

Shorter installation times with the new, user-friendly external fixing.

**3 Hinged cover**

The hinged cover which opens to one side, eases connection work.

**4 Ready for application**

All combinations are pre-wired for installation and tested for electric safety and quality.



Generally angled insertion direction.



Especially fast opening and closing of the enclosure due to captive double-threaded cover screws.



Both hands free because inspection windows fold downwards.

Window Pulse lock TDS1407 padlock, enclosure can be sealed Active: 30/09/2015 up to M 40.



Standard pre-punched cable entries at the top and at the bottom

Page 690 of 1633

## Receptacle combinations for versatile use

### EverGUM receptacle combinations with solid rubber enclosures

Wall mounted, enclosure  
380 x 230 mm or  
380 x 320 mm



Receptacle strip, enclosure  
445 x 135 mm



Portable, enclosure  
300 x 230 x 287.5 mm or  
360 x 340 x 330 mm



Portable, with feeder  
cable, enclosure  
300 x 230 x 287.5 mm or  
360 x 340 x 330 mm



With the EverGUM range MENNEKES provides a solid rubber alternative to enclosures in AMAPLAST, AMELAN and sheet steel. This is an alternative which is suitable for the most diverse environments, especially when there is likely to be exposure to rough handling or aggressive cleaning agents. These products can also be supplied to conform to the standards of other European countries.

### AirKRAFT and 3KRAFT

**AirKRAFT**  
for energy, data,  
compressed air.  
Also available with feeder cable.  
Enclosure  
400 x 229 x 220 mm  
(size without receptacles)



**3KRAFT**  
for energy, data,  
compressed air.  
Also available with feeder cable.  
Enclosure  
diam. 240-264 x H 152 mm  
(depending what receptacles  
are used)



### DELTA-BOX

**DELTA-BOXES**  
Enclosure  
114 x 160 x 97 mm  
(size without  
receptacles)



**DELTA-BOXES**  
with feeder cable.  
Enclosure  
114 x 160 x 97 mm  
(size without  
receptacles)



#### For ceilings, walls and floors.

Three colors: Signal yellow, red or silver.

**AirKRAFT.** Up to four receptacles, or data, or light, plus compressed air, plus fusing. Ready for connection or with supply cable and plug.

**3KRAFT.** Equipped to suit your requirements: Up to three receptacles, or data, plus compressed air. Ready for connection with supply cable and plug.

Q-Pulse ID: TMS1407

#### DELTA-BOX - the classic unit.

With cable grip. Enclosure and insert from impact and resistant AMAPLAST.

Available in ▲ IP 44, ♦♦ IP 67 and ♦♦♦ IP 68.

## Stainless steel surface and flush mounted receptacle combinations



**Safe.**  
**Practical.**  
**Timelessly elegant.**

- Protection type IP 43 or IP 44 with closed door, even when plugs are inserted.
- The cable guard aperture is sufficiently dimensioned for leading through cables.
- Safety lock protects against unauthorized access.

## Power posts

Rugged. Vandalism-proof.  
Steel power posts provide a safe means of energy supply,  
protection against car-crossing. Hot-dip galvanized and powder  
coated. Available in various sizes.



Q-Pulse Id: TMS1407

## CombiTOWER

Power. Compressed air. Water.  
Outdoors and indoors.  
The solution: CombiTOWER. Short routes to your energy source  
for industry, workshops, assembly shops, loading platforms, etc.



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# References



BMW motorcycle plant, Berlin – Germany



AIDAabella, Jos. L. Meyer Werft, Papenburg – Germany



Formula 1 circuit, Manama – Bahrain



Constitution, Heerema Marine Contractors – Netherland



Port of Salalah, Oman TMS1407



Active: 30/09/2015 Port Terminal, Le Havre – France



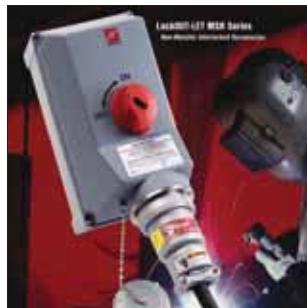
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The right combination for every application.



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Always well  
informed.

# TECHNICAL DATA SHEET

**Equipment Type:** Impulse Suppressor

**Location:** RTU Section

**Model Numbers:** IS-50NX-C2

**Manufacturer:** Polyphaser

**Supplier:**  
RFI Industries  
30 Raubers Road  
Banyo, QLD 4010

Ph: 07 3621 9400  
Fax: 07 3621 5505  
Web: [www.rfi.com.au](http://www.rfi.com.au)

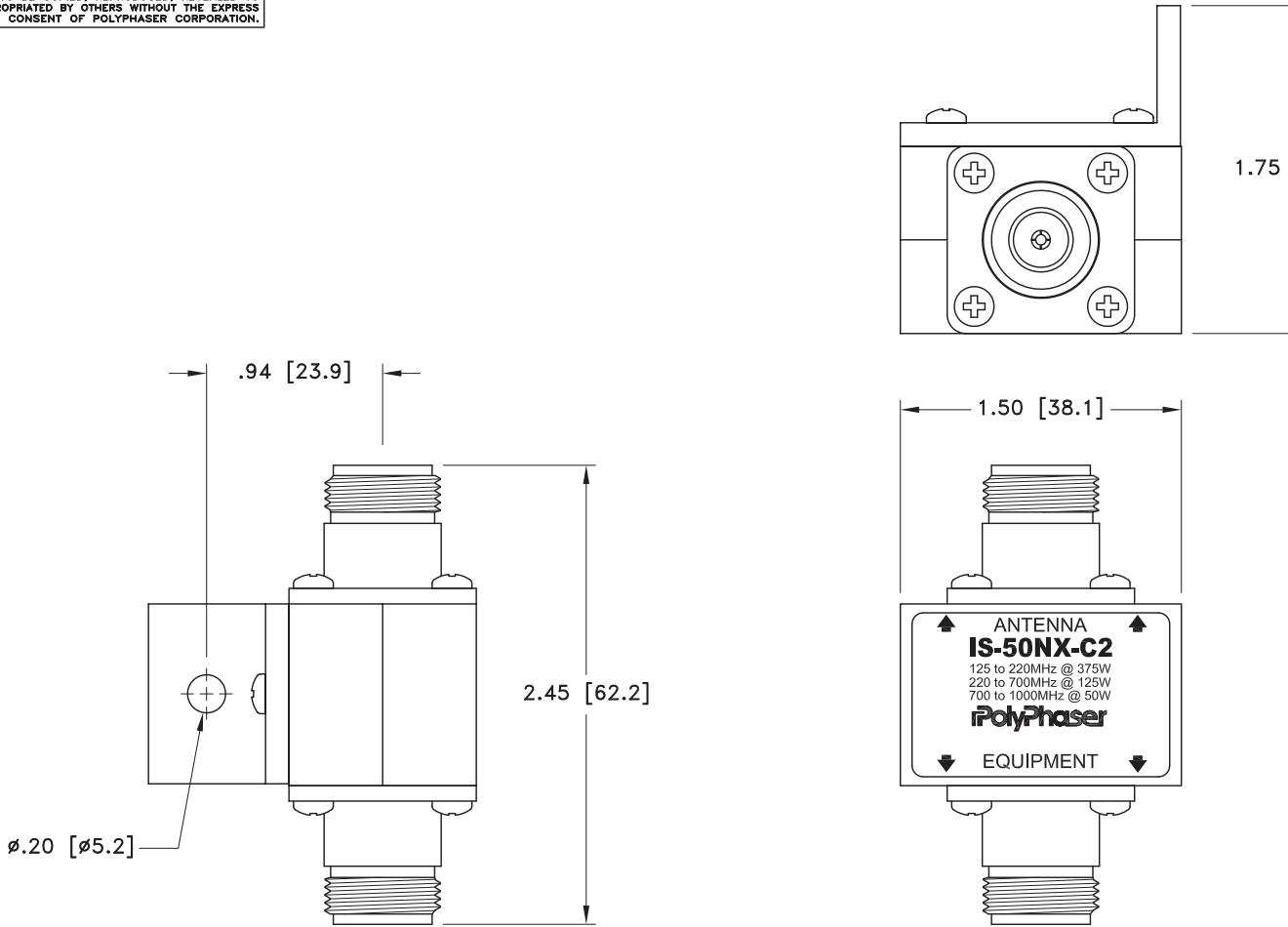
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## REVISIOnS

REV LTR	DATE	ENG	MKTG	Q.A.
A	01/30/96 <sub>PJP</sub>	T. K.	— —	R. M.
B	06/30/99 <sub>JCG</sub>	K.C.B.	T.G.F.	R. M.
C	01/16/01 <sub>SH</sub>	KCB	PH	RM
D	11/18/02 <sub>SH</sub>	LC	SD	LJ

## MAXIMUM CHARACTERISTICS

SURGE:  
50kA IEC 1000-4-5 8/20μs WAVEFORM 500 JOULES  
TURN ON:  
600Vdc ±20%  
TURN ON TIME:  
2.5ns FOR 2kV/ns  
FREQUENCY RANGE:  
125MHz TO 1GHz  
VSWR:  
≤1.1:1 OVER FREQUENCY RANGE  
INSERTION LOSS:  
≤0.1dB OVER FREQUENCY RANGE  
TEMPERATURE:  
-45°C TO +85°C STORAGE/OPERATING +50°C



CUSTOMER APPROVAL: \_\_\_\_\_ DATE: \_\_\_\_\_  
ALL DIMENSIONS SHOWN ABOVE ARE FOR REFERENCE ONLY.

DRAFTER J. CALLISTER	DATE 09/21/93	PolyPhaser <sup>®</sup> CORPORATION P.O. BOX 9000, MINDEN, NV 89423-9000 (775) 782-2511 FAX (775) 782-4476 DWG NO./PART NO./DESCRIPTION
MECH ENGINEER — — —	DATE — — —	
ELEC ENGINEER J. JONES	DATE 04/12/95	
MARKETING — — —	DATE — — —	
QUALITY DEPT R. MATHEUS	DATE 04/12/95	
CAGE CODE 61114	FILE NAME -C1	SCALE 1/1
		1 OF 1

IS-50NX-C2  
CUSTOMER PRINT

# TECHNICAL DATA SHEET

**Equipment Type:** Modem/Power Supply

**Location:** RTU Section

**Model Numbers:** PB251

**Manufacturer:** Powerbox

**Supplier:** Powerbox Australia Pty Ltd  
433 Logan Road  
Stones Corner, QLD 4120

Ph: 07 3394 8372  
Fax: 07 3394 8373  
Web: [www.powerbox.com.au](http://www.powerbox.com.au)

# PB251 Series

220-330 WATTS DC UPS

## Features

- Ultra-low noise output
- Independent battery charging output
- DC output OK & battery OK alarms & LEDs
- Battery-LVD and alarm
- Over-temperature protection
- Battery fuse fail LED



## Specifications

### INPUT

Voltage:	190 to 264 vac, or 190 to 400VDC
----------	----------------------------------

Line regulation:	0.2%typical
------------------	-------------

Current:	1.4A maximum
----------	--------------

Inrush current:	10A maximum
-----------------	-------------

Frequency:	45 to 65 Hz
------------	-------------

### OUTPUT

Voltage	See table
---------	-----------

Current	See table
---------	-----------

Load regulation	0.5%typical
-----------------	-------------

Current limit type - load cct	Constant current
-------------------------------	------------------

Current limit type - batt. cct	Constant current
--------------------------------	------------------

Short circuit protection	Indefinite, auto-resetting
--------------------------	----------------------------

Over-voltage protection	17.5 to 20V latching (13.8Vdc output) 31.5 to 39V latching (27.6Vdc output)
-------------------------	--

Ripple & noise 100 MHz bandwidth	28mVp-p (13.8Vdc output) 55mVp-p (27.6Vdc output)
-------------------------------------	--

### ENVIRONMENTAL

Operating temperature	0 to 70°C ambient with derating, 5...90% relative humidity (non-condensing)
-----------------------	---

Over-temperature protection	Automatic & auto-resetting
-----------------------------	----------------------------

Cooling requirement	Natural convection
---------------------	--------------------

Efficiency	80% minimum
------------	-------------

## STANDARDS & APPROVALS

Safety	Complies with AS/NZS 60950, class 1, NSW Office of Fair Trading Approval N20602
EMC	Emissions comply with AS/NZS CISPR11, Group 1, Class B. Complies with ACA EMC Scheme, Safety & EMC Regulatory Compliance Marked
Isolation i/p-o/p i/p-ground o/p-ground	4242VDC for 1 minute 2121VDC for 1 minute 707VDC for 1 minute

## ALARMS & BATTERY FUNCTIONS

Converter ON/OK alarm	Indicated by voltage-free changeover relay contacts &
green LED	ON=PSU OK
Battery low (& fuse) alarm	10.2 to 12.6V for 12V battery, adjustable 20.4 to 25.2V for 24V battery, adjustable Indicated by voltage-free changeover relay contacts & green LED: ON=BATT OK
Low voltage disconnect	9.6 to 12V for 12V battery, adjustable 19.2 to 24V for 4V battery, adjustable
Charger over-load protection	Auto-resetting electronic circuit breaker
Reverse polarity protection	Internal battery fuse
Battery to load voltage drop	0.2 to. 0.25V typical

## MECHANICAL

Case size	264 L x 172 W x 67 H mm
Case size with heatsink	264 L x 186 W x 67 H mm
Rack size	232 D x 19" W x 2RU H
Weight	1.9 kg
Weight with heatsink	2.1 kg
Weight (rack mounted version)	5.5 kg

## Selection Table

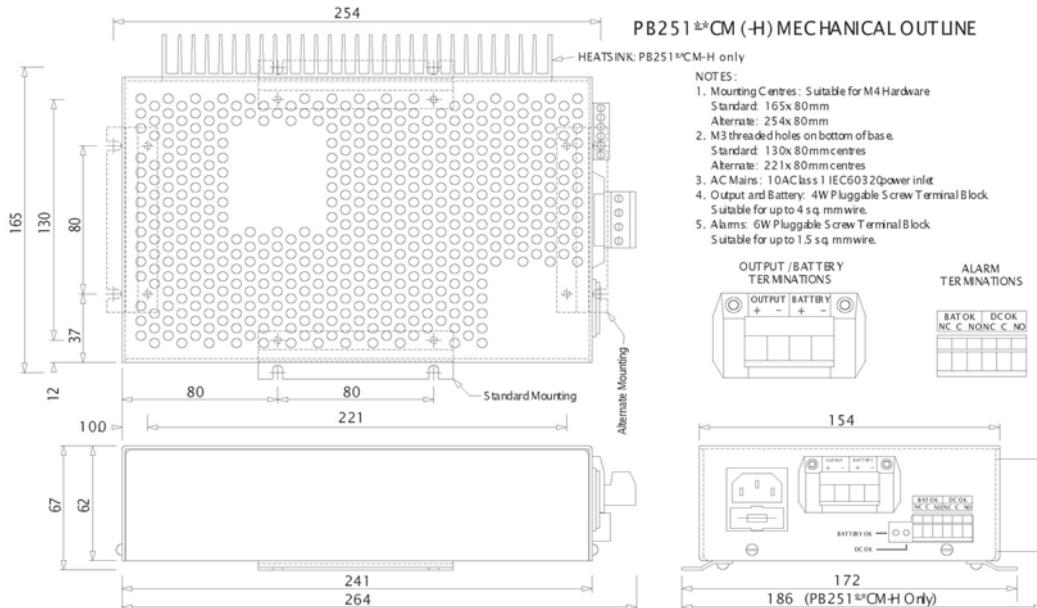
MODEL NUMBER	VDC	OUTPUT I <sub>LOAD</sub>	I <sub>BATT</sub>	OUTPUT POWER
PB251-12CM	13.8V	16A	2A	220W
PB251-12CM-H	13.8V	20A	2A	275W
PB251-24CM	27.6V	11A	2A	300W
PB251-24CM-H	27.6V	12A	2A	330W
PB251-12RML	13.8V	20A	4A	275W
PB251-12B	13.8V	20A	4A	275W
PB251-24RML	27.6V	12A	2A	330W

Note: Non standard battery charging current available on request. ie PB251-12CM-H-10 for 10A.

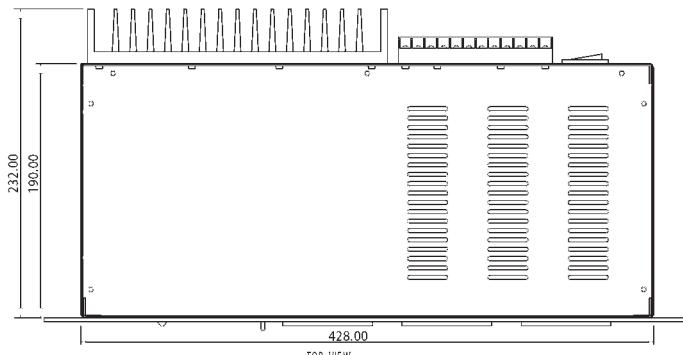
# PB251 Series

275-330 WATTS DC UPS

## Technical Illustrations

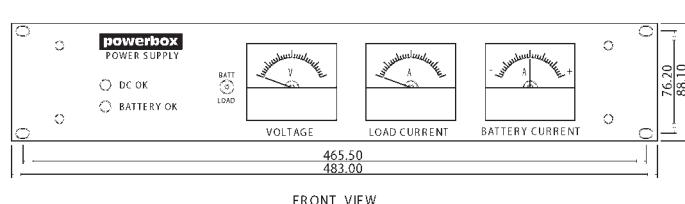


PB251-\*\*RML & -12B MECHANICAL OUTLINE

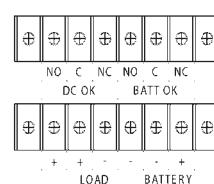


**NOTES:**

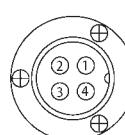
1. 2RU x 19" rack enclosure per IEC 297
2. Mounting slots are suitable for M6 hardware.
3. Input connector is a 10A Class 1 IEC 60320 inlet.
4. 2 meter IEC mains cord with Australian plug is supplied with unit.
5. PB251-12B alarm terminal is DB25 female.
6. PB251-12B output and battery connector is Hirose pin. HS 28R-4A. Mating connector is Hirose pin. HS 28P-4A (not supplied).
7. PB251-\*\*RM alarm and output terminals are M3.5 screws suitable for ring or fork lug up to 8 mm wide.



BB251 ■ RAM, ALARM AND OUTPUT TERMINALS



BR251-12B OUTPUT & BATTERY CONNECTOR



The diagram illustrates the rear panel of a Vizio M401i-B1 television. It features a central circular area with a 'GND' terminal and four 'HDMI' ports arranged in a cross pattern. To the left is a 'COAXIAL' port and a 'POWER IN' port. To the right is a 'USB' port. The entire panel is labeled 'REAR VIEW (MODEL A2D)' at the bottom.

BR2E1-12P ALARM CONNECTOR



# **TECHNICAL DATA SHEET**

**Equipment Type:** Level Probe

**Location:** Common Control

**Model Numbers:** 020130FSP

**Manufacturer:** Multitrode

**Supplier:** Brisbane Technology Park  
Unit 1, 18 Brandl Street  
P.O. Box 4633  
Eight Mile Plains  
Queensland 4113  
Australia  
7 3340 7000

# The MultiTrode Probe

**MultiTrode probes are unsurpassed for rugged reliability, cost effectiveness and simplicity. Designed for the tough, turbulent conditions found in water, sewage and industrial tanks and sumps, the probes can be found in the simplest and the most complex water and wastewater management systems around the world.**

- Low maintenance
- Simple installation
- Excellent in turbulence
- Short & long term cost savings
- Environmentally friendly
- Safe, low sensing voltage
- Unaffected by fat, grease, debris and foam
- Positive pump cut-out
- Safe – MTISB Barrier

## Reliable in all conditions

Operation is unaffected by build up of fat, grease debris and foam, which causes other systems such as floats, bubblers, pressure and ultrasonic transducers to fail. Turbulence does not affect the probe operation. The rugged, streamlined design eliminates tangling and is ideal for confined spaces.

## Positive pump cut-out

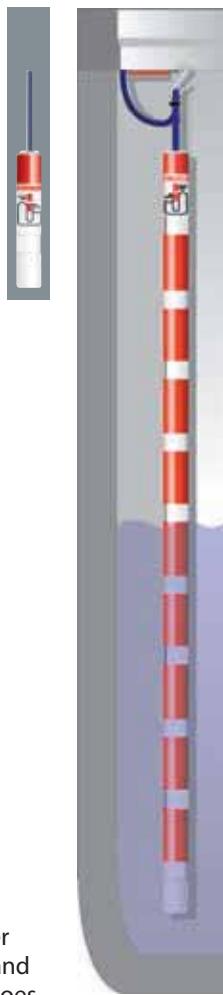
Operational consistency is important to longevity, low maintenance and cost control. The positive pump cut-out ensures pumps are turned off at the same level every time. This avoids damage due to pump over run and the cost of additional control equipment.

## Safe for people and environment

The extra low sensing voltage ensures operators and maintenance staff are protected. All MultiTrode products are environmentally safe, containing no mercury or other harmful contaminants.

## Cost savings

The low cost of equipment, installation and maintenance makes MultiTrode one of the most efficient level control systems available. Plus robust construction and longevity ensures continued cost savings when compared to other systems on the market.



## Standard and custom probes

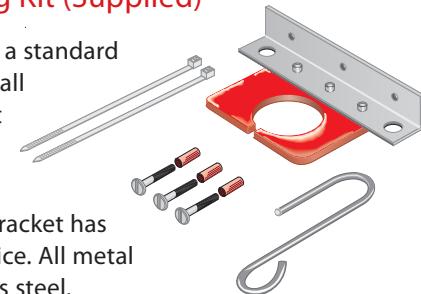
MultiTrode manufactures a wide range of standard probes, from a single sensor (200mm) to a ten-sensor probe (1000mm increasing to a maximum of nine metres). Custom probes can be manufactured to suit your requirements.

## Installation

Installation is straightforward. Probes are easy to install without entering the wet area. The probe is simply lowered in from the top and suspended by its own cable, using the mounting kit supplied.

## MTAK-1 Mounting Kit (Supplied)

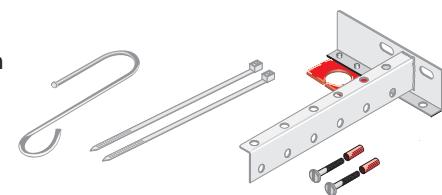
The mounting bracket is a standard accessory supplied with all multi-sensor probes (not standard with 0.2/1-xx single sensor probe).



The MTAK-1 mounting bracket has an integral cleaning device. All metal components are stainless steel.

## MTAK-2 Mounting Kit (Optional extra)

This extended bracket provides up to 300mm extra wall clearance. This bracket is not included as standard with probes.



## Ordering Examples and Information

Model Code	Probe Length (m/in)	Sensor Separation (mm/in)	Cable Length* (m/ft)	Number of Sensors
0.2/1-10	0.2/8	N/A	10/33	1
0.5/3-10	0.5/16	150/6	10/33	3
1.0/10-10	1/40	100/4	10/33	10
1.5/10-30	1.5/60	150/6	30/100	10
2.0/10-30	2/80	200/8	30/100	10
2.5/10-30	2.5/96	250/10	30/100	10
3.0/10-30	3/115	300/12	30/100	10
6.0/10-30	6/224	600/24	30/100	10
9.0/10-30	9/368	900/40	30/100	10

\*Cable Length 10m/33ft or 30m/100ft

Probe Length (meters)	Sensor Points	Cable Length (meters)
2.5	10	10



[www.multitrode.com](http://www.multitrode.com)

### MultiTrode Pty Ltd · Australia

Brisbane Technology Park 18 Brandl Street  
PO Box 4633 Eight Mile Plains Qld 4113  
Tel: +61 7 3340 7000 Fax: +61 7 3340 7077

Q-Pulse Id: TMS1407 sales@multitrode.com.au

Active: 30/09/2015

### MultiTrode Inc · USA

6560 East Rogers Circle  
Boca Raton Florida 33487  
Tel: +1 561 994 8090 Fax: +1 561 994 6282  
[sales@multitrode.net](mailto:sales@multitrode.net)

Page 702 of 1633

# TECHNICAL DATA SHEET

**Equipment Type:** Pressure Measurement instrument

**Location:**

**Model Numbers:** VEGABAR 52

**Manufacturer:** Vega

**Supplier:** Vega  
398 The Boulevard  
Kerrawee, NSW 2232

Ph: 02 9542 6662  
Fax: 02 9542 6665  
Web: [www.vega.com/au](http://www.vega.com/au)

# VEGABAR 52

## Profibus PA

### Pressure transmitter with CERTEC® measuring cell



#### Technical data

Measuring ranges	-1 ... +72 bar/-100 kPa ... +7200 kPa (-14.5 ... +1044 psig)
Smallest measuring range	+0.1 bar/+10 kPa (+1.45 psig)
Deviation	< 0.075 %, optionally up to < 0.05 %
Process fitting	Thread G1½ (EN 837), thread from G1½ (DIN 3852-A), flanges from DN 25 or ANSI 1", fittings for the food processing and paper industry
Process temperature	-40 ... +150 °C (-40 ... +302 °F)
Ambient, storage and transport temperature	-40 ... +80 °C (-40 ... +176 °F)
Betriebsspannung	9 ... 32 V DC

#### Materials

The wetted parts of the instrument are made of 316L, PVDF, Hastelloy, C4-plated or Sapphire-ceramic®. The process seal is available in FKM, FFKM as well as EPDM.

You will find a complete overview of the available materials and seals in the "configurator" on our homepage under [www.vega.com/configurator](http://www.vega.com/configurator).

#### Housing versions

The housings are available as single chamber or double chamber version in plastic, stainless steel or aluminium.

They are available in protection ratings up to IP 68 (25 bar) with external electronics.

#### Electronics versions

The instruments are available in different electronics versions. Apart from the two-wire electronics with 4 ... 20 mA or 4 ... 20 mA/HART, two purely digital versions with Profibus PA and Foundation Fieldbus are available.

#### Approvals

The instruments are suitable for use in hazardous areas and are approved e.g. according to ATEX and IEC. The instruments have also different ship approvals such as e.g. GL, LRS or ABS.

You can find detailed information on the existing approvals in the "configurator" on our homepage under [www.vega.com/configurator](http://www.vega.com/configurator).

#### Area of application

The VEGABAR 52 pressure transmitter can be used universally for measurement of gases, vapours and liquids. Also substances such as sand are not problem for the abrasion-resistant ceramic measuring cell. The VEGABAR 52 is an economical solution for a multitude of applications in all areas of industry.

#### Advantages

- High plant availability through maximum overload and vacuum resistance of the ceramic measuring cell
- Measurement down to the last drop through extremely small measuring ranges with high accuracy.
- Low costs for maintenance thanks to wear-free ceramic measuring cell

#### Function

The heart of the pressure transmitter is the pressure measuring cell that transforms pressure into an electrical signal. This pressure-dependent signal is converted into a standard output signal by the integrated electronics.

The sensor element is the CERTEC® measuring cell with excellent long-term stability and high overload resistance. The CERTEC® measuring cell is also equipped with a temperature sensor. The temperature value can be displayed via the indicating and adjustment module or processed via the signal output.

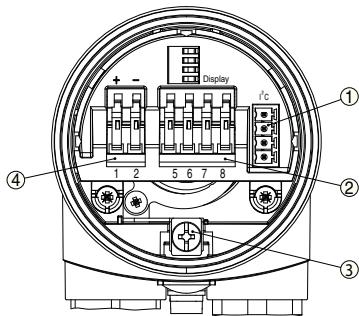


## Bedienung

Die Bedienung des Gerätes erfolgt über das optional einsetzbare Anzeige- und Bedienmodul PLICSCOM oder über einen PC mit der Bediensoftware PACTware und entsprechendem DTM. Eine alternative Bedienmöglichkeit ist das herstellerspezifische Bedienprogramm PDM.



## Elektrischer Anschluss



Elektronik- und Anschlussraum Einkammergehäuse

- 1 Steckverbinder für VEGACONNECT ( $\text{I}^2\text{C}$ -Schnittstelle)
- 2 Federkraftklemmen zum Anschluss der externen Anzeige VEGADIS 61
- 3 Erdungsklemme zum Anschluss des Kabelschirms
- 4 Federkraftklemmen für Spannungsversorgung und Signalausgang

Details zum elektrischen Anschluss finden Sie in der Betriebsanleitung des Gerätes auf unserer Homepage unter [www.vega.com/downloads](http://www.vega.com/downloads).

- 2 Threaded version G $\frac{1}{2}$  A
- 3 Flange version DN 50

## Information

You can find further information about the VEGA product line on our homepage [www.vega.com](http://www.vega.com).

In the download section under [www.vega.com/downloads](http://www.vega.com/downloads) you'll find free operating instructions, product information, brochures, approval documents, instrument drawings and much, much more. There, you will also find GSD and EDD files for Profibus PA systems as well as DD and CFF files for Foundation Fieldbus systems.

## Instrument selection

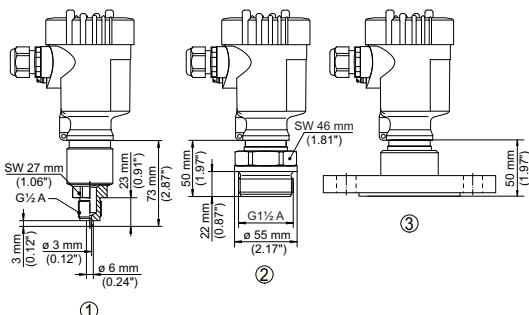
With the "finder" you can select the most suitable measuring principle for your application: [www.vega.com/finder](http://www.vega.com/finder).

You can find detailed information on the instrument versions in the "configurator" on our homepage under [www.vega.com/configurator](http://www.vega.com/configurator).

## Contact

You can find the VEGA agency serving your area on our homepage [www.vega.com](http://www.vega.com).

## Dimensions



Dimensions VEGABAR 52

- 1 Threaded version G $\frac{1}{2}$  A (manometer connection EN 837)

# TECHNICAL DATA SHEET

**Equipment Type:** Valve Measurement instrument

**Location:**

**Model Numbers:** VEGADIS 62

**Manufacturer:** Vega

**Supplier:**  
Vega  
398 The Boulevard  
Kerrawee, NSW 2232

Ph: 02 9542 6662  
Fax: 02 9542 6665  
Web: [www.vega.com/au](http://www.vega.com/au)

# VEGADIS 62

## External indicating and adjustment unit without external energy



### Technical data

#### General data

##### Materials

- Housing plastic PBT, Alu die-casting, 316L
- Inspection window in housing cover for indicating and adjustment module Polycarbonate (UL-746-C listed)
- Ground terminal 316Ti/316L
- Weight approx. 0.35 kg (0.772 lbs)

#### Supply circuit

- |                                      |                        |
|--------------------------------------|------------------------|
| Voltage supply and data transmission | via the signal circuit |
| Current range                        | 3.5 ... 22.5 mA        |

#### Indicating and adjustment module

##### Display

- |                               |  |
|-------------------------------|--|
| - Principle                   | LCD  |
| - Measured value presentation | 7 segments, 5-digit, height of digits 9 mm (0.354 in), indication range -99999 ... 99999 |
| - Bar graph                   | 20 segments  |
| - Info line                   | 14 segments, 6-digit, height of digits 5.5 mm (0.217 in)                                 |
| Adjustment elements           | 4 keys   |

##### Materials

- |                     |                |
|---------------------|----------------|
| - Housing           | ABS            |
| - Inspection window | Polyester foil |

#### Ambient conditions

- |                                   |                                  |
|-----------------------------------|----------------------------------|
| Ambient temperature               | -20 ... +70 °C (-4 ... +158 °F)  |
| Storage and transport temperature | -40 ... +80 °C (-40 ... +176 °F) |

#### Electromechanical data

- |  |   |
|--|---|
| Cable gland                                    | 2 x cable entry M20 x 1.5 (cable: ø 5 ... 9 mm) |
| Spring-loaded terminals for wire cross-section |   |
| - Massive wire, cord                           | 0.2 ... 2.5 mm <sup>2</sup> (AWG 24 ... 14)     |
| - Cord with cable end sleeve                   | 0.2 ... 1.5 mm <sup>2</sup> (AWG 24 ... 16)     |

#### Electrical protective measures

- |                                      |                       |
|--------------------------------------|-----------------------|
| Protection rating                    |                       |
| - Housing plastic                    | IP 66/IP 67           |
| - Housing Aluminium, stainless steel | IP 66/IP 68 (0.2 bar) |

### Approvals

You can find detailed information on the existing approvals in the "configurator" on our homepage under [www.vega.com/configurator](http://www.vega.com/configurator).

### Application area

VEGADIS 62 is suitable for measured value indication and adjustment of sensors with HART protocol. The instrument is looped directly into the signal line at any location.

VEGADIS 62 can be also used as indicator for bus participants in a HART multidrop system.

VEGADIS 62 operates also as a pure indicating instrument in a 4 ... 20 mA current loop.

### Advantages

- Digital and quasianalogue indication of the measured value
- Digital LC display with 4-key adjustment
- Detachable indicating and adjustment module
- Protection rating IP 65

### Function

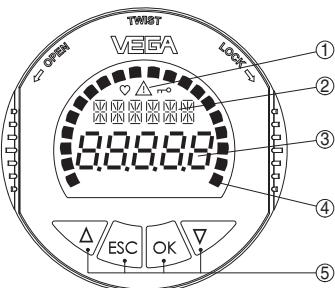
VEGADIS 62 measures the current in the current loop and indicates the measured value in digital and quasianalogue format.

The instrument operates in two modes: in HART mode the instrument listens continuously to the HART communication of the processing system with the sensor. Modifications of units and/or measuring range are adapted automatically. In the basic mode, all settings of VEGADIS 62 are carried out with the keys on the front.



## Operation

The adjustment of VEGADIS 62 is menu-controlled via four keys on the front and one LC display.



Indicating and adjustment elements

- 1 Status information (HART mode, unit lock, warning or error information)
- 2 Unit and information line
- 3 Digital measured value indication
- 3 Bar graph for quasianalogue measured value indication
- 3 Adjustment keys

## Information

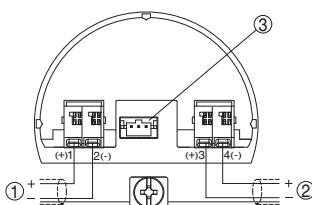
You can find further information about the VEGA product line on our homepage [www.vega.com](http://www.vega.com).

In the download section under [www.vega.com/downloads](http://www.vega.com/downloads) you'll find free operating instructions, product information, brochures, approval documents, instrument drawings and much, much more.

## Contact

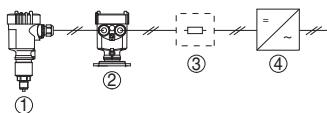
You can find the VEGA agency serving your area on our homepage [www.vega.com](http://www.vega.com).

## Electrical connection



Wiring plan VEGADIS 62

- 1 To the sensor
- 2 For power supply
- 3 For connection cable to indicating and adjustment module

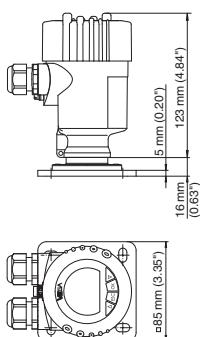


Installation example VEGADIS 62 in conjunction with an individual sensor

- 1 Sensor
- 2 VEGADIS 62
- 3 HART resistance 250 Ω (required depending on the processing)
- 4 Voltage supply/Processing

You can find details on the electrical connection in the operating instructions of the instruments on our homepage under [www.vega.com/downloads](http://www.vega.com/downloads).

## Dimensions



# **TECHNICAL DATA SHEET**

**Equipment Type:** Hydrostatic

**Location:**

**Model Numbers:** VEGADIS 62

**Manufacturer:** Vega

**Supplier:**  
Vega  
398 The Boulevard  
Kerrawee, NSW 2232

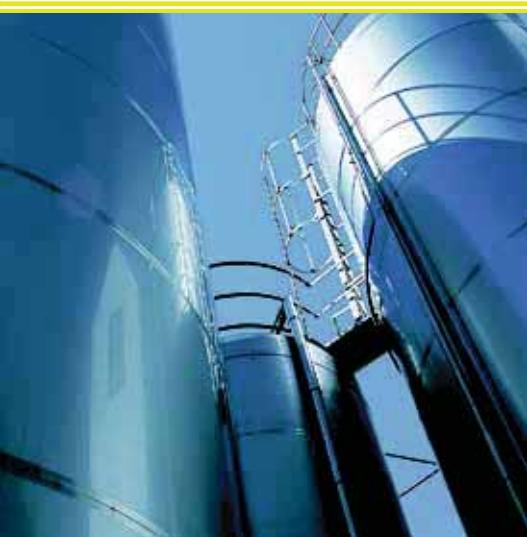
Ph: 02 9542 6662  
Fax: 02 9542 6665  
Web: [www.vega.com/au](http://www.vega.com/au)

Process pressure/Hydrostatic

## **VEGAWELL 52**



## **Product Information**



**VEGA**

## Contents

<b>1 Description of the measuring principle . . . . .</b>	<b>3</b>
<b>2 Type overview . . . . .</b>	<b>4</b>
<b>3 Mounting instructions. . . . .</b>	<b>5</b>
<b>4 Electrical connection</b>	
4.1 General requirements . . . . .	7
4.2 Power supply . . . . .	7
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<b>6 Technical data . . . . .</b>	<b>10</b>
<b>7 Dimensions. . . . .</b>	<b>14</b>
<b>8 Product code . . . . .</b>	<b>15</b>

**Take note of safety instructions for Ex applications**



Please note the Ex specific safety information which you can find on our homepage [www.vega.com\services\downloads](http://www.vega.com/services/downloads) and which comes with every instrument. In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units. The sensors must only be operated on intrinsically safe circuits. The permissible electrical values are stated in the certificate.

## 1 Description of the measuring principle

### Measuring principle

VEGAWELL 52 pressure transmitters work according to the hydrostatic measuring principle, which functions independently of the dielectric properties of the product and is not influenced by foam generation.

The sensor element of VEGAWELL 52 is the dry ceramic-capacitive CERTEC® measuring cell in two sizes. Base element and diaphragm consist of high purity sapphire-ceramic®.

The hydrostatic pressure of the product causes via the diaphragm a capacitance change in the measuring cell. This capacitance change is converted into an appropriate output signal.

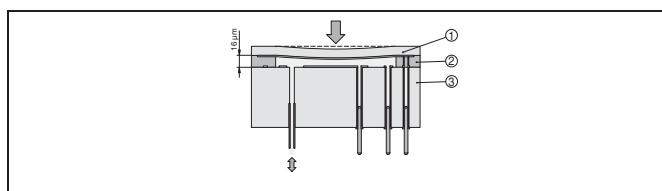


Fig. 1: Configuration of the CERTEC® measuring cell with VEGAWELL 52

- 1 Diaphragm
- 2 Soldered glass bond
- 3 Base element

The advantages of the CERTEC® measuring cell are:

- Very high overload resistance
- No hysteresis
- Excellent long-term stability
- Completely front flush installation
- Good corrosion resistance
- Very high abrasion resistance

### Wide application range

VEGAWELL 52 is suitable for level measurement in deep wells and ballast tanks as well as for gauge measurement in open flumes. Typical media are drinking water and waste water as well as water containing abrasive substances. All signal outputs are available in 4 ... 20 mA and 4 ... 20 mA/HART - Pt 100.

In the 4 ... 20 mA/HART - Pt 100 version, a temperature sensor Pt 100 in four-wire technology is integrated in the transducer. Power supply or processing are carried out via an external temperature transducer.

## 2 Type overview

VEGAWELL 52



Measuring cell:	CERTEC®
Media:	drinking water and waste water
Process fitting:	Straining clamp, screw connection, thread
Material process fitting:	316L
Material, suspension cable:	PE, PUR, FEP
Material transmitter:	316L, 1.4462 (Duplex), each also with PE coating, PVDF, Titanium
Diameter transmitter:	depending on material and version at least 22 mm
Measuring range:	0 ... 0.1 bar up to 0 ... 25 bar
Process temperature:	-20 ... +80 °C (-4 ... +176 °F)
Deviation:	< 0.2 %, < 0.1 %
Signal output:	4 ... 20 mA, 4 ... 20 mA/HART
Operation:	depending on the version via PACTware/PC

### 3 Mounting instructions

#### Mounting position

The following illustration shows a mounting example for VEGA WELL 52. The VEGA price list contains suitable mounting brackets under the section Accessories. With these parts, standard mounting arrangements can be realised quickly and reliably.

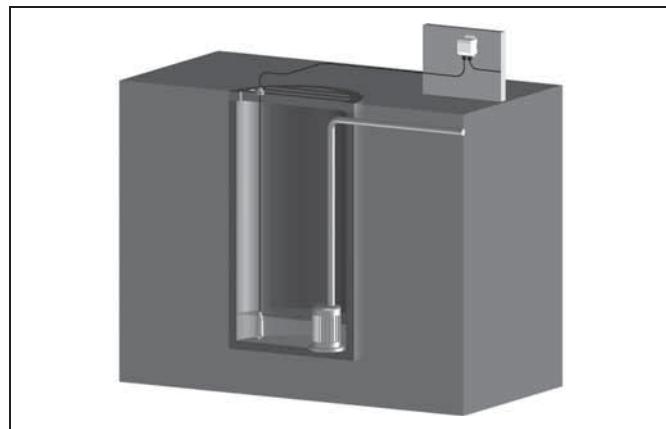


Fig. 3: VEGA WELL 52 in a pump shaft with VEGABOX 02

VEGA WELL 52 must be mounted in a calm area or in a suitable protective tube. This avoids lateral movements of the transmitter and the resulting corruption of measurement data.



#### Note:

As an alternative to fixing the transmitter, the use of a measuring instrument holder from VEGA's line of mounting accessories is recommended.

Beside the connection and suspension cables, the suspension cable also contains a capillary for atmospheric pressure compensation. All versions can be shortened on site.

With VEGA WELL 52, the electronics is completely integrated in the transmitter. The cable end can be lead directly to a dry connection compartment. Pressure compensation is then carried out via the filter element of the capillaries.



#### Note:

The pressure compensation housing VEGABOX 02 is recommended for connecting VEGA WELL 52.

It contains a high-quality ventilation filter and terminals. A protective cover is optionally available for use outdoors.

#### Mounting versions

The following illustrations show the different mounting versions depending on the instrument type.

#### Mounting with straining clamp

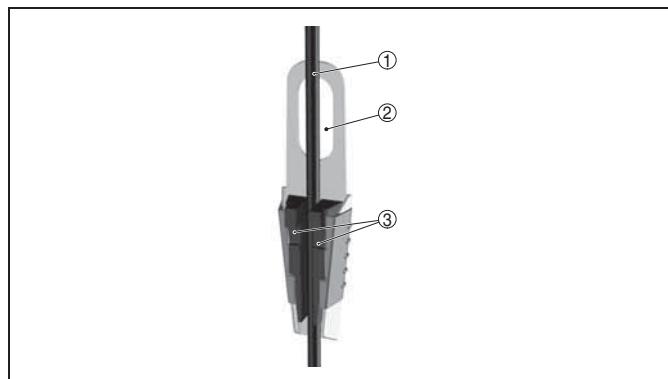


Fig. 5: Straining clamp

- 1 Suspension cable
- 2 Suspension opening
- 3 Clamping jaws

#### Mounting with screw connection

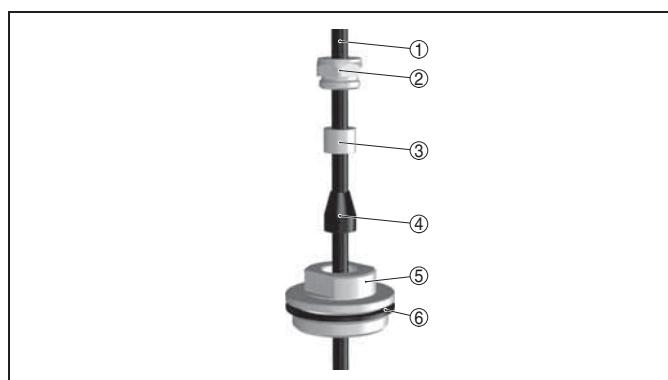


Fig. 6: Screw connection

- 1 Suspension cable
- 2 Seal screw
- 3 Cone bushing
- 4 Seal cone
- 5 Screw connection
- 6 Seal

**Mounting with housing and thread**

Fig. 7: Housing with thread G1½ A

- 1 Housing
- 2 Seal
- 3 Thread

## 4 Electrical connection

### 4.1 General requirements

The supply voltage range can differ depending on the instrument version. You can find exact specifications in chapter "Technical data".

The national installation standards as well as the valid safety regulations and accident prevention rules must be observed.



In hazardous areas you should take note of the appropriate regulations, conformity and type approval certificates of the sensors and power supply units.

### 4.2 Power supply

Supply voltage and current signal are carried on the same two-wire cable. The requirements on the power supply are specified in chapter "Technical data".

The VEGA power supply units VEGATRENN 149AEx, VEGAS-TAB 690, VEGADIS 371 as well as VEGAMET signal conditioning instruments are suitable for power supply. When one of these instruments is used, a reliable separation of the supply circuits from the mains circuits according to DIN VDE 0106 part 101 is ensured.

### 4.3 Connection cable

#### In general

An outer diameter of 5 ... 9 mm ensures the seal effect of the cable entry. If electromagnetic interference is expected, screened cable should be used for the signal lines.

The sensors are connected with standard two-wire cable without screen.



In Ex applications, the corresponding installation regulations must be noted for the connection cable.

### 4.4 Cable screening and grounding

If screened cable is necessary, the cable screen must be connected on both ends to ground potential. If potential equalisation currents are expected, the connection on the evaluation side must be made via a ceramic capacitor (e.g. 1 nF, 1500 V).

### 4.5 Wiring plan VEGAWELL 52 - 4 ... 20 mA

#### Direct connection

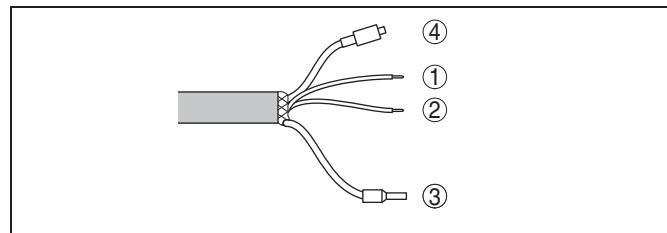


Fig. 8: Wire assignment, suspension cable

- 1 blue (-): to power supply or to the processing system
- 2 brown (+): to power supply or to the processing system
- 3 Shielding
- 4 Breather capillaries with filter element

#### Connection via VEGABOX 02

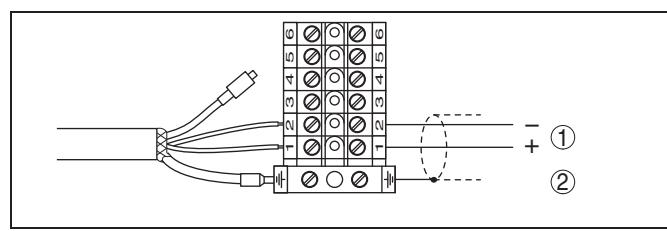


Fig. 9: Terminal assignment VEGABOX 02

- 1 To power supply or the processing system
- 2 Shielding<sup>1)</sup>

#### Connection via housing

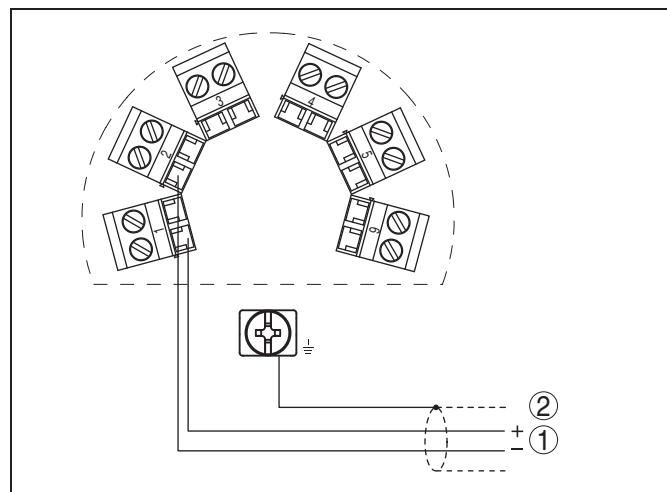


Fig. 10: Terminal assignment of the housing

- 1 To power supply or the processing system
- 2 Shielding<sup>2)</sup>

<sup>1)</sup> Connect screen to ground terminal. Connect ground terminal on the outside of the housing as prescribed. The two terminals are galvanically connected.  
<sup>2)</sup> Connect screen to ground terminal. Connect ground terminal on the outside of the housing as prescribed. The two terminals are galvanically connected.

## 4.6 Wiring plan VEGAWELL 52 - 4 ... 20 mA/ HART - Pt 100

### Direct connection

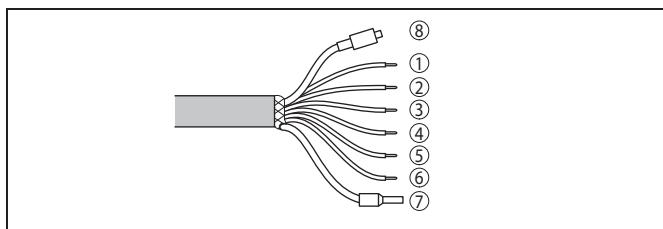


Fig. 11: Wire assignment, connection cable

- 1 blue (-): to power supply or to the processing system
- 2 Brown (+): to power supply or to the processing system
- 3 White: for processing of the integrated Pt 100 (power supply)
- 4 Yellow: for processing of the integrated Pt 100 (measurement)
- 5 Red: for processing of the integrated Pt 100 (measurement)
- 6 Black: for processing of the integrated Pt 100 (power supply)
- 7 Shielding
- 8 Breather capillaries with filter element

### Connection via VEGABOX 02

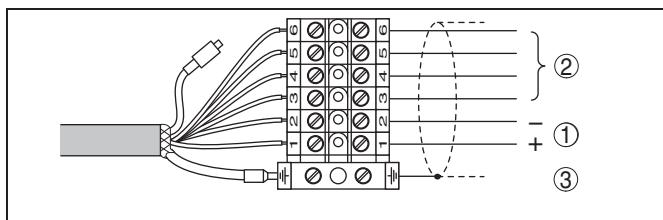


Fig. 12: Terminal assignment VEGABOX 02

- 1 To power supply or the processing system (signal pressure transmitter)
- 2 To power supply or the processing system (connection cables resistance thermometer Pt 100)
- 3 Shielding<sup>3)</sup>

### Connection via VEGABOX 02 with integrated temperature sensor

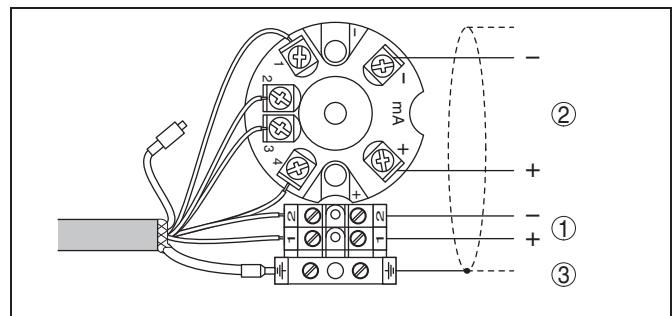


Fig. 13: Terminal assignment VEGABOX 02

- 1 To power supply or the processing system (signal pressure transmitter)
- 2 For voltage supply or to processing system (resistance thermometer Pt 100)
- 3 Shielding<sup>4)</sup>

### Connection via housing

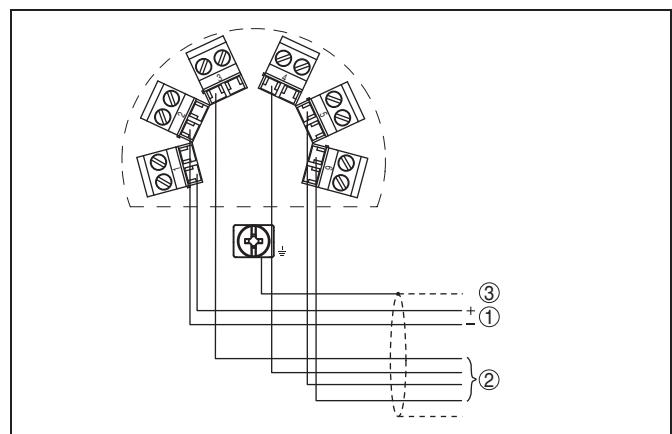


Fig. 14: Terminal assignment of the housing

- 1 To power supply or the processing system (signal pressure transmitter)
- 2 For voltage supply or to processing system (resistance thermometer Pt 100)
- 3 Shielding<sup>5)</sup>

<sup>3)</sup> Connect screen to ground terminal. Connect ground terminal on the outside of the housing as prescribed. The two terminals are galvanically connected.

<sup>4)</sup> Connect screen to ground terminal. Connect ground terminal on the outside of the housing as prescribed. The two terminals are galvanically connected.

<sup>5)</sup> Connect screen to ground terminal. Connect ground terminal on the outside of the housing as prescribed. The two terminals are galvanically connected.

## 5 Operation

### 5.1 Overview

#### VEGAWELL 52 4 ... 20 mA

VEGAWELL 52 - 4 ... 20 mA has no adjustment options.

#### VEGAWELL 52 4 ... 20 mA/HART - Pt 100

- Adjustment software according to FDT/DTM standard, e.g.  
PACTware and PC
- HART handheld

### 5.2 Adjustment with PACTware

#### Connecting the PC to the signal cable

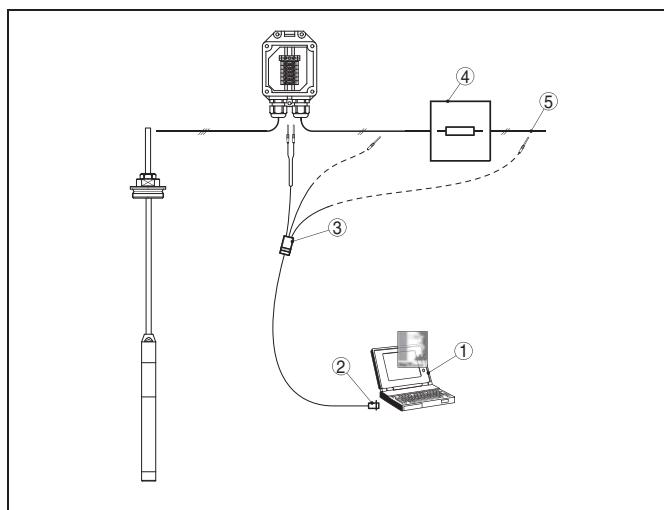


Fig. 15: Connection of the PC to VEGABOX 02 or communication resistor

- 1 PC with PACTware
- 2 RS232 interface (with VEGACONNECT 3), USB interface (with VEGACONNECT 4)
- 3 VEGACONNECT 3 or 4
- 4 Communication resistor 250  $\Omega$
- 5 Power supply unit

#### Necessary components:

- VEGAWELL 52
- PC with PACTware and suitable VEGA DTM
- VEGACONNECT with HART adapter cable
- HART resistor approx. 250  $\Omega$
- Power supply unit

#### Note:

With power supply units with integrated HART resistance (internal resistance approx. 250  $\Omega$ ), an additional external resistance is not necessary (e.g. VEGATRENN 149A, VEGAMET 381/624/625, VEGASCAN 693). In such cases, VEGACONNECT can be connected parallel to the 4 ... 20 mA cable.

## 6 Technical data

### Materials and weights

Materials, wetted parts	
– Transmitter	316L, 316L with PE coating, 1.4462 (Duplex), 1.4462 with PE coating, PVDF, Titanium
– Diaphragm	sapphire ceramic® (99.9 % oxide ceramic)
– Measuring cell seal	FKM (VP2/A) - FDA and KTW approved, FFKM (Perlast G75S), EPDM (A+P 75.5/KW75F)
– Suspension cable	PE (FDA and KTW-approved), FEP, PUR
– Cable gland on the transmitter	316L
– Process fitting	316L
– Straining clamp	1.4301
– Unassembled screw connection	316L, PVDF
– Threaded connection on the housing	316L
Materials, non-wetted parts	
– Housing	plastic PBT (Polyester), 316L
Weight approx.	
– Basic weight	0.8 kg (1.764 lbs)
– Suspension cable	0.1 kg/m (0.07 lbs/ft)
– Straining clamp	0.2 kg (0.441 lbs)
– Screw connection	0.4 kg (0.882 lbs)
– Plastic housing	0.8 kg (1.764 lbs)
– Stainless steel housing	1.6 kg (3.528 lbs)

### Input variable

Measured value	Level
Measuring range	see product code
Recommended max. turn down	10 : 1

### Output variable

<b>4 ... 20 mA</b>	
Output signal	4 ... 20 mA
Signal resolution	2 µA
Failure signal	< 3.6 mA
Max. output current	22 mA
Run-up time	2 s
Step response time	100 ms (ti: 0 s, 0 ... 63 %)
Fulfilled NAMUR recommendations	NE 43
<b>4 ... 20 mA/HART - Pt 100</b>	
Output signal	4 ... 20 mA/HART
Signal resolution	2 µA
Failure signal	< 3.6 mA; 20.5 mA; 22 mA; unchanged (adjustable via PACTware)
Max. output current	22 mA
Run-up time	15 s
Step response time	200 ms (ti: 0 s, 0 ... 63 %)
Fulfilled NAMUR recommendations	NE 43

### Additional output parameter - temperature

integrated resistance thermometer	Pt 100 according to DIN EN 60751
Range	-50 ... +100 °C (-58 ... +212 °F)
Resolution	1 °K

### Deviation for 4 ... 20 mA version<sup>6)</sup>

Specifications refer to the set span. Turn down (TD) = nominal measuring range/set span.

Deviation with version < 0.2 %

- Turn down 1 : 1 up to 5 : 1 < 0.2 %
- Turn down > 10 : 1 < 0.04 % x TD

<sup>6)</sup> Determined according to the limit point method according to IEC 60770, incl. non-linearity, hysteresis and non-repeatability.

Deviation with version < 0.1 %	< 0.1 %
– Turn down 1 : 1 up to 5 : 1	< 0.02 % x TD
– Turn down > 10 : 1	

**Deviation for version 4 ... 20 mA/HART - Pt 100<sup>7)</sup>**

Applies to **digital** HART interface as well as to **analogue** current output 4 ... 20 mA. Specifications refer to the set span. Turn down (TD) is the relation nominal measuring range/set span.

Deviation with version < 0.2 %	< 0.2 %
– Turn down 1 : 1 up to 5 : 1	< 0.04 % x TD
– Turn down > 10 : 1	
Deviation with version < 0.1 %	
– Turn down 1 : 1 up to 5 : 1	< 0.1 %
– Turn down > 10 : 1	< 0.02 % x TD

**Influence of the product or ambient temperature**

Applies to **digital** HART interface as well as to **analogue** current output 4 ... 20 mA. Specifications refer to the set span. Turn down (TD) is the relation nominal measuring range/set span.

**Average temperature coefficient of the zero signal**

In the compensated temperature range of 0 ... +80 °C (+32 ... +176 °F), reference temperature 20 °C (68 °F).

## Average temperature coefficient of the zero signal

– Turn down 1 : 1	< 0.05 %/10 K
– Turn down 1 : 1 up to 5 : 1	< 0.1 %/10 K
– Turn down > 10 : 1	< 0.15 %/10 K

## Outside the compensated temperature range

## Average temperature coefficient of the zero signal

– Turn down 1 : 1	typ. < 0.05 %/10 K
-------------------	--------------------

**Long-term stability (similar to DIN 16086, DINV 19259-1 and IEC 60770-1)**

Applies to **digital** HART interface as well as to **analogue** current output 4 ... 20 mA. Specifications refer to the set span. Turn down (TD) is the relation nominal measuring range/set span.

Long-term drift of the zero signal	< (0.1 % x TD)/year
------------------------------------	---------------------

**Ambient conditions**

Ambient temperature	
– Connection cable PE	-40 ... +60 °C (-40 ... +140 °F)
– Connection cable PUR, FEP	-40 ... +85 °C (-40 ... +185 °F)
Storage and transport temperature	-20 ... +80 °C (-4 ... +176 °F)

**Process conditions****Process pressure**

Max. process pressure, transmitter <sup>8)</sup>	
– Measuring range 0.1 bar (1.45 psig)	15 bar (218 psig)
– Measuring range 0.2 bar (2.9 psig)	20 bar (290 psig)
– Measuring range ≤ 0.4 bar (5.8 psig)	25 bar (363 psig)

## Pressure stage, process fitting

– Unassembled screw connection	316L: PN 3, PVDF: unpressurized
– Thread on the housing	PN 3

## Product temperature, depending on the version

<sup>7)</sup> Determined according to the limit point method according to IEC 60770, incl. non-linearity, hysteresis and non-repeatability.

<sup>8)</sup> Limited by the overpressure resistance of the measuring cell.

Suspension cable	Transmitter	Product temperature
PE	All	-20 ... +60 °C (-4 ... +140 °F)
PUR	All	-20 ... +80 °C (-4 ... +176 °F)
PUR	PE coating	-20 ... +60 °C (-4 ... +140 °F)
FEP	All	-20 ... +80 °C (-4 ... +176 °F)
FEP	PE coating	-20 ... +60 °C (-4 ... +140 °F)

Vibration resistance

mechanical vibrations with 4 g and 5 ... 100 Hz<sup>9)</sup>**Electromechanical data**

Suspension cable

– Configuration

– Tensile strength

– Max. length

– Min. bending radius

– Diameter approx.

– colour (non-Ex/Ex) - PE

– colour (non-Ex/Ex) - PUR, FEP

Cable entry housing or VEGABOX 02

Screw terminals

six wires, one suspension cable, one breather capillary, screen braiding, foil, mantle

≥ 1200 N (270 pound force)

1000 m (3280 ft)

25 mm (with 25 °C/77 °F)

8 mm (0.315 in)

black/blue

blue/blue

1 x cable gland M20 x 1.5 (cable: Ø 5 ... 9 mm), 1 x blind stopper M20 x 1.5 for wire cross section 1.5 mm<sup>2</sup> (AWG 16), screen up to 4 mm<sup>2</sup> (AWG 12)**Supply voltage - 4 ... 20 mA**

Operating voltage

8 ... 36 V DC

Permissible residual ripple

– &lt; 100 Hz

U<sub>ss</sub> < 1 V

– 100 Hz ... 10 kHz

U<sub>ss</sub> < 10 mV

Load

see diagram

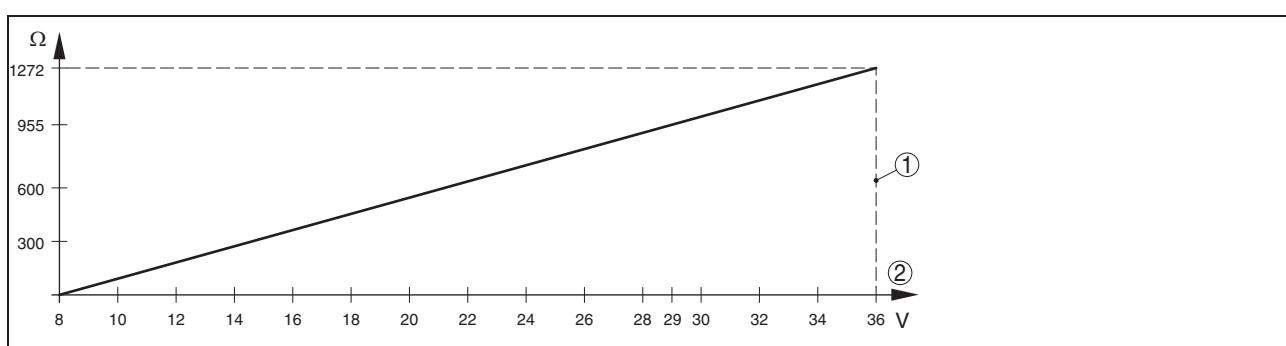


Fig. 16: Voltage diagram

1 Voltage limit

2 Operating voltage

**Supply voltage - 4 ... 20 mA/HART - Pt 100**

Operating voltage

9.6 ... 36 V DC

Permissible residual ripple

– &lt; 100 Hz

U<sub>ss</sub> < 1 V

– 100 Hz ... 10 kHz

U<sub>ss</sub> < 10 mV

Load

see diagram

<sup>9)</sup> Tested according to the regulations of German Lloyd, GL directive 2.

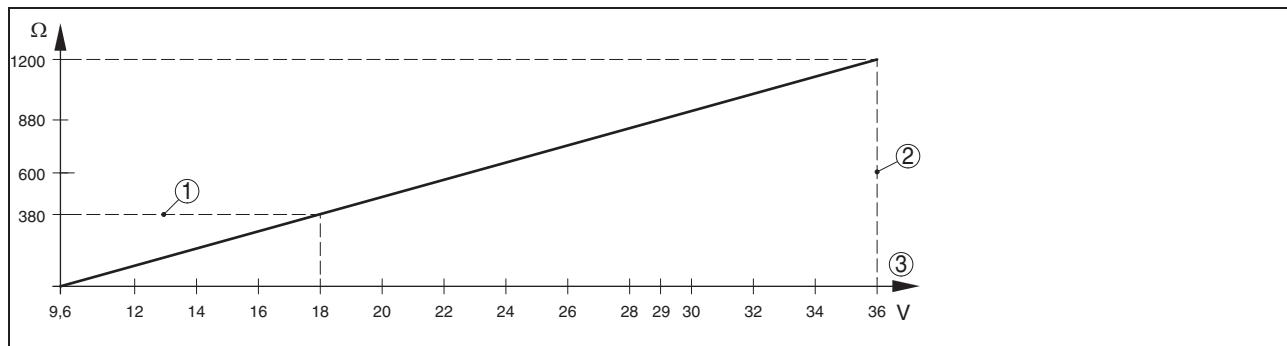


Fig. 17: Voltage diagram

- 1 HART load
- 2 Voltage limit
- 3 Operating voltage

### Electrical protective measures

Protection	
– Transmitter	IP 68 (30 bar)
– Housing	IP 66/IP 67
– VEGABOX 02	IP 65
Overvoltage category	III
Protection class	III

### Existing approvals or approvals applied for

Gas explosion protection	e.g. according to ATEX and IEC
Fire-damp protection	e.g. according to ATEX
Overfill protection	e.g. according to WHG
Ship approval	e.g. according to GL, LRS, ABS, RINA

The available approvals can be selected via the configurator on [www.vega.com](http://www.vega.com).

Depending on the version, instruments with approvals can have different technical data. For these instruments, please note the corresponding approval documents. They can be downloaded in the download section on [www.vega.com](http://www.vega.com).

### CE conformity

EMC (2004/108/EG)	EN 61326-1: 2006
LVD (2006/95/EG)	EN 61010-1: 2001

### Environmental instructions

VEGA environment management system	certified according to DIN EN ISO 14001
You can find detailed information under <a href="http://www.vega.com">www.vega.com</a> .	

## 7 Dimensions

### VEGAWELL 52 - suspension cable 1

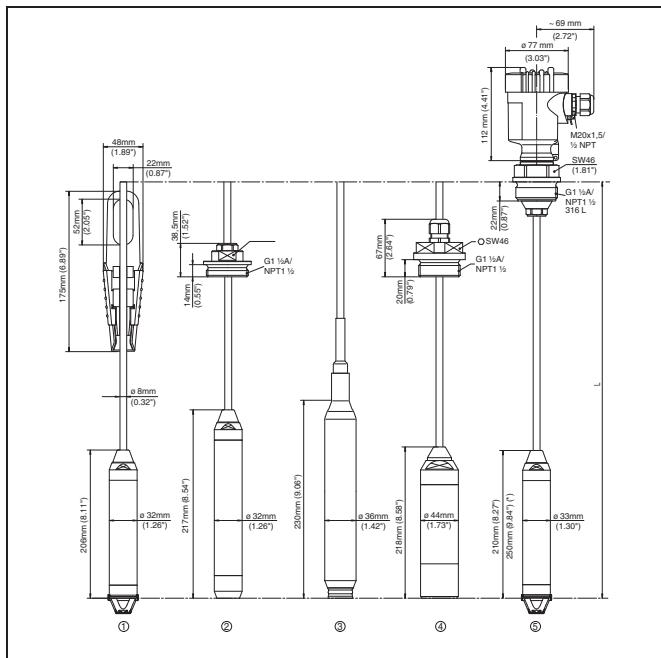


Fig. 18: VEGAWELL 52 - suspension cable

- 1 Transmitter Duplex, with straining clamp
- 2 Transmitter Duplex for deep wells, with unassembled screw connection G1½A (1½ NPT) and closing cap
- 3 Transmitter Duplex, with PE coating
- 4 Transmitter with screwed connection of PVDF
- 5 Transmitter Titanium/Titanium with glass leadthrough, with thread G1 A (1 NPT) and plastic housing

### VEGAWELL 52 - suspension cable 2

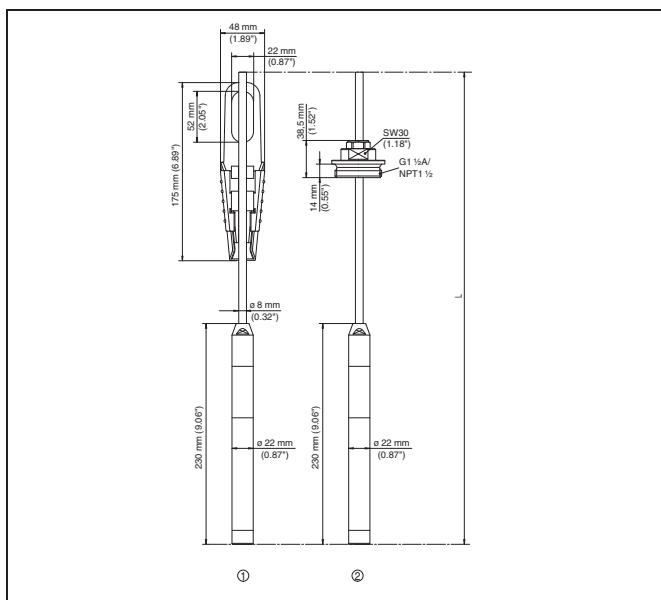


Fig. 20: VEGAWELL 52 - suspension cable

- 1 Transmitter 316L, with straining clamp
- 2 Transmitter Titanium, with unassembled screw connection G1 A (1 NPT)

### VEGAWELL 52 - threaded fitting

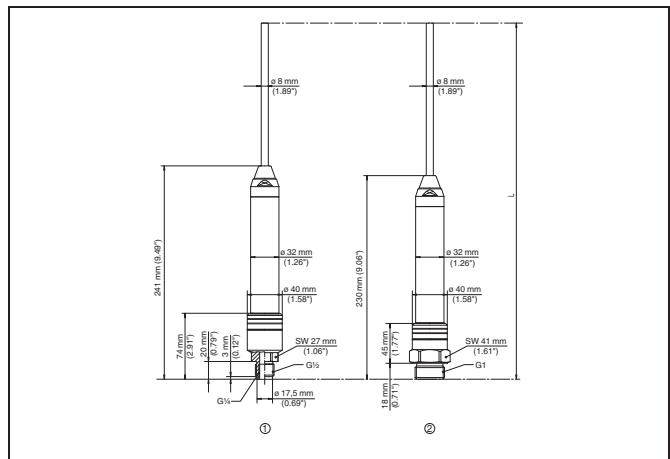
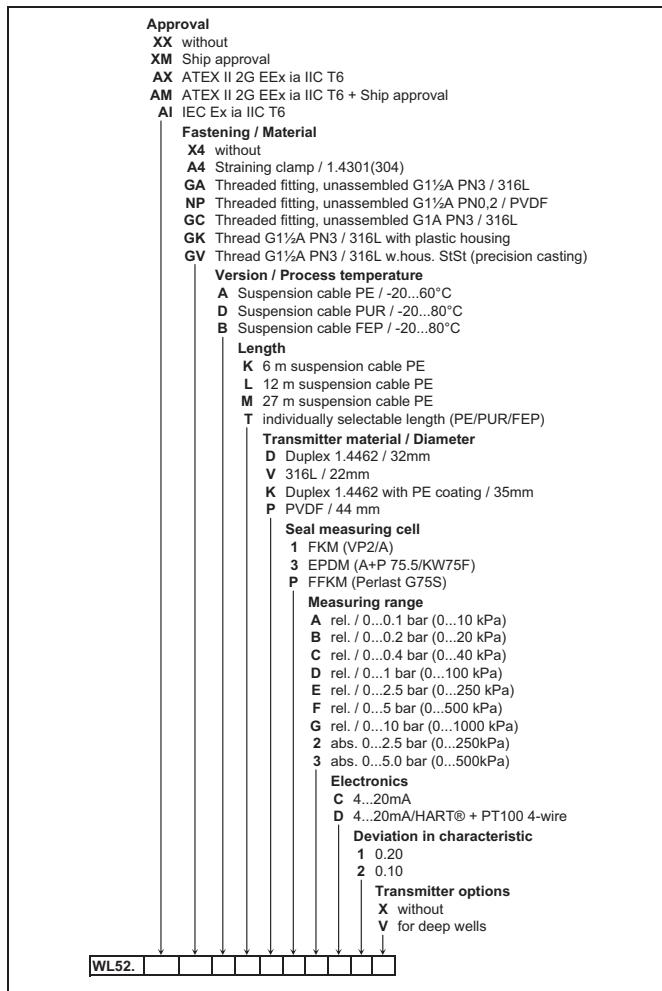


Fig. 22: VEGAWELL 52 - thread

- 1 Threaded fitting G½ inner G¼
- 2 Threaded fitting G1

## 8 Product code

### VEGAWELL 52





**VEGA**

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# **TECHNICAL DATA SHEET**

**Equipment Type:** Control Relays

**Location:** RTU Section

**Model Numbers:** Various

**Manufacturer:** Specher & Schuh

**Supplier:** NHP Pty Ltd

16 Riverview Place  
Murarrie  
(07) 3909 4999

# G

## Control & Timing Relays

<b>CS7 Industrial Control Relays.....</b>	<b>G2</b>
Technical Information.....	G14
<b>CS8 Industrial Control Relays.....</b>	<b>G18</b>
Technical Information.....	G21
<b>RZ7-FS Electronic Timing Relays.....</b>	<b>G24</b>
Technical Information.....	G34
<b>RZ7-FE Electronic Timing Relays .....</b>	<b>G36</b>
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## Relpol Ice Cube Relays

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Technical Information.....	G84

# CS7 Industrial Control Relays

**Reliable, general purpose relays for heavy duty applications**



CS7 Industrial Control Relays share the same design as our modern CA7 contactor range. They are compact and designed for heavy duty industrial control applications where reliability and versatility are essential.

## Introducing Three CS7 Models for any Control Application

The standard CS7 relay utilizes x-stamped contact technology that reliably switches typical control circuits up to 10A (AC-15). For master relay circuits requiring higher amp capacity, the CS7-M Master Relay is designed for control circuits up to 15A (AC-15).

For applications requiring low energy switching such as PLC's or other electronic circuits, the CS7-B relay with bifurcated contacts is designed for 20 million operations down to a signal level of 5V @ 3mA.

The bifurcated H-bridge design divides each movable gold contact into two sections at the tip of the spanner which provides a higher degree of reliability for low signal applications.

## Auxiliary components provide a range of options

CS7 auxiliary components convert the basic four pole relay into a:

- 5, 6, 7, 8, 9, 10, 11 or 12 pole relay
- 4, 5, 6, 7 or 8 pole latched relay
- 4, 5, 6, 7 or 8 pole relay with two pneumatic time delay contacts
- Mechanically latched 4, 5, 6, 7 or 8 pole relay
- Also available are top mounted bifurcated auxiliary contacts which operate down to 5V @ 3mA.

Since the CS7 uses the same auxiliary components as our CA7 contactors, inventory is reduced.



*The base four pole CS7 relay can be expanded up to twelve poles with the addition of front and side mount auxiliaries*



## Mechanically linked contacts for safety

CS7 control relays are perfect for fail-safe control circuits. An interlock contact design, which maintains minimum 0.3mm clearance, prevents the NC contact from reclosing if the NO contact is welded when in operation. This feature not only includes the base contact poles, but extends to the front and/or side mounted auxiliary contacts. This is a requirement in safety circuits and is backed by SUVA-PRO certification.

## Maximum convenience and safety

CS7 relays are designed for fast and trouble free installation and maintenance. All components are modular and snap-on without the use of tools. The relays are DIN-rail mountable so they can be installed, moved or replaced quickly. All terminals are "captive" and are shipped in the open position, saving you an operation. The entire line is UL Listed, CSA Certified and CE marked and offers finger and back of hand protection to the strictest international standards.

## Effortless installation

CS7 relays are DIN-rail mountable for instant installation and modification. Fittings are also included for base mounting. All terminals are clearly marked and ready for installation with either manual or power screwdrivers. A complete identification system is also available using self-adhesive labels, paper tags or plastic clip-on tags.

## Series CS7 Standard Control Relays - 4 Pole ①④

CS7 Relay	Contact Arrangement and Numbering	Contacts ①		AC Operation		Electronic DC ⑥	
		NO	NC	Catalog Number	Price	Catalog Number	Price
 CS7-31E		2	2	CS7-22E-*	92	CS7E-22E-*	127
		3	1	CS7-31E-*		CS7E-31E-*	
		4	0	CS7-40E-*		CS7E-40E-*	
		0	4	CS7-04E-*		CS7E-04E-*	

## Contact Ratings (Per UL508/NEMA A600 &amp; P600)

Standard	Circuit Voltage	Make (Amps/VA)	Break (Amps/VA)	Continuous Amps
A600	120AC	60A/720VA	6A/720VA	10
	240AC	30A/720VA	3A/720VA	
	480AC	15A/720VA	1.5A/720VA	
	600AC	12A/720VA	1.2A/720VA	
P600	125DC ②	1.1A/138VA	1.1A/138VA	5
	250DC ②	0.55A/138VA	0.55A/138VA	
	301-600DC ②	0.2A/138VA	0.2A/138VA	

## Other UL Ratings

Maximum Voltage	600 volts AC or DC
General Purpose Amps	
CS7	25 amps
Auxiliaries (@ 40°C)	10 amps
Auxiliaries (@ 60°C)	6 amps

## AC Coil Codes ③

AC Coil Code	Voltage Range	
	50 Hz	60 Hz
24Z	24V	24V
120	110V	120V
208	~	208V
220W	200V-220V	208V-240V
240	220V	240V
277	240V	277V
380	380V-400V	440V
480	440V	480V
600	550V	600V

## DC Coil Codes ④

DC Coil Codes	Voltage
12E	12V
24E	24V
48E ⑥	48-72V
110E ⑥	110-125V
220E ⑥	220-250V

① Side mounted and/or top auxiliaries may be field installed to increase the number of available poles, limitations apply. Refer to page G12 for ordering and restriction details. Please note that side mount auxiliary terminal markings may conflict with base relay and/or top mount auxiliary terminal markings.

② DC rating for CS7 base control relay.

③ Other voltages available, see page G13. Non-standard coil voltages not listed here must be ordered and installed separately as renewal parts.

④ Positively-Guided/Mechanically-Linked Contacts per IEC 947-5-1 Annex L on 4 main poles.

⑤ CS7E electronic coils are not interchangeable with non-electronic DC or AC coils.

⑥ Not applicable with Electronic Timer accessories (CRZ\_7).

## Ordering Instructions

Specify Catalog Number	See Coil Codes on this page
Replace (*) with Coil Code	

## Discount Schedule B

## Series CS7-B Control Relays - 4 Pole, Bifurcated Contacts for Lower Level Signals ①④

CS7-B Relay	Contact Arrangement and Numbering	Contacts ①		AC Operation		Electronic DC ②	
		NO	NC	Catalog Number	Price	Catalog Number	Price
 <b>CS7-B22E</b>		2	2	CS7-B22E-*	117	CS7E-B22E-*	190
		3	1	CS7-B31E-*		CS7E-B31E-*	
		4	0	CS7-B40E-*		CS7E-B40E-*	
		0	4	CS7-B04E-*		CS7E-B04E-*	

## Contact Ratings (Per UL508/NEMA A600 &amp; Q600)

Standard	Circuit Voltage	Make (Amps/VA)	Break (Amps/VA)	Continuous Amps
A600	120AC	60A/7200VA	6A/720VA	10
	240AC	30A/7200VA	3A/720VA	
	480AC	15A/7200VA	1.5A/720VA	
	600AC	12A/7200VA	1.2A/720VA	
Q600	125DC ②	0.55A/69VA	0.55A/69VA	2.5
	250DC ②	0.27A/69VA	0.27A/69VA	
	301-600DC ②	0.1A/69VA	0.1A/69VA	

## CS7-B Bifurcated Control Relay

- Gold plated bifurcated contacts for low level switching application, min 5V, 3mA
- Maximum voltage 600V AC or DC
- General purpose amps - 10 amps
- Positively guided/mechanically-linked main contacts

## Principle moving contact designs:

CS7-B  
Bifurcated ContactsCS7  
Standard Contacts

## AC Coil Codes ③

AC Coil Code	Voltage Range	
	50 Hz	60 Hz
120	110V	120V

## DC Coil Codes ⑤

DC Coil Codes	Voltage
12E	12V
24E	24V
48E ⑥	48-72V
110E ⑥	110-125V
220E ⑥	220-250V

① Side mounted and/or top auxiliaries may be field installed to increase the number of available poles, limitations apply. Refer to page G12 for ordering and restriction details. Please note that side mount auxiliary terminal markings may conflict with base relay and/or top mount auxiliary terminal markings.

② DC rating for CS7-B base control relay.

③ Other AC voltages available, see page G13. Non-standard coil voltages not listed here must be ordered and installed separately as renewal parts.

④ Positively-Guided/Mechanically-Linked Contacts per IEC 947-5-1 Annex L on 4 main poles.

⑤ CS7E electronic coils are not interchangeable with non-electronic DC or AC coils.

⑥ Not applicable with Electronic Timer accessories (CRZ\_7).

## Ordering Instructions

Specify Catalog Number	See Coil Codes on this page
Replace (*) with Coil Code	

## Series CS7 Master Control Relays - 4 Pole ①④

CS7-M Relay	Contact Arrangement and Numbering	Contacts ①		AC Operation		Electronic DC ⑥	
		NO	NC	Catalog Number	Price	Catalog Number	Price
 CS7-M22E		2	2	CS7-M22E-*	168	CS7E-M22E-*	239
		3	1	CS7-M31E-*		CS7E-M31E-*	
		4	0	CS7-M40E-*		CS7E-M40E-*	
		0	4	CS7-M04E-*		CS7E-M04E-*	

## Contact Ratings (Per UL508/NEMA A600 &amp; P600)

Standard	Circuit Voltage	Make (Amps/VA)	Break (Amps/VA)	Continuous Amps
A600	120AC	60A/720VA	6A/720VA	20
	240AC	30A/720VA	3A/720VA	
	480AC	15A/720VA	1.5A/720VA	
	600AC	12A/720VA	1.2A/720VA	
P600	125DC ②	1.1A/138VA	1.1A/138VA	5
	250DC ②	0.55A/138VA	0.55A/138VA	
	301-600DC ②	0.2A/138VA	0.2A/138VA	

## AC Coil Codes ③

AC Coil Code	Voltage Range	
	50 Hz	60 Hz
120	110V	120V

## DC Coil Codes ⑤

DC Coil Codes	Voltage
12E	12V
24E	24V
48E ⑦	48-72V
110E ⑦	110-125V
220E ⑦	220-250V

## CS7-M Master Control Relays

- Excellent replacement for heavy duty NEMA master relay users.
- Maximum voltage 600V AC or DC
- General purpose rating 30 amps (2X A600 for CS7-M Base Relay)

## Principle moving contact designs:



CS7-M  
Contacts For  
Master Control Relay

CS7  
Standard Contacts

## Ordering Instructions

Specify Catalog Number	See Coil Codes on this page
Replace (*) with Coil Code	

① Side mounted and/or top auxiliaries may be field installed to increase the number of available poles, limitations apply. Refer to page G12 for ordering and restriction details. Please note that side mount auxiliary terminal markings may conflict with base relay and/or top mount auxiliary terminal markings.

② DC rating for CS7-M base control relay.

③ Other AC voltages available, see page G13. Non-standard coil voltages not listed here must be ordered and installed separately as renewal parts.

④ Positively-Guided/Mechanically-Linked Contacts per IEC 947-5-1 Annex L on 4 main poles.

⑤ CS7E electronic coils are not interchangeable with non-electronic DC or AC coils.

⑦ Not applicable with Electronic Timer accessories (CRZ\_7).

## Discount Schedule B

**CS7 Complete Assemblies - 6 Pole, AC Control ①⑤**

CS7 Relay	Contact Arrangement and Numbering	Contacts ①		AC Operation	
		NO	NC	Catalog Number	Price
 <b>CS7-33Y</b>		3	3	<b>CS7-33Y-*</b>	122
		4	2	<b>CS7-42E-*</b>	
		4	2	<b>CS7-42Y-*</b>	
		5	1	<b>CS7-51E-*</b>	
		6	0	<b>CS7-60E-*</b>	

**AC Coil Codes ④**

AC Coil Code	Voltage Range	
	50 Hz	60 Hz
<b>24Z</b>	24V	24V
<b>120</b>	<b>110V</b>	<b>120V</b>
<b>208</b>	~	208V
<b>220W</b>	<b>200V-220V</b>	<b>208V-240V</b>
<b>240</b>	220V	240V
<b>277</b>	240V	277V
<b>380</b>	380V-400V	440V
<b>480</b>	440V	480V
<b>600</b>	550V	600V

**Contact Ratings (Per UL508/NEMA A600, P600 & Q600)**

Standard	Circuit Voltage	Make (Amps/VA)	Break (Amps/VA)	Continuous Amps
<b>A600</b>	120AC	60A/720VA	6A/720VA	10
	240AC	30A/720VA	3A/720VA	
	480AC	15A/720VA	1.5A/720VA	
	600AC	12A/720VA	1.2A/720VA	
<b>P600</b>	125DC ②	1.1A/138VA	1.1A/138VA	5
	250DC ②	0.55A/138VA	0.55A/138VA	
	301-600DC ②	0.2A/138VA	0.2A/138VA	
<b>Q600</b>	125DC ③	0.55A/69VA	0.55A/69VA	2.5
	250DC ③	0.27A/69VA	0.27A/69VA	
	301-600DC ③	0.1A/69VA	0.1A/69VA	

**Other UL Ratings**

**Maximum Voltage**  
600 volts AC or DC

**General Purpose Amps**

CS7	25 A
Aux. (@40°C)	10 A
Aux. (@60°C)	6 A

① Side mounted and/or top auxiliaries may be field installed to increase the number of available poles, limitations apply. Refer to page G12 for ordering and restriction details. Please note that side mount auxiliary terminal markings may conflict with base relay and/or top mount auxiliary terminal markings.

② DC rating for CS7 base control relay.

③ DC rating for CS7 auxiliary blocks.

④ Other voltages available, see page G13. Non-standard coil voltages not listed here must be ordered and installed separately as renewal parts.

⑤ Positively-Guided/Mechanically-Linked Contacts per IEC 947-5-1 Annex L on 4 main poles and auxiliaries.

**Ordering Instructions**

Specify Catalog Number	See Coil Codes on this page
Replace (*) with Coil Code	

**Discount Schedule B**

Active: 30/09/2015  
visit [www.sprecherschuh.com/ecatalog](http://www.sprecherschuh.com/ecatalog) for the most up to date information

## CS7 Complete Assemblies - 8 Pole, AC Control ①⑤

CS7 Relay	Contact Arrangement and Numbering	Contacts ①		AC Operation		150
		NO	NC	Catalog Number	Price	
 CS7-44E		4	4	CS7-44E-*		
		4	4	CS7-44Y-*		
		5	3	CS7-53E-*		
		5	3	CS7-53Y-*		
		6	2	CS7-62E-*		
		7	1	CS7-71E-*		
		8	0	CS7-80E-*		

## AC Coil Codes ④

AC Coil Code	Voltage Range	
	50 Hz	60 Hz
24Z	24V	24V
120	110V	120V
208	~	208V
220W	200V-220V	208V-240V
240	220V	240V
277	240V	277V
380	380V-400V	440V
480	440V	480V
600	550V	600V

## Contact Ratings (Per UL508/NEMA A600, P600 &amp; Q600)

Standard	Circuit Voltage	Make (Amps/VA)	Break (Amps/VA)	Continuous Amps
A600	120AC	60A/720VA	6A/720VA	10
	240AC	30A/720VA	3A/720VA	
	480AC	15A/720VA	1.5A/720VA	
	600AC	12A/720VA	1.2A/720VA	
P600	125DC ②	1.1A/138VA	1.1A/138VA	5
	250DC ②	0.55A/138VA	0.55A/138VA	
	301-600DC ②	0.2A/138VA	0.2A/138VA	
Q600	125DC ③	0.55A/69VA	0.55A/69VA	2.5
	250DC ③	0.27A/69VA	0.27A/69VA	
	301-600DC ③	0.1A/69VA	0.1A/69VA	

## Other UL Ratings

Maximum Voltage  
600 volts AC or DC

## General Purpose Amps

CS7	25 A
Aux. (@40°C)	10 A
Aux. (@60°C)	6 A

① Side mounted and/or top auxiliaries may be field installed to increase the number of available poles, limitations apply. Refer to page G12 for ordering and restriction details. Please note that side mount auxiliary terminal markings may conflict with base relay and/or top mount auxiliary terminal markings.

② DC rating for CS7 base control relay.

③ DC rating for CS7 auxiliary blocks.

④ Other voltages available, see page G13. Non-standard coil voltages not listed here must be ordered and installed separately as renewal parts.

⑤ Positively-Guided/Mechanically-Linked Contacts per IEC 947-5-1 Annex L on 4 main poles and auxiliaries.

## Ordering Instructions

Specify Catalog Number	See Coil Codes on this page
Replace (*) with Coil Code	

## Side Mount Auxiliary Contact Blocks (1 &amp; 2 Pole) ①②

Contact Block	Description	NO	NC	Contact Arrangement	For use with...	Standard Contacts Catalog Number	Price
 <b>1-pole (typical)</b>	<b>Auxiliary Contact Blocks for Side Mounting ②③</b> <ul style="list-style-type: none"> <li>• 1 and 2-pole</li> <li>• Two way numbering for right or left mounting on the contactor</li> <li>• Snap-on design - mounts without tools</li> <li>• Electronic compatible contacts 17V, 10mA</li> <li>• Late break / early make (L) available</li> <li>• Mirror contact performance to control relay poles</li> </ul>	0	1		CS7 all	CA7-PA-01	17
		1	0		CS7 all	CA7-PA-10	17
		0	2		CS7 all	CA7-PA-02	27
		1	1		CS7 all	CA7-PA-11	27
		2	0		CS7 all	CA7-PA-20	27
		1L	1L		CS7 all	CA7-PA-L11	37

## Top Mount Auxiliary Contact Blocks (2 &amp; 4 Pole) ②

Contact Block	Description	NO	NC	Contact Arrangement	For use with...	Standard Contacts Catalog Number	Price	Bifurcated Contacts Catalog Number	Price
 <b>2-pole (typical)</b>	<b>Auxiliary Contact Blocks for Top Mounting ②</b> <ul style="list-style-type: none"> <li>• 2 and 4 pole</li> <li>• Snap-on design - mounts without tools</li> <li>• Electronic compatible standard contacts down to 17V, 5mA, bifurcated version 5V, 3mA</li> <li>• Mechanically linked between N.O. and N.C. poles and to the control relay poles (excluding L types).</li> <li>• Several terminal numbering choices even for models with equal function</li> <li>• Late break / early make (L) available</li> </ul>	0	2		CS7 all	CS7-PV-02	27	CS7-PVB-02	42
		1	1		CS7 all	CS7-PV-11	27	CS7-PVB-11	42
		2	0		CS7 all	CS7-PV-20	27	CS7-PVB-20	42
		2	2		CS7 all	CS7-PV-22	53	CS7-PVB-22	80
		3	1		CS7 all	CS7-PV-31	53	CS7-PVB-31	80
		1	3		CS7 all	CS7-PV-13	53	CS7-PVB-13	80
		4	0		CS7 all	CS7-PV-40	53	CS7-PVB-40	80
		0	4		CS7 all	CS7-PV-04	53	CS7-PVB-04	80
		1+1L	1+1L		CS7 all	CS7-PV-L22	74	Not Available	~

① Side mounted auxiliaries may be field installed to increase the number of available poles. Please note that terminal markings may conflict with base relay and/or top mount auxiliary terminal markings.

② Max. number of auxiliary contacts that may be mounted:  
AC and Electronic DC Coil relays -max. 4 N.O. contacts on the front of the relay, 2-N.O. contacts on the side, 4-N.C. front or side: 6 total

## Control Modules

Module	Description	For use with...	Connection Diagrams	Catalog Number	Price
	<b>Mechanical Latch</b> Following relay latching, the relay coil is immediately de-energized by the NC auxiliary contact (65-66). <ul style="list-style-type: none"> <li>• Electrical or manual release</li> <li>• 1 NO + 1 NC auxiliary switch</li> <li>• Suitable for all CS7 relays</li> </ul>	CS7 all		CV7-11-* <i>Replace * with coil code below (See Application Note)</i>	94

## CV7 Mechanical Latch Coil Codes ①②③

Coil Code	Application Range			Latch & Contactor Coil Rating
	50 Hz	60 Hz	VDC	
24Z	24 VAC	24 VAC	12 VDC	24V 50/60 Hz
48Z	48 VAC	48 VAC	24 VDC	48V 50/60 Hz
110	100 VAC	110 VAC	48 or 60VDC	110V50/110V60
120	110 VAC	120 VAC	~	110V50/120V60
220W	~	208...240 VAC	~	208...240V60
230Z	230 VAC	230 VAC	110 VDC	230V 50/60 Hz
240Z	240 VAC	240 VAC	125 VDC	240V 50/60 Hz
277	240 VAC	277 VAC	~	240V50/277V60
380	380...400 VAC	440 VAC	~	380...400V50/440V60
400Z	400 VAC	400 VAC	220 VDC	400V 50/60 Hz
415	400...415 VAC	~	~	400...415 V50 Hz
480	440 VAC	480 VAC	~	440V50/480V60
600	550 VAC	600 VAC	~	550V50/600V60

**APPLICATION NOTE:**

The CV7 Mechanical Latch for CS7 Control Relay may be used for both AC and DC applications; however when using DC control circuit the user must apply the following rules for coil selection of the control relay and latch combination:

- When DC control circuits are required use CS7 control relay with AC coil and latch with AC coil. From column "VDC" in the table on the left, identify the required application DC control voltage and then select its specific Coil Code. Enter this Coil Code to complete the catalog numbers for both the control relay and latch (i.e.: 125V DC control circuit should use a 240Z coil code in both the CS7 and CV7). This works because both coils are only momentary energized and coil clearing contacts breaks the circuit after closing or opening.
- The CS7E control relay uses an electronic DC coil and the CV7 latch coil code should be chosen from the table on the left. (i.e.: 24V DC control circuit select CS7E with code 24E and CV7 latch uses a 48Z AC coil code).

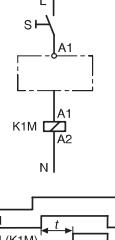
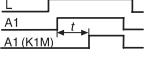
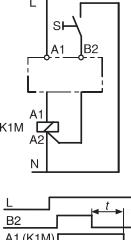
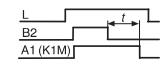
① Other voltages available. Contact your Sprecher + Schuh representative.

② CV7 must be wired for momentary impulse operation only.

③ Command duration 0.03...15 seconds.

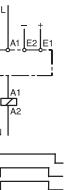
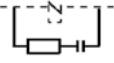
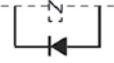
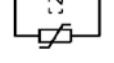
④ Use 600V AC when 575 V is required.

## Control Modules

Module	Description	For use with...	Connection Diagrams	Function	Catalog Number	Price
	<b>Pneumatic Timing Module –</b> The contacts in the Pneumatic Timing Element switch after the delay time. The contacts on the relay continue to operate without delay. • Continuous adjustment range	CS7 all	 	<b>ON-Delay</b> .3...30s 1.8...180s	CZE7-30 CZE7-180	160
				<b>OFF-Delay</b> 0.3...30s 1.8...180s	CZA7-30 CZA7-180	160
	<b>Electronic Timing Module – ON-Delay ①</b> The relay is energized at the end of the delay time.	CS7 all	 	110...240V 50/60Hz 110...250VDC0. 0.1...3s 1...30s 10...180s	CRZE7-3-110/240 CRZE7-30-110/240 CRZE7-180-110/240	98
				24...48VDC 0.1...3s 1...30s 10...180s	CRZE7-3-24/48VDC CRZE7-30-24/48VDC CRZE7-180-24/48VDC	104
	<b>Electronic Timing Module – OFF-Delay ①</b> After interruption of the control signal, the relay is de-energized at the end of the delay time.	CS7 all	 	110...240V 50/60Hz 0.3...3s 1...30s 10...180s	CRZA7-3-110/240 CRZA7-30-110/240 CRZA7-180-110/240	112
				24V AC 50/60Hz 0.3...3s 1...30s 10...180s	CRZA7-3-24VAC CRZA7-30-24VAC CRZA7-180-24VAC	112

① Not available for use on CS7E coil voltage 48V...220V.

**Control Modules (continued)**

Module	Description	For use with...	Connection Diagrams	Function		Catalog Number	Price
	<b>Electronic Interface -</b> Interface between the DC control signal from a PLC and the AC operating mechanism of the relay. <ul style="list-style-type: none"><li>• Requires no additional surge suppression for the coils</li><li>• Switching capacity 200VA</li><li>• Suitable for all CS7 relays</li></ul>	CS7 all (with AC control)		Input 24V DC 18...30V DC 48V DC	Output 110...240V AC	<b>CRI7E-24</b> <b>CRI7E-12</b> <b>CRI7E-48</b> <i>Indicates special order</i>	72 72 72
	<b>Surge Suppressors -</b> Limits coil switching transients. <ul style="list-style-type: none"><li>• Plug-in, coil mounted</li><li>• Suitable for all CS7 contactors</li></ul>	CS7 all		<b>RC Module -</b> AC Control (50/60Hz) 24...48V 110...280V 380...480V		<b>CRC7-48</b> <b>CRC7-280</b> <b>CRC7-480</b>	34
				<b>Diode Module -</b> DC Control 12-250VDC		<b>CRD7-250</b> ②	34
				<b>Varistor Module -</b> AC/DC Control 12...55VAC/ 12...77VDC 56...136VAC/ 78...180VDC 137...277VAC/ 181...350VDC 278...575VAC		<b>CRV7-55</b> ② <b>CRV7-136</b> ② <b>CRV7-277</b> ② <b>CRV7-575</b> ②	34

**Assembly Components**

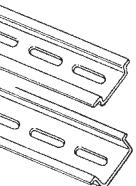
Component	Description	For Use With...	Pkg. Qty.	Catalog Number	Price Each
	<b>Protective Covers -</b> Protects against unintended manual operation.	CS7 all	1	<b>CA7-SCC</b>	<b>See page A54</b>
	<b>Protective Covers -</b> For front mounted auxiliary contacts, pneumatic timers and latches.	CS7-PV, CA7-PV, CZE7, CZA7, CV7	1	<b>CA7-SCF</b>	
	<b>Spade Connectors -</b> Dual stab for coil terminals (0.250 inch)	All CS7	20	<b>CA7-SC2</b>	<b>1.75</b>

- ① Minimum order quantity is one package of 10. Price each x 10 = total price.  
 ② Electronic DC Control Relays (CS7E) include internal surge protection and do not require additional external surge protection.

**Marking Systems**

Component	Description	Pkg. Qty.	Catalog Number	Price Each
	<b>Label Sheet</b> – 1 sheet with 105 self-adhesive paper labels each, 6 x 17mm	1	<b>CA7-FMS</b>	See page A54
	<b>Marking Tag Sheet</b> – 1 sheet with 160 perforated paper labels each, 6 x 17mm. To be used with transparent cover.	1	<b>CA7-FMP</b>	
	<b>Transparent Cover</b> – To be used with Marking Tag Sheets.	100 <b>①</b>	<b>CA7-FMC</b>	
	<b>Tag Carrier</b> – For marking with Series V7 Terminal Clip-on Tags.	100 <b>①</b>	<b>CA7-FMA2</b>	

**Mounting Accessories**

Accessory	Description	Catalog Number	Price
	<b>DIN-rail</b> – 2 meter lengths (6' 6") Top Hat, low profile (price per rail) Top Hat, high profile (price per rail)	<b>3F</b> <b>3AF</b>	See page A54

① Minimum order quantity is one package of 100. Price each x 100 = total price.

Prices  
Effective  
5/11/13

## Renewal Coils - AC ①②

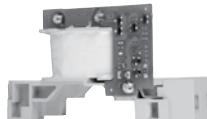
AC Control Voltages			AC Coil ↓ Codes ↓ ②	Catalog No.
50 Hz	60 Hz	50/60 Hz		
	12V		12B	TA006
12V			12A	TA404
	24V		24B	TA013
24V			24A	TA407
		24V	24Z	TA855
32V	36V		36	TA481
36V			36A	TA410
42V	48V		48	TA482
48V			48A	TA414
		48V	48Z	TA860
100V	100...110V		110	TA861
110V	120V		120	TA473
		110V	110Z	TA856
120V			120A	TA425
127V			127A	TA428
200V	200...220V	200V	220	TA862
	208V		208	TA049
	208V...240V		220W	TA296
220V	240V		240	TA474
220V...230V	260V		230A	TA441
	200...230V	230W	TA864	
		230V	230Z	TA851
230V...240V			240A	TA440
240V	277V		277	TA480
		240V	240Z	TA858
	347V		347	TA065
	380V		380B	TA067
380V...400V	440V		380	TA071
		400V	400Z	TA863
400V...415V			415	TA457
440V	480V		480	TA475
		440V	440Z	TA859
500V			500A	TA479
550V	600V		600	TA476
Price			59	



CS7 AC coil (typical)

## Renewal Coils - DC ①②⑤

DC Control Voltages	DC Coil ↓ Codes ↓ ②	Electronic DC Coils ⑤	True DC Coils	Two Winding DC Coils ⑥
		Cat. No.	Cat. No.	Cat. No.
9V ③	9D	~	TA766	TA766Y
12V	12E	TC708E	~	~
12V	12D	~	TA708	TA708Y
24V	24E	TC714E	~	~
24V ④	24D	~	TA714	TA714Y
24V Diode ④	24DD	~	TA714M	TA714Y
36V	36D	~	TA719	TA719Y
48-72V	48E	TC724E	~	~
48V	48D	~	TA724	TA724Y
60V	60D	~	TA774	TA774Y
64V	64D	~	TA727	TA727Y
72V	72D	~	TA728	TA728Y
80V	80D	~	TA729	TA729Y
110-150V	110E	TC733E	~	~
110V	110D	~	TA733	TA733Y
115V	115D	~	TA734	TA734Y
125V	125D	~	TA737	TA737Y
220-250V	220E	TC747E	~	~
220V	220D	~	TA747	TA747Y
230V	230D	~	TA749	TA749Y
250V	250D	~	TA751	TA751Y
Price (no diode)		~	138	~
Price (with diode)		202	202	134



12V &amp; 24V Electronic DC coil ⑤



48V, 110V &amp; 220V Electronic DC coil with Back Pack ⑥



Two Winding DC coil (typical) ⑥

- ① Other coil voltages available. Contact your Sprecher + Schuh representative for information.
- ② Coil Codes in bold letters indicate coils that are standard stocked items.
- ③ Voltage operating range: 0.65...1.3 x  $U_s$ .
- ④ Voltage operating range: 0.7...1.25 x  $U_s$ .

- ⑤ CS7...YY(EY) two winding coils are sold for renewal parts only and are not interchangeable with standard CS7-Y(E) AC coil relays or CS7...Y(E) true DC coil relays. CS7...YY(EY) relays should be tested following a coil swap to insure functionality of the timed auxiliary.
- ⑥ Electronic DC Coils are not interchangeable with non-electronic DC or AC coils.

## Discount Schedule R

## Technical Information

	Mounted Standard Auxiliary	Standard Control Relay CS7	Front Mounted Standard Auxiliary Contacts	Bifurcated Control Relay CS7-B	Front Mounted Bifurcated Auxiliary Contacts	Master Relay CS7-M	Side Mounted Contacts
Electrical Contact Ratings - NEMA		A600, P600	A600, Q600		2x A600, P600		A600, Q600
Min. Contact Rating		17V, 10 mA	17V, 5 mA	5V, 3 mA		17V, 10 mA	
Contact Ratings - IEC AC-15 (solenoids, contactors) rated voltage IEC 60947-5-1	24V	10 A	6 A	3 A	3 A	15 A	6 A
	48V	10 A	6 A	3 A	3 A	15 A	6 A
	120V	10 A	6 A	3 A	3 A	15 A	6 A
	240V	10 A	5 A	3 A	3 A	15 A	5 A
	400V	6 A	3 A	2 A	2 A	7.5 A	3 A
	480V/500V	2.5 A	1.6 A	1.2 A	1.2 A	5 A	1.6 A
	600V	1 A	1 A	0.7 A	0.7 A	2 A	1 A
	690V	1 A	1 A	0.7 A	0.7 A	2 A	1 A
	40 °C	$I_{th}$ 230V 400V 690V	20 A 8 kW 14 kW 24 kW	10 A	10 A	20 A	10 A
	60 °C	$I_{th}$ 230V 400V 690V	20 A 8 kW 14 kW 24 kW	6 A	6 A	20 A	6 A
DC-12 Switching DC Loads $\frac{I}{t_R} < 1 \text{ ms}$ , Resistive Loads IEC 60947-5-1	24V	15 A	10 A	6 A	6 A	20 A	6 A
	48V	10 A	9 A	3.2 A	3.2 A	20 A	3.2 A
	110V	6 A	3.5 A	1.0 A	1.0 A	8 A	1.0 A
	220V	1.0 A	0.7 A	0.5 A	0.5 A	1.5 A	0.5 A
	440V	0.4 A	0.2 A	0.2 A	0.2 A	0.4 A	0.2 A
DC-13 IEC 60947-5-1, Solenoids and contactors	24V	5 A	5 A	2.5 A	2.5 A	5 A	5 A
	48V	3 A	3 A	1.5 A	1.5 A	3 A	2.5 A
	110V	1.2 A	1.2 A	0.6 A	0.6 A	1.2 A	0.68 A
	220V	0.6 A	0.6 A	0.3 A	0.3 A	0.6 A	0.32 A
	440V	0.3 A	0.15 A	0.15 A	0.15 A	0.3 A	0.15 A

## Mechanically Linked Contacts ②

Location of welded NO contacts	State of NC contacts if NO contact welds			
	Main	Front mount auxiliary	Left side auxiliary	Right side auxiliary
Main	Open	Open ①	Open ③	Open ④
Front auxiliary	Open	Open ①	Open ③	Open ④
Left side aux.	Open	Open ①	Open ③	Open ④
Right side aux.	Open	Open ①	Open ③	Open ④

DC Switching Ratings for CS7 Main Poles in Series  
(Resistive Load at 60 °C)

	1 pole	2 poles	3 poles
24/48 V	25/20 A	25 A	25 A
125 V	6 A	25 A	25 A
220 V	1.5 A	8 A	25 A
440 V	0.4 A	1 A	3 A

## Standards Compliance

UL 508

CSA C22.2 NO. 14

EN/IEC 60947-1, -5-1

Meets the material restrictions for European Directive

2002/95/EC - EU-RoHS.

	CS7 Relays	Front Mount Auxiliaries & Pneumatic Timer Contacts
<b>Mechanical</b>		
Mechanical Life		
[Mil] 15 5		
<b>Electrical Life</b>		
AC-15 (240V, 3A) AC Operations [Mil] 1.5 1.5 1.5		
<b>Weight</b>		
[g] 390 –		
<b>Terminal Cross-Sections</b>		
<b>Terminal Type</b>		
<b>Terminal Size per IEC 947-1</b>		
Flexible with Wire End Ferrule Solid/Stranded		
1 Cond. [mm <sup>2</sup> ] 1...4 1 Cond. [mm <sup>2</sup> ] 1.5...6		
2 Cond. [mm <sup>2</sup> ] 1...4 2 Cond. [mm <sup>2</sup> ] 1.5...6		
<b>Max. Wire Size</b>		
per UL/CSA [AWG] 16...10 16...10		
Tightening Torque [Nm] 1.5...2.5 1...1.5		
[lb-in] 13...22 8.9...13		

## Certifications

cULus Listed (File No. E33916,

Guide NKCR/NKCR7)

CE Marked

- ① If the accessory is a Pneumatic Timer or latch, there is no positive guidance; the accessory contacts are independent.  
 ② Defined in IEC 947-5-1 annex L. Mechanically linked is a relationship between contacts of opposite types (i.e., NO and NC).  
 ③ Side mounted auxiliary contacts provide "mirror contact" performance with main poles only.

## Technical Information

CS7 Relays			
<b>Control Circuit Operating Voltage</b>			
AC 50/60 Hz	Pickup	[x U <sub>e</sub> ]	0.85...1.1
	Dropout	[x U <sub>e</sub> ]	0.3...0.6
Electronic DC	Pickup	[x U <sub>e</sub> ]	0.7...1.25
	Dropout	[x U <sub>e</sub> ]	0.1...0.6
<b>Coil Consumption</b>			
AC 50/60 Hz	Inrush	[VA/W]	70 / 50
	Seal	[VA/W]	8 / 2.6
Electronic DC	Inrush	[W]	10 / 17
	Seal	[W]	1.7
<b>Operating Times</b>			
AC- 50/60 Hz	Pickup Time	[ms]	15...30
	Dropout Time	[ms]	10...60
Electronic DC	Pickup Time	[ms]	25...50
	Dropout Time	[ms]	25...50
<b>Latch Attachment Release, CV7-11</b>			
Coil Consumption	AC	[VA/W]	45 / 40
	DC	[W]	25
<b>Contact Signal Duration</b>			
	[min/max]		0.03...15s
<b>Timing Attachment, CRZE7, CRZA7</b>			
Reset Time			
at min. time setting	[ms]		10
at max. time setting	[ms]		70
Repeat Accuracy	± 10%		

CS7 Relays	
<b>General</b>	
<b>Rated Insulation Voltage <math>U_i</math></b>	IEC 690V UL; CSA 600V
<b>Rated Impulse Strength <math>U_{imp}</math></b>	6 kV
<b>High Test Voltage</b>	1 minute (per IEC 947-4) 2500V
<b>Rated Voltage <math>U_e</math></b>	AC 115, 230, 400, 500, 690V DC 24, 48, 110, 220, 440V
<b>Rated Frequency</b>	50/60 Hz, DC
<b>Ambient Temperature</b>	Storage -55...+80°C (-67...176°F) Operation at nominal current -25...+60°C (-13...140°F)
Conditioned 15% current reduction after AC-1 at > 60°C	-25...+70°C (-13...158°F)
<b>Corrosion Resistance</b>	humid-alternating climate, cyclic, per IEC 68-2-30 and DIN 50 016, 56 cycles
<b>Altitude</b>	2000m above main sea level, per IEC 947-4
<b>Type of Protection</b>	IP 2X (IEC 60529 and DIN 40050) in connected state
<b>Finger Protection</b>	safe from touch by fingers and back of hand per VDE 0106, Part 100
<b>Shock Protection</b>	IEC 68-2: Half Sinusoidal shock 11ms 30G (in 3 directions)
<b>Vibration Resistance</b>	IEC 68-2: static >2G in normal position no malfunction <5G

## Utilization Category Table from EN 947-5-1

Verification of Making and Breaking Capacities of Switching Elements Under Normal Conditions  
Corresponding to the Utilization Categories ①

Utilization Category	Normal Condition of Use								
	Make ②			Break ③			Number & Rate of Making & Breaking Operations		
	I / I <sub>e</sub>	U / U <sub>e</sub>	COS Ψ	I / I <sub>e</sub>	U / U <sub>e</sub>	COS Ψ	No. of operating cycles ④	Operating cycles per minute	ON time(s) ⑤
AC-12 ⑥	1	1	0.9	1	1	0.9	6050	6	0.05
AC-13 ⑥	2	1	0.65	1	1	0.65	6050	6	0.05
AC-14 ⑥	6	1	0.3	1	1	0.3	6050	6	0.05
AC-15 ⑥	10	1	0.3	1	1	0.3	6050	6	0.05
DC			T <sub>0.95</sub>				T <sub>0.95</sub>		
DC-12	1	1	1ms	1	1	1ms	6050	6	0.05 ⑤
DC-13	1	1	6 x P ⑦	1	1	6 x P ⑧	6050	6	0.05 ⑤
DC-14 ⑥	10	1	15ms	1	1	15ms	6050	6	0.05 ⑤

I<sub>e</sub> Rated operational current  
P=U<sub>e</sub>I<sub>e</sub> steady-state power consumption (W)

U<sub>e</sub> Rated operational voltage.  
Current to be made or broken.

T<sub>0.95</sub> Time to reach 95% of the steady-state current (ms)  
UVoltage before make

① See sub-clause 8.3.3.5.2

② For tolerances on test quantities, see sub-clause 8.3.2.2

③ The first 50 operating cycles shall be run at U/U<sub>e</sub>=1.1 with the loads set at U<sub>e</sub>

④ The value "6 x P" results from an empirical relationship which is found to represent most DC magnetic loads to an upper limit of P = 50W, i.e. 6 x P = 300ms.

⑤ The ON time shall be at least equal to T<sub>0.95</sub>

⑥ Where the break current differs from the make current value, the ON time refers to the make current value after which the current is reduced to break current value for a suitable period e.g., 0.05 s.



G

Control &amp; Timing Relays

CS7

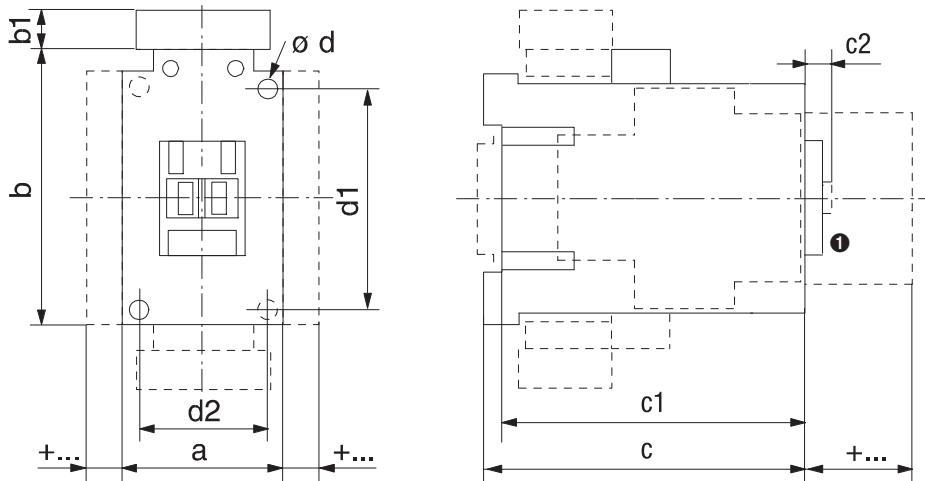
## NEMA Ratings and Test Values for AC (50 and 60Hz) and DC Control Circuits Contacts

Designation ①	Utilization Category	Therm. Continuous Test Current (A)	Maximum Current								VA	
			120V		240V		480V		600V			
AC			Make	Break	Make	Break	Make	Break	Make	Break	Make	Break
A150	AC-15	10	60	6.00	~	~	~	~	~	~	7200	720
A300	AC-15	10	60	6.00	30	3.00	~	~	~	~	7200	720
A600	AC-15	10	60	6.00	30	3.00	15	1.50	12	1.20	7200	720
B150	AC-15	5	30	3.00	~	~	~	~	~	~	3600	360
B300	AC-15	5	30	3.00	15	1.50	~	~	~	~	3600	360
B600	AC-15	5	30	3.00	15	1..50	7.5	0.75	6	0.60	3600	360
C150	AC-15	2.5	15	1.50	~	~	~	~	~	~	1800	180
C300	AC-15	2.5	15	1.50	7.5	0.75	~	~	~	~	1800	180
C600	AC-15	2.5	15	1.50	7.5	0.75	3.75	0.375	3	0.30	1800	180
D150	AC-14	1.0	3.60	0.60	~	~	~	~	~	~	432	72
D300	AC-14	1.0	3.60	0.60	1.8	0.30	~	~	~	~	432	72
E150	AC-14	0.5	1.80	0.30	~	~	~	~	~	~	216	36
2 x A300	AC-15	20	120	12	60	6.00	~	~	~	~	14400	1440
2 x A600	AC-15	20	120	12	60	6.00	30	3.00	24	2.40	14400	1440
DC			5...28V		125V		250V		301...600V		Make or Break at 300V or less [VA]	
N150	DC-13	10	10		2.2		~		~		275	
N300	DC-13	10	10		2.2		1.1		~		275	
N600	DC-13	10	10		2.2		1.1		0.40		275	
P150	DC-13	5.0	5.0		1.1		~		~		138	
P300	DC-13	5.0	5.0		1.1		0.55		~		138	
P600	DC-13	5.0	5.0		1.1		0.55		0.20		138	
Q300	DC-13	2.5	2.5		0.55		0.27		0.11		69	
Q600	DC-13	2.5	2.5		0.55		0.27		0.11		69	
2 x P600	DC-13	10	102.2		2.2		1.1		0.40		275	

① This is the NEMA Contact Rating Designation, where the letter stands for the conventional thermal current and identifies AC or DC: e.g., B = 5A AC. The number that follows is the rated insulation voltage.

**Series CS7 Industrial Control Relays (AC and Electronic DC)**

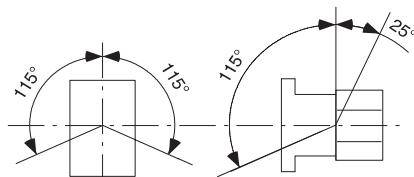
Dimensions are in millimeters (inches). Dimensions not intended for manufacturing purposes.



Catalog Number	Coil Code	a	b	b1	c	c1	c2	Ød	d1	d2
CS7 (AC)		45 (1-25/32)	81 (3-3/16)		80.5 (3-11/64)	75.5 (3-3/32)	6 (1/4)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-25/64)
CA7-9E...CA7-23E, CAN7-12E...CAN7-16E	12E	45 (1-25/32)	81 (3-3/16)	~	80.5 (3-11/64)	75.5 (2-31/32)	6 (15/64)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-3/8)
	24E	45 (1-25/32)	81 (3-3/16)	~	80.5 (3-11/64)	75.5 (2-31/32)	6 (15/64)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-3/8)
	48E	45 (1-25/32)	81 (3-3/16)	24 (15/16)	80.5 (3-11/64)	75.5 (2-31/32)	6 (15/64)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-3/8)
	110E	45 (1-25/32)	81 (3-3/16)	24 (15/16)	80.5 (3-11/64)	75.5 (2-31/32)	6 (15/64)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-3/8)
	220E	45 (1-25/32)	81 (3-3/16)	24 (15/16)	80.5 (3-11/64)	75.5 (2-31/32)	6 (15/64)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-3/8)

**Relays & Accessories (+...)**

Relays with...	Dim. [mm]	Dim. [inches]
auxiliary contact block for front mounting	c/c1 + 39	c/c1 + 1-37/64
auxiliary contact block for side mounting	a + 9	a + 23/64
pneumatic timing module	c/c1 + 58	c/c1 + 2-23/64
electronic timing module	b + 24	b + 15/16
mechanical latch	c/c1 + 61	c/c1 + 2-31/64
interface module	b + 9	b + 23/64
surge suppressor	b + 3	b + 1/8
① Labeling with...	+ 0	+ 0
label sheet	+ 0	+ 0
marking tag sheet with clear cover	+ 0	+ 0
marking tag adapter for V7 Terminals	+ 5.5	+ 7/32

**Mounting Position**

AC &amp; Electronic DC control relays

# **TECHNICAL DATA SHEET**

**Equipment Type:** Push Buttons

**Location:** RTU Section

**Model Numbers:** Various

**Manufacturer:** Specher & Schuh

**Supplier:** NHP Pty Ltd

16 Riverview Place  
Murarrie  
(07) 3909 4999



[CATALOGUE D7-CAT]

# D7 Pushbuttons



INDUSTRIAL SWITCHGEAR & AUTOMATION SPECIALISTS

NHP



PUT YOUR CONTROL AND SWITCHING  
SOLUTIONS IN OUR HANDS



*Experience a Touch of Quality*

D7



## New D7...

### Experience a Touch of Quality



Introducing the all new D7 range from Sprecher + Schuh. The D7 range is the latest in a long line of quality 22.5 mm control and signalling equipment from a company with a long built reputation for combining high quality manufacturing skills and attention to detail to produce only the finest quality products.

Available in both thermoplastic and metal variations, the D7 range incorporates all the features that you have come to expect from Sprecher + Schuh and raises the bar one step further with a functional low profile design and all new stylish appearance.

Once you get past the new appearance you will find the D7 range has some unique features incorporated, such as improved operational feel on the pushbuttons for a positive "tactile" response and a new positive detent on selector switches. In addition optional time saving cage style termination on contact blocks, improved LED illumination on pilot lights and hard wearing laser engraving have also been included.

Utilising state of the art modelling technologies and finite element analysis, you can be sure every component used in the D7 range has been optimised for durability and reliability with the aim of providing the ultimate in control and indication.

Designed and manufactured to meet the most exacting performance, the new D7 range is **the** pushbutton to use in today's demanding environments.



## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

**D7 at a glance...****"Auto Break" Safety contacts**

Separation of the contact block assembly from the front operator or mounting latch can prevent an Emergency Stop from shutting down the controlled process in an emergency. Correct contact block installation is critical to ensure that the normally closed contacts will open when the emergency stop operator is active. The exclusive Sprecher + Schuh "Auto Break" contact block monitors itself to ensure it is always correctly installed.

A normally open "Auto Break" contact is physically moulded and wired in series with a standard set of normally closed contacts. When correctly installed the operator creates a maintained pressure on the normally open "Auto Break" contact and automatically closes the contact. In this state the normally closed contact operates as normal.

If the contact block assembly should separate from the front operator, the pressure releases and the "Auto Break" contact will automatically open. Because the "Auto Break" contact is wired in series with the normally closed, the opening of either set of contacts will open the circuit controlled by the emergency stop operator.

**Coupling plates and contact blocks**

- Choice of metal or plastic coupling plates
- Rotating collar with "snap secure" system ensures fast one-hand removal
- Contact blocks snap-fit and are hinged at one end for easy installation
- Colour coded contact block plungers for easy identification
- H-bridge contact design and the option of gold contacts provides cleaner current flow for maximum reliability at lower voltages
- Bifurcated contacts provide excellent wiping and optimal switching reliability
- Option of Cage style wire termination or Screw clamp
- Live components are shrouded and touch safe to IP 20

**Inscription caps and diffusers**

- Durable abrasion-proof press plates
- 6 colour choices
- Ergonomically contoured design
- Diffusers constructed in two colour moulded assembly
- Durable wear resistant laser printing available

**Enclosures**

- Metal and plastic enclosures
- In choices to accommodate up to 6 x 22.5 mm operators
- Yellow thermoplastic pendant style enclosure available for up to 2 operators
- 20 mm metric cable entry
- Suitable for base or panel mount contact blocks
- Accepts two piece snap-in legend

**Illumination**

- Modern and compact integrated LED lamp modules
- Superior illumination qualities
- 5 colour choices
- 11 year lamp life (100,000 hrs)
- Maintenance free
- Vibration and shock resistant
- 24 V AC/DC, 110 V AC and 240 V AC

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**D7 22.5 mm CONTROL & SIGNALLING PRODUCTS****Design**

- Functional low profile appearance
- Ergonomic easy to operate handles
- Reduced depth contact blocks
- Improved positive “tactile” operation on pushbuttons
- Improved “positive detent” on rotary selector switches
- Durable two colour plastic caps and laser engraving

**Improved safety**

- Unique “Auto break” self-monitoring emergency contact system
- IP 20 touch protection
- Tamperproof rear fixing nut

**Time saving**

- New design snap-lock, twist-to-reset rotating collar on coupling plates for easier mounting and assembly
- Snap-on components
- Redesigned anti-rotation tab

**Flexibility**

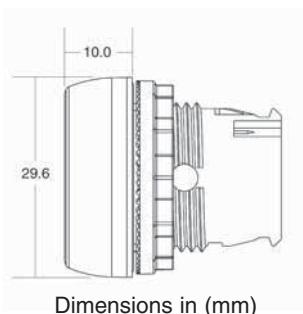
- Thermoplastic or metal operators
- Latching or impulse operators
- Five different colour choices
- Maximum of six contact blocks
- Full voltage and transformer lamp blocks

**Improved reliability**

- IP 65/66 sealing across the range for reliability in dusty and wet conditions
- Improved vibration resistance
- Continuous wiping contact for improved reliability
- Tested to IEC 947
- Positive detent on rotary switches which ensures operation will not “hang up” between positions

**Contact blocks**

- Improved mounting from “Snapsecure” snap fit mounting system
- Colour coded plungers for easy identification
- Optional Quadrifurcated Gold contacts for improved low voltage switching
- Optional spring clamp termination on contact blocks for reduced wiring time

**Non-Illuminated Momentary Pushbuttons**

- Metal or plastic options
- Improved momentary action for fast response
- Low mounting depth from panel

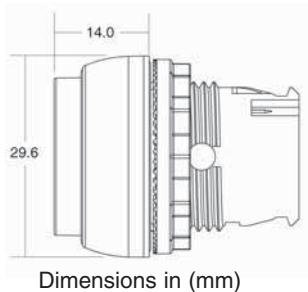


D7P-F3-PX10



D7M-F4-MX01

Description	Contact	Plastic Body Cat. No.	Metal Body Cat. No.
<b>Flush Pushbutton</b> with Green insert	— —	D7P-F3-PX10 <sup>1)</sup>	D7M-F3-MX10 <sup>1)</sup>
with Red insert	— —	D7P-F4-PX01 <sup>1)</sup>	D7M-F4-MX01 <sup>1)</sup>
with Blue insert	— —	D7P-F6-PX10 <sup>1)</sup>	D7M-F6-MX10 <sup>1)</sup>

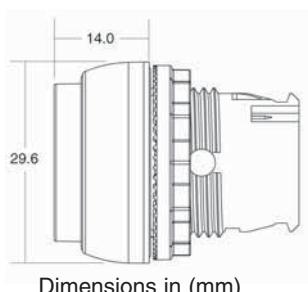


D7P-E4-PX01



D7M-E4-MX01

Description	Contact	Plastic Body Cat. No.	Metal Body Cat. No.
<b>Extended Pushbutton</b> with Red insert	— —	D7P-E4-PX01 <sup>1)</sup>	D7M-E4-MX01 <sup>1)</sup>

**Non-Illuminated Momentary Pushbuttons with labelled Press Plates**

- Laser etched markings for improved abrasion resistance



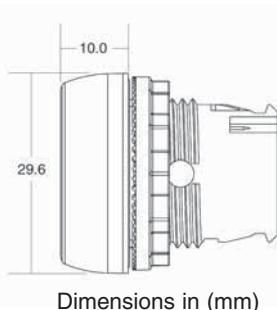
D7P-E402-PX01



D7M-F301-MX10

Description	Contact	Plastic Body Cat. No.	Metal Body Cat. No.
<b>Flush Pushbutton</b> with Green insert labelled "Start"	— —	D7P-F301-PX10 <sup>1)</sup>	D7M-F301-MX10 <sup>1)</sup>
with Red insert labelled "Stop"	— —	D7P-F402-PX01 <sup>1)</sup>	D7M-F402-MX01 <sup>1)</sup>
with Blue insert labelled "Reset"	— —	D7P-F607-PX10 <sup>1)</sup>	D7M-F607-MX10 <sup>1)</sup>
with extended Red press plate labelled "Stop"	— —	D7P-E402-PX01 <sup>1)</sup>	D7M-E402-MX01 <sup>1)</sup>

Note: <sup>1)</sup> Add suffix "bx" for special box/hang-sell packaging eg: D7P-F3-PX10bx.

**Illuminated Momentary Flush Pushbuttons with integrated LED Lamp Block**

- Long life integrated LED illumination
- 24 V and 240 V versions
- Supplied complete with contact blocks

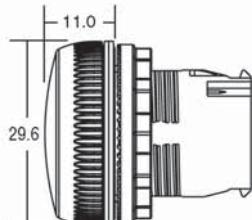


D7P-LF5-PN3Y-X10



D7M-LF6-MN3B-X10

Description	Contact	Plastic Body Cat. No.	Metal Body Cat. No.
<b>24 V AC/DC</b>			
Green pushbutton with Green LED		D7P-LF3-PN3G-X10 <sup>1)</sup>	D7M-LF3-MN3G-X10 <sup>1)</sup>
Red pushbutton with Red LED		D7P-LF4-PN3R-X01 <sup>1)</sup>	D7M-LF4-MN3R-X01 <sup>1)</sup>
Blue pushbutton with Blue LED		D7P-LF6-PN3B-X10 <sup>1)</sup>	D7M-LF6-MN3B-X10 <sup>1)</sup>
Yellow pushbutton with Yellow LED		D7P-LF5-PN3Y-X10 <sup>1)</sup>	D7M-LF5-MN3Y-X10 <sup>1)</sup>
<b>240 V AC</b>			
Green pushbutton with Green LED		D7P-LF3-PN7G-X10 <sup>1)</sup>	D7M-LF3-MN7G-X10 <sup>1)</sup>
Red pushbutton with Red LED		D7P-LF4-PN7R-X01 <sup>1)</sup>	D7M-LF4-MN7R-X01 <sup>1)</sup>
Blue pushbutton with Blue LED		D7P-LF6-PN7B-X10 <sup>1)</sup>	D7M-LF6-MN7B-X10 <sup>1)</sup>
Yellow pushbutton with Yellow LED		D7P-LF5-PN7Y-X10 <sup>1)</sup>	D7M-LF5-MN7Y-X10 <sup>1)</sup>

**Pilot Light with integrated LED Lamp Block**

- Superior LED illumination qualities
- Scratch resistant lenses
- Modern low profile bodies



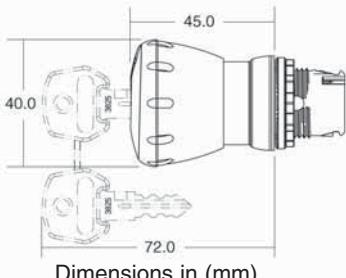
D7P-P5-PN3Y



D7M-P3-MN3G

Description	Contact	Plastic Body Cat. No.	Metal Body Cat. No.
<b>24 V AC/DC</b>			
Green pilot light with Green LED		D7P-P3-PN3G <sup>1)</sup>	D7M-P3-MN3G <sup>1)</sup>
Red pilot light with Red LED		D7P-P4-PN3R <sup>1)</sup>	D7M-P4-MN3R <sup>1)</sup>
Blue pilot light with Blue LED		D7P-P6-PN3B <sup>1)</sup>	D7M-P6-MN3B <sup>1)</sup>
Yellow pilot light with Yellow LED		D7P-P5-PN3Y <sup>1)</sup>	D7M-P5-MN3Y <sup>1)</sup>
Translucent pilot light with White LED		D7P-P7-PN3W <sup>1)</sup>	D7M-P7-MN3W <sup>1)</sup>
<b>240 V AC</b>			
Green pilot light with Green LED		D7P-P3-PN7G <sup>1)</sup>	D7M-P3-MN7G <sup>1)</sup>
Red pilot light with Red LED		D7P-P4-PN7R <sup>1)</sup>	D7M-P4-MN7R <sup>1)</sup>
Blue pilot light with Blue LED		D7P-P6-PN7B <sup>1)</sup>	D7M-P6-MN7B <sup>1)</sup>
Yellow pilot light with Yellow LED		D7P-P5-PN7Y <sup>1)</sup>	D7M-P5-MN7Y <sup>1)</sup>
Translucent pilot light with White LED		D7P-P7-PN7W <sup>1)</sup>	D7M-P7-MN7W <sup>1)</sup>

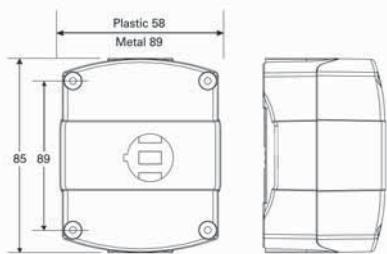
Note: <sup>1)</sup> Add suffix "bx" for special box/hang-sell packaging eg: D7P-LF3-PN3GX10bx.

**Emergency Stop Operators**

- Choice of "Auto Break" or Standard normally closed contacts
- 30, 40 or 60 mm Mushroom head
- Extra security key release



Description	Contact	Plastic Body Cat. No.	Metal Body Cat. No.
<b>Twist To Reset with Standard Contact Blocks</b>			
30 mm Operator	—	D7P-MT34-PX01 <sup>1)</sup>	D7M-MT34-MX01 <sup>1)</sup>
40 mm Operator	—	D7P-MT44-PX01 <sup>1)</sup>	D7M-MT44-MX01 <sup>1)</sup>
60 mm Operator	—	D7P-MT64-PX01 <sup>1)</sup>	D7M-MT64-MX01 <sup>1)</sup>
<b>Key To Reset with Standard Contact Blocks</b>			
40 mm Operator	—	D7P-MK44-PX01 <sup>1)</sup>	D7M-MK44-MX01 <sup>1)</sup>
<b>Twist To Reset with "Auto Break" Safety Contact Blocks</b>			
30 mm Operator	—	D7P-MT34-PX01S <sup>1)</sup>	D7M-MT34-MX01S <sup>1)</sup>
40 mm Operator	—	D7P-MT44-PX01S <sup>1)</sup>	D7M-MT44-MX01S <sup>1)</sup>
60 mm Operator	—	D7P-MT64-PX01S <sup>1)</sup>	D7M-MT64-MX01S <sup>1)</sup>
<b>Key To Reset with "Auto Break" Safety Contact Blocks</b>			
40 mm Operator	—	D7P-MK44-PX01S <sup>1)</sup>	D7M-MK44-MX01S <sup>1)</sup>

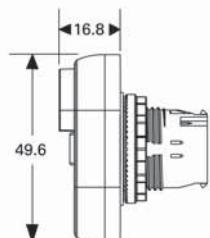
**Enclosed Emergency Stop Operators**

- Modern low profile enclosures
- Supplied complete
- 20 mm metric cable entry
- Plastic or Metal enclosures



Description	Contact	Cat. No.
<b>Plastic Enclosures with Emergency Stop "Twist To Reset" Operator</b>		
Yellow enclosure 40 mm plastic operator	—	D71YM1
<b>Plastic Enclosures with Emergency Stop "Twist Key To Reset" Operator</b>		
Yellow enclosure 40 mm plastic operator	—	D71Y4
<b>Metal Enclosures with Emergency Stop "Twist To Reset" Operator</b>		
Grey enclosure 40 mm metal operator	—	D71MM1
<b>Metal Enclosures with Emergency Stop "Twist Key To Reset" Operator</b>		
Grey enclosure 40 mm metal operator	—	D71MM4

Note: <sup>1)</sup> Add suffix "bx" for special box/hang-sell packaging eg: D7P-MT34-PX01bx.

**Multi Function Operators**

Dimensions in (mm)

**Time saving**

- Central nut fixing
- Snap fitting of components

**Space efficient**

- 2 or 3 functions in a minimum of space
- Single 22.5 mm hole mounting

**Economical**

- Negates the need for 3 separate devices
- Less mounting time

**Flexible**

- Uses standard D7 rear elements
- 2 contact levels possible
- Choice of plastic or metal body
- IP 66 protection

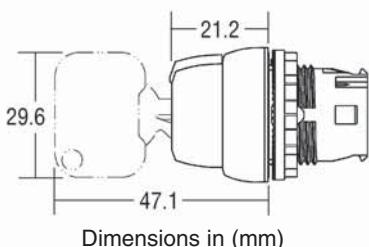


D7P-U2E4F3-PX11



D7M-U2E4F3-MX11

Description	Contact	Plastic Body Cat. No.	Metal Body Cat. No.
<b>Maintained Operation</b>			
Blank press plates (Red / Green)	— — — —	D7P-U2E4F3-PX11 <sup>1)</sup>	D7M-U2E4F3-MX11 <sup>1)</sup>
O-I (Red "Stop" / Green "Start")	— — — —	D7P-U2EFFE-PX11 <sup>1)</sup>	D7M-U2EFFEMX11 <sup>1)</sup>

**Short lever Rotary Switches and Key Operated Rotary Switches**

Dimensions in (mm)

- Improved sealing
- Raised detent for improved switching capabilities
- Ergonomic handles
- Key release at off position

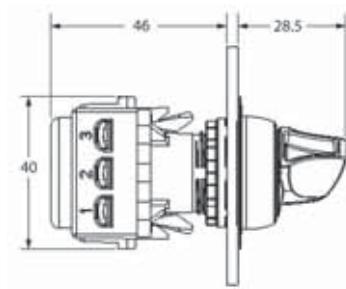


D7P-SM22-PX10



D7M-KM31-MX20

Description	Contact	Plastic Body Cat. No.	Metal Body Cat. No.
<b>Maintained Operation</b>			
2 pos Rotary SW 90°	— —	D7P-SM22-PX10 <sup>1)</sup>	D7M-SM22-MX10 <sup>1)</sup>
3 pos Rotary SW 2 x 60°	— — — —	D7P-SM32-PX20 <sup>1)</sup>	D7M-SM32-MX20 <sup>1)</sup>
2 pos Key SW 90°	— —	D7P-KM21-PX10 <sup>1)</sup>	D7M-KM21-MX10 <sup>1)</sup>
3 pos Key SW 2 x 60°	— — — —	D7P-KM31-PX20 <sup>1)</sup>	D7M-KM31-MX20 <sup>1)</sup>

**Potentiometer**

Dimensions in (mm)



D7P-POT

- Supplied complete with resistive elements
- Thermoplastic body

Description	Contact	Plastic Body Cat. No.
Operator without resistive element		D7P-POT
Operator with 1000 Ω resistive		D7P-POT3
Operator with 5000 Ω resistive		D7P-POT5
Operator with 10000 Ω resistive		D7P-POT6

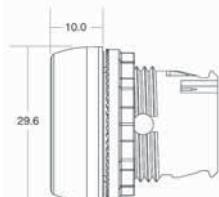
Note: <sup>1)</sup> Add suffix "bx" for special box/hang-sell packaging eg: D7P-U2E4F3-PX11bx.

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

**NHP**

- D7PF** Flush frame, non-illuminated plastic pushbutton operators  
**D7PLF** Flush frame, illuminated plastic pushbutton operators  
**D7MF** Flush frame, non-illuminated metal pushbutton operators  
**D7MLF** Flush frame, illuminated metal pushbutton operators

- Protection class IP 66
- Individually packaged
- 2 part ordering

**1**

Dimensions in (mm)



D7P-F301



D7M-F6



D7PL-F4



D7ML-F5

Description	Non Illuminated Plastic Cat. No.	Non Illuminated Metal Cat. No.	Illuminated Plastic Cat. No. <sup>3)</sup>	Illuminated Metal Cat. No. <sup>3)</sup>
Operator only - no insert	D7P-F9	D7M-F9	D7PL-F9	D7ML-F9
Operator with White / Clear insert	D7P-F1	D7M-F1	D7PL-F1	D7ML-F1
Operator with Black insert	D7P-F2	D7M-F2	-	-
Operator with Green insert	D7P-F3	D7M-F3	D7PL-F3	D7ML-F3
Operator with Red insert	D7P-F4	D7M-F4	D7PL-F4	D7ML-F4
Operator with Yellow insert	D7P-F5	D7M-F5	D7PL-F5	D7ML-F5
Operator with Blue insert	D7P-F6	D7M-F6	D7PL-F6	D7ML-F6
Operator with Green "Start" insert	D7P-F301	D7M-F301	-	-
Operator with Green "I" insert	D7P-F306	D7M-F306	-	-
Operator with Red "STOP" insert	D7P-F402	D7M-F402	-	-
Operator with Red "O" insert	D7P-F405	D7M-F405	-	-
Operator with Black "→" insert	D7P-F208	D7M-F208	-	-

**2**

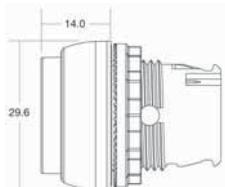
**D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate  
**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	D7PX10	D7PQ10	D7MX10	D7MQ10
1 N/C contact block	D7PX01	D7PQ01	D7MX01	D7MQ01
1 N/O and 1 N/C contact block	D7PX11	D7PQ11	D7MX11	D7MQ11
1 N/O and 1 N/C contact block and incandescent lamp block	D7PD <sup>1)</sup> CX11	D7PD <sup>1)</sup> CQ11	D7MD <sup>1)</sup> CX11	D7MD <sup>1)</sup> CQ11
1 N/O and 1 N/C contact block and integrated LED lamp block	D7PN <sup>1)</sup> <sup>2)</sup> X11	D7PQ <sup>1)</sup> <sup>2)</sup> Q11	D7MN <sup>1)</sup> <sup>2)</sup> X11	D7MQ <sup>1)</sup> <sup>2)</sup> X11

**Notes:**

- <sup>1)</sup> Enter voltage 6 V AC/DC = 1, 12 V AC/DC = 2, 24 V AC/DC = 3, 48 V AC/DC = 4, 120 V AC/DC = 5, 240 V AC/DC = 7  
Example D7PD3CX11 = 24 V AC/DC Incandescent lamp block, lamp ordered separately (24, 110, 240 available with LED).
- <sup>2)</sup> Enter lamp colour **C** = clear (incandescent), **R** = Red LED, **G** = Green LED, **Y** = Yellow LED, **W** = White LED,  
**B** = Blue LED - Example D7PN3RX11 = 24 V AC/DC RED integrated LED lamp block.
- <sup>3)</sup> A full range of labelled press plates available separately refer to page 37.

- Protection class IP 66
- Individually packaged
- 2 part ordering

**1**

Dimensions in (mm)



D7P-E1

D7M-E402

D7PL-E4

D7ML-E4

Description	Non Illuminated Plastic Cat. No.	Non Illuminated Metal Cat. No.	Illuminated Plastic Cat. No. <sup>3)</sup>	Illuminated Metal Cat. No. <sup>3)</sup>
Operator only - no insert	D7P-E9	D7M-E9	D7PL-E9	D7ML-E9
Operator with White / Clear insert	D7P-E1	D7M-E1	D7PL-E1	D7ML-E1
Operator with Black insert	D7P-E2	D7M-E2	-	-
Operator with Green insert	D7P-E3	D7M-E3	D7PL-E3	D7ML-E3
Operator with Red insert	D7P-E4	D7M-E4	D7PL-E4	D7ML-E4
Operator with Yellow insert	D7P-E5	D7M-E5	D7PL-E5	D7ML-E5
Operator with Blue insert	D7P-E6	D7M-E6	D7PL-E6	D7ML-E6
Operator with Green "Start" insert	D7P-E301	D7M-E301	-	-
Operator with Green "I" insert	D7P-E306	D7M-E306	-	-
Operator with Red "STOP" insert	D7P-E402	D7M-E402	-	-
Operator with Red "O" insert	D7P-E405	D7M-E405	-	-
Operator with Black "→" insert	D7P-E208	D7M-E208	-	-

**2****D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	D7PX10	D7PQ10	D7MX10	D7MQ10
1 N/C contact block	D7PX01	D7PQ01	D7MX01	D7MQ01
1 N/O and 1 N/C contact block	D7PX11	D7PQ11	D7MX11	D7MQ11
1 N/O and 1 N/C contact block and incandescent lamp block	D7PD <sup>1)</sup> CX11	D7PD <sup>1)</sup> CQ11	D7MD <sup>1)</sup> CX11	D7MD <sup>1)</sup> CQ11
1 N/O and 1 N/C contact block and integrated LED lamp block	D7PN <sup>1)</sup> <sup>2)</sup> X11	D7PQ <sup>1)</sup> <sup>2)</sup> Q11	D7MN <sup>1)</sup> <sup>2)</sup> X11	D7MQ <sup>1)</sup> <sup>2)</sup> X11

Notes: <sup>1)</sup> Enter voltage 6 V AC/DC = 1, 12 V AC/DC = 2, 24 V AC/DC = 3, 48 V AC/DC = 4, 120 V AC/DC = 5, 240 V AC/DC = 7

Example D7PD3CX11 = 24 V AC/DC Incandescent lamp block, lamp ordered separately (24, 110, 240 available with LED).

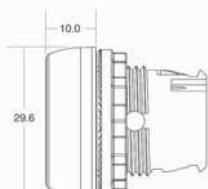
<sup>2)</sup> Enter lamp colour **C** = clear (incandescent), **R** = Red LED, **G** = Green LED, **Y** = Yellow LED, **W** = White LED.**B** = Blue LED - Example D7PN3RX11 = 24 V AC/DC RED integrated LED lamp block.<sup>3)</sup> A full range of labelled press plates available separately refer to page 37.

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

**NHP**

- D7PG** Guarded frame, non-illuminated plastic pushbutton operators  
**D7PLG** Guarded frame, illuminated plastic pushbutton operators  
**D7MG** Guarded frame, non-illuminated metal pushbutton operators  
**D7MLG** Guarded frame, illuminated metal pushbutton operators

- Protection class IP 66
- Individually packaged
- 2 part ordering



**1** Dimensions in (mm)

**2**

Description	Non Illuminated Plastic Cat. No.	Non Illuminated Metal Cat. No.	Illuminated Plastic Cat. No. <sup>3)</sup>	Illuminated Metal Cat. No. <sup>3)</sup>
Operator only - no insert	<b>D7P-G9</b>	<b>D7M-G9</b>	<b>D7PL-G9</b>	<b>D7ML-G9</b>
Operator with White / Clear insert	<b>D7P-G1</b>	<b>D7M-G1</b>	<b>D7PL-G1</b>	<b>D7ML-G1</b>
Operator with Black insert	<b>D7P-G2</b>	<b>D7M-G2</b>	-	-
Operator with Green insert	<b>D7P-G3</b>	<b>D7M-G3</b>	<b>D7PL-G3</b>	<b>D7ML-G3</b>
Operator with Red insert	<b>D7P-G4</b>	<b>D7M-G4</b>	<b>D7PL-G4</b>	<b>D7ML-G4</b>
Operator with Yellow insert	<b>D7P-G5</b>	<b>D7M-G5</b>	<b>D7PL-G5</b>	<b>D7ML-G5</b>
Operator with Blue insert	<b>D7P-G6</b>	<b>D7M-G6</b>	<b>D7PL-G6</b>	<b>D7ML-G6</b>
Operator with Green "Start" insert	<b>D7P-G301</b>	<b>D7M-G301</b>		
Operator with Green "I" insert	<b>D7P-G306</b>	<b>D7M-G306</b>		
Operator with Red "STOP" insert	<b>D7P-G402</b>	<b>D7M-G402</b>		
Operator with Red "O" insert	<b>D7P-G405</b>	<b>D7M-G405</b>		
Operator with Black "→" insert	<b>D7P-G208</b>	<b>D7M-G208</b>		

**2**

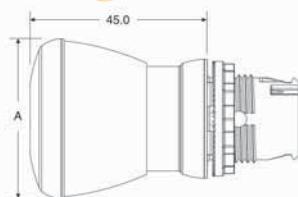
**D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate  
**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	<b>D7PX10</b>	<b>D7PQ10</b>	<b>D7MX10</b>	<b>D7MQ10</b>
1 N/C contact block	<b>D7PX01</b>	<b>D7PQ01</b>	<b>D7MX01</b>	<b>D7MQ01</b>
1 N/O and 1 N/C contact block	<b>D7PX11</b>	<b>D7PQ11</b>	<b>D7MX11</b>	<b>D7MQ11</b>
1 N/O and 1 N/C contact block and incandescent lamp block	<b>D7PD<sup>1)</sup>CX11</b>	<b>D7PD<sup>1)</sup>CQ11</b>	<b>D7MD<sup>1)</sup>CX11</b>	<b>D7MD<sup>1)</sup>CQ11</b>
1 N/O and 1 N/C contact block and integrated LED lamp block	<b>D7PN<sup>1) 2)</sup>X11</b>	<b>D7PQ<sup>1) 2)</sup>Q11</b>	<b>D7MN<sup>1) 2)</sup>X11</b>	<b>D7MN<sup>1) 2)</sup>Q11</b>

**Notes:**

- <sup>1)</sup> Enter voltage 6 V AC/DC = **1**, 12 V AC/DC = **2**, 24 V AC/DC = **3**, 48 V AC/DC = **4**, 120 V AC/DC = **5**, 240 V AC/DC = **7**. Example D7PD3CX11 = 24 V AC/DC Incandescent lamp block, lamp ordered separately (24, 110, 240 available with LED).
- <sup>2)</sup> Enter lamp colour **C** = clear (incandescent), **R** = Red LED, **G** = Green LED, **Y** = Yellow LED, **W** = White LED, **B** = Blue LED - Example D7PN3RX11 = 24 V AC/DC RED integrated LED lamp block.
- <sup>3)</sup> A full range of labelled press plates available separately refer to page 37.

- Protection class IP 66
- Individually packaged
- 2 part ordering

**1**

Dimensions in (mm)

D7P-MM62

D7M-MM44

D7P-LMM43

D7M-LMM46

- D7PMM** 40 mm and 60 mm, non-illuminated momentary plastic mushroom operators  
**D7PLMM** 40 mm and 60 mm, illuminated momentary plastic mushroom operators  
**D7MMM** 40 mm and 60 mm, non-illuminated momentary metal mushroom operators  
**D7MLMM** 40 mm and 60 mm, illuminated momentary metal mushroom operators



Description	Non Illuminated Plastic Cat. No.	Non Illuminated Metal Cat. No.	Illuminated Plastic Cat. No.	Illuminated Metal Cat. No.
40 mm operator with Clear insert	-	-	D7P-LMM42	D7M-LMM42
40 mm operator with Black insert	D7P-MM42	D7M-MM42	-	-
40 mm operator with Green insert	D7P-MM43	D7M-MM43	D7P-LMM43	D7M-LMM43
40 mm operator with Red insert	D7P-MM44	D7M-MM44	D7P-LMM44	D7M-LMM44
40 mm operator with Yellow insert	D7P-MM45	D7M-MM45	D7P-LMM45	D7M-LMM45
40 mm operator with Blue insert	D7P-MM46	D7M-MM46	D7P-LMM46	D7M-LMM46
60 mm operator with Clear insert	-	-	D7P-LMM62	D7M-LMM62
60 mm operator with Black insert	D7P-MM62	D7M-MM62	-	-
60 mm operator with Green insert	D7P-MM63	D7M-MM63	D7P-LMM63	D7M-LMM63
60 mm operator with Red insert	D7P-MM64	D7M-MM64	D7P-LMM64	D7M-LMM64
60 mm operator with Yellow insert	D7P-MM65	D7M-MM65	D7P-LMM65	D7M-LMM65
60 mm operator with Blue insert	D7P-MM66	D7M-MM66	D7P-LMM66	D7M-LMM66

**2**

- D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate  
**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	D7PX10	D7PQ10	D7MX10	D7MQ10
1 N/C contact block	D7PX01	D7PQ01	D7MX01	D7MQ01
1 N/O and 1 N/C contact block	D7PX11	D7PQ11	D7MX11	D7MQ11
1 N/O and 1 N/C contact block and incandescent lamp block	D7PD <sup>1</sup> )CX11	D7PD <sup>1</sup> )CQ11	D7MD <sup>1</sup> )CX11	D7MD <sup>1</sup> )CQ11
1 N/O and 1 N/C contact block and integrated LED lamp block	D7PN <sup>1</sup> ) <sup>2</sup> X11	D7PQ <sup>1</sup> ) <sup>2</sup> Q11	D7MN <sup>1</sup> ) <sup>2</sup> X11	D7MQ <sup>1</sup> ) <sup>2</sup> Q11

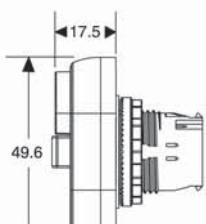
**Notes:** <sup>1</sup>) Enter voltage 6 V AC/DC = 1, 12 V AC/DC = 2, 24 V AC/DC = 3, 48 V AC/DC = 4, 120 V AC/DC = 5, 240 V AC/DC = 7  
Example D7PD3CX11 = 24 V AC/DC Incandescent lamp block, lamp ordered separately (24, 110, 240 available with LED).  
<sup>2</sup>) Enter lamp colour **C** = clear (incandescent), **R** = Red LED, **G** = Green LED, **Y** = Yellow LED, **W** = White LED,  
**B** = Blue LED - Example D7PN3RX11 = 24 V AC/DC RED integrated LED lamp block.

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

NHP

- D7PU2 / D7PLU2** 2 Position plastic illuminated and non-illuminated multifunction operators  
**D7MU2 / D7MLU2** 2 Position metal illuminated and non-illuminated multifunction operators  
**D7PU3** 3 Position plastic non-illuminated multifunction operators  
**D7MU3** 3 Position metal non-illuminated multifunction operators

- Protection class IP 66
- Individually packaged
- 3 part ordering



1 Dimensions in (mm)

D7P-U2X\*)

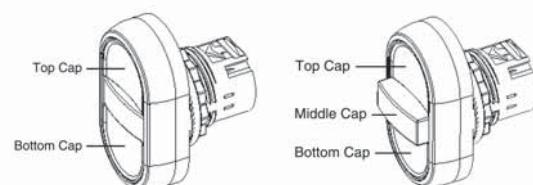
D7M-U2X

D7P-LU2X

D7P-U3X

Description	Two Position Plastic Operator Cat. No.	Two Position Metal Operator Cat. No.	Three Position Plastic Operator Cat. No.	Three Position Metal Operator Cat. No.
Non-illuminated operator without insert	D7P-U2X	D7M-U2X	D7P-U3X	D7M-U3X
Illuminated operator without insert	D7P-LU2X	D7M-LU2X	D7P-LU3X	D7M-LU3X

2 Blank inserts for top or bottom cap To suit 2 or 3 position operators	Flush Cat. No.	Extended Cat. No.	Two Position *) Multi-Function	Three Position *) Multi-Function
White Blank	D7-AFU1	D7-AEU1		
Black Blank	D7-AFU2	D7-AEU2		
Green Blank	D7-AFU3	D7-AEU3		
Red Blank	D7-AFU4	D7-AEU4		
Yellow Blank	D7-AFU5	D7-AEU5		
Blue Blank	D7-AFU6	D7-AEU6		
Engraved inserts To suit 2 or 3 position operators	Flush plate for top cap	Flush plate for bottom cap	Extended plate for bottom cap	
Green I	D7-AFCU3CU909	D7-AFAU3CU909	-	
Green II	D7-AFCU3CU230	D7-AFAU3CU230	-	
Green O	-	D7-AFAU3CU910	-	
Green Start	D7-AFCU3CU208	-	-	
Red Stop	-	-	D7-AEAU4CU910	
Red O	-	-	D7-AEAU4CU212	

**D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plates

3

**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plates

Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	D7PX10	D7PQ10	D7MX10	D7MQ10
1 N/C contact block	D7PX01	D7PQ01	D7MX01	D7MQ01
1 N/O and 1 N/C contact block	D7PX11	D7PQ11	D7MX11	D7MQ11
1 N/O and 1 N/C contact block and integrated LED lamp block	D7PN*) X11	D7PQ*) Q11	D7MN*) X11	D7MQ*) Q11

**Notes:** 1) Enter voltage 6 V AC/DC = 1, 12 V AC/DC = 2, 24 V AC/DC = 3, 48 V AC/DC = 4, 120 V AC/DC = 5, 240 V AC/DC = 7,  
 Example D7PD3CX11 = 24 V AC/DC Incandescent lamp block, lamp ordered separately (24, 110, 240 available with LED)

2) Enter lamp colour C = clear (incandescent), R = Red LED, G = Green LED, Y = Yellow LED, W = White LED, B = Blue LED,  
 Example D7PN3RX11 = 24 V AC/DC RED integrated LED lamp block.

Full list of labelled press plates refer to page 37.

\*) Shown fitted with inserts.

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

**NHP**

- Protection class IP 66
- Individually packaged
- 2 part ordering



**1** Dimensions in (mm)

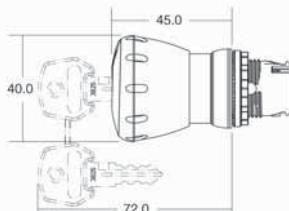
- D7PMT** Plastic twist to release emergency stop operators  
**D7MMT** Metal twist to release emergency stop operators  
**D7PLMT** Plastic twist to release illuminated emergency stop operators  
**D7MLMT** Metal twist to release illuminated emergency stop operators



Description	Non Illuminated Plastic Cat. No.	Non Illuminated Metal Cat. No.	Illuminated Plastic Cat. No.	Illuminated Metal Cat. No.
30 mm Red operator	<b>D7P-MT34</b>	<b>D7M-MT34</b>	N/A	N/A
40 mm Red operator	<b>D7P-MT44</b>	<b>D7M-MT44</b>	<b>D7P-LMT44</b>	<b>D7M-LMT44</b>
60 mm Red operator	<b>D7P-MT64</b>	<b>D7M-MT64</b>	<b>D7P-LMT64</b>	<b>D7M-LMT64</b>

**D7PMK** Plastic key-release emergency stop operators

**D7MMK** Metal key-release emergency stop operators



Dimensions in (mm)



40 mm Red operator **D7P-MK44** **D7M-MK44**



**2**

**D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate

**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	<b>D7PX10</b>	<b>D7PQ10</b>	<b>D7MX10</b>	<b>D7MQ10</b>
1 N/C contact block	<b>D7PX01</b>	<b>D7PQ01</b>	<b>D7MX01</b>	<b>D7MQ01</b>
1 N/O and 1 N/C contact block	<b>D7PX11</b>	<b>D7PQ11</b>	<b>D7MX11</b>	<b>D7MQ11</b>
1 N/O and 1 N/C contact block and incandescent lamp block	<b>D7PD<sup>1</sup>)CX11</b>	<b>D7PD<sup>1</sup>)CQ11</b>	<b>D7MD<sup>1</sup>)CX11</b>	<b>D7MD<sup>1</sup>)CQ11</b>
1 N/O and 1 N/C contact block and integrated LED lamp block	<b>D7PN<sup>1</sup> <sup>2</sup>)X11</b>	<b>D7PQ<sup>1</sup> <sup>2</sup>)Q11</b>	<b>D7MN<sup>1</sup> <sup>2</sup>)X11</b>	<b>D7MN<sup>1</sup> <sup>2</sup>)Q11</b>

**Notes:** <sup>1</sup>) Enter voltage 6 V AC/DC = **1**, 12 V AC/DC = **2**, 24 V AC/DC = **3**, 48 V AC/DC = **4**, 120 V AC/DC = **5**, 240 V AC/DC = **7**  
Example D7PD3CX11 = 24 V AC/DC Incandescent lamp block, lamp ordered separately (24, 110, 240 available with LED)

<sup>2</sup>) Enter lamp colour **C** = clear (incandescent), **R** = Red LED, **G** = Green LED, **Y** = Yellow LED, **W** = White LED,  
**B** = Blue LED - Example D7PN3RX11 = 24 V AC/DC RED integrated LED lamp block

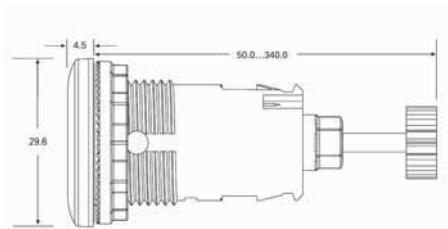
Safety auto break contact available, refer to page 28.

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

**NHP**

**D7P-R / D7M-R** Flush frame reset rod operators - Mechanical and/or electrical reset, momentary operation

- Protection class IP 66
- Individually packaged
- 2 part ordering



**1** Dimensions in (mm)

*D7P-R611*

*D7MM-R607*



Description	Legend / Text	Plastic <sup>1)</sup> Cat. No.	Metal <sup>1)</sup> Cat. No.
Blue operator	R	<b>D7P-R611</b>	<b>D7M-R611</b>
Blue operator	RESET	<b>D7P-R607</b>	<b>D7M-R607</b>
Blue operator	Blank	<b>D7P-R6</b>	<b>D7M-R6</b>

**D7-ATR** Adjustable threaded reset rod



*D7-ATR06*

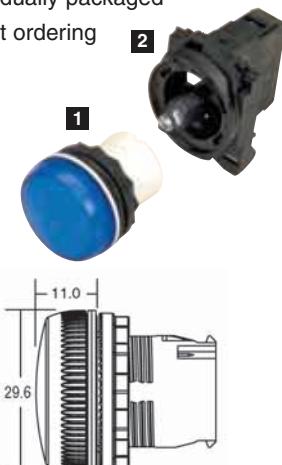
Rod Length <sup>2)</sup>	Rod length adjustability	Cat. No.
40 mm	34...52 mm	<b>D7-ATR01</b>
55 mm	50...67 mm	<b>D7-ATR02</b>
85 mm	80...98 mm	<b>D7-ATR04</b>
115 mm	110...128 mm	<b>D7-ATR06</b>
145 mm	141...195 mm	<b>D7-ATR08</b>
315 mm	157...326 mm	<b>D7-ATR19 <sup>3)</sup></b>

**Notes:** <sup>1)</sup> For electrical operation, operator will accept coupling plate and up to four circuit contact blocks or two dual level contact blocks. (Refer to page 28 for contact blocks).

<sup>2)</sup> If contact blocks are used, they must have a minimum rod length of 55 mm for one level of contact blocks and 85 mm for two levels of contact blocks.

<sup>3)</sup> Rod is threaded along its entire length. Fully threaded rod can be provided after cutting.

- Protection class IP 66
- Individually packaged
- 2 part ordering

**1**

Dimensions in (mm)

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

**D7PP / D7MM** Superior illumination qualities  
Scratch resistant lens  
Modern low profile bodies



D7P-P3

D7M-M4

**Description**Plastic  
Cat. No.Metal  
Cat. No.

Pilot light with Clear lens

D7P-P7

D7M-P7

Pilot light with Green lens

D7P-P3

D7M-P3

Pilot light with Red lens

D7P-P4

D7M-P4

Pilot light with Yellow lens

D7P-P5

D7M-P5

Pilot light with Blue lens

D7P-P6

D7M-P6

**2****D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate**Description**Plastic  
Screw  
Cat. No.Plastic  
Spring Clamp  
Cat. No.Metal  
Screw  
Cat. No.Metal  
Spring Clamp  
Cat. No.

Integrated LED lamp block White

D7PN 'W

D7PQ 'W

D7MN 'W

D7MQ 'W

Integrated LED lamp block Green

D7PN 'G

D7PQ 'G

D7MN 'G

D7MQ 'G

Integrated LED lamp block Red

D7PN 'R

D7PQ 'R

D7MN 'R

D7MQ 'R

Integrated LED lamp block Yellow

D7PN 'Y

D7PQ 'Y

D7MN 'Y

D7MQ 'Y

Integrated LED lamp block Blue

D7PN 'B

D7PQ 'B

D7MN 'B

D7MQ 'B

Ba9s incandescent lamp block  
- lamp supplied separately <sup>2)</sup>

D7PDOC

-

D7MDOC

-

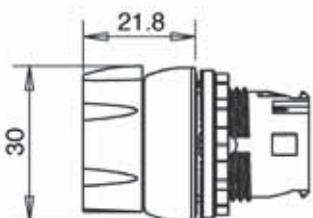
**Notes:** <sup>1)</sup> Enter voltage 24 V AC/DC = 3, 110 V AC/DC = 5, 240 V AC/DC = 7  
<sup>2)</sup> Refer page 31 for full lamp selections.

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

NHP

**D7PSJ** Plastic, selector jog operators 2 or 3 position**D7MSJ** Metal, selector jog operators 2 or 3 position

- Protection class IP 66
- Individually packaged
- 2 part ordering



1

Dimensions in (mm)



D7M-SJ23



2

Description	Plastic operator Cat. No.	Metal operator Cat. No.
Black 2 position	D7P-SJ22	D7M-SJ22
Green 2 position	D7P-SJ23	D7M-SJ23
Black 3 position	D7P-SJ32	D7M-SJ32
Green 3 position	D7P-SJ33	D7M-SJ33

Target Table and Operator Position (2-Position)<sup>1)</sup>

Contact Type	Position On Mounting Latch	○		○	
		Selector Left Free	Selector Left Depressed	Selector Right Free	Selector Right Depressed
N/O	Left	○	X	○	○
N/O	Right	○	○	○	X
N/O	Centre	○	X	○	X
N/C	Left	X	○	X	X
N/C	Right	X	X	X	○
N/C	Centre	X	○	X	○

Target Table and Operator Position (3-Position)<sup>1)</sup>

Contact Type	Position On Mounting Latch	○		↑		○	
		Selector Left Free	Selector Left Depressed	Selector Right Free	Selector Right Depressed	Selector Right Free	Selector Right Depressed
N/O	Left	○	X	○	X	○	○
N/O	Right	○	○	○	X	○	X
N/O	Centre	○	X	○	X	○	X
N/C	Left	X	○	X	○	X	X
N/C	Right	X	X	X	○	X	○
N/C	Centre	X	○	X	○	X	○

Note: 1) X = Closed 0 = Open



2

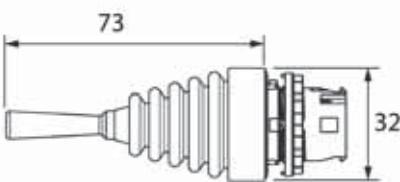
**D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	D7PX10	D7PQ10	D7MX10	D7MQ10
1 N/C contact block	D7PX01	D7PQ01	D7MX01	D7MQ01
1 N/O and 1 N/C contact block	D7PX11	D7PQ11	D7MX11	D7MQ11

- Protection class IP 66
- Individually packaged
- 2 part ordering



**D7MJM / JR2** Metal, 2 position joystick operator  
**D7MJM / JR4** Metal, 4 position joystick operator



**1** Dimensions in (mm)



*D7M-JM2*



*D7M-JM4*

Description	Cat. No.	Cat. No.	
Metal 2 position Maintained	<b>D7M-JM2</b>	Metal 4 position Maintained	<b>D7M-JM4</b>
Metal 2 position Spring Return	<b>D7M-JR2</b>	Metal 4 position Spring Return	<b>D7M-JR4</b>

Target Table and Operator Position (2-Position) <sup>1)</sup>				
Contact Type	Position on Mounting Latch	Toggle Left	Centre	Toggle Right
N/O	Left	O	O	X
N/O	Right	X	O	O
N/O	Centre	X	O	X
N/O	Left	X	X	O
N/O	Right	O	X	X
N/O	Centre	O	X	O

Note: <sup>1)</sup> X = Closed O = Open



**2**

**D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate  
**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

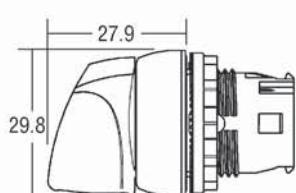
Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	<b>D7PX10</b>	<b>D7PQ10</b>	<b>D7MX10</b>	<b>D7MQ10</b>
1 N/C contact block	<b>D7PX01</b>	<b>D7PQ01</b>	<b>D7MX01</b>	<b>D7MQ01</b>
1 N/O and 1 N/C contact block	<b>D7PX11</b>	<b>D7PQ11</b>	<b>D7MX11</b>	<b>D7MQ11</b>

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

**NHP**

- D7PS / D7MS** Non illuminated short handle 2 position selector switch operators  
**D7PLS / D7MLS** Illuminated short handle 2 position selector switch operators

- Protection class IP 66
- Individually packaged
- 2 part ordering



**1** Dimensions in (mm)



D7P-SM22



D7M-SL22



D7P-LSM26



D7M-LSM25

Description	Non Illuminated Plastic Cat. No.	Non Illuminated Metal Cat. No.	Illuminated Plastic Cat. No.	Illuminated Metal Cat. No.
Stayput 60°	D7P-SM22	D7M-SM22	D7P-LSM2 <sup>1)</sup>	D7M-LSM2 <sup>1)</sup>
Stayput 90°	D7P-SN22	D7M-SN22	N/A	N/A
Spring return from Left 60°	D7P-SL22	D7M-SL22	D7P-LSL2 <sup>1)</sup>	D7M-LSL2 <sup>1)</sup>
Spring return from Right 60°	D7P-SR22	D7M-SR22	D7P-LSR2 <sup>1)</sup>	D7M-LSR2 <sup>1)</sup>

**Note:** <sup>1)</sup> Illuminated operators available in a choice of six different knob colours.

Green = 3, Red = 4, Yellow = 5, Blue. = 6, Clear = 7

**Example D7P-LSM24 = Red Knob**



**2**

**D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate

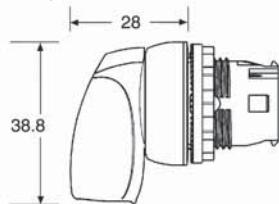
**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	D7PX10	D7PQ10	D7MX10	D7MQ10
1 N/C contact block	D7PX01	D7PQ01	D7MX01	D7MQ01
1 N/O and 1 N/C contact block	D7PX11	D7PQ11	D7MX11	D7MQ11
1 N/O and 1 N/C contact block and incandescent lamp block	D7PD <sup>2)</sup> CX11	D7PD <sup>2)</sup> CQ11	D7MD <sup>2)</sup> CX11	D7MD <sup>2)</sup> CQ11
1 N/O and 1 N/C contact block and integrated LED lamp block	D7PN <sup>2)</sup> <sup>3)</sup> X11	D7PQ <sup>2)</sup> <sup>3)</sup> Q11	D7MN <sup>2)</sup> <sup>3)</sup> X11	D7MQ <sup>2)</sup> <sup>3)</sup> Q11

**Notes:** <sup>1)</sup> Enter voltage 6 V AC/DC = 1, 12 V AC/DC = 2, 24 V AC/DC = 3, 48 V AC/DC = 4, 120 V AC/DC = 5, 240 V AC/DC = 7  
 Example D7PD3CX11 = 24 V AC/DC Incandescent lamp block, lamp ordered separately (24, 110, 240 available with LED)

<sup>2)</sup> Enter lamp colour **C** = clear (incandescent), **R** = Red LED, **G** = Green LED, **Y** = Yellow LED, **W** = White LED,  
**B** = Blue LED - Example D7PN3RX11 = 24V AC/DC RED integrated LED lamp block.

- Protection class IP 66
- Individually packaged
- 2 part ordering



**1** Dimensions in (mm)

### D7PH / D7MH

Non-illuminated long lever 2 position selector switch operators



D7P-HM22



D7M-HM22

Description	Non Illuminated Plastic Cat. No.	Non Illuminated Metal Cat. No.
Stayput 60°	D7P-HM22	D7M-HM22
Stayput 90°	D7P-HN22	D7M-HN22
Spring return from Left 60°	D7P-HL22	D7M-HL22
Spring return from Right 60°	D7P-HR22	D7M-HR22



**2**

**D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate

**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

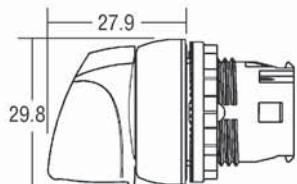
Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	D7PX10	D7PQ10	D7MX10	D7MQ10
1 N/C contact block	D7PX01	D7PQ01	D7MX01	D7MQ01
1 N/O and 1 N/C contact block	D7PX11	D7PQ11	D7MX11	D7MQ11

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

NHP

- D7PS / D7MS** Non-illuminated short lever 3 position selector switch operators  
**D7PLS / D7MLS** Illuminated short lever 3 position selector switch operators

- Protection class IP 66
- Individually packaged
- 2 part ordering



**1** Dimensions in (mm)

D7P-SM32

D7M-SL32

D7P-LSM36

D7M-LSM35

Description	Non Illuminated Plastic Cat. No.	Non Illuminated Metal Cat. No.	Illuminated Plastic Cat. No.	Illuminated Metal Cat. No.
Stayput 60°	<b>D7P-SM32</b>	<b>D7M-SL32</b>	<b>D7P-LSM3_ 1)</b>	<b>D7M-LSM3_ 1)</b>
Spring return from Left 60°	<b>D7P-SL32</b>	<b>D7M-SL32</b>	<b>D7P-LSL3_ 1)</b>	<b>D7M-LSL3_ 1)</b>
Spring return from Right 60°	<b>D7P-SR32</b>	<b>D7M-SR32</b>	<b>D7P-LSR3_ 1)</b>	<b>D7M-LSR3_ 1)</b>
Spring return from Left and Right 60°	<b>D7P-SB32</b>	<b>D7M-SB32</b>	<b>D7P-LSB3_ 1)</b>	<b>D7M-LSB3_ 1)</b>

**Note:** <sup>1)</sup> Illuminated operators available in a choice of six different knob colours.

Green = 3, Red = 4, Yellow = 5, Blue. = 6, Clear = 7

**Example D7P-LSM34 = Red Knob**



**D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate

**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

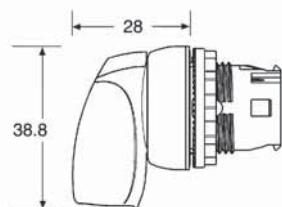
**2**

Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	<b>D7PX10</b>	<b>D7PQ10</b>	<b>D7MX10</b>	<b>D7MQ10</b>
1 N/C contact block	<b>D7PX01</b>	<b>D7PQ01</b>	<b>D7MX01</b>	<b>D7MQ01</b>
1 N/O and 1 N/C contact block	<b>D7PX11</b>	<b>D7PQ11</b>	<b>D7MX11</b>	<b>D7MQ11</b>
1 N/O and 1 N/C contact block and incandescent lamp block	<b>D7PD<sup>2</sup>)CX11</b>	<b>D7PD<sup>2</sup>)CQ11</b>	<b>D7MD<sup>2</sup>)CX11</b>	<b>D7MD<sup>2</sup>)CQ11</b>
1 N/O and 1 N/C contact block and integrated LED lamp block	<b>D7PN<sup>2</sup>)<sup>3</sup>X11</b>	<b>D7PQ<sup>2</sup>)<sup>3</sup>Q11</b>	<b>D7MN<sup>2</sup>)<sup>3</sup>X11</b>	<b>D7MQ<sup>2</sup>)<sup>3</sup>Q11</b>

**Notes:** <sup>2)</sup> Enter voltage 6 V AC/DC = 1, 12 V AC/DC = 2, 24 V AC/DC = 3, 48 V AC/DC = 4, 120 V AC/DC = 5, 240 V AC/DC = 7  
 Example D7PD3CX11 = 24 V AC/DC Incandescent lamp block, lamp ordered separately (24, 110, 240 available with LED)

<sup>3)</sup> Enter lamp colour **C** = clear (incandescent), **R** = Red LED, **G** = Green LED, **Y** = Yellow LED, **W** = White LED,  
**B** = Blue LED - Example D7PN3RX11 = 24V AC/DC RED integrated LED lamp block

- Protection class IP 66
- Individually packaged
- 2 part ordering



**1** Dimensions in (mm)

### D7PH / D7MH

Non illuminated long lever 3 position selector switch operators



Description	Non Illuminated Plastic Cat. No.	Non Illuminated Metal Cat. No.
Stayput 60°	D7P-HM32	D7M-HM32
Spring return from Left 60°	D7P-HL32	D7M-HL32
Spring return from Right 60°	D7P-HR32	D7M-HR32
Spring return from Left and Right 60°	D7P-HB32	D7M-HB32



**2**

**D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate

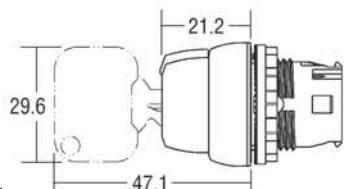
**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	D7PX10	D7PQ10	D7MX10	D7MQ10
1 N/C contact block	D7PX01	D7PQ01	D7MX01	D7MQ01
1 N/O and 1 N/C contact block	D7PX11	D7PQ11	D7MX11	D7MQ11

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

**NHP****D7PK / D7MK** Key operated 2 position selector switch operators

- Protection class IP 66
- Individually packaged
- 2 part ordering

**1**

Dimensions in (mm)



D7P-KM21

D7M-KL22

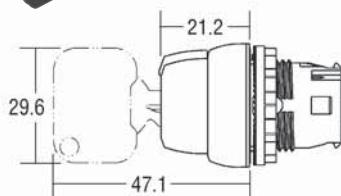
Description	Key Removable	Illuminated Plastic Cat. No.	Illuminated Metal Cat. No.
Stayput 60°	Key removable Left	D7P-KM21	D7M-KM21
	Key removable Right	D7P-KM22	D7M-KM22
	Key removable Both	D7P-KM23	D7M-KM23
Spring return from Left 60°	Key removable Right	D7P-KL22	D7M-KL22
Spring return from Right 60°	Key removable Left	D7P-KR21	D7M-KR21

**2**

**D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate  
**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	D7PX10	D7PQ10	D7MX10	D7MQ10
1 N/C contact block	D7PX01	D7PQ01	D7MX01	D7MQ01
1 N/O and 1 N/C contact block	D7PX11	D7PQ11	D7MX11	D7MQ11

- Protection class IP 66
- Individually packaged
- 2 part ordering



**1** Dimensions in (mm)

### D7PK / D7MK Key operated 3 position selector switch operators



D7P-KM33

D7P-KR31

Description	Key Removable	Illuminated Plastic Cat. No.	Illuminated Metal Cat. No.
Stayput 60°	Key removable Left	D7P-KM31	D7M-KM31
	Key removable Both	D7P-KM33	D7M-KM33
	Key removable Centre	D7P-KM34	D7M-KM34
	Key removable Left and Centre	D7P-KM35	D7M-KM35
Spring return from Left 60°	Key removable Centre	D7P-KL34	D7M-KL22
Spring return from Right 60°	Key removable Left	D7P-KR31	D7M-KR31
	Key removable Centre	D7P-KR34	D7M-KR34
	Key removable Left and Centre	D7P-KR35	D7M-KR35
Spring return from Left and right 60°	Key removable Left and Centre	D7P-KB34	D7M-KB34



**D7PX / D7PQ** Pre-assembled clip-on rear elements with plastic coupling plate  
**D7MX / D7MQ** Pre-assembled clip-on rear elements with metal coupling plate

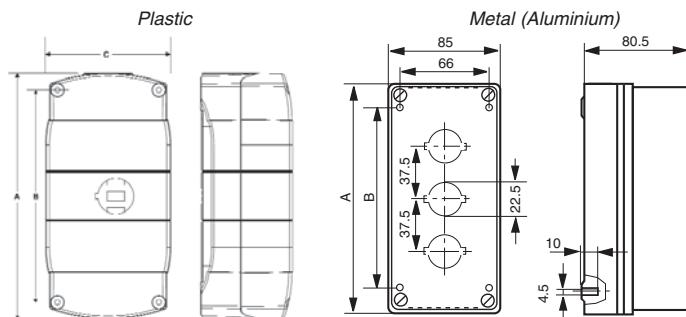
Description	Screw Cat. No.	Spring Clamp Cat. No.	Metal Screw Cat. No.	Metal Spring Clamp Cat. No.
1 N/O contact block	D7PX10	D7PQ10	D7MX10	D7MQ10
1 N/C contact block	D7PX01	D7PQ01	D7MX01	D7MQ01
1 N/O and 1 N/C contact block	D7PX11	D7PQ11	D7MX11	D7MQ11

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

**NHP****Enclosures**

Enclosures with 22.5 mm cut-outs

- Individually packaged



Dimensions in (mm)

No. of Units (Holes)	A	B
1	85	89
2	124	79
3	155	79
4 / 5	186	79
6	248	87



D7-3PM

D7-5MM

**Enclosures****No. of Cut-Outs****Plastic Cat. No.****Metal Cat. No.**Grey plastic enclosures <sup>1)</sup>

1 D7-1PM D7-1MM

Degree of protection IP 65 to IEC 529

2 D7-2PM D7-2MM

Water jet protected to SEV 3047

3 D7-3PM D7-3MM

Empty, with 22.5 mm ø holes and 2 cable entries

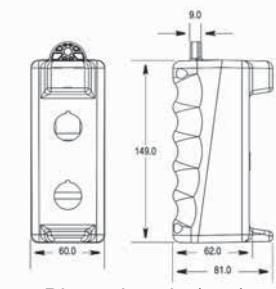
4 D7-4PM -

21.5 mm ø, top with knock-out, bottom with cable sleeve

5 - D7-5MM

Yellow plastic (as above)

6 D7-6MP -

1 D7-1YM - <sup>3)</sup>

Dimensions in (mm)



D7-P25

**Pendant Enclosures - Yellow Plastic <sup>2)</sup>****No. of Cut-Outs****Cat. No.**

1 Hole in Face

1 D7-P15

2 Holes in Face

2 D7-P25



D7-N2

**Blanking Plugs****Colour****Cat. No.**Round blanking plug (PG 16 mm) with grey fixing nut,  
used to fill 22.5 mm ø mounting holes and cable entry holes

Black

D7-N2

Grey

D7-N8

**Note:** <sup>1)</sup> Legend plates refer page 41-42.<sup>2)</sup> Buttons supplied separately, enclosures supplied without buttons.<sup>3)</sup> Yellow metal enclosure due late 2006.

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

- Back of panel components for base or panel mounting
- Each component supplied separately

**D7-ALP / D7-ALM**

Contact block coupling plates

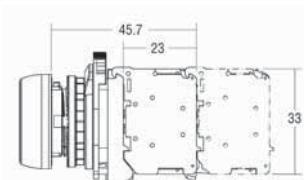
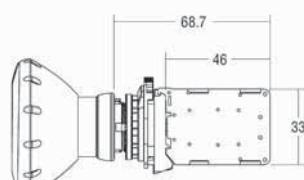
- Time saving snap-on twist to release operation
- Suitable for 3 contacts in one level
- Available in metal or plastic

**Description****Cat. No.**

Plastic coupling plate

**D7-ALP**

Metal coupling plate

**D7-ALM**

Dimensions in (mm)

**D7-X / D7-Q  
D7-BX / D7-BQ**

Panel mount contact blocks

Base mount contact blocks

- Option of screw or spring clamp termination
- Self-cleaning operation for long life
- Colour coded operators for easy identification
- Small dimensions
- Panel mount can be mounted to metal or plastic coupling plate



D7-X01S



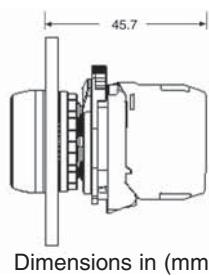
D7-X10V



D7-BX01V

<b>Description</b>	<b>Operator Colour</b>	<b>Panel Mount Cat. No.</b>	<b>Base Mount Cat. No.</b>
Normally open contact block	Green	D7-X10	D7-B10
Normally closed contact block	Red	D7-X01	D7-B01
Normally open contact block with spring clamp terminals	Green	D7-Q10	D7-BQ10
Normally closed contact block with spring clamp terminals	Red	D7-Q01	D7-BQ01
Normally open early make	Green	D7-X10E	D7-BX10E
Normally closed late break	Red	D7-X01L	D7-BX01L
Normally open low voltage (Quadfurcated gold contacts)	Blue	D7-X10V	D7-BX10V
Normally closed low voltage (Quadfurcated gold contacts)	Blue	D7-X01V	D7-BX01V
Dual circuit 2 normally open	Green	D7-X20D	N/A
Dual circuit 2 normally closed	Red	D7-X02D	N/A
Autobreak safety contact block for emergency stop operators	Yellow	D7-X01S	N/A

<b>D7-DOC / BDOC</b>	Incandescent lamp module for panel and base mount applications	• Back of panel components for base or panel mounting
<b>D7-N / D7-BN</b>	Integrated LED lamp module for panel and base mount applications <ul style="list-style-type: none"><li>• Supplied less coupling plate</li><li>• Option of screw or spring clamp termination <sup>3)</sup></li><li>• Self cleaning operation for long life</li><li>• Small dimensions</li><li>• High illumination qualities</li></ul>	• Each component supplied separately



Description	Colour	Panel Mount Cat. No.	Base Mount Cat. No.
Incandescent lamp module (without Ba9s lamp)		D7-DOC <sup>1)</sup>	-
Integrated LED module 24 V AC/DC <sup>2)</sup>	Yellow	D7-N3Y	D7-BN3Y
	Green	D7-N3G	D7-BN3G
	Red	D7-N3R	D7-BN3R
	Blue	D7-N3B	D7-BN3B
	White	D7-N3W	D7-BN3W
Integrated LED module 120 V AC/DC <sup>2)</sup>	Yellow	D7-N5Y	D7-BN5Y
	Green	D7-N5G	D7-BN5G
	Red	D7-N5R	D7-BN5R
	Blue	D7-N5B	D7-BN5B
	White	D7-N5W	D7-BN5W
Integrated LED module 240 V AC/DC <sup>2)</sup>	Yellow	D7-N7Y	D7-BN7Y
	Green	D7-N7G	D7-BN7G
	Red	D7-N7R	D7-BN7R
	Blue	D7-N7B	D7-BN7B
	White	D7-N7W	D7-BN7W

Spring - clamp termination is available for the integrated LED lamp block upon request.

Substitute **N** for **Q** in the catalogue number.

#### Example D7-Q3R

**Notes:** <sup>1)</sup> Ba9s lamps supplied separately. Refer page 31.

<sup>2)</sup> For best results LED should match lens colour.

<sup>3)</sup> Spring clamp terminations only available on integrated LED lamp block.

- For standard and extended pushbutton operators and pilot lights
- Each component supplied separately



## D7 22.5 mm CONTROL & SIGNALLING PRODUCTS

### Replacement Len's and colour caps

#### Coloured inserts



D7-AE5



D7-AF3

Description	To suit Extended operator Cat. No.	To suit Flush and Guarded operator Cat. No.
Non-illuminated inserts		
White	D7-AE1	D7-AF1
Black	D7-AE2	D7-AF2
Green	D7-AE3	D7-AF3
Red	D7-AE4	D7-AF4
Yellow	D7-AE5	D7-AF5
Blue	D7-AE6	D7-AF6



#### Lens caps



D7-ALF6



D7-ALE2



D7-AP5

Description	To suit Flush operator Cat. No.	To suit Extended Guarded operator Cat. No.	To suit Pilot Light operator Cat. No.
Illuminated lens cap and pilot light lenses			
Green	D7-ALF3	D7-ALE1	D7-AP3
Red	D7-ALF4	D7-ALE2	D7-AP4
Yellow	D7-ALF5	D7-ALE3	D7-AP5
Blue	D7-ALF6	D7-ALE4	D7-AP6
Clear	D7-ALF7	D7-ALE5	D7-AP7

#### Diffuser for illuminated pushbuttons and pilot lights



D7-AD2



D7-AD4



D7-AD3

Description	To suit Flush operator Cat. No.	To suit Extended Guarded operator Cat. No.	To suit Pilot Light operator Cat. No.
Spare lens diffuser	D7-AD2	D7-AD4	D7-AD3

**Spare lamps**

- Incandescent, multi-cluster LED and neon lamps
- Each component supplied separately

**Incandescent lamps for pilot lights**

Ba9s style for full voltage lamp block  
D7-DOC



Voltage	Typical Current	1.2 Watt Cat. No.	2 Watt Cat. No.
6 V	150 mA	BA9S-I3-6V-1.2W	BA9S-I3-6V-2W
12 V	80 mA	BA9S-I3-12V-1.2W	BA9S-I3-12V-2W
24 V	70 mA	BA9S-I3-24V-1.2W	BA9S-I3-24V-2W
36 V	60 mA	BA9S-I3-36V-1.2W	BA9S-I3-36V-2W
48 V	50 mA	BA9S-I3-48V-1.2W	BA9S-I3-48V-2W
60 V	22 mA	BA9S-I3-60V-1.2W	BA9S-I3-60V-2W

**Neon lamps**

Ba9s style for full voltage lamp block D7-DOC



Voltage	Typical Current	Cat. No.
110 V...127 V Clear	22 mA	BA9S-CN3-110V
220 V...240 V Clear	22 mA	BA9S-CN3-240V

**Multi-Cluster LED lamp Ba9s style**

**Ultra bright extended life (typical 50,000 + hours) multi-cluster Ba9s style.**

Available in White (WL), Red (RL), Green (GL), Yellow (YL), Blue (BL)  
eg: Ba9s-WL-8VACDCM



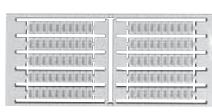
Voltage	Typical Current	Cat. No. <sup>1)</sup>	Ultra Bright Style Cat. No. <sup>1)</sup>
8 V AC/DC	72 mA	BA9S- _ -8VACDCM	
12 V AC/DC	20 mA	BA9S- _ -12VACDCM	
24 V AC/DC	20 mA	BA9S- _ -24VACDCM	BA9S- _ -24VACDC
48 V AC/DC	20 mA	BA9S- _ -48VACDCM	BA9S- _ -48VACDC
110 V AC/DC	4.8 mA	BA9S- _ -110VACM	BA9S- _ -110VAC
240 V AC/DC	2.5 mA	BA9S- _ -240VACM	BA9S- _ -240VAC

Notes: <sup>1)</sup> Add colour code (shown above) to Cat. No.

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

**General accessories**

Description	Cat. No.
<b>Adaptor</b>	
Allows a 22.5 mm pushbutton operator to be installed into a panel with existing 30.5 mm mounting hole	Shiny metal IP 66 <b>D7-AHA1</b>
<b>Lock nuts</b>	
For fixing front elements	Plastic <b>D7-ARP</b>
	Metal <b>D7-ARM</b>
Mounting ring tool	Plastic <b>D7-AW2</b>
<b>Lens / lamp removal tool</b>	
To remove incandescent lamps or neon lamps and for fixing the lens	Plastic <b>D7-ALR1</b>
<b>Anti-rotation washer</b>	
Metal	<b>D7-ALC1</b>
<b>Snap-in contact marker (Blank)</b>	
For circuit identification of back of panel components (card 100) (Marking available).	<b>V7-SM5X9</b>
<b>85 mm Protective guard yellow</b>	
Suit 40 + 60 mm illuminated and non-illuminated Emergency Stop	<b>D7-A6PR5</b>
<b>Emergency stop rings</b>	
-	Blank 60 mm diameter <b>D7-15Y</b>
-	Blank 90 mm diameter <b>D7-16Y</b>
Printed "Emergency Stop"	60 mm diameter <b>D7-15YE112</b>
Printed "Emergency Stop"	90 mm diameter <b>D7-16YE112</b>
<b>Sealing caps</b>	
For flush pushbuttons	IP 66 <b>D7-AB7</b>
For multi-function operators	Flush IP 66 <b>D7-AB3</b>
	Pos. A extended IP 66 <b>D7-AB2</b>
	Pos. B extended IP 66 <b>D7-AB1</b>



**General accessories**

D7-ABJS

Description	Cat. No.
Replacement Boot for Joystick operator	Silicone <b>D7-ABJS</b>



D7-N2

Hole Plug used to plug 22.5 mm holes	Black plastic	<b>D7-N2</b>
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D7-30WN

Potentiometer Legend Plate scale 1-10	-	<b>D7-30WN</b>
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**Note:** Sold in multiples of 10.

Order (quantity of) 10 to receive one packet of 10 pieces



D7-30WG

Potentiometer Legend Plate	-	<b>D7-30WG</b>
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Graphical scale

**Note:** Sold in multiples of 10.

Order (quantity of) 10 to receive one packet of 10 pieces



D7-AC3

	Resistance	Cat. No.
Replacement Resistive Elements for the 800FP Potentiometer operator	150 Ω	<b>D7-AC1</b>
	500 Ω	<b>D7-AC2</b>
	1000 Ω	<b>D7-AC3</b>
	2500 Ω	<b>D7-AC4</b>
	5000 Ω	<b>D7-AC5</b>
	10000 Ω	<b>D7-AC6</b>

- Type 304 stainless steel <sup>2)</sup>

## D7 22.5 mm CONTROL & SIGNALLING PRODUCTS

### Padlocking attachments



D7-AFL1

Description	Cat. No.
<b>Padlocking attachments for pushbutton operators</b>	
Flush standard padlocking attachment <sup>1)</sup>	D7-AFL1



D7-AEL1

Extended standard padlocking attachment <sup>1)</sup>	D7-AEL1
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D7-AML2

Mushroom padlocking attachments <sup>1)</sup>	
For 40 mm Mushroom operators	D7-AML1
For 40 mm Emergency Stop operators	D7-AML2



D7-AL01

Locking cover	D7-AL01
For use on flush, extended, guarded and latched pushbuttons, short knob selector switches and potentiometer operators	



D7-AMRG

40 mm protective ring	D7-AMRG
For use on 2 position push-pull operators only	



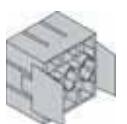
D7-ASL3C

<b>Selector switch padlocking attachment</b>	
Left lock position	D7-ASL2L
Centre lock position	D7-ASL3C

**Note:** <sup>1)</sup> When the operator is activated

- N/C contacts are held open.
- N/O contacts may or may not be held open.
- N/C.L.B. contacts may or may not be held closed.
- N/O.E.M. contacts are held closed.

## General accessories

	Description	Cat. No.
D7-ALP	 <b>Plastic Coupling Plate</b> <b>Note:</b> Sold only in multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces.	D7-ALP
D7-ALM	 <b>Metal Coupling Plate</b> These are zinc-plate, metal die cast coupling plates. <b>Note:</b> Sold only in multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces.	D7-ALM
D7-AGS1	 <b>Ground Screws</b> These are self-tapping #6-32 (M3.5) ground screws for metal coupling plates. <b>Note:</b> Sold only in multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces.	D7-AGS1
D7-ATK2	 <b>Stab Terminals</b> <b>Note:</b> Sold only in multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces.	D7-ATK2
D7-AGS2	 <b>Ground Screws</b> This accessory is used for grounding on D7 plastic enclosures only.	D7-AGS2
D7-ATW1	 <b>Replacement Trim Washer</b> This accessory comes standard with all enclosures. It must be utilised if using base-mounted contact blocks/power modules without legend plates.	D7-ATW1
D7-A3BA	 <b>Replacement Base Mount Adaptor</b> This accessory comes standard with all metal enclosures. It is required when using metal enclosures with base-mounted contact blocks or base-mounted power modules.	D7-A3BA
	Description	Ronis Key
	<b>Replacement Ronis Key</b> Standard replacement key is <b>Cat. No. D7-AKR3825</b>	3825
		455
		3801
		3802
		3803
		3804
		3805
		3806
		4001
		4002
		4003
		4004
		4005
		4006
		4007

**Laser-Engraved Caps and Diffusers****Standard Text / Symbols Configurator 1, 2, 3**

D7 - A	F	3	C	E 166
Type		Colour	Suffix No.	
<b>Code</b>		<b>Code</b>		
<b>E</b>	Pushbutton extended cap	<b>1</b>	White	See pages 37 for laser engraved text / symbol options. Insert suffix code Exx / Uxx as shown.
<b>F</b>	Pushbutton flush cap	<b>2</b>	Black	
<b>FAU</b>	Multi-function flush cap (for bottom cap)	<b>3</b>	Green	
<b>EAU</b>	Multi-function extended cap (for bottom cap)	<b>4</b>	Red	
<b>FCU</b>	Multi-function flush cap (for top cap)	<b>5</b>	Yellow	
<b>ECU</b>	Multi-function extended cap (for top cap)	<b>6</b>	Blue	
<b>D</b>	Pilot light diffuser	<b>3</b>	Default code for pilot light diffusers	
<b>D</b>	Illuminated pushbutton diffuser, flush	<b>2</b>	Default code for flush diffusers	
<b>D</b>	Illuminated pushbutton diffuser, extended	<b>4</b>	Default code for extended diffusers	

**Ordering Information for Standard Text / Symbols**

1. Select the Cat. No. for the appropriate product type and colour from the Configurator Table on this page.
  2. Complete the Cat. No. by adding the appropriate suffix no. selected from pages per letter.
  3. List price for non-standard text / symbols, laser engraved caps and diffusers, per letter.
- Example: **Cat. No. D7-AF3CE166** identifies a pushbutton flush cap, green cap with laser engraved text "ON".

**Customer Laser-Engraved Caps and Diffusers Form 2 / 3**

Customer: _____	Date: _____	
Quantity: _____	Delivery Date: _____	Cust. Order No. _____
<b>Customer Laser-Engraved Caps and diffusers - (3 steps required)</b>		
<b>Step 1 - Insert Type code from the table: (example "E", Pushbutton extended cap)</b>		
<input type="text"/> <input type="text"/> <input type="text"/>	Type code	
<b>Step 2 - Insert Colour code from the table: (example "4", Red cap)</b>		
<input type="text"/>	Colour/Diffuser code	
<b>Step 3 - Enter quantity and customer text:</b>		
Qty: _____	Small font size, 12 pt.	Line 1 <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Qty: _____	Standard font size, 16 pt.	Line 1 <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Qty: _____	Large font size, 20 pt.	Line 1 <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>

**Notes:** 1. Package quantity of one for all standard laser-engraved caps and diffusers.

2. Standard font is Arial Narrow.

3. Font size is automatically determined by the number of characters. Seven characters maximum allowable.

### Standard Engraved

#### Pushbutton inserts and diffusers with text

Description	Cat. No. Flush Non Illuminated	Cat. No. Extended Non Illuminated	Cat. No. Diffuser for Flush Illum. Pushbutton	Cat. No. Diffuser for Extended Illum. Pushbutton	Cat. No. Diffuser for Pilot Light
START	D7-AF_CE208	D7-AF_CE208	D7-AD2CE208	D7-AD4CE208	D7-AD3CE208
STOP	D7-AF_CE212	D7-AF_CE212	D7-AD2CE212	D7-AD4CE212	D7-AD3CE212
ON	D7-AF_CE166	D7-AF_CE166	D7-AD2CE166	D7-AD4CE166	D7-AD3CE166
OFF	D7-AF_CE163	D7-AF_CE163	D7-AD2CE163	D7-AD4CE163	D7-AD3CE163
I	D7-AF CU229	D7-AF CU229	D7-AD2CE229	D7-AD4CE229	D7-AD3CE229
O	D7-AF CU228	D7-AF CU228	D7-AD2CE228	D7-AD4CE228	D7-AD3CE228
RESET	D7-AF_CE186	D7-AF_CE186	D7-AD2CE186	D7-AD4CE186	D7-AD3CE186
R	D7-AF CU924	D7-AF CU924	D7-AD2CE924	D7-AD4CE924	D7-AD3CE924
UP	D7-AF_CE223	D7-AF_CE223	D7-AD2CE223	D7-AD4CE223	D7-AD3CE223
DOWN	D7-AF_CE110	D7-AF_CE110	D7-AD2CE110	D7-AD4CE110	D7-AD3CE110
OPEN	D7-AF_CE110	D7-AF_CE110	D7-AD2CE170	D7-AD4CE170	D7-AD3CE170
CLOSE	D7-AF_CE107	D7-AF_CE107	D7-AD2CE107	D7-AD4CE107	D7-AD3CE107
RAISE	D7-AF_CE182	D7-AF_CE182	D7-AD2CE182	D7-AD4CE182	D7-AD3CE182
LOWER	D7-AF_CE152	D7-AF_CE152	D7-AD2CE152	D7-AD4CE152	D7-AD3CE152
RIGHT	D7-AF_CE191	D7-AF_CE191	D7-AD2CE191	D7-AD4CE191	D7-AD3CE191
LEFT	D7-AF_CE145	D7-AF_CE145	D7-AD2CE145	D7-AD4CE145	D7-AD3CE145
FORWARD	D7-AF_CE120	D7-AF_CE120	D7-AD2CE120	D7-AD4CE120	D7-AD3CE120
REVERSE	D7-AF_CE188	D7-AF_CE188	D7-AD2CE188	D7-AD4CE188	D7-AD3CE188
FAST	D7-AF_CE114	D7-AF_CE114	D7-AD2CE114	D7-AD4CE114	D7-AD3CE114
SLOW	D7-AF_CE210	D7-AF_CE210	D7-AD2CE201	D7-AD4CE201	D7-AD3CE201
RUN	D7-AF_CE193	D7-AF_CE193	D7-AD2CE193	D7-AD4CE193	D7-AD3CE193
TEST	D7-AF_CE219	D7-AF_CE219	D7-AD2CE219	D7-AD4CE219	D7-AD3CE219
AUTO	D7-AF_CE219	D7-AF_CE219	D7-AD2CE101	D7-AD4CE101	D7-AD3CE101

#### Spare Blank diffusers for pilot lights and illuminated pushbuttons

Description	Diffuser for Flush Illum. Pushbutton Cat. No.	Diffuser for Extended Illum. Pushbutton Cat. No.	Diffuser for Pilot Light Cat. No.
Blank	D7-AD2	D7-AD4	D7-AD3

**Notes:**

1. Not all combinations are held in stock. Indent items are engraved to order allow 1-2 days.
2. Supplied with white engraving (black with white lettering). Add insert colour code as follows eg: D7-AF3CE208 is green.
3. Diffusers are supplied clear with black lettering.

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

## Engraving / Legend plates and colour caps

For standard multi-function operators <sup>1)</sup>

Description	Pos. C Green symbol white text Cat. No.	Pos. A Green symbol white text Cat. No.	Pos. A Red symbol white text Cat. No.	Pos. A Red symbol white text Cat. No.
→	D7-AFAU3CU700			
←		D7-AFAU3CU700		
+	D7-AFAU3CU730	D7-AFAU3CU730		
-	D7-AFAU3CU731	D7-AFAU3CU731		
I	D7-AFAU3CU909	D7-AFAU3CU909		
II	D7-AFAU3CU602	D7-AFAU3CU602		
↑	D7-AFAU3CU712			
↓		D7-AFAU3CU713		
O			D7-AEAU4CU910	D7-AEAU4CU910
UP	D7-AFAU3CU223			
DOWN		D7-AFAU3CU110		
RIGHT	D7-AFAU3CU191			
LEFT		D7-AFAU3CU145		
FORWARD	D7-AFAU3CU120			
REVERSE		D7-AFAU3CU188		
START	D7-AFAU3CU208			
STOP			D7-AEAU4CU212	D7-AEAU4CU212

## Legend plates with symbol

Description	Plastic black, inscription white, for legend plate carrier D7-110 30 x 40 mm <sup>2)</sup> Cat. No.	Plastic black, inscription white, for legend plate carrier D7-RO 30 x 50 mm <sup>3)</sup> Cat. No.	Aluminium, inscription black, for legend plate carrier D7-120 & D7-200 30 x 50 mm <sup>4)</sup> Cat. No.
O . I	D7-17BU231	D7-18BU231	D7-18AU231
I II	D7-17BU229	D7-18BU229	D7-18AU229
I O II	D7-17BU234	D7-18BU234	D7-18AU234
O I	D7-17BU255	D7-18BU255	D7-18AU255
← O I	D7-17BU252	D7-18BU252	D7-18AU252
← O →	D7-17BU253	D7-18BU253	D7-18AU253
O →	D7-17BU256	D7-18BU256	D7-18AU256

Notes: <sup>1)</sup>). Operators, refer page 15.

<sup>2)</sup>). Legend plate size 27 x 6 mm.

<sup>3)</sup>). Legend plate size 27 x 16 mm.

<sup>4)</sup>). Legend plate size 26 x 15 mm.

**Legend plates**

Dimensions	Component	Description	Cat. No.
		<b>Legend Plate Frame</b> 30 x 40 mm	D7-110
		<b>Legend Plate Frame</b> 30 x 50 mm	D7-120
		<b>Legend Plate Frame</b> (for use with multi-function operator) 30 x 60 mm	D7-110
		<b>Legend Plate Frame</b> (for use with multi-function operator) 50 x 50 mm	D7-110
		<b>Legend Plate (blank)</b> 30 x 40 mm White plastic Black plastic Aluminium	D7-34WE100 D7-34BE100 D7-34AE100
		<b>Legend Plate (blank)</b> 30 x 50 mm White plastic Black plastic Aluminium	D7-35WE100 D7-35BE100 D7-35AE100
<b>HAND OFF AUTO</b>		<b>Legend Plate - for D7-110</b> <b>Legend Plate Frame 30 x 40 mm</b> White with black text Black with white text Aluminium with black text	1) D7-17WE100 D7-17BE100 D7-17AE100
<b>OFF HAND AUTO</b>		<b>Legend Plate - for D7-120 &amp; D7-200</b> <b>Legend Plate Frame 30 x 50 mm</b> White with black text Black with white text Aluminium with black text	1) D7-18WE100 D7-18BE100 D7-18AE100
<b>START</b>		<b>Legend Plate - for D7-400</b> <b>Legend Plate Frame</b> <sup>2)</sup> White with black text Black with white text Aluminium with black text	1) D7-42WE100 D7-42BE100 D7-42AE100

Note: 1) Supplied blank refer to page 40 - 41 for available legends.

2) Three snap-in legend plates are required for each D7-400 legend plate frame.

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

## Custom legend plates

## D7 Custom Legend Plate ordering Form (for text/symbols not found on other pages)

Customer: _____	Date: _____	
Quantity: _____	Delivery Date: _____	Cust. Order No. _____
<b>Customer Legend Plate Ordering Instructions - (3 steps required)</b>		
<b>Step 1 - Check legend frame type:</b> 2-piece legend frames <input type="checkbox"/> D7-110 <input type="checkbox"/> D7-120 <input type="checkbox"/> D7-200 <input type="checkbox"/> D7-400 1-piece legend plate <input type="checkbox"/> D7-34... <input type="checkbox"/> D7-35...		
<b>Step 2 - Check legend plate type:</b> <input type="checkbox"/> White with black type <input type="checkbox"/> Black with white type <input type="checkbox"/> Aluminium		
<b>Step 3 - Enter quantity and custom text:</b> <i>See table below for maximum lines/characters per selected legend plate in Step 1:</i>		
Qty: _____ Small font size, 0.08"	Line 1	<table border="1" style="width: 100px; height: 15px;"> </table>
	Line 2	<table border="1" style="width: 100px; height: 15px;"> </table>
	Line 3	<table border="1" style="width: 100px; height: 15px;"> </table>
	Line 4	<table border="1" style="width: 100px; height: 15px;"> </table>
	Line 5	<table border="1" style="width: 100px; height: 15px;"> </table>
Qty: _____ Standard font size, 0.10"	Line 1	<table border="1" style="width: 100px; height: 15px;"> </table>
	Line 2	<table border="1" style="width: 100px; height: 15px;"> </table>
	Line 3	<table border="1" style="width: 100px; height: 15px;"> </table>
Qty: _____ Large font size, 0.14"	Line 1	<table border="1" style="width: 100px; height: 15px;"> </table>
	Line 2	<table border="1" style="width: 100px; height: 15px;"> </table>
	Line 3	<table border="1" style="width: 100px; height: 15px;"> </table>

Font Size	One-Piece			Two-Piece			Special Multi-Function	
	Max. Char. per Line	Max. No. of Lines		Max. Char. per Line	Max. No. of Lines		Max. Char. per Line	Max. No. of Lines ( D7-400 <sup>1)</sup> )
		D7-34...	D7-35...		D7-110	D7-120 & D7-200		
Small, size 0.08"	16	2	5	15	2	5	7	3
Standard, size 0.10"	14	2	3	13	1	3	6	3
Large, size 0.14"	10	1	3	9	1	3	4	2



Note: 1). Three snap-in legend plates are required for each D7-400 legend plate frame.



**Engraving / legend plates with text**

Description	Plastic black, inscription white, for legend plate carrier D7-110 30 x 40 mm <sup>1)</sup>	Plastic black, inscription white, for legend plate carrier D7-120 30 x 50 mm <sup>2)</sup>	Aluminium, inscription black, for legend plate carrier D7-150 & D7-200 30 x 50 mm <sup>3)</sup>
AUTO	D7-17BE101	D7-18BE101	-
CLOSE	D7-17BE107	D7-18BE107	-
DOWN	D7-17BE110	D7-18BE110	-
EMERGENCY STOP	D7-17BE112	D7-18BE112	-
FAULT	D7-17BE113	D7-18BE113	-
FAST	D7-17BE114	D7-18BE114	-
FORWARD	D7-17BE120	D7-18BE120	-
HAND	D7-17BE126	D7-18BE126	-
HIGH	D7-17BE129	D7-18BE129	-
IN	D7-17BE132	D7-18BE132	-
INCH	D7-17BE134	D7-18BE134	-
JOG	D7-17BE138	D7-18BE138	-
LEFT	D7-17BE145	D7-18BE145	-
LOW	D7-17BE148	D7-18BE148	-
LOWER	D7-17BE152	D7-18BE152	-
OFF	D7-17BE163	D7-18BE163	-
ON	D7-17BE166	D7-18BE166	-
OPEN	D7-17BE170	D7-18BE170	-
OUT	D7-17BE173	D7-18BE173	-
RAISE	D7-17BE182	D7-18BE182	-
REVERSE	D7-17BE188	D7-18BE188	-
RIGHT	D7-17BE191	D7-18BE191	-
SLOW	D7-17BE201	D7-18BE201	-
START	D7-17BE208	D7-18BE208	-
STOP	D7-17BE212	D7-18BE212	-
UP	D7-17BE223	D7-18BE223	-
I O AUTO	D7-17BU250	D7-18BU250	D7-30AU250
HAND O AUTO	D7-17BU251	D7-18BU251	D7-30AU251
MAN O AUTO	D7-17BE238	D7-18BE238	D7-30AE238
ON OFF AUTO	D7-17BE300	D7-18BE300	D7-30AE300
MAN AUTO	D7-17BE301	D7-18BE301	D7-30AE301
HAND AUTO	D7-17BE127	D7-18BE127	D7-30AE127
FROW. OFF REV.	D7-17BE261	D7-18BE261	D7-30AE261
SET-UP RUN	D7-17BE302	D7-18BE302	D7-30AE302
FROW. REV.	D7-17BE303	D7-18BE303	D7-30AE303
UP DOWN	D7-17BE224	D7-18BE224	D7-30AE224
OFF ON	D7-17BE165	D7-18BE165	D7-30AE165
STOP START	D7-17BE305	D7-18BE305	D7-30AE305
BLANK LEGEND PLATE	D7-17BE100	D7-18BE100	D7-30AE100

Notes:

<sup>1)</sup> Legend plate size 27 x 6 mm.<sup>2)</sup> Legend plate size 27 x 16 mm.<sup>3)</sup> Legend plate size 26 x 15 mm.

## D7 22.5 mm CONTROL &amp; SIGNALLING PRODUCTS

## Engraving / legend plates with text

Description	Plastic black, inscription white, for legend plate carrier D7-110 30 x 40 mm <sup>1)</sup> )	Plastic black, inscription white, for legend plate carrier D7-120 30 x 50 mm <sup>2)</sup> )		
HIGH	LOW	D7-17BE130		
INCH	REVERSE	D7-17BE135		
JOG	FORWARD	D7-17BE255		
JOG	REVERSE	D7-17BE256		
JOG	RUN	D7-17BE142		
LEFT	RIGHT	D7-17BE146		
OFF	ON	D7-17BE165		
OPEN	CLOSE	D7-17BE171		
RAISE	LOWER	D7-17BE183		
SLOW	FAST	D7-17BE204		
UP	DOWN	D7-17BE224		
FORWARD	STOP	REVERSE	D7-17BE254	D7-18BE254
HAND	OFF	AUTO	D7-17BE128	D7-18BE128
JOB	STOP	RUN	D7-17BE144	D7-18BE144
FORWARD	OFF	REVERSE	D7-17BE261	D7-18BE261
LOW	OFF	HIGH	D7-17BE150	D7-18BE150
RAISE	OFF	LOWER	D7-17BE184	D7-18BE184
SLOW	OFF	FAST	D7-17BE205	D7-18BE205
SLOW	OFF	START	D7-17BE207	D7-18BE207

Notes:      <sup>1)</sup>) Legend plate size 27 x 6 mm.  
<sup>2)</sup>) Legend plate size 27 x 16 mm.

**Front-of-Panel (Operators) (1)**

<b>Mechanical Ratings</b>		
Description	Plastic (D7P)	Metal (D7M)
Vibration (assembled to panel)	(G) Tested at 10...2000 Hz, 1.52 mm displacement (peak-to-peak) max./G max. for 3 hr duration, no damage	
Shock	(G) Tested at 1/2 cycle sine wave for 11 ms; no damage at 100 G	
Degree of protection <sup>2)</sup>	UL Type 3/3R/4/4X/12/13 (IP 65/66)	UL Type 3/3R/4/12/13 (IP 65/66)
Mechanical durability per EN 60947 (Annex C)	10,000,000 Cycles 1,000,000 Cycles 500,000 Cycles 300,000 Cycles	Pushbuttons, momentary mushroom Multi-function Push-pull mushroom E-stops, selector switches
Operating forces (typical with one contact block)	(N)	Flush/extended = 5N E-stop = 36N Mushroom = 9N
Operating torque (typical application with one contact block) (N-m)		Selector switch = 0.25 N-m
<b>Environmental</b>		
Temperature range (operating) <sup>3)</sup>	(°C)	-25...+70 °C (-13...+158 °F)
Temperature range (short-term storage)	(°C)	-25...+85 °C (-13...+185 °F)
Humidity	(%) 50...95 % RH from 25...60 °C (77...140 °F) per: procedure IV of MIL-STD-810C, Method 507.1 cycling test	

**Back-of-Panel Components <sup>1)</sup>**

<b>Electrical Ratings</b>		
Standard contact block rating		A600, Q600 600 V AC AC 15, DC 13 to EN 60947-5-1 and UL 508, 17 V, 5 mA min.
Low voltage contact block <sup>4)</sup>		5 V, 1 mA DC min. C300, R150, AC 15, DC 13 to EN 60947-5-1 and UL 508
Thermal current	(A)	10 A max. enclosed (40 °C ambient) to UL 508, EN 60947-5-1
Wire capacity		#18...12 AWG (0.75...2.5 mm <sup>2</sup> ) Max. (2) #14 AWG or (1) #12 AWG
Screw terminal	(AWG)	
Spring-clamp terminal	(AWG)	#18...14 AWG (0.75...1.5 mm <sup>2</sup> )
Insulation voltage	(Ui)	Ui = 680 V (screw terminal) Ui = 300 V (screwless terminal)
Dielectric strength (minimum)		(V) 2200 V for one minute
External short circuit protection	Standard blocks Low voltage contact blocks	10 A type gL/gG cartridge fuse to EN 60269-2-1 or gN (Class J to UL 248-8 or Class C to UL 348-4) 6 A type gL/gG cartridge fuse to EN 60269-2-1 or gN (Class J to UL 248-8 or Class C to UL 348-4)
Electrical shock protection		Finger-safe conforming to IP2X

<b>Mechanical Ratings</b>		
Vibration (assembled to panel)	(G)	10...2000 Hz, 1.52 mm displacement (peak-to-peak) max./10 G max. 6 hr
Shock	(G)	Tested at 1/2 cycle sine wave for 11 ms and no damage at 100 G max.
Contact durability per EN 60947-5-1 (Annex C)		10,000,000 cycles
Contact operation	NO NC NOEM NCLB	Slow make, double break Slow make, double break (positive opening) Early make, double break Late break, double break (positive opening)
Opening forces (typical)	(N)	3.4 N: each single circuit contact block 5...6.6 N: each dual circuit contact block

**Notes:** <sup>1)</sup> Performance data given in this publication is provided only as a guide for the user in determining suitability and do not constitute a performance warranty of any kind. Such data may represent the results of accelerated testing at elevated stress levels, and the user is responsible for correlating the data to actual application requirements.

ALL WARRANTIES AS TO ACTUAL PERFORMANCE, WHETHER EXPRESS OR IMPLIED, ARE EXPRESSLY DISCLAIMED.

<sup>2)</sup> Momentary mushroom operators are IP 65, multi-function operators have no Type 13 rating. Plastic operators with keys have no Type 4X rating.

<sup>3)</sup> Operating temperatures below 0 °C (32 °F) are based on the absence of freezing moisture and liquids.

<sup>4)</sup> Low voltage contacts are recommended for applications below 17 V, 5 mA.

**Back-of-Panel Components<sup>1)</sup>, continued**

<b>Illumination</b>	<b>Plastic (D7P)</b>		<b>Metal (D7M)</b>		
LED dominant wavelength	Green Red Yellow Blue White	(nm)	525 nm 629 nm 590 nm 470 nm		
LED luminous intensity	Green Red Yellow Blue White	(mcd)	890 mcd 890 mcd 690 mcd 193 mcd 412 mcd		
Incandescent maximum wattage		(W)	1 W		
<b>Environmental</b>					
Temperature range (operating) <sup>2)</sup>		(°C)	-25...+70 °C (-13...+158 °F)		
Temperature range (short-term storage)		(°C)	-25...+85 °C (-13...+185 °F)		
Humidity	(%)	tested at 50...95 % relative humidity from 25...60 °C (77...140 °F) per: procedure IV of MIL-STD-810C, Method 507.1 cycling test			
<b>Materials</b>					
Springs	Stainless steel and zinc coated music wire				
Electrical contacts	Standard Low voltage	Silver-nickel Gold-plated over silver			
Terminals	Screw Screwless	Brass Silver-plated copper			

**Environmental Approval Note:** Front elements UL Recognised; Complete assemblies UL Approved.

See Table A2 (below) for your application.

This table is extracted from Sprecher + Schuh's UL 508A file and can be used to determine which D7 Pilot Device is approved for a particular enclosure type.

<b>TABLE A2 - Openings in Enclosure</b>	
Enclosure Type	Openings May Be Closed By Equipment Marked...
2	2, 3, 3R, 3S, 4, 4X, 6, 6P, 11, 12, 12K, 13
3	3, 3R, 3S, 4, 4X, 6, 6P
3R	3, 3R, 3S, 4, 4X, 6, 6P
3S	3, 3R, 3S, 4, 4X, 6, 6P
4	4, 4X, 6, 6P
4X	4X
6	6, 6P
6P	6P
11	11
12, 12K	12, 12K, 13
13	13

**Product Certification**

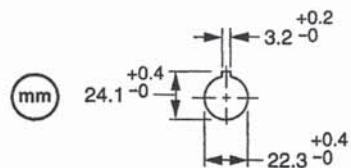
Certifications	UL, UR, CSA, CCC, CE
Standards	NEME ICS-5; UL 508, EN 418, EN 60947-1, EN 60947-5-1, EN 60947-5-5
Terminal Identification	IEC 60947-1
Shipping Approvals	RINA, LR, ABS

**Notes:** <sup>1)</sup> Performance data given in this publication is provided only as a guide for the user in determining suitability and do not constitute a performance warranty of any kind. Such data may represent the results of accelerated testing at elevated stress levels, and the user is responsible for correlating the data to actual application requirements. ALL WARRANTIES AS TO ACTUAL PERFORMANCE, WHETHER EXPRESS OR IMPLIED, ARE EXPRESSLY DISCLAIMED.

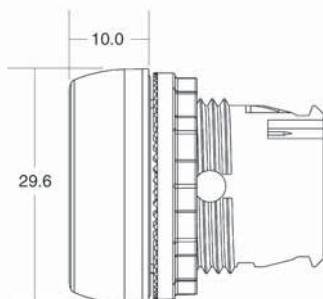
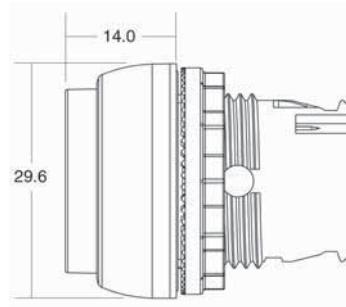
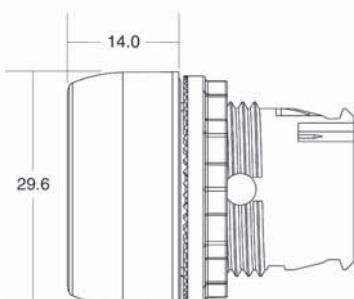
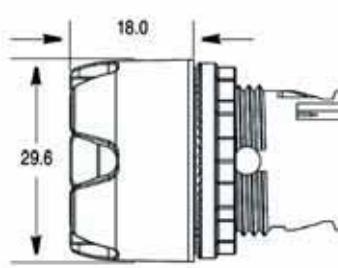
<sup>2)</sup> Operating temperatures below 0 °C (32 °F) are based on the absence of freezing moisture and liquids.

**Material Listing**

Component	For Use With	Material Used
Panel gasket	All operators	Nitrile
Diaphragm seal	Illuminated pushbutton, non-illuminated pushbutton	Automotive acceptable silicone
K-seal	Selector switch, key selector switch, push/twist-to-release E-stop, key E-stop, push/pull mushroom	Nitrile
Diaphragm retainer, return spring I	Illuminated pushbutton, non-illuminated pushbutton, momentary mushroom, push/twist-to-release E-stop, key E-stop, push/pull mushroom	Stainless steel
Return spring II	Reset, selector switch, key selector switch	Zinc coated music wire
Button cap/mushroom head	Non-illuminated pushbutton, momentary mushroom, reset, push/twist-to-release E-stop, key E-stop, push/pull mushroom, multi-function	PBT/polycarbonate blend
2-colour moulded button insert	Non-illuminated pushbutton	PBT/polycarbonate blend
Lens	Multi-function	Acetal
Lens, knob	Illuminated pushbutton, illuminated momentary mushroom, illuminated selector switch	Polyamide
Plastic bezel/bushing I	Non-illuminated pushbutton, illuminated pushbutton, momentary mushroom, selector switch, key selector switch, push/twist-to-release E-stop, key E-stop, push/pull mushroom, multi-function	Glass-filled polyamide
Plastic bezel/bushing II, jam nut, knob	Reset, non-illuminated selector switch, pilot light	Glass-filled polyamide
Metal bezel/bushing	All metal operators	Zinc
Diffuser	Illuminated pushbutton, pilot light	Polycarbonate
Legend frames	-	Glass-filled nylon
Plastic mounting ring	All plastic operators	Glass-filled polyamide
Metal mounting ring	All metal operators	Chromated zinc
Plastic coupling plate	-	Glass-filled nylon
Metal coupling plate	-	Chromated zinc + stainless steel
Plastic enclosures	-	PBT/polycarbonate blend
Metal enclosure	-	Aluminium
Terminal screws	LED module, incandescent module, contact blocks	Zinc-plated steel with chromate
Terminals	LED module, incandescent module, contact blocks	Brass with silver-nickel contacts
Screwless	LED module, incandescent module, contact blocks	Stainless steel
Lamp socket	Incandescent module	Brass
Housing	Incandescent module, LED module	Glass-filled nylon
Low voltage terminals	Contact blocks	Gold-plated brass with silver-nickel contacts
Low voltage spanner	Contact blocks	Gold-plated brass with silver-nickel contacts
Spanner	Contact blocks	Brass with silver-nickel contacts

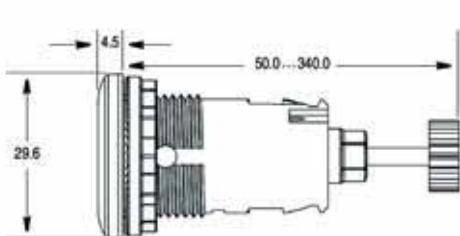
**Dimensions (mm) and panel hole spacing****Panel Hole Spacing**

	40	50	40	50	40/60	50/60	70	50
	30		48		40/60	60/90	30	50
								40
								50

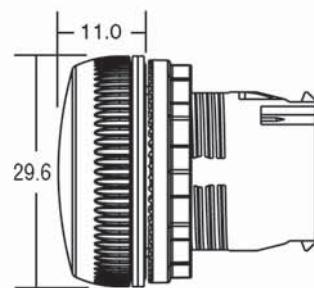
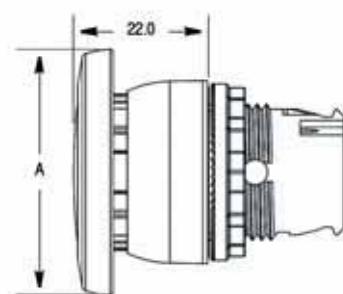
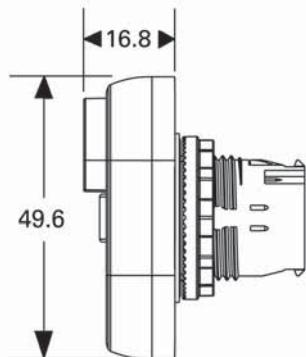
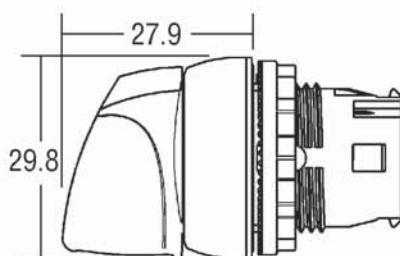
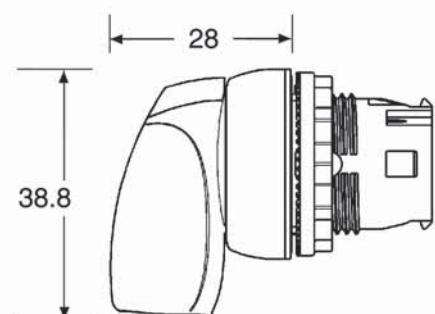
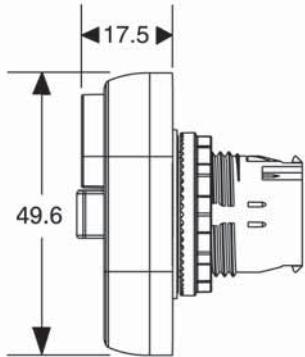
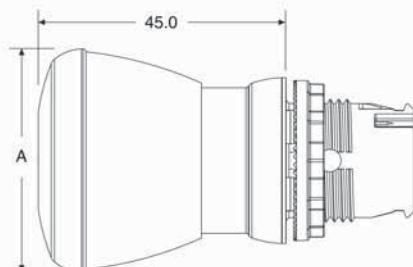
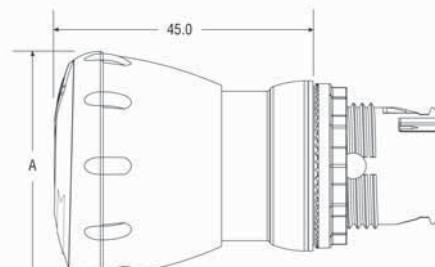
Non-Illuminated and Illuminated Momentary  
Flush pushbutton OperatorsIlluminated and Non-Illuminated Momentary  
Extended pushbutton OperatorsNon-Illuminated Guarded, Illuminated  
and Non-Illuminated Alternate Action  
pushbutton OperatorsIlluminated Momentary Guarded  
pushbutton Operators

**Dimensions (mm)**

Reset Operators with Reset Rod



Pilot Light Operators

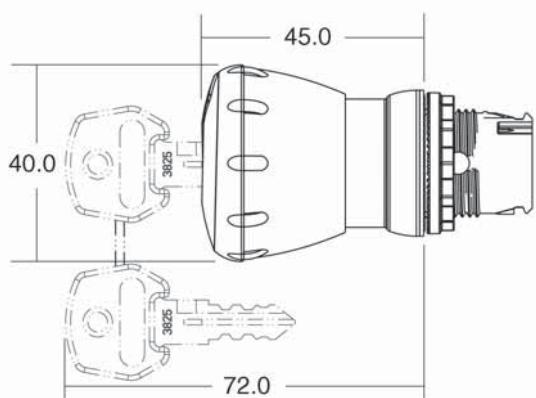
Illuminated and Non-Illuminated  
Momentary Mushroom Operators  
40 mm and 60 mmIlluminated and Non-Illuminated  
2-Position Multi-Function OperatorsIlluminated and Non-Illuminated  
Knob Selector Switch and  
Potentiometer OperatorsNon-Illuminated Knob Lever  
Selector Switch OperatorsNon-Illuminated  
3-Position Multi-Function OperatorsIlluminated and Non-Illuminated  
Push-Pull Mushroom Operators  
30 mm, 40 mm and 60 mmIlluminated and Non-Illuminated  
Twist-to-Release Operators  
30 mm, 40 mm and 60 mm

Operator	A
30 mm	30.0
40 mm	40.0
60 mm	60.0

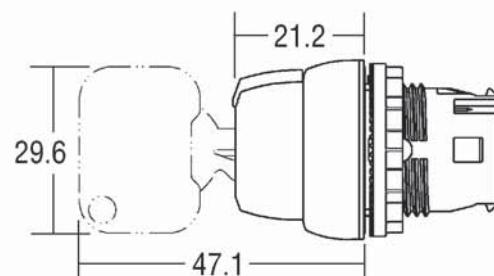
Operator	A
30 mm	30.0
40 mm	40.0
60 mm	60.0

**Dimensions (mm)**

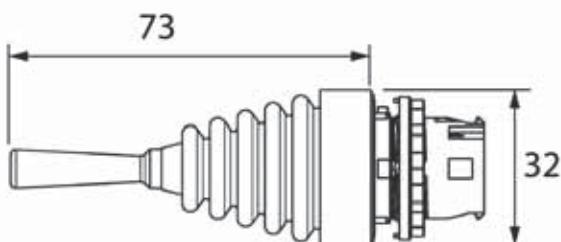
Mushroom Key Release Operator  
40 mm



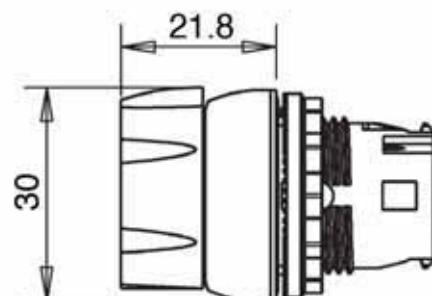
Key Selector Switch and Key Ejected  
SensEject Operators



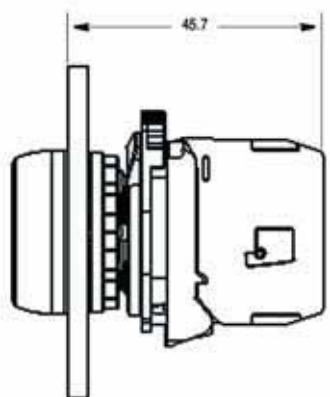
Joystick Operators



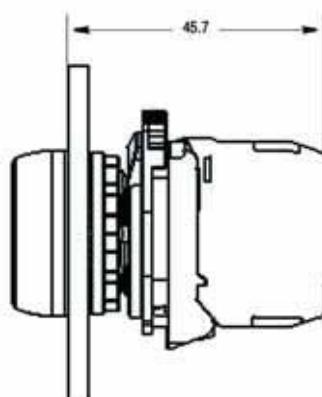
Selector Jog Operators

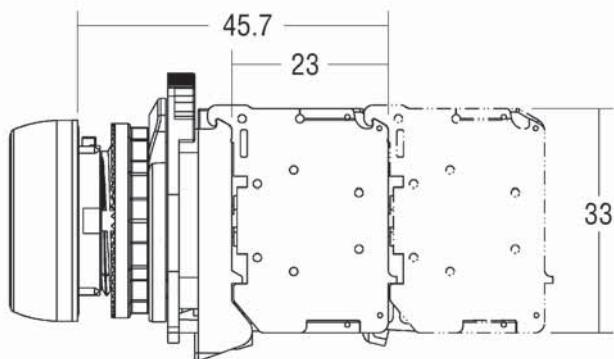
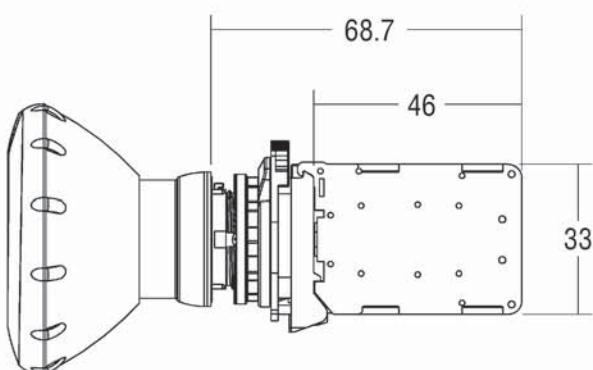


Back-of-Panel Components -  
Incandescent Module with coupling plate

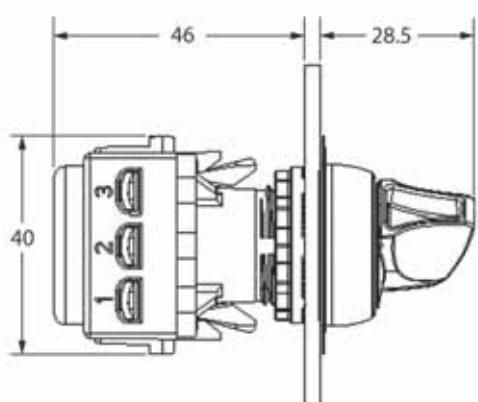


Back-of-Panel Components -  
LED Module with coupling plate

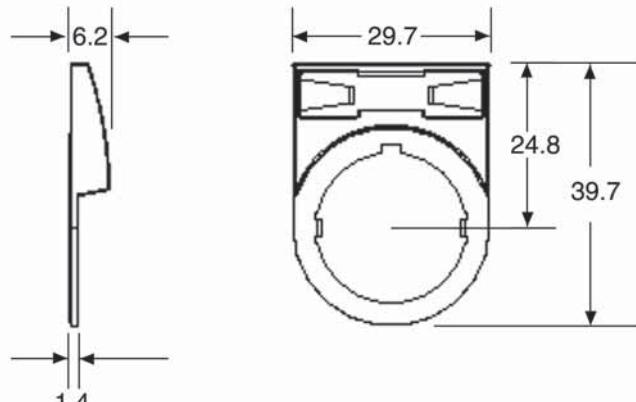


**Dimensions (mm)**Back-of-Panel Components -  
Contact Cartridges with coupling plateBack-of-Panel Components -  
Dual Circuit Contact Block or SMBC Contact Block  
(Max. of 1 Deep)

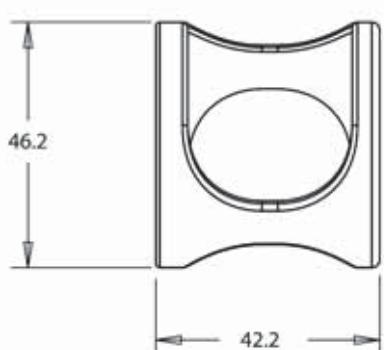
Potentiometer with Resistive Element



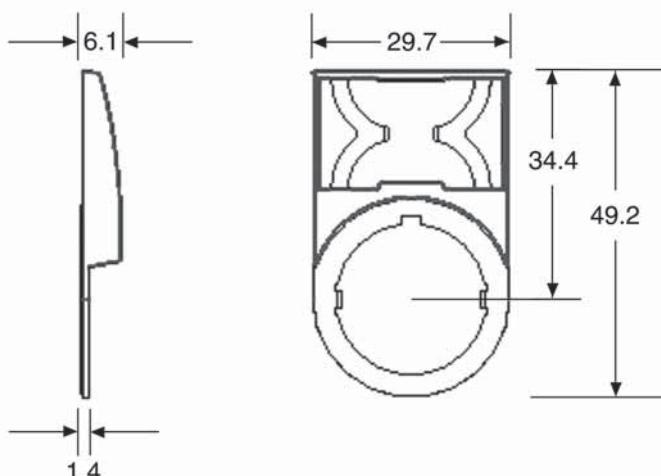
30 x 40 mm Snap-In Legend Plate



Protective Ring

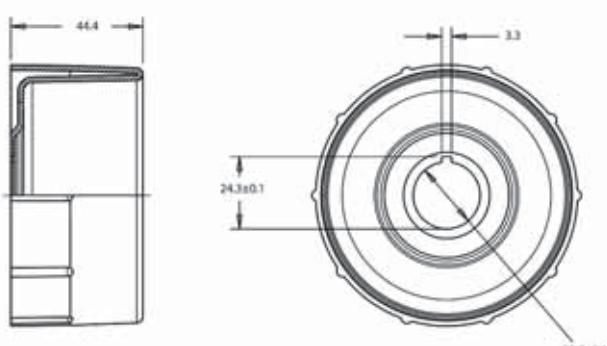
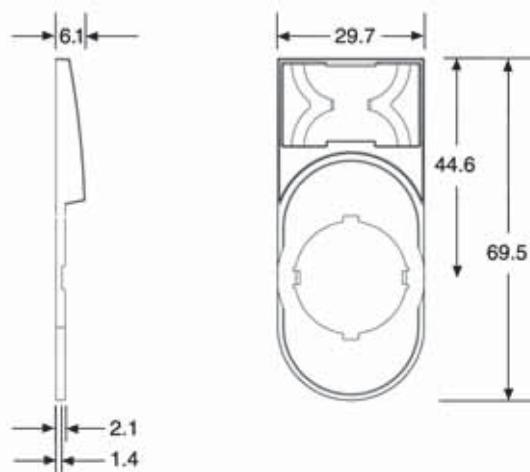


30 x 50 mm Snap-In Legend Plate

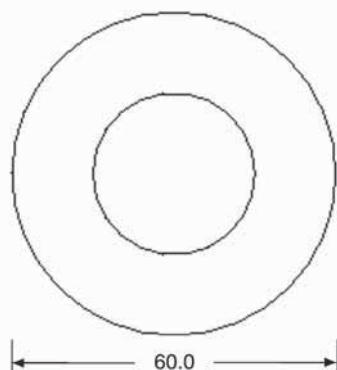


**Dimensions (mm)**

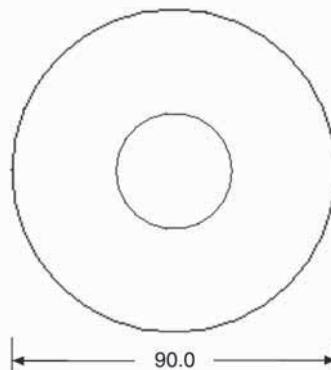
Plastic Guard

30 x 60 mm  
Snap-In Legend Plate

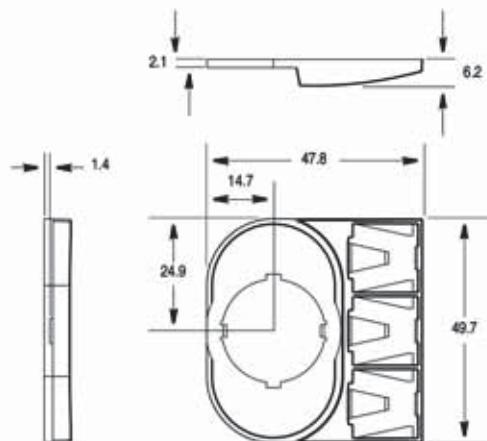
60 mm Round Legend



90 mm Round legend

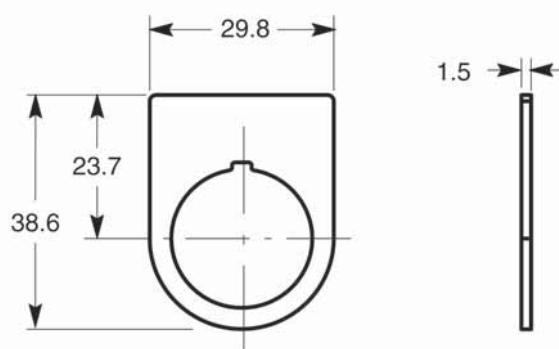


Potentiometer Legend Plate

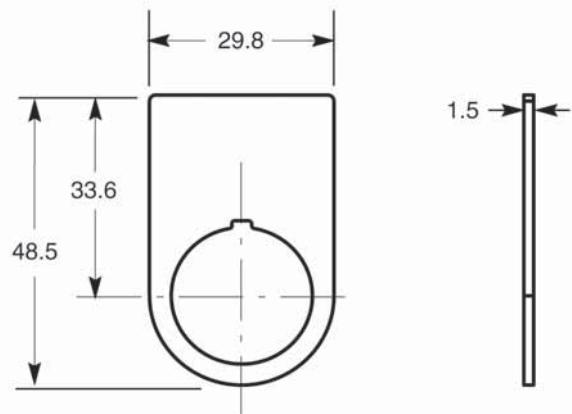
Special Multi-Function  
Snap-In Legend Plate

**Dimensions (mm)**

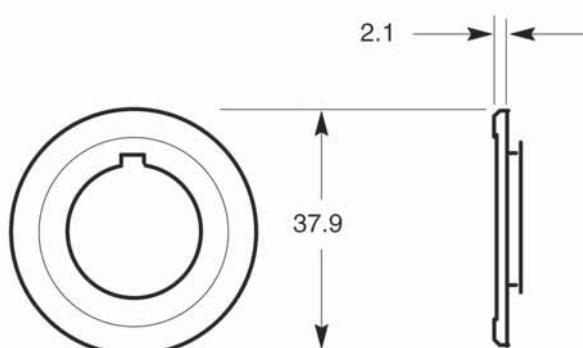
30 x 40 mm One-Piece Legend Plate



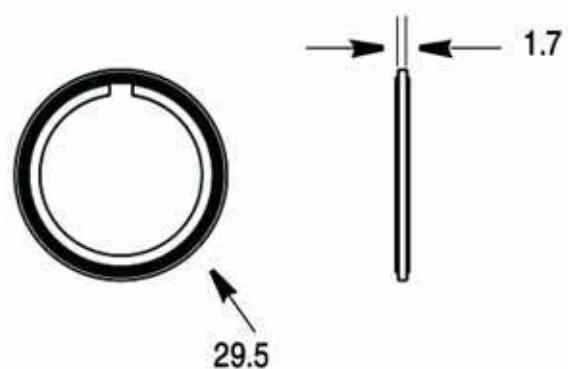
30 x 50 mm One-Piece Legend Plate



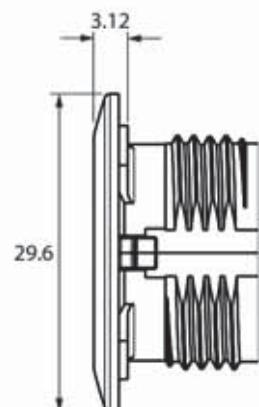
30 to 22.5 mm Hole Adaptor



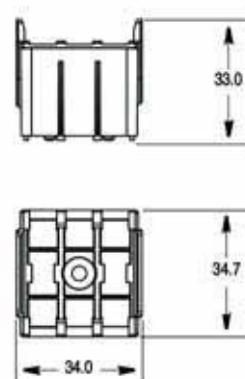
Trim Washer



Hole Plug

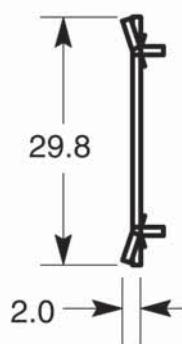
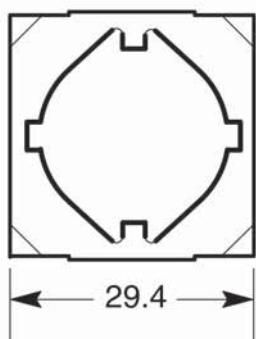


Base Mount Adaptor

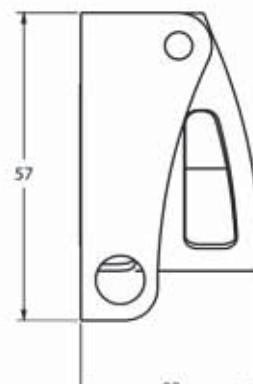
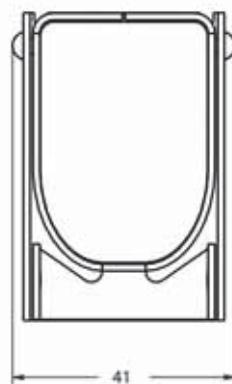


**Dimensions (mm)**

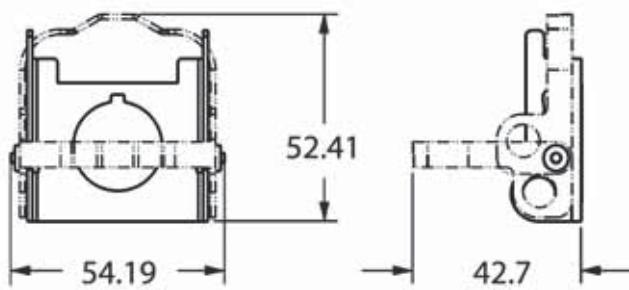
Anti-Rotation Washer



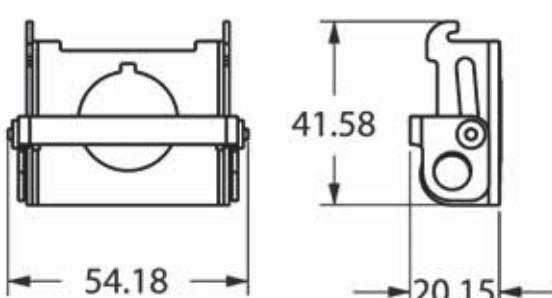
Locking Cover



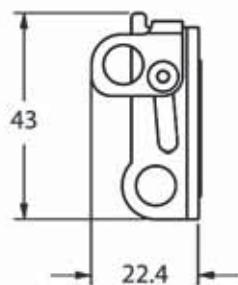
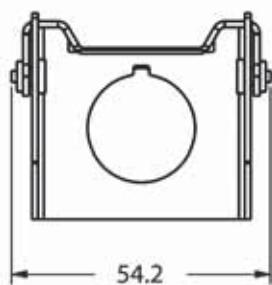
Maintained Mushroom Locking Attachment



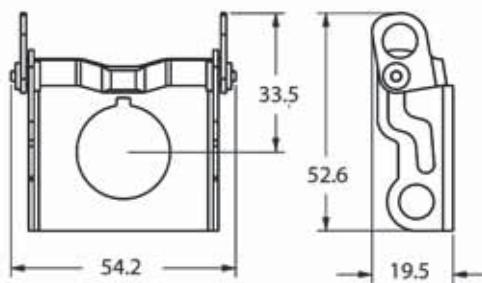
Momentary Mushroom Locking Attachment



Extended Non-Illuminated locking Attachment

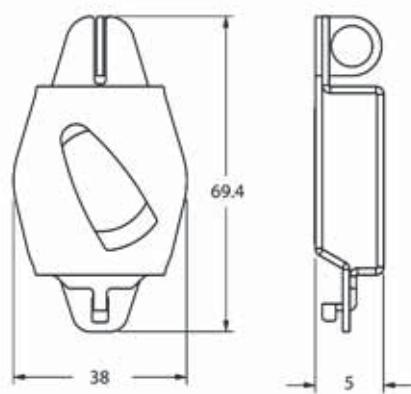


Flush Non-Illuminated Locking Attachment

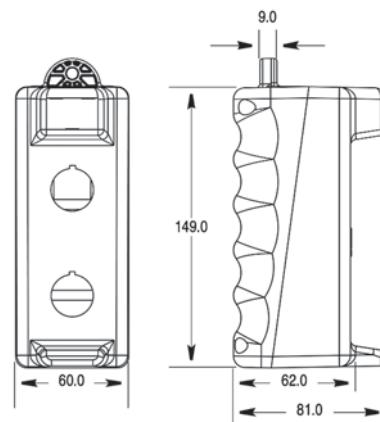


**Dimensions (mm)**

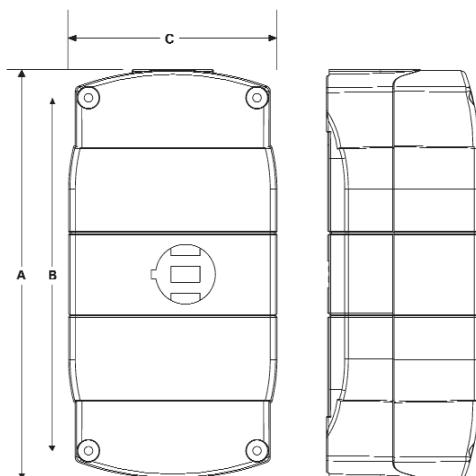
Selector Switch Locking Cover  
(Same for all Lock Positions)



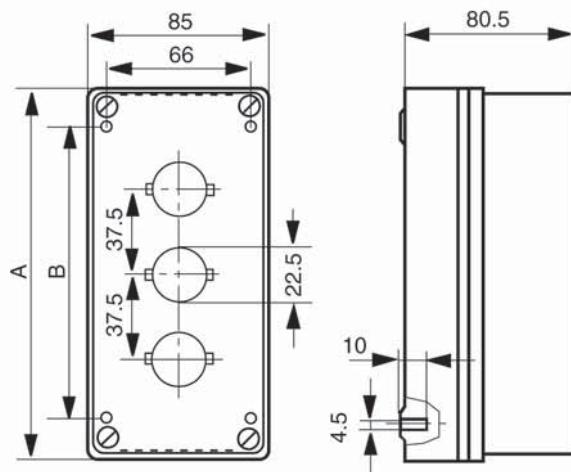
Pendant Stations



Plastic Enclosures



Metal Enclosures



Cat. No.	No. of Units (Holes)	A	B	C
D7F-1PM	1	85	89	58
D7F-2PM	2	124	79	58
D7F-3PM	3	155	79	58
D7F-4PM	4	186	79	58
D7F-6PM	6	248	87	64

Cat. No.	No. of Units (Holes)	A	B
D7F-1MM	1	85	89
D7F-2MM	2	124	79
D7F-3MM	3	155	79
D7F-5MM	5	186	79

## Product selection made easy

Until now, NHP has been easily recognisable by its logo **NHP**. However, we realise that, as a customer you need to locate the products and information most relevant to you quickly and easily. That's why we're phasing in our new product icons, to help you differentiate the product information you need amongst the clutter that is business today.

You may have already come across these icons, prominent on the front of our literature as new catalogues and flyers become available. These brightly coloured icons in an obvious location mean no longer will you have to worry about searching for product information amongst the mounds of promotional literature. No more flicking through pages of catalogues, wondering where the things you need might be. We've done the searching for you. Just look for the icon that suits your product needs.....your guide to save yourself time.....so that you can get back to your business.



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Automation and communication systems are central to your productivity and efficiency. Our range consists of the world's best and proven products, from Hitachi drives to the technically advanced Adroit SCADA system.



Our control and switching range keeps the risk of human error to a minimum with pushbuttons, cam switches, pendant controllers, foot switches, relays and timers.



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The NHP Ex Hazardous area equipment range helps you protect people and property in areas such as petro-chemical and grain handling. Products include Exde control equipment and Ex Lighting products.



If it's there, our sensing and detection products will see it, touch it, or find it. From beam sensors and magnetic reed switches to limit switches, we offer numerous variations of each sensor type.



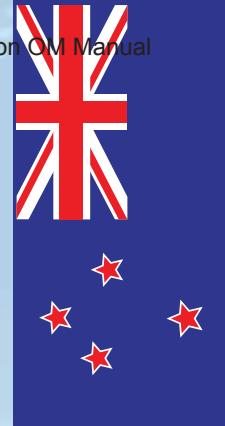
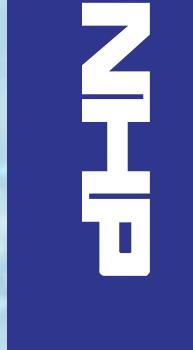
When you need to know how high or low a level is, how much you have used or how long there is to go, NHP offers a vast series of measuring and display instruments, for panel, base or DIN rail mounting.



Our enclosures and termination products answer all your housing and cabling needs. The range includes insulated, weatherproof and stainless steel enclosures, slotted and solid cable duct and DIN rail mounting terminals.



These products are sold exclusively through electrical wholesaling outlets, and include such items as the BelMate conduit bell tool and the TestPro range of voltage and continuity testers.



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ELECTRICAL ENGINEERING PRODUCTS PTY LTD

# TECHNICAL DATA SHEET

**Equipment Type:** Switches

**Location:** RTU Section

**Model Numbers:** Various

**Manufacturer:** Kraus & Naimer

**Supplier:** Kraus & Naimer

22 Brookes St Bowen Hills QLD  
4006  
(07) 3252 8344



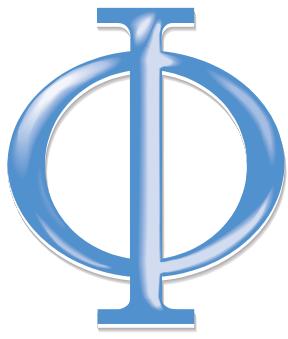
# Kraus & Naimer Pty.Ltd.

## BLUE LINE switchgear

2013  
Short Form Catalogue



FOR COMPLETE PRODUCT RANGE VISIT  
[www.krausnaimer.com.au](http://www.krausnaimer.com.au)



# Kraus & Naimer

## BLUE LINE switchgear

The development of the Blue Line rotary switch, load break switch disconnector, contactor and motor starter product ranges is based on One Hundred years experience by Kraus & Naimer. In the Design and manufacture of electrical switchgear, Kraus and Naimer have pioneered the introduction of the cam operated rotary switch, and continues to be recognised as the world leader in that product field.

### BLUE LINE

Blue Line products are protected by numerous patents throughout the industrial world. They are built to national and international standards and designed to withstand adverse temperatures and climates.

Blue Line products are accepted and universally recognised for their quality and workmanship. They are supported by the world-wide sales and service organisation.

The Kraus & Naimer Registered Trademark



WORLDWIDE SYMBOL  
FOR QUALITY SWITCHGEAR

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- CA / CG / CH Switches with captive plus-minus terminal screws	
- CAD Switches having self-cleaning "H" Bridge with 'cross wire' contacts	
- CHR Switches with captive terminal screws for use with ring terminals	
- Special Switches designed to any contact programme	



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- Padlockable maintenance and safety switches	
- Enclosed IP 65 protection in Plastic or Stainless Steel	
- 3, 4, 6 and 8 pole models available	
- Enclosure cable entries top, bottom, sides and rear, or blank	



<b>KG Main Switches 20A - 315A</b>	<b>16 - 18</b>
- Padlockable main and emergency switches	
- Modular frame sizes	
- 3, 4, 6 and 8 pole models available	
- Forced positive contact movement	
- Cam operated auxilliary contacts	
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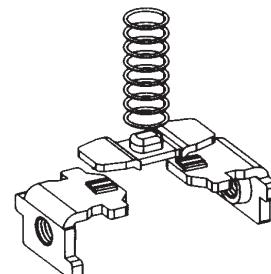
# Technical Data

<sup>u</sup> Rated Operational Current							
Multi cross point contacts	1V	6V	12V	24V	48V	110V	240V
<b>CA4/CG4</b> AC21A	-	-	-	10	10	10	10
DC21 B	-	-	10	6	0.7	0.2	
H-Bridge cross wire contacts							
<b>CGD4 - 1</b> AC21A	5	2	1.2	0.7	0.45	0.25	0.15
DC21B	3	1.2	0.7	0.4	0.25	0.13	0.08
<b>CAD11</b> AC21A	5	3	2	1	0.8	0.4	0.2
DC21B	4	2.5	1.5	0.8	0.3	0.2	0.1
<b>CAD12</b> AC21A	-	5	5	5	4	3	2
DC21B	-	4	3	2.2	1.2	0.6	0.3

## Special Contact Systems

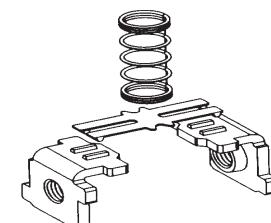
### CA4/CG4 (@1μ gold plating)

A high contact reliability is achieved by the use of multiple crosspoint contacts, having a fourpoint contact face to minimise contact resistance. Terminals on the CA series are accessible from both sides, and the terminals on the CG series are accessible from the rear. Both switches have finger proof terminals. These are the smallest cam switch 30mm sq.



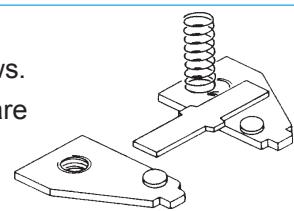
### CAD11/CAD12 / CGD4 - 1

H-bridge cross wire contact system. The moving contact is made of spring type material to absorb possible contact bounce. These corrosive resistant contacts are capable of operating on systems voltages as low as 1 volt. CAD11 = Gold contacts. CAD12 = Silver contacts. Both switches have screw driver guides, finger proof terminals and captive plus-minus terminal screws capable of accepting two variant cable sizes.



### C/CA

Switches C/CA have finger proof terminals and captive plus-minus terminal screws. Each stage contains two rigid, double-break silver alloy contacts. The terminals are accessible from both sides. Ranging from 20 ~ 315 amperes these switches will accept a wide range of "optional extras".



**KG/KH Switches:** This durable switch line possesses high short circuit withstand capabilities, with positive movement during both making and breaking functions. The KG/KH range of isolators and changeover switches exhibit excellent AC-3 and AC-23 making and breaking capabilities.

This 'Short Form' catalogue illustrates only a small selection of the KRAUS & NAIMER switches. Other switches available are:- A11, A14, A30, AD11, AD12, CH10 ~ CHR16B, D10 ~ D14R, DH, DHR, DK, DKR, L350 ~ L1251, X63 ~ X630. Additional information available on request.

**Rotary Cam Switches****Rated Values**

Escutcheon Plate Dimensions Note: for drilling details refer to pages 31 & 32		TYPE	According to IEC 60947-3/VDE 0660, part 107				
S00			Cable mm²	Nominal Voltage U_i v	Thermal Current I_u/I_th A	Motor Rating kW	AC-23A AC-3 kW
S0		CA4	2 x 1.5	440	10	3	2.2
		CG4	2 x 1.5	440	10	3	2.2
S1		CG 8	2 x 2.5	690	20	7.5	5.5
		CA10	2 x 2.5	690	20	7.5	5.5
S2		CA20	2 X 4	690	25	11	7.5
		CA25	2 x 6	690	32	15	11
S3		CH10	2 x 4	690	20	7.5	5.5
		CH16	2 x 4	690	25	11	7.5
S10B		CA10B	2 x 2.5	690	20	7.5	5.5
		CA20B	2 x 4	690	25	11	7.5
S15B		CA25B	2 x 6	690	32	15	11
		CA40	1 x 16	690	40	18.5	15
S20B		CA50	1 x 16	690	50	22	18.5
		CA63	1 x 16	690	63	30	18.5
S25B		C26	2 x 6	690	32	15	11
		C32	2 x 10	690	50	22	15
S30B		C42	2 x 16	690	63	30	18.5
		CHR10B	Ring	690	20	7.5	5.5
S35B		CHR20B	Ring	690	25	11	7.5
		C43	2 x 16	690	63	30	18.5
S40B		C80	35	690	115	45	30
		C125	70	690	150	75	37
S45B		C200-4	M8	690	200	75	37
		C315	M12	690	315	132	55
S50B		C316	M12	1000	315	132	55
		L400	M12	690	500	132	55
S55B		L600	M16	690	800	132	55
		L800	M16	690	1100	132	55
S60B		L1200	M16	690	1450	132	55
		L1600	2 X M16	690	1900	132	55
S65B		L2000	2 X M16	690	2400	132	55
		For further technical details, refer to Catalogue 100 and 120. Gold contacts and quick connects see Catalogue 100 P4.					

For Safety and Maintenance Switches Refer Page 16-19

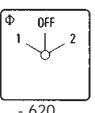
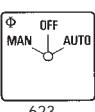
## Rotary Cam Switches - Panel Mounting

	Selection Data IEC 60947-3, EN 60947, VDE 0660	CG 4	CG 8 CH 10	CA20	C26	C32			
		CA 4	CA 10	CA20B	CA25	CA 40	CA 50		
CG4 A290 FS2	Rated Thermal Current $I_u = I_{th}$ Rated Category 3 x 380 V/440 V AC-23A	A	10	20	25	32	40	50	
CA10 A291 E		kW	3	7.5	11	15	18.5	22	
	Rated Thermal Current $I_u = I_{th}$ Rated Category 3 x 380 V/440 V AC-23A		C 42 CA 63	C 80	C125	C200-4	C315	L400	
			A	63	115	150	200	315	500
			kW	30	45	75	75	132	132

Function	Front Plate	Code No.	No. of Stages	Code No.	No. of Stages
<b>OFF / ON Switches 90° Switching</b>		<b>1 Pole</b>		<b>2 Pole</b>	
Waterproof switches to IP 65 available in E24 Mounting - no additional price		CG 4 A290-621 E CA 10 A290-621 E CH 10 A290-621 E CA20 A290-621 E CA25 A290-621 E CA40/C26 A290-621 E CA50/C32 A290-621 E CA63/C42 A290-621 E C80 A290-621 E C125 A290-621 E C200-4 A290-621 E C315 A290-621 E	1	CG 4 A291-621 E CA 10 A291-621 E CH 10 A291-621 E CA20 A291-621 E CA25 A291-621 E CA40/C26 A291-621 E CA50/C32 A291-621 E CA63/C42 A291-621 E C80 A291-621 E C125 A291-621 E C200-4 A291-621 E C315 A291-621 E	1
1 - 8 Pole		<b>3 Pole</b>		<b>4 Pole</b>	
		CG 4 A292-621 E CA10 A292-621 E CH10 A292-621 E CA20 A292-621 E CA25 A292-621 E CA40/C26 A292-621 E CA50/C32 A292-621 E CA63/C42 A292-621 E C80 A292-621 E C125 A292-621 E C200-4 A292-621 E C315 A292-621 E	2	CG 4 A324-621 E CA10 A324-621 E CH10 A324-621 E CA20 A324-621 E CA25 A324-621 E CA40/C26 A324-621 E CA50/C32 A324-621 E CA63/C42 A324-621 E C80 A324-621 E C125 A324-621 E C200-4 A324-621 E C315 A324-621 E	2
		<b>6 Pole</b>		<b>8 Pole - 60°</b>	
		CG 4 A326-621 E CA10 A326-621 E CH10 A326-621 E CA20 A326-621 E CA25 A326-621 E CA40/C26 A326-621 E CA50/C32 A326-621 E CA63/C42 A326-621 E C80 A326-621 E C125 A326-621 E C200-4 A326-621 E C315 A326-621 E	3	CG 4 A344-620 E CA10 A344-620 E CH10 A344-620 E CA20 A344-620 E CA25 A344-620 E CA40/C26 A344-621 E CA50/C32 A344-621 E CA63/C42 A344-621 E C80 A344-620 E C125 A344-620 E C200-4 A344-620 E C315 A344-620 E	4
<b>OFF / ON Switches 60° Switching</b>		<b>1 Pole</b>		<b>3 Pole</b>	
1 - 4 Pole		CG 4 A200-620 E CA 10 A200-620 E CH 10 A200-620 E CA20 A200-620 E CA25 A200-620 E CA40/C26 A200-620 E CA50/C32 A200-620 E CA63/C42 A200-620 E C80 A200-620 E C125 A200-620 E C200-4 A200-620 E C315 A200-620 E	1	CG 4 A202-620 E CA 10 A202-620 E CH 10 A202-620 E CA20 A202-620 E CA25 A202-620 E CA40/C26 A202-620 E CA50/C32 A202-620 E CA63/C42 A202-620 E C80 A202-620 E C125 A202-620 E C200-4 A202-620 E C315 A202-620 E	2

## Rotary Cam Switches - Panel Mounting

	Selection Data IEC 60947-3, EN 60947, VDE 0660	CG 4	CG 8	CA20	C26	C32		
		CA 4	CH 10	CA20B	CA25	CA 40	CA 50	
CG4 A210 FS2	Rated Thermal Current I <sub>th</sub> = I <sub>th</sub> Rated Category 3 x 380 V/440 V AC-23A	A kW	10 3	20 7.5	25 11	32 15	40 18.5	50 22
CA10 A211 E	Rated Thermal Current I <sub>th</sub> = I <sub>th</sub> Rated Category 3 x 380 V/440 V AC-23A	A kW	63 30	115 45	150 75	200 75	315 132	500 132

Function	Front Plate	Code No.	No of Stages	Code No.	No. of Stages
<b>Changeover Switches with Centre "OFF" 60° Switching</b>		<b>1 Pole</b>		<b>2 Pole</b>	
		CG4 A210-620 E CA10 A210-620 E CH10 A210-620 E CA20 A210-620 E CA25 A210-620 E CA40/C26 A210-620 E CA50/C32 A210-620 E CA63/C42 A210-620 E C80 A210-620 E C125 A210-620 E C200-4 A210-620 E C315 A210-620 E	1	CG4 A211-620 E CA10 A211-620 E CH10 A211-620 E CA20 A211-620 E CA25 A211-620 E CA40/C26 A211-620 E CA50/C32 A211-620 E CA63/C42 A211-620 E C80 A211-620 E C125 A211-620 E C200-4 A211-620 E C315 A211-620 E	2
					
					
					
					
		<b>3 Pole</b>		<b>4 Pole(1)</b>	
		CG4 A212-620 E CA10 A212-620 E CH10 A212-620 E CA20 A212-620 E CA25 A212-620 E CA40/C26 A212-620 E CA50/C32 A212-620 E CA63/C42 A212-620 E C80 A212-620 E C125 A212-620 E C200-4 A212-620 E C315 A212-620 E	3	CG4 A213-620 E CA10 A213-620 E CH10 A213-620 E CA20 A213-620 E CA25 A213-620 E CA40/C26 A213-620 E CA50/C32 A213-620 E CA63/C42 A213-620 E C80 A213-620 E C125 A213-620 E C200-4 A213-620 E C315 A213-620 E	4
		<b>6 Pole</b>		<b>8 Pole</b>	
		CA10 A362-620 E	6	CA10 WAA364-620 E	8

## Gang Switches - Sequence Switching

Function	Code No.	Function	Code No.
OFF / A / A + B 60° Switching	1 Pole CA10 A310-620 E	OFF / A / A + B 60° Switching	3 Pole CA10 WAA314-620 E
OFF / A / A + B 60° Switching	2 Pole CA10 A312-620 E	OFF/A/A+B/A+B+C 30° Switching	Without Bridges CA10 A311-620 E

## Special Application Switches:-

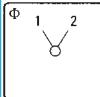
Ship To Shore Switches, UPS Bypass Switches\*, Series Parallel Switches, Special Meters Switches, For further information, contact your nearest KRAUS & NAIMER stockist.

\*(see p13)

(1) If Preclosing 4th Pole Required Change A213 To A663

## Rotary Cam Switches - Panel Mounting

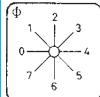
 <b>KG Switch</b> See P17~P20	 <b>CA10 A220 E</b>	Selection Data IEC 60947-3, EN 60947, VDE 0660		CG 4	CG 8	CA20	C26	C32				
		Rated Thermal Current	$I_U = I_{th}$	A	10	20	25	40	50			
		Rated Category	3 x 380 V/440 V	AC-23A	kW	3	7.5	11	15	18.5	22	
		Rated Thermal Current	$I_U = I_{th}$	A	C 42	C 80	C125	C200-4	C315	L400		
		Rated Category	3 x 380 V/440 V	AC-23A	kW	63	115	150	200	315	500	
						CA 63					132	132

Function	Front Plate	Code No.	No of Stages	Code No.	No. of Stages
Changeover Switches without Centre "OFF" 60° Switching					
1-4 pole		1 Pole		2 Pole	
		CG4 A220-600 E	1	CG4 A221-600 E	2
		CA10 A220-600 E	1	CA10 A221-600 E	2
		CH10 A220-600 E	1	CH10 A221-600 E	2
		CA20 A220-600 E	1	CA20 A221-600 E	2
		CA25 A220-600 E	1	CA25 A221-600 E	2
		CA40/C26 A220-600 E	1	CA40/C26 A221-600 E	2
		CA50/C32 A220-600 E	1	CA50/C32 A221-600 E	2
		CA63/C42 A220-600 E	1	CA63/C42 A221-600 E	2
		C80 A220-600 E	1	C80 A221-600 E	2
		C125 A220-600 E	1	C125 A221-600 E	2
		C200-4 A220-600 E	1	C200-4 A221-600 E	2
		C315 A220-600 E	1	C315 A221-600 E	2
5 pole		3 Pole		4 Pole (1)	
		CG4 A222-600 E	3	CG4 A223-600 E	4
		CA10 A222-600 E	3	CA10 A223-600 E	4
		CH10 A222-600 E	3	CH10 A223-600 E	4
		CA20 A222-600 E	3	CA20 A223-600 E	4
		CA25 A222-600 E	3	CA25 A223-600 E	4
		CA40/C26 A222-600 E	3	CA40/C26 A223-600 E	4
		CA50/C32 A222-600 E	3	CA50/C32 A223-600 E	4
		CA63/C42 A222-600 E	3	CA63/C42 A223-600 E	4
		C80 A222-600 E	3	C80 A223-600 E	4
		C125 A222-600 E	3	C125 A223-600 E	4
		C200-4 A222-600 E	3	C200-4 A223-600 E	4
		C315 A222-600 E	3	C315 A223-600 E	4
6- and 7 pole		6 Pole		8 Pole	
		CA10 A370-600 E	6	CA10 A372-600 E	8

Binary Coded Decimal Switches - from 1 Volt.  
For PLC and Electronic Applications.

Additional positions and combinations available on request.

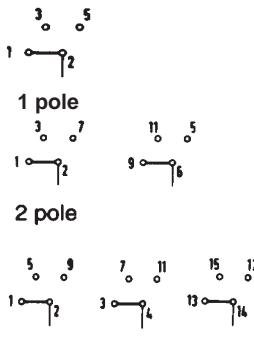
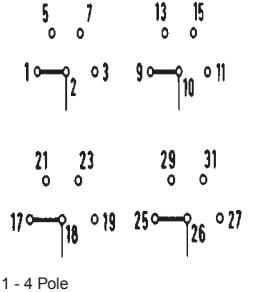
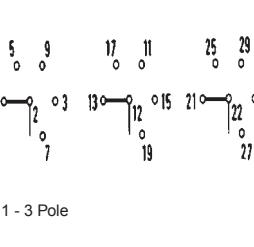
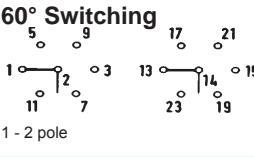
CG4-1 = Gold Plated Contact POA  
CAD11 = Gold Wiping H-bridge Contacts  
CAD12 = Silver Wiping H-bridge Contacts

Front Plate	Code No.	No of Stages	Code No.	No of Stages
	0-7 Binary		0-11 Binary	
	CAD11 A540-600 E	2	CAD11 A543-600 E	2
	CAD12 A540-600 E	2	CAD12 A543-600 E	2
	0-7 Complement		0-9 Binary	
	CAD11 A541-600 E	2	CAD11 A550-600 E	2
	CAD12 A541-600 E	2	CAD12 A550-600 E	2
	0-7 + Complement		0-9 Complement	
	CAD11 WAA542-600 E	3	CAD11 A551-600 E	2
	CAD12 WAA542-600 E	3	CAD12 A551-600 E	2

(1) If Preclosing 4th Pole Required Change A223 To A673

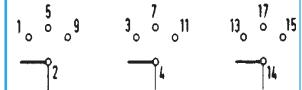
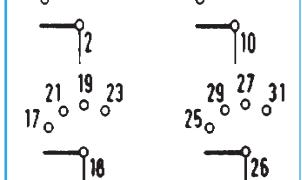
**Rotary Cam Switches - Panel Mounting**

CG4 A230 FS2	CA10 A251 E	Selection Data IEC 60947-3, EN 60947, VDE 0660	CG 4 CA 4	CG 8 CH 10 CA 10	CA20 CA20B	C26 CA25	C32 CA 40	CA 50
		Rated Thermal Current $I_u = I_{th}$ A 10 20 25 32 40 50 Rated Category 3 x 380 V/440 V AC-23A kW 3 7.5 11 15 18.5 22						
		Rated Thermal Current $I_u = I_{th}$ A 63 115 150 200 315 500 Rated Category 3 x 380 V/440 V AC-23A kW 30 45 75 75 132 132	C 42 CA 63	C 80 C125	C200-4	C315 L400		

Function	Front Plate	Code No.	No. of Stages	Code No.	No. of Stages
<b>3 Step Switches without "OFF" 60° Switching</b>  1 - 3 Pole Drawing for 4 - 6 Pole on Request		<b>1 Pole</b> CG 4 A230-600 E CA10 A230-600 E CH10 A230-600 E CA20 A230-600 E <b>3 Pole</b> CG 4 A270-600 E CA10 A270-600 E CH10 A270-600 E CA20 A270-600 E <b>5 Pole</b> CA10 WAA484-600E	2	<b>2 Pole</b> CG 4 A250-600 E CA10 A250-600 E CH10 A250-600 E CA20 A250-600 E <b>4 Pole</b> CG 4 A476-600 E CA10 A476-600 E CH10 A476-600 E CA20 A476-600 E <b>6 Pole</b> CA10 WAA489-600 E	3 3 3 3 6 6 6 6 9
<b>4 Step Switches without "OFF" 60° Switching</b>  1 - 4 Pole		<b>1 Pole</b> CG 4 A231-600 E CA10 A231-600 E CH10 A231-600 E CA20 A231-600 E <b>3 Pole</b> CG 4 A271-600 E CA10 A271-600 E CH10 A271-600 E CA20 A271-600 E	2	<b>2 Pole</b> CG 4 A251-600 E CA10 A251-600 E CH10 A251-600 E CA20 A251-600 E <b>4 Pole</b> CG 4 A477-600 E CA10 A477-600 E CH10 A477-600 E CA20 A477-600 E	4 4 4 4 8 8 8 8
<b>5 Step Switches without "OFF" 60° Switching</b>  1 - 3 Pole		<b>1 Pole</b> CG 4 A232-600 E-V CA10 A232-600 E CH10 A232-600 E CA20 A232-600 E <b>3 Pole</b> CG 4 WAA272-600E CA10 WAA272-600E CH10 WAA272-600E CA20 WAA272-600E	3	<b>2 Pole</b> CG 4 A252-600 E CA10 A252-600 E CH10 A252-600 E CA20 A252-600 E	5 5 5 5
<b>6 Step Switches without "OFF" 60° Switching</b>  1 - 2 pole		<b>1 Pole</b> CG 4 A233-600 E CA10 A233-600 E CH10 A233-600 E CA20 A233-600 E <b>2 Pole</b> CG 4 WAA253-600E CA10 WAA253-600E CH10 WAA253-600E CA20 WAA253-600E	3	Refer to catalogue or enquire for details on additional 'standard' switches	6 6 6 6

## Rotary Cam Switches - Panel Mounting

  CG4 A240 FS2      CA10 A280 E	Selection Data IEC 60947-3, EN 60947, VDE 0660				CG 4	CG 8 CH 10	CA20	C26	C32
		CA 4	CA 10	CA20B	CA25	CA 40	CA 50		
Rated Thermal Current	$I_u = I_{th}$	A	10	20	25	32	40	50	
Rated Category	3 x 380 V/440 V AC-23A	kW	3	7.5	11	15	18.5	22	
Rated Thermal Current	$I_u = I_{th}$	A	63	115	150	200	315	500	
Rated Category	3 x 380 V/440 V AC-23A	kW	30	45	75	75	132	132	
			C 42 CA 63	C 80	C125	C200-4	C315	L400	

Function	Front Plate	Code No.	No. of Stages	Code No.	No. of Stages
<b>6 Step Switches cont.</b>		<b>3 Pole</b>			
3 Pole		CA10 WAA273-600 E CH10 WAA273-600 E CA20 WAA273-600 E	9 9 9	Refer to catalogue or enquire for details on additional 'standard' switches.	
<b>2 Step Switches with "OFF"</b>		<b>1 Pole</b>		<b>2 Pole</b>	
<b>60° Switching</b>		CG 4 A240-620 E CA10 A240-620 E CH10 A240-620 E CA20 A240-620 E	1 1 1 1	CG 4 A260-620 E CA10 A260-620 E CH10 A260-620 E CA20 A260-620 E	2 2 2 2
<b>3 Step Switches with "OFF"</b>		<b>3 Pole</b>		<b>4 Pole</b>	
<b>45° Switching</b>		CG 4 A280-620 E CA10 A280-620 E CH10 A280-620 E CA20 A280-620 E	3 3 3 3	CG 4 WAA480-620 E CA10 WAA480-620 E CH10 WAA480-620 E CA20 WAA480-620 E	4 4 4 4
<b>1- 4 Pole</b>					
<b>1- and 2 pole</b>		<b>1 Pole</b>		<b>2 Pole</b>	
		CG 4 A241-620 E CA10 A241-620 E CH10 A241-620 E CA20 A241-620 E	2 2 2 2	CG 4 A261-620 E CA10 A261-620 E CH10 A261-620 E CA20 A261-620 E	3 3 3 3
<b>1- 3 Pole</b>		<b>3 Pole</b>		<b>4 Pole</b>	
		CG 4 A281-620 E CA10 A281-620 E CH10 A281-620 E CA20 A281-620 E	5 5 5 5	CG 4 WAA481-620 E CA10 WAA481-620 E CH10 WAA481-620 E CA20 WAA481-620 E	6 6 6 6
4 Pole Drawing on Request					
<b>4 Step Switches with "OFF"</b>		<b>1 Pole</b>		<b>2 Pole</b>	
<b>30° Switching</b>		CG 4 A242-620 E CA10 A242-620 E CH10 A242-620 E CA20 A242-620 E	2 2 2 2	CG 4 WAA262-620 E CA10 WAA262-620 E CH10 WAA262-620 E CA20 WAA262-620 E	4 4 4 4
<b>1- 4 Pole</b>		<b>3 Pole</b>		4 Pole drawing on request	
		CG 4 WAA282-620 E CA10 WAA282-620 E CH10 WAA282-620 E CA20 WAA282-620 E	6 6 6 6	4 Pole	
				CG 4 WAA482-620 E CA10 WAA482-620 E CH10 WAA482-620 E CA20 WAA482-620 E	8 8 8 8
		This catalogue lists some of the many common 'Standard Switches' available. For additional selection refer to catalogue 100 or enquire.			

## Rotary Cam Switches - Panel Mounting

CG4 A244 FS2	CA10 A263 E-V	Selection Data IEC 60947-3, EN 60947, VDE 0660	CG 4 CA 4	CG 8 CH 10 CA 10	CA20	C26	C32			
		Rated Thermal Current 3 x 380 V/440 V	$I_u = I_{th}$ AC-23A	A kW	10 3	20 7.5	25 11	32 15	40 18.5	50 22
		Rated Thermal Current 3 x 380 V/440 V	$I_u = I_{th}$ AC-23A	A kW	63 30	115 45	150 75	200 75	315 132	500 132
					C 42 CA 63	C 80	C 125	C 200-4	C 315	L 400

Function	Front Plate	Code No.	No. of Stages	Code No.	No. of Stages
5 Step Switches with "OFF" 30° Switching		1 Pole  CG 4 A243-620 E CA10 A243-620 E CH10 A243-620 E CA20 A243-620 E  3 Pole  CG 4 WAA283-620 E CA10 WAA283-620 E CH10 WAA283-620 E CA20 WAA283-620 E	3	2 Pole  CG 4 WAA263-620 E CA10 WAA263-620 E CH10 WAA263-620 E CA20 WAA263-620 E	5
6 Step Switches with "OFF" 30° Switching		1 Pole  CG 4 A244-620 E CA10 A244-620 E CH10 A244-620 E CA20 A244-620 E  3 Pole  CA10 WAA284-620 E CH10 WAA284-620 E CA20 WAA284-620 E	3	2 Pole  CG 4 WAA264-620 E CA10 WAA264-620 E CH10 WAA264-620 E CA20 WAA264-620 E	6
Double Throw Spring Return to "OFF" 30° Switching		1 Pole  CA10 A214-620 E CH10 A214-620 E  3 Pole  CA10 A216-620 E CH10 A216-620 E	1	2 Pole  CA10 A215-620 E CH10 A215-620 E	2
Stop Start Switch 30° Switching		1 Pole  CA10 A176-600 E CH10 A176-600 E	1	2 Pole  CA10 WAA183-600 E CH10 WAA183-600 E	2
Stop Start Switch Spring return to "RUN"		1 Pole  CA10 A178-620 E	1	Refer to catalogue or enquire for details on additional 'standard' switches.	

## Rotary Cam Switches - Panel Mounting

	Selection Data IEC 60947-3, EN 60947, VDE 0660	CG 4	CG 8 CH 10	CA20	C26	C32		
		CA 4	CA 10	CA20B	CA25	CA 40	CA 50	
Rated Thermal Current Rated Category	I <sub>U</sub> = I <sub>th</sub> 3 x 380 V/440 V	A kW	10 3	20 7.5	25 11	32 15	40 18.5	50 22
			C 42 CA 63	C 80	C125	C200-4	C315	L400
Rated Thermal Current Rated Category	I <sub>U</sub> = I <sub>th</sub> 3 x 380 V/440 V	A kW	63 30	115 45	150 75	200 75	315 132	500 132
			C 42 CA 63	C 80	C125	C200-4	C315	L400

Function	Front Plate	Code No.	No. of Stages	Code No.	No. of Stages
Motor Reversing 3 Phase 60° Switching			3	<b>Single or Three phase 90° Enclosed IP65</b> <b>Single Phase Rev.</b> 	3
		<b>CA10 A401-620 E</b> <b>CA40/C26 A401-620 E</b>			
			3	<b>3 Phase Rev.</b> M3 M1 M2 	3
		<b>CA10 WAA622-600 E</b> <b>CA20B WAA622-600 E</b>		<b>CA10C2Y096*PFAUS0001</b> <b>CA10 AU9Y96600FT20002</b>	
Motor Reversing 3 Phase Spring Return			3	<b>Off-Star-Delta</b> 	4
		<b>CA10 A228-600 E</b> <b>CA40/C26 A228-600 E</b>		<b>CA10 A410-620 E</b> <b>CA40/C26 A410-620 E</b>	
Meter/Motor Switches		<b>3 Phase - 3 Wire</b> 	2	<b>Δ Y Tap wound Motor</b> 	(2 Speed)
		<b>CA10 A004-625 E</b> <b>CH10 A004-625 E</b>		<b>CA10 A441-620 E</b> <b>CA20 A441-620 E</b>	
Meter Switches		<b>1 Pole - 3 Current Transformers</b> 	3	<b>3 Ph - Ph / 3 Ph - N</b> 	3
		<b>CA10 A058/AUN0180 E</b> <b>CH10 A058/AUN0180 E</b>		<b>CA10 A007/AU2122 E</b> <b>CH10 A007/AU2122 E</b>	
		<b>1 Pole - 4 Current Transformers</b> 	4	<b>2 Pole - 3 Current Transformers</b> (Can be used for direct reading) 	5
		<b>CA10 WAA036-620 E</b> <b>CH10 WAA036-620 E</b>		<b>CA10 A038-622 E</b> <b>CA40/C26 A038-622 E</b>	

## UPS – Maintenance Bypass Switches

### Maintenance Bypass Switches

Kraus & Naimer Maintenance Bypass Switches are an accepted industrial standard wherever emergency power equipment is installed and maintained.

The Maintenance Bypass Switch can be utilized as a simple method of isolating a UPS without interrupting the power source. This allows servicing of the UPS with complete safety to maintenance personnel. A wide range of models has been established, while a broad selection of designer specified options is available on request.

#### Options Include

Maintenance Bypass Switches are available as - Switch only, Enclosed or Enclosed wired to terminals.

1. Key interlock (V760) with auxiliaries for signal confirmation on locking/unlocking or to shut down the inverter of a UPS prior to switching to the bypass position.
2. Push button interlock with auxiliaries (V400). Switching only possible if push button is depressed, simultaneously closing or opening auxiliaries for signal confirmation to the UPS.
3. A solenoid interlock device (V140) that prevents the operation of the switch except under predetermined electrical conditions.
4. Automatic changeover switches also available.

Current rating to AC22A – 240v	amps	max. cable size	KVA ratings to AC22A – 240v	KVA
CA10B	16	2.5mm	CA10B	3.68
C26	32	6mm	C26	7.3
C42	63	16mm	C42	14
Current rating to AC22A – 415v	amps	max. cable size	KVA ratings to AC22A – 415v	KVA
CA10B	16	2.5mm	CA10B	11.5
C26	32	6mm	C26	23
C42	63	16mm	C42	45
C80	100	35mm	C80	72
C125	150	70mm	C125	107
C200-4	200	M8 95mm	C200-4	143
C315	315	M12 185mm	C315	225



Enclosed & Wired  
to Terminals

**Be smart look for them  
NOW, at your nearest  
Wholesaler.**

# Get smart with Smart Switch

**The complete switch solution-  
First time everytime.**

**IP 65 22.5mm**  
PROTECTION MOUNTING

control switches  
suitable for all applications.

SMART SWITCH STOCK LIST

Product	Description	Barcode	Trade Price
KN11	Smart Body - On Off 1 Pole	9004257083664	
KN12	Smart Body - On Off 2 Pole	9004257083671	
KN13	Smart Body - On Off 3 Pole	9004257083688	
KN14	Smart Key - For KN11, KN12, KN13	9004257083572	
KN15	Smart Padlock Yellow - For KN11, KN12, KN13	9004257083596	
KN25	Smart Padlock Black - For KN11, KN12, KN13	9004257091942	
KN27	Smart Main Switch - 32A 3 Pole	9004257092680	
KN16	Smart Body - Auto Off Man 1 Pole	9004257083626	
KN17	Smart Body - Auto Off Man 3 Pole	9004257083633	
KN18	Smart Key - For KN16, KN17	9004257083589	
KN19	Smart Body - C/O w/out Off 1 Pole	9004257083640	
KN20	Smart Body - C/O w/out Off 3 Pole	9004257083657	
KN21	Smart Key - For KN19, KN20	9004257083701	
KN26	Smart Reverser - 1 & 3 Phase	9004257091959	
KN31	Smart Contactor - 20A AC1, 4kW AC3	9004257092703	
KN22	Smart Handle - Bezel Only	9004257083602	
KN23	Smart Handle - With Frame & Plate	9004257083619	
KN24	Smart Box - IP65 Enclosure	9004257091966	
KN28	Smart Header Plate - For KN22	9004257092710	
KN29	Smart Header Plate - For KN23	9004257092727	
KN30	Smart DIN Mount	9004257092697	

FOR PRICING  
REFER TO YOUR NEAREST  
WHOLESALE

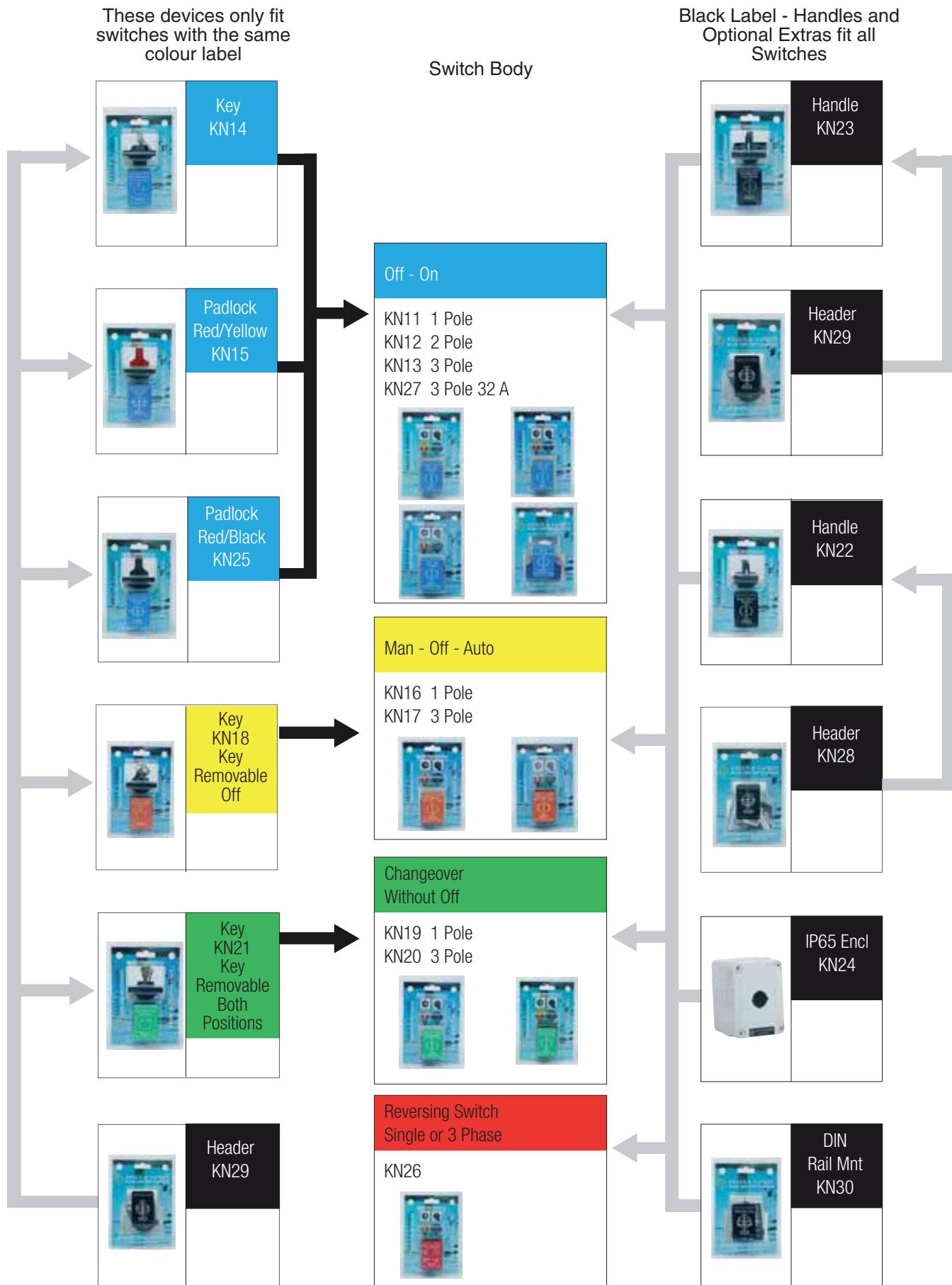
Simply select a contact body and match it to the operator of your choice.



*Make perfect contact...*

## Smart Switch

Match the label colours (blue to blue, yellow to yellow) to ensure the switch body and handle, key or padlock device are compatible.



**KG Main Switches****Nominal Ratings**

	Frame Size	Type	IEC 60947-3/VDE 0660, part 107					
			Rated Values					
			Cable Size mm <sup>2</sup>	Thermal Current I <sub>u</sub> /I <sub>th</sub>	Operational Current AC-21A A	Utilization AC-23A kW	Category 3 x 380 V - 440 V kW	
S0 = 48mm x 48mm	S0/S1	<b>KG10A/KG10B</b>	2.5	20	20	5.5	3.7	
S0 = 48mm x 48mm	S0/S1	<b>KG20A/KG20B</b>	6	25	25	7.5	5.5	
S1 = 64mm x 64mm	S0/S1	<b>KG32A/KG32B</b>	6	32	32	11	7.5	
S1 = 64mm x 64mm	S0/S1	<b>KG41/KG41B</b>	16	40	40	15	11	
S1 = 64mm x 64mm	S0/S1	<b>KG64/KG64B</b>	16	63	63	22	18.5	
S1 = 64mm x 64mm	S1	<b>KG80</b>	50	80	80	30	22	
S1 = 64mm x 64mm	S1	<b>KG100</b>	50	100	100	37	30	
S1 = 64mm x 64mm	S1	<b>KG105</b>	50	125	125	45	37	
S2 = 88mm x 88mm	S2	<b>KG125 (Tunnel)</b>	95					
S2 = 88mm x 88mm	S2	<b>KG126 (Lugs)</b>	M10	125	125	45	37	
S2 = 88mm x 88mm	S2	<b>KG127 (Both)</b>	Both					
S2 = 88mm x 88mm	S2	<b>KG160 (Tunnel)</b>	95					
S2 = 88mm x 88mm	S2	<b>KG161 (Lugs)</b>	M10	160	160	55	45	
S2 = 88mm x 88mm	S2	<b>KG162 (Both)</b>	Both					
S2 = 88mm x 88mm	S2	<b>KG210 (Tunnel)</b>	185					
S2 = 88mm x 88mm	S2	<b>KG211 (Lugs)</b>	M12	200	200	75	55	
S2 = 88mm x 88mm	S2	<b>KG212 (Both)</b>	Both					
S2 = 88mm x 88mm	S2	<b>KG250 (Tunnel)</b>	185					
S2 = 88mm x 88mm	S2	<b>KG251 (Lugs)</b>	M12	250	250	90	55	
S2 = 88mm x 88mm	S2	<b>KG252 (Both)</b>	Both					
S2 = 88mm x 88mm	S2	<b>KG315 (Tunnel)</b>	185					
S2 = 88mm x 88mm	S2	<b>KG316 (Lugs)</b>	M12	315	315	110	75	
S2 = 88mm x 88mm	S2	<b>KG317 (Both)</b>	Both					

**FOR HIGHER CURRENT RATINGS**

Please contact your nearest KRAUS &amp; NAIMER stockist.

**IEC 60947-3****SWITCHES - DISCONNECTORS - SWITCH DISCONNECTORS**

IEC 60947 is a safety and performance standard for low voltage switchgear (up to 1000V) which has universally replaced IEC 408 and combined specific requirements of many individual national standards. IEC 60947 is a uniform standard for most countries around the world and establishes a truly global marketplace. IEC 60947-3 is a section of the standard specific to switches. Importantly, it recognises that devices for the switching function and isolating function require very different performance criteria. Switching requires high performance of current carrying parts to make and break loads under normal and overload conditions, ie., motor reversing applications. Isolation requires high insulation, sufficient spacing of current carrying parts and mechanical integrity that the handle corresponds to actual contact position for the safety of maintenance personnel.

Practicality of real life applications calls for three definitions within IEC 60947-3; Switches, Disconnectors and Switch Disconnectors. A switch does not have to satisfy the isolation and mechanical strength tests, and a disconnector likewise the load tests. A Switch Disconnector must satisfy all tests and is suitable for safety switch applications. A switch disconnector must have a direct drive late make early break auxiliary contact in series with a load breaking device to be suitable as a safety switch.

Kraus & Naimer have developed complete products which satisfy all IEC 60947 criteria, some of which are listed overleaf. For further information, please contact our offices.

**KG Main Switches - Padlockable Panel Mount, Enclosed Plastic or Stainless Steel**

<b>Selection Data</b>		<b>Switch Type</b>														
IEC 60947, EN 60947, VDE 0660		KG10 KG20 KG32 KG41 KG64										KG125 KG160 KG210 KG250 KG315				
IEC 204, EN 60204, VDE 0113		KG10B KG20B KG32B KG41B KG64B										KG126 KG161 KG211 KG251 KG316				
Nominal Voltage	$U_i$	V	690	690	690	690	690	690	690	690	690	1000 <sup>(2)</sup>	1000 <sup>(2)</sup>	1000 <sup>(2)</sup>	1000 <sup>(2)</sup>	1000 <sup>(2)</sup>
Thermal Current	$I_u / I_{th}$	A	20	25	32	40	63	80	100	125	125	160	200	250	315	
Enclosed Thermal Current	$I_{the}$	A	20	25	32	40	50	63	80	100	100	140	200	250	315	
Operational Current AC21A	$I_e$	A	20	25	32	40	63	80	100	125	125	160	200	250	315	
Utilisation Category 3 x 380V / 440V AC-23A/B	kW		5,5	7,5	11	15	22	30	37	45	45	55	75	90	110	

Product	Code No.		Code No.
Panel Mount IP65 Red / Yellow Padlock Handle - V840G/D C/W Off . On Escutcheon	Panel Mount - Lockable 3 Pole  KG10B K300*AU2100 E KG20B K300*AU2100 E KG32B K300*AU2100 E KG41B K300*AU2100 E KG64B K300*AU2100 E KG80 K300*AU2100 E KG100 K300*AU2100 E KG105 K300*AU2100 E KG126 K300*AU2100 E KG161 K300*AU2100 E KG211 K300*AU2100 E KG251 K300*AU2100 E KG316 K300*AU2100 E  Panel Mount - Lockable 3 Pole .  KG10B K302*AU2100 E KG20B K302*AU2100 E KG32B K302*AU2100 E KG41B K302*AU2100 E KG64B K302*AU2100 E KG80 K302*AU2100 E KG100 K302*AU2100 E KG105 K302*AU2100 E KG126 K302*AU2100 E KG161 K302*AU2100 E KG211 K302*AU2100 E KG251 K302*AU2100 E KG316 K302*AU2100 E  Panel Mount - Lockable 4 Pole  KG10B K400*AU2100 E KG20B K400*AU2100 E KG32B K400*AU2100 E KG41B K400*AU2100 E KG64B K400*AU2100 E KG80 K400*AU2100 E KG100 K400*AU2100 E KG105 K400*AU2100 E KG126 K400*AU2100 E KG161 K400*AU2100 E KG211 K400*AU2100 E KG251 K400*AU2100 E KG316 K400*AU2100 E		Enclosed - Plastic - Lockable 3 Pole  KG20A T203/AU1902 PFE1 KG32A T203/AU1902 PFE1 KG41 K302-PFE1 AUS0001 KG41 K302*AU0162*KL12 KG64 K302-PFE1 AUS0001 KG64 K302*AU0162*KL12 KG80 K302*AU0163*KL12 KG100 K302*AU0163*KL12 KG126 K302*AU0760*6FE KG161 K302*AU0760*6FE KG211 K302*AU0171*6FE KG251 K302*AU0171*6FE KG316 K302*AU0171*6FE  Enclosed - Plastic - Lockable 3 Pole  KG20B K302*AU0160*KL12 KG32B K302*AU0160*KL12 KG41B K302*AU0152*KL12 KG64B K302*AU0152*KL12 KG80 K302*AU0153*6FE KG100 K302*AU0153*6FE KG126 K302*AU0761*6FE KG161 K302*AU0761*6FE KG211 K302*AU0172*6AE <sub>metal</sub> KG251 K302*AU0172*6AE <sub>metal</sub> KG316 K302*AU0171*6AE <sub>metal</sub>  (1) Enclosed - Plastic - Lockable 3 Pole C/O with centre OFF  KG20B K900*AU0157*KL12 KG32B K900*AU0157*KL12 KG41B K900*AU0158*KL12 KG64B K900*AU0158*KL12 KG80 K900*AU0159*6FE KG100 K900*AU0159*6FE  Enclosed - Lockable Stainless Steel 3 pole  KG41B K302*AU1150*6SH1 KG64B K302*AU1150*6SH1 KG80 K302*AU1148*6SH1 KG100 K302*AU1148*6SH1 KG125 K302*AU1145*6SH2 KG161 K302*AU1145*6SH2 KG211 K302*AU1151*6SH3 KG251 K302*AU1151*6SH3 KG316 K302*AU1151*6SH3  Stainless Steel Enclosures... Marine Grade 316 IP65 N/O contact late make early break. Finish:- Bead Blast or Food Industry.(FL) Available on request:- Intergated Rain Hood. Hinged Door. Mounting Flanges Stainless Steel Padlock Device
Plastic Enclosure IP65 Red / Yellow Padlock Handle - V845			
Stainless Steel Enclosure IP65	Enclosed - Lockable Stainless Steel 3 Pole  KG20A K302*AUN0478*6SS0 KG32A K302*AUN0478*6SS0 KG41B K302*AUN0479*6SS1 KG64B K302*AUN0479*6SS1 KG80 K302*AUN0479*6SS1 KG100 K302*AUN0479*6SS1 KG125 K302*AUN0480*6SS2 KG161 K302*AUN0480*6SS2  Variations on request:- Stop/Start Pushbuttons. Control & Changeover Switches. Selection of auxillary contacts.		

(1) 4 Pole changeover enclosed. Refer page 20.

For Panel and Base mount 4 Pole changeover Refer to page 20.

(2) Suitable for no load switching (AC-20A) above 690v.

## KG Main Switches - Base Mounted Padlockable with Extension Shafts

Selection Data		Switch Type										KG125 KG160 KG210 KG250 KG315				
IEC 60947-3, EN 60947, VDE 0660		KG10 KG20 KG32 KG41 KG64					KG126 KG161 KG211 KG251 KG316					KG125 KG160 KG210 KG250 KG315				
IEC 204, EN 60204, VDE 0113		KG10B KG20B KG32B KG41B KG64B					KG80 KG100 KG105 KG127 KG162 KG212 KG252 KG317					KG126 KG161 KG211 KG251 KG316				
Nominal Voltage	U <sub>i</sub>	V	690	690	690	690	690	690	690	690	690	1000 <sup>(1)</sup>	1000 <sup>(1)</sup>	1000 <sup>(1)</sup>	1000 <sup>(1)</sup>	1000 <sup>(1)</sup>
Thermal Current	I <sub>U</sub> / I <sub>th</sub>	A	20	25	32	40	63	80	100	125	125	160	200	250	315	
Enclosed Thermal Current	I <sub>the</sub>	A	20	25	32	40	50	63	80	100	100	140	200	250	315	
Operational Current AC21A	I <sub>e</sub>	A	20	25	32	40	63	80	100	125	125	160	200	250	315	
Utilisation Category 3 x 380V / 440V AC-23A/B	kW		5,5	7,5	11	15	22	30	37	45	45	55	75	90	110	

Product	Code No.	Code No.		
KG10B - KG100 = Base/DIN Mount  Base Mounted with Door Clutch M280E Padlock Device V840G/D	Door Clutch <b>M280E/EF</b> P'lockable Handle V840G/D Esc. plate OFF - ON <b>3 Pole</b>  <b>KG10B K300*AUN0481 VE</b> <b>KG20B K300*AUN0481 VE</b> <b>KG32B K300*AUN0481 VE</b> <b>KG41B K300*AUN0481 VE</b> <b>KG64B K300*AUN0481 VE</b> <b>KG80 K300*AUN0481 VE</b> <b>KG100 K300*AUN0481 VE</b> <b>KG105 K300*AUN0481 VE</b> <b>KG126 K300*AUN0481 VE</b> <b>KG161 K300*AUN0481 VE</b> <b>KG211 K300*AUN0481 VE</b> <b>KG251 K300*AUN0481 VE</b> <b>KG316 K300*AUN0481 VE</b>	Door Clutch <b>M280E/EF</b> P'lockable Handle V840G/D Esc. plate OFF - ON <b>3 Pole + 1N/O 1 N/C aux.</b> (N/O aux. early break)  <b>KG10B K302*AUN0483VE</b> <b>KG20B K302*AUN0483VE</b> <b>KG32B K302*AUN0483VE</b> <b>KG41B K302*AUN0483VE</b> <b>KG64B K302*AUN0483VE</b> <b>KG80 K302*AUN0483VE</b> <b>KG100 K302*AUN0483VE</b> <b>KG105 K302*AUN0483VE</b> <b>KG126 K302*AUN0483VE</b> <b>KG161 K302*AUN0483VE</b> <b>KG211 K302*AUN0483VE</b> <b>KG251 K302*AUN0483VE</b> <b>KG316 K302*AUN0483VE</b>		
KG10B - KG100 = Base/DIN Mount  Base Mounted with Door Clutch M280E & V845	Door Clutch <b>M280E/EF</b> P'lockable Handle V845 Esc. plate OFF - ON  <b>3 Pole (without aux's)</b>  <b>KG10B K300*AUN0482 VE</b> <b>KG20B K300*AUN0482 VE</b> <b>KG32B K300*AUN0482 VE</b> <b>KG41B K300*AUN0482 VE</b> <b>KG64B K300*AUN0482 VE</b> <b>KG80 K300*AUN0482 VE</b> <b>KG100 K300*AUN0482 VE</b> <b>KG105 K300*AUN0482 VE</b> <b>KG126 K300*AUN0482 VE</b> <b>KG161 K300*AUN0482 VE</b> <b>KG211 K300*AUN0482 VE</b> <b>KG251 K300*AUN0482 VE</b> <b>KG316 K300*AUN0482 VE</b>	Door Clutch <b>M280E/EF</b> P'lockable Handle V840G/D Esc. plate OFF - ON  <b>4 Pole</b>  <b>KG10B K400*AUN0481VE</b> <b>KG20B K400*AUN0481VE</b> <b>KG32B K400*AUN0481VE</b> <b>KG41B K400*AUN0481VE</b> <b>KG64B K400*AUN0481VE</b> <b>KG80 K400*AUN0481VE</b> <b>KG100 K400*AUN0481VE</b> <b>KG105 K400*AUN0481VE</b> <b>KG126 K400*AUN0481VE</b> <b>KG161 K400*AUN0481VE</b> <b>KG211 K400*AUN0481VE</b> <b>KG251 K400*AUN0481VE</b> <b>KG316 K400*AUN0481VE</b>		
6 Pole Isolator  	<b>6 Pole Isolator Panel Mounted</b> Escutcheon plate OFF-ON  <b>KG20B K600*AU2103 E</b> <b>KG32B K600*AU2103 E</b> <b>KG41B K600*AU2103 E</b> <b>KG64B K600*AU2103 E</b> <b>KG80 K600*AU2103 E</b> <b>KG100 K600*AU2103 E</b> <b>KG126 K600*AU2103 E</b> <b>KG161 K600*AU2103 E</b>	<b>3 Pole Change Over Panel Mounted with OFF Escutcheon 1/0FF/2</b>  <b>KG20B K900-620 E</b> <b>KG32B K900-620 E</b> <b>KG41B K900-620 E</b> <b>KG64B K900-620 E</b> <b>KG80 K900-620 E</b> <b>KG100 K900-620 E</b> <b>KG126 K900-620 E</b> <b>KG161 K900-620 E</b>		
Aux. Contacts fitted on request  8 Pole Isolators and 4 Pole c/o also available	<b>TERMINATION:</b> KG10 ~ KG125, KG160, KG210 KG250 & KG315 Tunnel. KG126, KG161, KG211, KG251 & KG316 Lugs. KG127, KG162, KG212, KG252 & KG317 Tunnel & Lugs.			

(1) Suitable for no load switching (AC-20A) above 690v.

Note: EF = Supplied with IP65 seal

# Application Guide AS/NZS 947-3 3F Lockout Isolators

Get a Handle on Safety with your Eyes Closed

## Product Features

### M700 Door Interlock

- Padlockable in 'OFF' only - safety requirement according to AS/NZS 947-3
- In 'ON' the door interlock is engaged - the cabinet cannot be opened
- In 'ON' the door interlock can be defeated by using a tool - authorised entry only
- The door interlock re-engages when the door is closed after authorised defeat in 'ON'
- In 'OFF' and padlocked, the door interlock defeat is disabled - no access
- When the door is opened the handle position is locked - assured alignment
- Mechanical Position Indicator on the switch module - visible when the door is open
- Internal Padlock Device on switch module
- Robust, keyed, floating head on switch shaft



### KG Switch Disconnectors

- 13/14mm contact gap. 690v - 1000v insulation
- High AC3 and AC23 ratings
- Large, finger proof IP20 box type terminals
- Double break forced opening safety rated auxiliary contacts. Silver or Gold 1 to 6 N/O - N/C
- Positive drive make and break main contacts. 3 to 8 poles OFF ON, 3 or 4 pole C/O
- IEC 947-3 3F disconnect handle. Isolation is assured 'OFF' is 'OFF'

### General Features

- Custom colours and engraving for escutcheon plates and header labels
- Scratch-proof reverse engraving
- IP65 dust and water protection
- Robust, double insulated handle
- Asymmetric shaft and interlock profiles ensure the handle position matches the switch position
- Fixed length shaft ensures shaft must engage with the handle

[Telephone now for a demonstration](#)

## IEC 947-1

### Equipment Suitable For Isolation - The Following Clauses Apply

**Clause 7.1.6** Additional constructional requirements for equipment suitable for isolation

#### Clause 7.1.6.1 Additional constructional requirements

Equipment suitable for isolation shall provide, in the open position (see 2.4.21) an isolation distance in accordance with the requirements necessary to satisfy the isolation function (see 7.2.3.1 and 7.2.2) (dielectric test)

Indication of the position of the mains contacts shall be provided by one or more of the following means:

- (1) The position of the actuator
- (2) A separate mechanical indicator
- (3) Visibility of the moving contacts

The effectiveness of each of the means of indication provided on the equipment and its mechanical strength shall be verified in accordance with clause 8.2.5

#### Clause 8.2.5 Verification of the effectiveness of indication of the main contact position of equipment suitable for isolation

To verify the effectiveness of the indication of the main contact position, all means of indication of contact position shall continue to function correctly after the operational performance type tests, and special durability type tests (if performed).

### Switch Classifications

All low voltage switches installed in Australia and New Zealand shall meet AS/NZS 60947 and carry the appropriate easily identifiable symbol depending on the switch classification.

#### Switch

A mechanical switching device capable of making and breaking currents under normal conditions, which may include specified overload conditions according to the duty, and abnormal circuit conditions such as short-circuit. (motor reversing switches, control switches, start delta switches, etc)

#### Disconnector

A mechanical switching device which in the open position, complies with the requirements specified for the isolating function (Off load isolator)

#### Switch Disconnector

A 'Switch' which in the open position, complies with the requirements specified for the isolating function (On load isolator)

## Changeover Switches Base Mount & Enclosed

Product	Base Mount Code No.	Base Mount Code No.
 VE2-Mounting	<b>2 Pole Changeover</b> Din Rail Mtg - MCB cut out Eng: Mains Off Gen  KH32 T902*NZ0001 VE2 KH40 T902*NZ0001 VE2 KH63 T902*NZ0001 VE2 KH80 T902*NZ0001 VE2	<b>Enclosed Code No.</b>  <b>3 Pole Changeover</b> <u>Enclosed</u> - Plastic IP65 Eng: Mains Off Gen  KG20B K900*AUN0115*KL12 KG32B K900*AUN0115*KL12 KG41B K900*AUN0116*KL12 KG64B K900*AUN0116*KL12 KG 80 K900*AUN0117*6FE KG100 K900*AUN0117*6FE KG126 K900*AUN0118*6FE KG161 K900*AUN0118*6FE
 VE-Mounting	<b>3 Pole Changeover</b> Din Rail Mtg - MCB cut out Eng: Mains Off Gen  KG32A T903*NZ0001 VE2 KG41B T903*NZ0001 VE2 KG64B T903*NZ0001 VE2 KG80 T903*NZ0001 VE2 KG100 T903*NZ0001 VE2	<b>3 Pole Changeover</b> <u>Enclosed</u> - Plastic IP65 Eng: Mains Off Aux  KG20B K900*AUV0290*KL12 KG32B K900*AUV0290*KL12 KG41B K900*AUV0290*KL12 KG64B K900*AUV0290*KL12 KG 80 K900*AUV0290*6FE KG100 K900*AUV0290*6FE KG126 K900*AUV0290*6FE KG161 K900*AUV0290*6FE
 Enclosed- Plastic	<b>3 Pole Changeover</b> Din Rail Mtg - MCB cut out Eng: Mains Off Aux  KG32A T903*AUV0290 VE2 KG41B T903*AUV0290 VE2 KG64B T903*AUV0290 VE2 KG80 T903*AUV0290 VE2 KG100 T903*AUV0290 VE2	<b>4 Pole Changeover</b> <u>Enclosed</u> - Plastic IP65/ * Metal IP65 Eng: Mains Off Gen  KG20B K950*AUN0119*6FE KG32B K950*AUN0119*6FE KG41B K950*AUN0120*6FE KG64B K950*AUN0120*6FE KG 80 K950*AUN0121*6FE KG100 K950*AUN0121*6FE KG126 K950*AUN0122*6FE KG161 K950*AUN0122*6FE 6KF252 K950*AUN0128*6AE(250A) * 6KF402 K950*AUN0129*6IP (400A) *

For Further Information Regarding The Range of Enclosed Isolators

Refer to the Kraus & Naimer "Enclosed Switch Catalogue" on [www.krausnaimer.com.au](http://www.krausnaimer.com.au)

## Changeover Switches Base Mount & Enclosed

Product	Base Mount Code No.		Base Mount Code No.	
	3 Pole changeover (unenclosed) with M280E door clutch Eng: Mains Off Gen  KG20B K900*AUN0123 VE KG32B K900*AUN0123 VE KG41B K900*AUN0123 VE KG64B K900*AUN0123 VE KG 80 K900*AUN0123 VE KG100 K900*AUN0123 VE KG126 K900*AUN0124 VE KG161 K900*AUN0124 VE		Enclosure for Domestic / Commercial Installations  Suitable for VE2 2 & 3 Pole Changeover To 63 Amp IP40	64CC6
	3 Pole changeover (unenclosed) with M280E door clutch Eng: Mains Off Aux  KG20B K900*AUV0291 VE KG32B K900*AUV0291 VE KG41B K900*AUV0291 VE KG64B K900*AUV0291 VE KG 80 K900*AUV0291 VE KG100 K900*AUV0291 VE KG126 K900*AUV0291 VE KG161 K900*AUV0291 VE		Suitable for VE2 2 Pole Changeover	6FKV
	4 Pole Changeover (unenclosed) with M280E door clutch Eng: Mains Off Gen  KG20B K950*AUN0125 VE KG32B K950*AUN0125 VE KG41B K950*AUN0125 VE KG64B K950*AUN0125 VE KG 80 K950*AUN0125 VE KG100 K950*AUN0125 VE KG126 K950*AUN0126 VE KG161 K950*AUN0126 VE 6KF252 K950*AUN0130 VE(250A) 6KF402 K950*AUN0130 VE(400A)		  64CC6	For 3 Pole changeover  KG20B - 190 x 100 x 90 - 6mm KG32B - 190 x 100 x 90 - 6mm KG41B - 250 x 145 x 100 - 16mm KG64B - 250 x 145 x 100 - 16mm KG 80 - 280 x 190 x 130 - 35mm KG100 - 280 x 190 x 130 - 35mm KG126 - 560 x 380 x 180 - M10 (Lugs) - 95mm KG161 - 560 x 380 x 180 - M10 (Lugs) - 95mm  For 4 Pole changeover  KG20B - 190 x 190 x 130 - 6mm KG32B - 190 x 190 x 130 - 6mm KG41B - 280 x 190 x 130 - 16mm KG64B - 280 x 190 x 130 - 16mm KG 80 - 380 x 280 x 130 - 35mm KG100 - 380 x 280 x 130 - 35mm KG126 - 560 x 380 x 180 - M10 (Lugs) - 95mm KG161 - 560 x 380 x 180 - M10 (Lugs) - 95mm 6KF252 - 600 x 600 x 350 Metal - M10 (Lugs) - 150mm 6KF402 - 800 x 600 x 400 Metal - M10 (Lugs) - 240mm

For Further Information Regarding The Range of Enclosed Isolators  
Refer to the Kraus & Naimer "Enclosed Switch Catalogue" on [www.krausnaimer.com.au](http://www.krausnaimer.com.au)

## Optional Extras

Keylocks	Code	Mounting Units	Code
Direct drive operator	V750/A9 	Panel mount 2 or 4 screw	E 
For base mounting	V750D/ VE21 	Panel mount 2 or 4 screw IP65	EFA 
IP66 For single hole 22mm Standard K&N Key	V750D/3 	Base mounting 4 screw mount	VE 
Direct Drive Key Operator Mounted in a IP66 Hinged / Flip Lid Enclosure	V755/ 6CL 	Base mount DIN rail	VE1 
Direct Drive Key Operator <u>Nominate key barrel:-</u> 570 Lockwood, Bi-Lock, Lock Focus, KabaQuattro, Efco, Schlage, CL, etc..... <u>Customised key systems:-</u> Key Indication, cylinder removable from front (RL), Electronic key interlocks etc. <u>Nominate Mounting:-</u> Panel mount, Wall Plate mounting, enclosed (plastic, s/steel etc),	6S0LW V755/A 	Base mount DIN rail with MCB cut out	VE2 
Separate Drive Key Lock Programmable locking positions using <u>Streb</u> barrel	V760/A.E 	Double end mount 4 screw fixing	ER 
Separate Drive Key Lock Programmable locking positions for: Lockwood 5-6 pin barrels C4 (201). Bi - Lock.(specify) Includes: <u>australian solenoid co pty ltd.</u> standard barrel:- 6S1 V760 S (Lockwood type).	V760/A  SO V760/A.E	Double end mount for fixing of plate with DIN mounting	VE1E 
Mounting Units	Code		
Right Angle Drive	K3 M330/A K3 M330/B 	IP66 Single hole without plate 16/22mm 22/30mm	FSI FT1 
		IP66 Single hole square plte 16/22mm 22/30mm	FS2 FT2 
		Next size up handle and plate	EG 
Terminal Covers			
3 main contacts KG 20 - KG 100 KG 126 / KG 161 KG 251 / KG 316	M160 / 3 M160 / 33 M160 / 4 	Single hole with plate 16/22mm Rectangle 30 x 39 Single hole with plate 16/22mm Rectangle 48 x 59 Single hole with plate 16/22mm Rectangle 64 x 78 Header 2 Lines Header 3 Lines	FS4 FT6 
4 main contacts KG 20 - KG 100 KG 126 / KG 161 KG 251 / KG 316	M160 / 43 M160 / 43 M160 / 41	FH4 PRC PRA 	

## Optional Extras

Padlock	Code	Door Clutch & Shaft Extensions	Code
The padlock is an integral part of the switch handle	V840A 	Door clutch for misaligned doors with locking handle Note: Knowledgeable personnel using a simple tool are able to defeat the interlock Refer to Page 19	M700 
Locking handle for DIN cutout handles	V840B 	Door clutch with shaft extension Interlocked or Non Interlocked Available	M280E 
For a padlocks	V845 	IP66 Single hole 22mm door clutch and locking handle	V840G/B 
Padlock with integral flat or raised handle - 2 padlock	V840D 	IP66 Single hole 22mm door clutch and locking handle	V840G 
Padlock with integral flat or raised handle - 3 padlock	V840G/B 	IP66 Single hole 22mm door clutch and locking handle	V845 
Padlock with integral flat or raised handle - 4 padlock	V840G 	Single hole 22mm door clutch and locking handle	V840E 
Padlock device	V850 	Single hole 22mm door clutch	M295A 
Shaft locking device	V840VE 	IP66/67 Single hole mounting with integrated door clutch *Override function in On-Position	M800 
Heavy Duty Stainless Steel Lock-out safety device	6SS V840 	Shaft extention asymmetric profile	M004D 
Clip on aux contacts - base mount for KG20 -KG32 for KG41 - KG64	KO-H010/A11-VE K1-H010/A11-VE	Shaft extention square profile	L100A/M004E 
Clip on aux contacts - panel mount for KG20 -KG32 for KG41 - KG64	KO-H010/A11-E K1-H010/A11-E		

## Special Drive Options & Enclosures

Special Drives	Description	Optional Code No.	CG 4 - CA 4	CA10 - CA25	CA10B - C 42	C 43 - C125	C315 - L2000
	<b>Heavy Duty Drive</b> Create your own handle/drive unit and weld it onto the removable plate. Long rods, T-bars, etc.  <b>E</b> Panel Mount, <b>PK</b> Plastic Encl. <b>GK</b> Aluminum Enclosure	<b>G800/A</b>					<b>PRICES AVAILABLE ON REQUEST</b>
	<b>Limit Switch</b> Heavy duty roller & actuator for spring return or stepping applications.  <b>E</b> Panel Mount <b>PK</b> Plastic Enclosure <b>GK</b> Aluminum Enclosure Also Available in 6CL 56 Plastic Enclosure.	<b>G800/B</b>					<b>PRICES AVAILABLE ON REQUEST</b>
	<b>Rope Operator</b> Heavy duty for <b>GK</b> / <b>PK</b> or <b>6CL 56</b> series enclosures.  Drive Only Also Available in 6CL 56 Plastic Enclosure	<b>G900/B</b>					<b>PRICES AVAILABLE ON REQUEST</b>
	<b>Aluminium Enclosures for Drives</b>  Switch length 4 stages.  Various sizes available on request.	<b>GK</b>					<b>PRICES AVAILABLE ON REQUEST</b>
	<b>Plastic Enclosures for Drives</b>  Switch length 4 stages.  Various sizes available on request.	<b>PK</b>					<b>PRICES AVAILABLE ON REQUEST</b>
	<b>HAZARDOUS AREAS</b> <b>Dust Ignition Proof</b> <b>Flame Proof</b>	<b>DIP</b>  <b>Ex d</b>					<b>PRICES AVAILABLE ON REQUEST</b>
	<b>Stainless Steel Enclosures</b> <b>Marine Grade 316</b>  208H x 113W x 96D 240H x 140W x 120D 350H x 230W x 170D 500H x 320W x 175D 710H x 320W x 175D C/W rain hood  (Other sizes available on request)	<b>6S</b>					<b>Finish:-</b> Bead Blast or Food Industry. (N°4)  <b>Options:-</b> Rain Hood. Hinge Door.  <b>Variations on request:-</b> Stop / Start Pushbutton. Control & Changeover Switches. Selection of auxillary contacts.

## Standard Enclosures

### Enclosure Information

The following options can be included by substituting suffix code "E" for the optional code number.. **PF, KS, KL, 6CL....**

**Note: KG enclosed isolators listed complete on page 17**

**Example:** 3pole 20Amp Off/On Switch  
Enclosed with Padlockabe handle

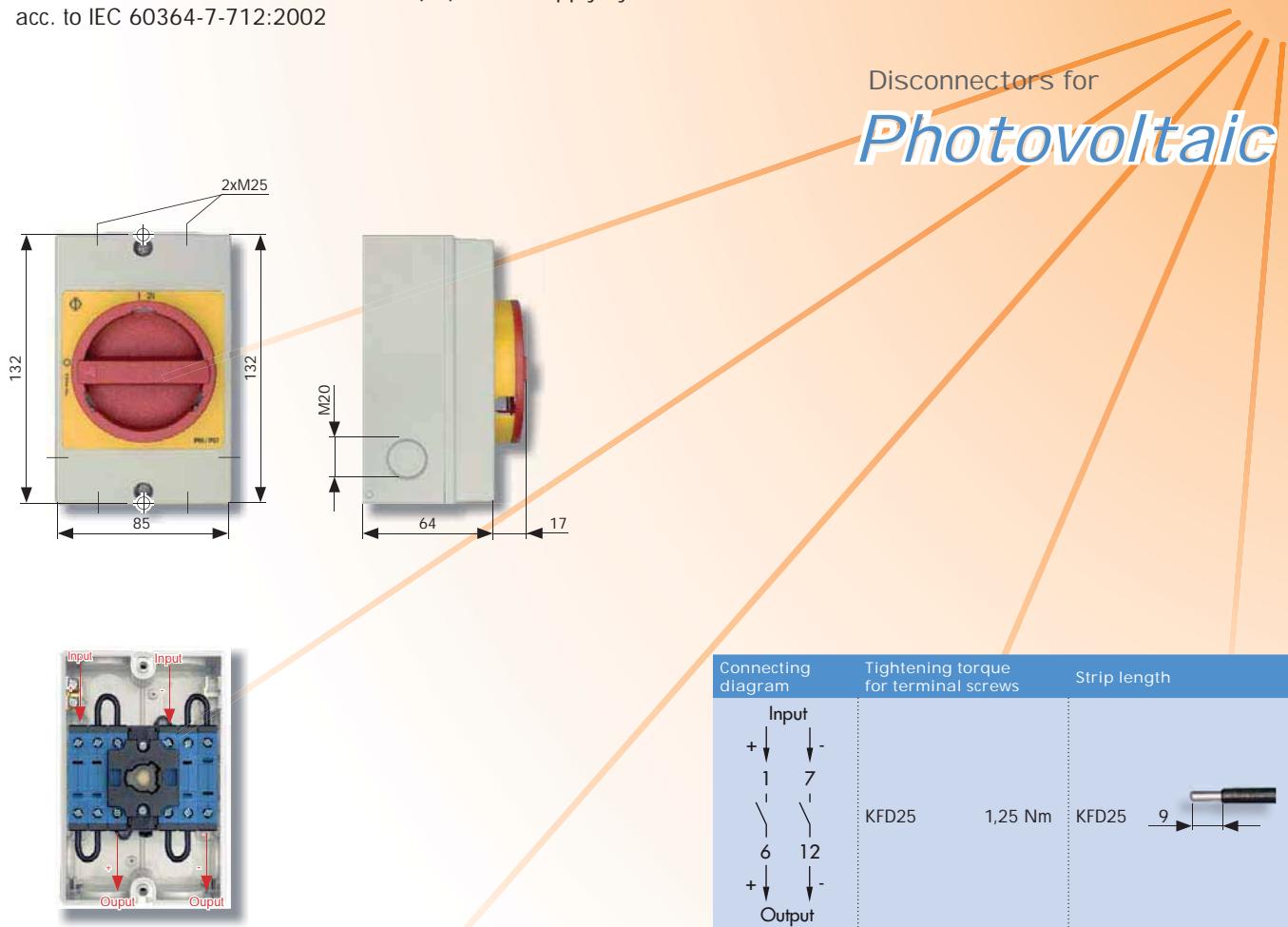
CA 10 A292-621 **PF**  
**V840G**

Enclosures	Description	Code No.	CG 4 - CA 4	CA10 - CA20	CA10B - C 42	C 43 - C125	C315 - L2000
 KS enclosure	<b>CG 4 &amp; CA 4 Switches</b> Material - Very high UV resistance - High chemical resistance Dimensions mm 1 stage - 90L x 70W x 60H 2 stage - 90L x 70W x 72.5H	KS KS					<b>PRICES AVAILABLE ON REQUEST</b>
 PF enclosure	<b>Standard without Cover Interlock</b> Very high UV resistance Excellent chemical resistance	PF					<b>PRICES AVAILABLE ON REQUEST</b>
 6 CL 56/98 enclosure	<b>Industrial Enclosure IP66</b> Dimensions mm - 101L x 101W x 91H /98 series - 198L x 101W x 91H /195 series  Chemical resistant orange available on request. (Nominate entries prefered).	6 CL 56/98 6 CL 56/98-4 6 CL 56/195	6 CL 56/98 6 CL 56/98-4 6 CL 56/195	Flip Lid			<b>PRICES AVAILABLE ON REQUEST</b>
 6 FE enclosure	<b>General Purpose ABS Enclosures</b> Excellent Chemical resistance IP67.  6FE B85AG - 110H x 80W x 85D 6FE C65AG - 140H x 80W x 65D 6FE C85AG - 140H x 80W x 85D 6FE D85AG - 170H x 60W x 85D 6FE M95AG - 230H x 140W x 95D	6FE B85AG 6FE C65AG 6FE C85AG 6FE D85AG 6FE M95AG	6FE B85AG 6FE C65AG 6FE C85AG 6FE D85AG 6FE M95AG				<b>PRICES AVAILABLE ON REQUEST</b>
 6 FEC enclosure	<b>Polycarbonate Enclosures IP67</b> 6FEC - 190H x 190W x 130D 6FEC - 190H x 190W x 180D 6FEC - 280H x 190W x 130D 6FEC - 280H x 190W x 180D 6FEC - 280H x 280W x 130D 6FEC - 380H x 280W x 130D 6FEC - 380H x 280W x 180D 6FEC - 560H x 380W x 180D 6FEC - 560H x 380W x 230D						<b>PRICES AVAILABLE ON REQUEST</b>
 AE enclosure	<b>Metal Enclosures IP67</b> Switches mounted to gear tray with door interlock. 6AE 1033/300 x 300 x 210 6AE 1385/380 x 380 x 250 6AE 1338/600 x 380 x 350 Additional metal enclosures available	6AE 1033 6AE 1385 6AE 1338	6AE 1033 6AE 1385 6AE 1338				<b>PRICES AVAILABLE ON REQUEST</b>

FOR FURTHER INFORMATION ON LARGER ENCLOSURES  
PLEASE TELEPHONE YOUR NEAREST BRANCH



DC Disconnectors for Solar Photovoltaic (PV) Power Supply System  
acc. to IEC 60364-7-712:2002



Contact development: 2 pole, 6 contacts per circuit (2 x 3 in series)

#### General Data

Switch Disconnector according to EN 60947-3 respectively VDE 0660 Part 107

Utilization Category: for Photovoltaic Application  
with rapid handle operation

DC-21B (Switching of resistive loads, including moderate overloads)

Overvoltage category III, pollution degree II

Terminal Lugs finger-proof according to VDE 0660-514 and BGV A3, IP 20

Maximum permissible wire size (use copper wire only)  
single core wire or stranded wire  
flexible wire

KFD25: 6 mm<sup>2</sup>  
KFD25: 4 mm<sup>2</sup>, or 6 mm<sup>2</sup> flexible wire with a diameter not larger than 3,9mm after the insulation has been removed and the end has been reshaped.

#### Mounting

Plastic Enclosures, Protection IP66/67, totally insulated, threaded entries,

OFF-position lockable with padlocks, cover coupling with interlock

#### Rated Value/Order Number

Operational Current (enclosed up to 50 °C) DC-21B	19 A	23 A	25 A
1,2 x Voc 2 pol	1380 V	1200 V	1020 V
1,2 x Voc on each side	690 V	600 V	510 V
Insulation Voltage	1500 V	1500 V	1500 V

Order Number

<----- KFD25 T206/AUP0013 KT11V ----->

## New Product

### G20 (S) - DC Switch With Knife Contacts

Kraus and Naimer have developed and designed a new DC Switch; the G20(S). The 'Knife contacts' have been designed in a new way resulting in a switching capacity of 20 Amps at 690V DC (DC-22A) and high short circuit withstand capability.

Finger-proof terminals according to EN 50274 and protection degree IP20 offer maximum safety. With a standard latching mechanism, the G20 complies with all regulations required for main switches according to IEC/EN 60204.

In addition the G20 is also ideal for AC applications with high short circuit fault levels, as well as electronic circuitry with low current and voltages.

- Self-cleaning and vibration resistant knife contacts
- Compact design
- High DC switching capacity
- Highest contact reliability (better than any H-bridge contact system)
- High short circuit withstand capability
- Finger-proof terminals (IP20) even if jumper leads are used
- Terminal extensions (accessory item) for ring type cable lugs (max. width 6mm) and quick connect lugs available
- Heat resistant contact system according to standard EN 12101-3

G20 - with normal latching (in preparation)

G20S - with snap action latching



Utilisation Category	No. of Series Contacts G20S						Rated Operational Current Ie/A
	Total Voltage in Volts						
	1	2	3	4	5	6	
DC-21A	250	500	750	1000	-	-	20
	440	880	-	-	-	-	13
DC-22A	250	500	750	1000	-	-	20
	330	660	990	-	-	-	10
	440	880	-	-	-	-	5
DC-23A	48	96	144	192	240	144	20
	60	120	180	240	300	288	15
	110	220	330	440	550	360	12
	160	320	480	640	-	-	8
	250	500	750	1000	-	-	5
	330	660	990	-	-	-	3
	440	880	-	-	-	-	1

### KF Switch Range 1 Pole per module (16-32A)

The innovative modular system is both simple and very safe while offering enormous flexibility.

The position of the various modules in relation to each other can be defined by the user.

Than assembled in the factory

Rotating contact movement (instead of the classical vertical lifting) allows

- Big contact gaps
- High mechanical life expectancy
- Very precise movement sequence
- Self cleaning contacts
- Forced opening and closing of contacts
- Compact (very shallow design)
- Up to 1000V insulation voltage according to IEC possible
- Lateral drive possible (latching module not in the centre but on left or right hand side)
- Coupling profile determines pre-closing function of switched 4th pole
- Visible contacts (windows) available on request
- Design allows a big variation of terminal markings



Telephone now for a demonstration

New Product

Maintenance Switches For EMC - Frequency Regulated Motor

According to IEC 60204 and VDE 0113



# Kraus & Naimer

BLUE LINE switchgear

since 1907

Maintenance Switches for

**EMC-compliant connection**



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**Kraus & Naimer** Ltd.  
BLUE LINE switchgear

NZ  
since 1907

# New from Kraus & Naimer



3 & 4 POLE CONTACTORS 4kW—160kW

DC CONTACTORS

MOTOR STARTERS—DOL, STAR -DELTA & REVERSING

MODULAR CONTACTORS

EXTRAS INCLUDE—THERMAL OVERLOADS, CLIP ON AUX (TOP AND SIDE MOUNT), MECHANICAL INTERLOCKS, COIL SUPPRESSOR, MECHANICAL LATCH

AC & DC COILS - SPECIAL COIL VOLTAGES AVAILABLE ON REQUEST



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## Control & Signalling Units 22mm - Assembled Units

Item	Code No.		Item	Code No.	
Push Button IP67/IP69K 	1 Normally Open AC - 15 240v 6A  Green Red Yellow Blue White		Push Button IP67/IP69K 	1 Normally Closed AC - 15 240v 6A  Green Red Yellow Blue White	
Pilot Light IP67/IP69K 	c/w 24V LED  PSN-WD0003 PSN-WD0004 PSN*NZ0021 PSN*NZ0022 PSN*NZ0023		Pilot Light IP67/IP69K 	c/w 240V LED  PSN-WD0005 PSN-WD0006 PSN*NZ0004 PSN*NZ0012 PSN*NZ0013	
Double - Push Button IP67/IP69K 	c/w 240V LED  PSN/DDL/GR/X1-XO-K11  c/w 24V LED  PSN*AUN0144		Emergency Stop Non-Illuminated IP67/IP69K 	*Reset by twisting 1 Normally Closed  PSN*NZ0006 (enclosure available on request)	

For further information refer to Catalogue 302

\*NOTE ALSO AVAILABLE AS RESET BY PULLING OR  
KEY OPERATION

## Palm Push Buttons AC-15 230v 6A, IP66

Foot & Palm Switch Red & Yellow Reset By Pulling				Foot & Palm Switch Spring Return Black & White Enclosed with Red Operator	
1 x N/C	PFT/R-V-KC01-1Y			N/O x N/C	PFT/R-KC11-1

## Potentiometer Units Heavy Duty & Standard 22mm Mounting

Heavy Duty With K&N Switch Front IP65 Reinforced Stop. Optional Keyed or Stepping 48mm Square Front Engraved With Swoop				Standard IP66 3 Screw Terminals P max = 0.5 watt	
1k	CA10NZQ172*02FT2			1.0k Ohm	PSN/R1k
2.2	CA10NZU606*01FT2			4.7k Ohm	PSN/R4K7
4.7k	CA10NZU607*01FT2			10k Ohm	PSN/R10K
10k	CA10NZV049*02FT2				
64mm Square Front Engraved With Swoop				Heavy Duty Pot Units. Developed by Kraus & Naimer for use in industrial applications. The 270° single turn pot drive features a HEAVY DUTY drive, large operator handle and sealing to IP65. With easy mount 22mm single hole mounting the drive has smooth stepless operation and comes complete with a header label. Options include keys and additional contacts	
1k	CA10NZQ172*02FH3				
2.2k	CA10NZU606*01FH3				
4.7k	CA10NZQ607*01FH3				
10k	CA10NZQ049*02FH3				

## Control & Signalling Units 22mm - Loose Components

Push Buttons AC-15 230v 6A, IP67/IP69K		
Push Buttons Front Element Flush Illuminated		Push Buttons Front Element Flush Illuminated
Green PSN/DL/G		Green PSN/DLH/G
Red PSN/DL/R		Red PSN/DLH/R
Push Buttons AC-15 230v 6A, IP67/IP69K		
Push Buttons Front Element Flush Non Illuminated		Push Buttons Front Element Flush Non Illuminated
Green PSN/D/G		Green PSN/DH/G
Red PSN/D/R		Red PSN/DH/R
Rotary Switches AC-15 230v 6A, IP66		
Rotary Switch Front Element Latching Non Illuminated (changeable to spring return)		Rotary Switch Front Element Latching Non Illuminated (changeable to spring return)
2 Position PSN/WRK		2 Position PSN/WRLK/*K
2 Position PSN/WKV		2 Position PSN/WKLK3/*
3 Position PSN/WRK3		*Specify colour - G,R,Y,B,O
Rotary Switch Front Element Latching Key Operated (changeable to spring return)		Colour Green -G Red - R Yellow - Y Blue - B Opaque - O
2 Position (1) PSN/WRS		
2 Position (2) PSN/WKS/A1		
3 Position (3) PSN/WRS3		
3 Position (2) PSN/WRS3/A1		
Key Removable Programme (1) Both Pos (2) Centre Off Pos (3) Three Pos		
Double Push Buttons AC-15 230v 6A, IP66 Colour Cap Opaque		
Double Push Button Non Illuminated		Double Push Button Non Illuminated
Red/Green PSN/DDL/GR		Black/Black
Red/Green PSN/DDL/GR/X1-X0		Arrow/Arrow PSN/DDL/S/X7-X7
Red/Green STOP START PSN/DDL/GR/GB1-GB0		Black/White PSN/DDL/WS
Pilot Lights IP67/69K		
Flush		Extended (conical)
Green PSN/L/G		Green PSN/LH/G
Red PSN/L/R		Red PSN/LH/R
Yellow PSN/L/Y		Yellow PSN/LH/Y
Blue PSN/L/B		Blue PSN/LH/B
Opaque PSN/L/W		Opaque PSN/LH/W
Push Buttons Pilot Lights Accessories		
Contact Blocks Front Mounting		Contact Blocks Base Mounting
N/O PSN/K10		N/O PSN/KC10
N/C PSN/K01		N/C PSN/KC01
LED Pilot Assemblies 12-30v AC/DC		
Green PSN/LED/G		LED Pilot Assemblies 85-260v AC/DC
Red PSN/LED/R		Green PSN/LED/230/G
White PSN/LED/W		Red PSN/LED/230/R
Coupling Plate		White PSN/LED/230/W
PB's & Lights PSN/A		
Legend Carrier W/O Legend		
PB's Lights PSB/ST/X		Protection Extras (not with legend carriers)
Double PB's PSB/STDD/X		Single PB's PSN/T/D
Legend Insert PSN/XST		Double PB's PSN/T/DD
Engraving F*AU		Shroud PSN/XGWK
Plastic Enclosure		Bulb Extractor PSN/LG
Top Yellow, Bottom Black		
1 x 22.5mm PSN/IY1		Emergency Stop Extras
		Shroud PSN/XGPV
		Plate 60mm PSN/XAK1
		Plate 90mm PSN/XBK1
LED Test Elements For Press To Test		
12v to 30v PSN/XLED/T		
85v to 260v PSN/XLED230/T		
Resistor Element		
42v -60v PSN/XLED60		

## Castell & Fortress Trapped Key Interlocking Systems

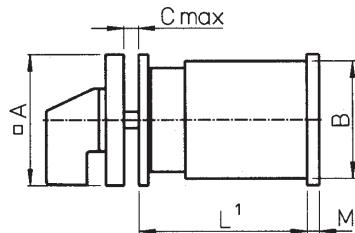
Products	Applications
Panel Door Interlock Multiple Panel Door Interlock	As part of an interlock system, the locks are used to control access to areas, e.g. switchgear panels or machines where hazards may be present, until a safe condition has been achieved.
Key Operated Rotary Switches	As part of an interlock system, the switch units are used for the direct control or isolation of control or power circuits controlling the plant or machinery.
Solenoid Controlled Interlock Unit	As above with a solenoid facility to integrate with other electronic control processes within the system.
Key Operated Rotary Switch for Use in Hazardous Areas	A key operated rotary switch for use as part of an interlocked system, in areas where explosive/flammable gases or dust particles may be present. BASEEFA certified (EExdIIC T6 Zones 1 & 2.)
H31 Basic Interlock and Keys	This form of basic interlock is normally used in the mechanical interlocking of electrical switchgear. Used in conjunction with other interlocking systems.
Door Interlock	Specifically designed for sliding doors.
Interlock Deadlock	Single or multi-keyed deadlocks, with either claw bolt or limit switch.
Mechanical Key Exchange Boxes	A range of mechanical key exchange units into which any sequence of trapped and freed keys can be incorporated.
Electronic Time Delay Rotation Sensing Unit Temperature Sensing	As part of an interlock system, the locks are used to control access to areas, e.g. switchgear panels or machines where hazards may be present, until a safe condition has been achieved.
Other Products	Fortress Amgard Modular Safety Systems. Castell Products. Smith Ellis – Valve Interlocks. HF Securite Products. Load banks



## Handles

Type	Colour	Code	Size 00 0 1 2 3	Type	Colour	Code	Size 00 0 1 2 3
------	--------	------	--------------------	------	--------	------	--------------------

<b>I - Handle</b> "Standard Handle"	Black	<b>G251</b>	√ √ √ √ -	<b>R - Handle</b>	Black	<b>G001</b>	- √ √ √ √
	Red	<b>G252</b>	√ √ √ √ -		Red	<b>G002</b>	- √ √ √ √
	Electro-grey	<b>G257</b>	√ √ √ √ -		Electro-grey	<b>G007</b>	- √ √ √ √
<b>F - Handle</b>	Black	<b>G221</b>	√ √ √ √ -	<b>B - Handle</b>	Black	<b>G521</b>	- √ √ - -
	Red	<b>G222</b>	√ √ √ √ -		Red	<b>G522</b>	- √ √ - -
	Electro-grey	<b>G227</b>	√ √ √ √ -		Electro-grey	<b>G257</b>	- √ √ - -
<b>K - Handle</b>	Black	<b>G411</b>	-- √ √ √		White (For UE mtg)	<b>G258</b>	-- √ - -
	Red	<b>G412</b>	-- √ √ √				
	Electro-grey	<b>G417</b>	-- √ √ √				
<b>L Handle</b>	Black	<b>G501</b>	-- √ - -	<b>P - Handle</b>	Black	<b>G211</b>	- √ √ √ √
	Red	<b>G502</b>	-- √ - -		Red	<b>G212</b>	- √ √ √ √
	Electro-grey	<b>G507</b>	-- √ - -		Electro-grey	<b>G217</b>	- √ √ √ √
	S0	S1 ~ S3					
<b>S Handle</b>	Black	<b>G301</b>	- √ √ - -				
	Red	<b>G302</b>	- √ √ - -				
	Electro-grey	<b>G307</b>	- √ √ - -				
<b>Handwheel</b>	Black		-- - - √				
	S0	S1					

**Dimensions mm****Rotary Cam Switches - Panel Mounting**

**E Panel Mounting**  
Size 0 - Size 3

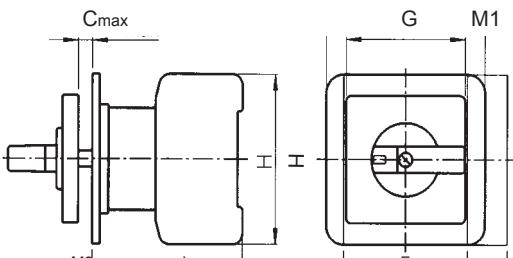
	CG4	CAD's CA10	CA20	CA25	CA63 CA50 CA40 C26	C32	C42	C80	C200-4 C125	C315 L400
<b>A</b>	30	48	48	48	64	64	64	88	88	130
<b>B</b>	28	43	45	46	45/58	60	66	84	88	126
<b>C</b>	4	4	4	4	4	4	4	5,5	5,5	7
<b>D1</b>	3,2	5	5	5	5	5	5	6	6	7
<b>D2</b>	8	8	8	10	10	10	10	13	13	16
<b>E</b>	-	36	36	36	48	48	48	68	68	104
<b>M</b>	-	4,5	4,5	5,5	6,5	7,5	7,5	9,4	9,4	11,9

**Length L**

Stages	CG4	CAD's CA10	CA20	CA25	CA63 CA50 CA40 C26	C32	C42	C80	C200-4 C125		C315 L-switches Size S3
									C200-4	C125	
<b>1</b>	38,5	31,7	35,9	37,2	41	45,8	49,8	61,5	67,5	78,6	
<b>2</b>	50	41,2	48,6	51,2	53,7	63,3	71,3	88	100	117,2	
<b>3</b>	62,5	50,7	61,3	65,2	66,4	80,8	92,8	114,5	132,5	155,8	
<b>4</b>	74,5	60,2	74	79,2	79,1	98,3	114,3	141	165	194,4	
<b>5</b>	86,5	69,7	86,7	93,2	91,8	115,8	135,8	167,5	197,5	233	
<b>6</b>	94,5	79,2	99,4	107,2	104,5	133,3	157,3	194	230	271,6	
<b>7</b>	110,5	88,7	112,1	121,2	117,2	150,8	178,8	220,5	262,5	310,2	
<b>8</b>	122,5	98,2	124,8	135,2	129,9	168,3	200,3	247	295	348,8	
<b>9</b>	-	107,7	137,5	149,2	142,6	185,8	221,8	273,5	327,5	387,4	
<b>10</b>	-	117,2	150,2	163,2	155,3	203,3	243,3	300	360	426	
<b>11</b>	-	126,7	162,9	177,2	168	220,8	264,8	326,5	392,5	464,6	
<b>12</b>	-	136,2	175,6	191,2		238,3	286,3	353	425	503,2	

**Dimensions mm****KG Main Switches****Panel Mounting**

3 and 4 Pole

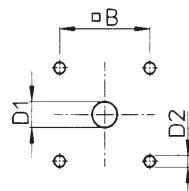


	A	B	C	D1	D2	F	G	H	L	M1	M2	M3
KG10A	48	36	4	11	5	48	48	50	48.2			
KG20A, KG32A	48	36	4	10	5	48	42	54	53.8			
KG20B, KG32B	64	48	4	10	5	64	42	54	53.8	13.5	9	2
KG41B, KG64B	64	48	4	10	5	64	50	64	60.5	16	12.5	16
KG80, KG100, KG105	64	48	4	10	5	70	70	80	70.6	22	10	25
KG126, KG161	88	68	5.5	13	6	-	112	108	96	38	21	22
KG251, KG316	88	68	5.5	13	6	-	145	126	103	52.5	21	24.5 x 2

M1 = Extra Length 4th Pole / Neutral Contact / Earth Block

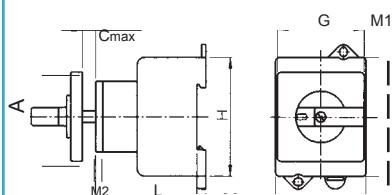
M2 = Extra Length Top Mounted Auxiliary Contacts

M3 = Extra Length Terminal Cover

**Base Mounted**

3 and 4 Pole

Note : 6 Pole Width = 3 Pole Width x 2

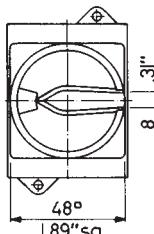
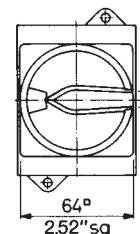
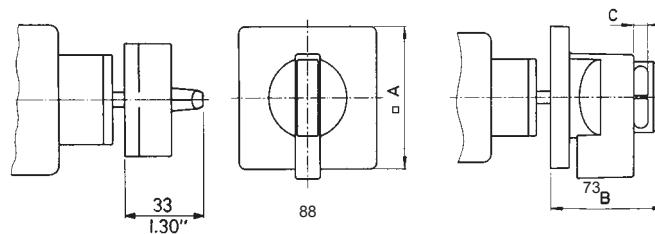
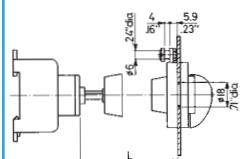
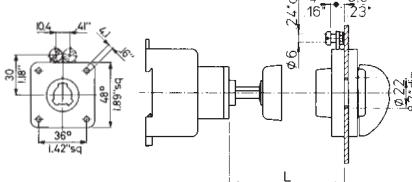
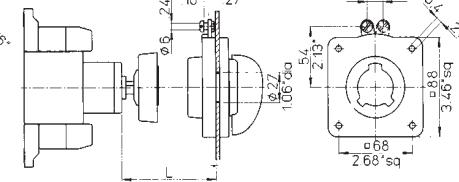
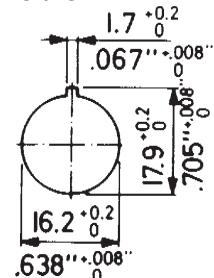
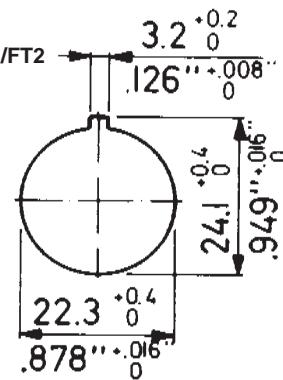


	A	B	C	D1	D2	G	H	L	M1	M2	M3
KG10	48	36	12	8	5	48	50	49.2			
KG20A, KG32A	48	36	12	8	5	42	54	50			
KG20B, KG32B	64	48	13.5	10	5	42	54	50	13.5	-	20
KG41B, KG64B	64	48	13.5	10	5	50	64	61	16	10	16
KG80, KG100, KG105	64	48	13.5	10	5	70	80	68	22	10	25
KG126, KG161	88	68	16	13	6	112	108	91	38	0	22
KG251, KG316	88	68	16	13	6	145	126	98	52.5	0	24.5 x 2

M1 = Extra Length 4th Pole / Neutral Contact / Earth Block

M2 = Extra Length Top Mounted Auxiliary Contacts

M3 = Extra Length Terminal Cover

**Padlock Device V840G**36 mm sq. Fixation  
KG10, KG20, KG32**Padlock Device V840G**48 mm sq. Fixation  
KG10B, KG20B, KG32B, KG41B, KG64B,  
KG80, KG100, KG105**Padlock Device V845**68mm sq. Fixation  
KG126, KG161, KG251, KG316**Door Interlock M280E 48mm sq.**36 mm sq. Fixation  
KG10, KG20, KG32**Door Interlock M280E 64mm sq.**48mm sq. Fixation  
KG10, KG20, KG32, KG41, KG64, KG80, KG100, KG105**Door Interlock M280E 88mm sq.**68mm sq. Fixation  
KG126, KG161, KG251, KG316**Single Hole Mounting FS1/FS2 (Size 00)**To accomodate  
16.2 in 22.3 Hole  
S00 T160 - 01**Single Hole Mounting FT1/FT2 (Size 0)**To accomodate  
22.3 in 30.5 Hole  
S0E T160 - 01

**SWITCH ORDERING CHART****Mounting Requirements**

- |  |   |  |  |
|--|---|--|--|
| <input type="checkbox"/> <b>E</b>      | Panel Mount. (5 hole mount)                           | <input type="checkbox"/> <b>L100</b>       | Various shaft lengths (metal)              |
| <input type="checkbox"/> <b>VE</b>     | Base mount suitable for door clutch etc.              | <input type="checkbox"/> <b>M004</b>       | Adjustable shaft (advise length).          |
| <input type="checkbox"/> <b>E - V</b>  | Panel Mount.(vertical access to terminals)            | <input type="checkbox"/> <b>PF</b>         | Enclosure ABS IP56                         |
| <input type="checkbox"/> <b>E22</b>    | Panel mount. ( 3 hole, size 0)                        | <input type="checkbox"/> <b>GK</b>         | Enclosure aluninium IP54.                  |
| <input type="checkbox"/> <b>ER</b>     | Combined panel square base plates.                    | <input type="checkbox"/> <b>M280E</b>      | Door clutch (specify depth required).      |
| <input type="checkbox"/> <b>T146 K</b> | DIN rail mounting plate. (size 0 and size 1)          | <input type="checkbox"/> <b>6 CL</b>       | Enclosure 56 series.                       |
| <input type="checkbox"/> <b>FT1</b>    | Single hole mtg. w/o esc. plate IP65. (S0 = 22.3mm)   | <input type="checkbox"/> <b>6 SS</b>       | Enclosure stainless steel.                 |
| <input type="checkbox"/> <b>FT2</b>    | Single hole mtg. wth square plate IP65. (S0 = 22.3mm) | <input type="checkbox"/> <b>KS/KL</b>      | Enclosures IP65.                           |
| <input type="checkbox"/> <b>EF</b>     | Panel seal IP65. (mounts between switch and panel).   | <input type="checkbox"/> <b>6S115 x 70</b> | Wall plate stainless or Plastic            |
| <input type="checkbox"/> <b>KD/KN</b>  | Heavy duty mounting plate and metal shaft.            | <input type="checkbox"/>                   | Other, nominate type of mounting required. |

**Handle Operation**

- |   |  |
|---|--|
| <input type="checkbox"/> Normal/standard handle (G251) or .....               | <input type="checkbox"/> <b>V840A/.Padlockable handle (S0 &amp; S1).</b> |
| <input type="checkbox"/> <b>V750D</b> Key operator size 00 ~ 0.               | <input type="checkbox"/> <b>V845 Padlock Handle. (c/w esc.plate)</b>     |
| <input type="checkbox"/> <b>V755A or C</b> Key operator (530 series) .        | <input type="checkbox"/> <b>V840G Padlock device.</b>                    |
| <input type="checkbox"/> <b>V750/A9</b> Key operator size 0 switch.(Lockwood) | <input type="checkbox"/> <b>V850 Padlockable with handle device</b>      |
| <input type="checkbox"/> <b>6SOLW V750</b> Key operator (201 Lockwood etc.)   | <input type="checkbox"/> <b>V400 Push-button interlock device.</b>       |
| <input type="checkbox"/> <b>V760</b> Seperate key and handle (programmable).  | <input type="checkbox"/> Other specify                                   |

**Essential Data**

1. Switch/circuit requirement. . . . . Amp ..... Volts ..... kW .....
2. Cable size ..... or limiting dimensions .....
3. AC or DC (DC voltage required).....Duty:- AC21/AC22/AC23/AC11 or other.
4. PLC/Electronic circuit/dry circuit or standard switch.

KRAUS & NAIMER "The Switchgear Innovators"

## Ohm's Law

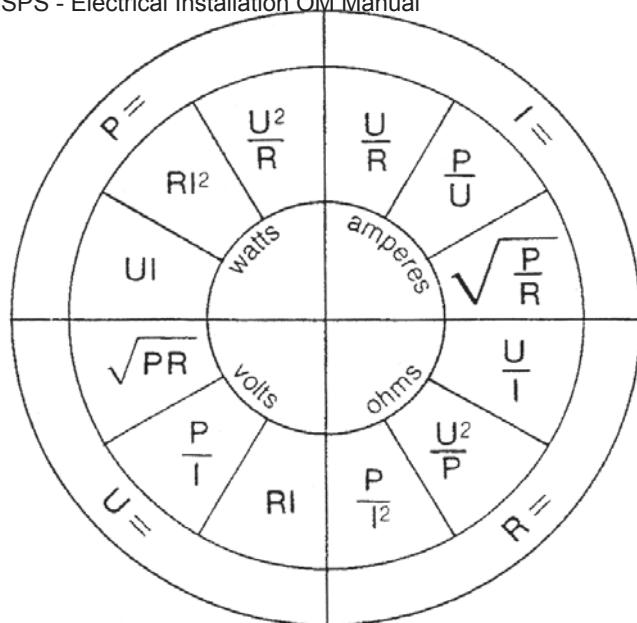
### SYMBOLS

**U** = Voltage in volts

**I** = Current in amperes

**R** = Resistance on ohms

**P** = Power in watts



## Useful Formulae

$$kW = kVA \times pF$$

$$kW = \frac{hp \times 746}{1000 \times Eff} \quad \frac{hp \times 746 \times 100}{1000 \times \%Eff}$$

$$kW = \frac{\text{Line amps} \times \text{Line volts} \times 1.732 \times pF}{1000}$$

$$kVA = \frac{kW}{pF}$$

$$kVA = \frac{hp \times 756}{1000 \times Eff \times pF}$$

$$kVA = \frac{\text{Line amps} \times \text{Line volts} \times 1.732}{1000}$$

$$\text{Line Amps} = \frac{kVA \times 1000}{\text{Line volts} \times 1.732}$$

$$\text{Line Amps} = \frac{kW \times 1000}{\text{Line volts} \times 1.732 \times pF}$$

$$\text{Line Amps} = \frac{hp \times 746}{\text{Line volts} \times 1.732 \times Eff \times pF}$$

$$\text{Horsepower} = \frac{kVA \times 1000 \times Eff}{746}$$

$$hp = \frac{kVA \times 1000 \times Eff \times pF}{746}$$

$$hp = \frac{\text{Line amps} \times \text{Line volts} \times 1.732 \times Eff \times pF}{746}$$

1 Watt = 1 joule/second

1 hp = 746 Watts

1 hp = 746 joules/second

### VOLT-DROP Single Phase

Service Voltage = 240V

$$\text{Max Permissible } V_d = \frac{240 \times 2.5}{100} \quad (2.5\% \text{ Service Voltage}) \\ = 6V$$

$$\text{Max Unit } V_d = \frac{\text{Max } V_d \times 1000}{1 \times \text{distance}} \quad (\text{Length of cable run})$$

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### AC-1

**Resistive or low inductive loads.**

### AC-3

**Direct on line starting, star delta starting.**

### AC-4

**Direct on line starting, reversing, plugging and inching.**

### AC-21

**Switching of resistive loads, including moderate overloads.**

### AC-23A

**Frequent switching of motors or other highly inductive loads (selection criteria for main switches).**

### AC-22

**Isolation of 6 Pole star delta motor circuits**

POWER Motor Size		CURRENT three phase 50-60 Hz	
kW	h.p.	415V	440V
0.37	0.5	1.2	1
0.55	0.75	1.6	1.3
0.75	1	2	1.68
1.1	1.5	2.5	2.37
1.5	2	3.5	3.06
2.2	3	5	4.42
3	4	6.5	5.77
4	5.5	7.5	7
5.5	7.5	11	10.4
7.5	10	14	13.7
10	13.5	19	16.5
11	15	21	20.1
15	20	28	26.5
18.5	25	35	32.8
22	30	40	39
30	40	55	51.5
37	50	66	64
45	60	80	76.3
55	75	100	90
75	100	135	125
90	125	165	156
110	150	200	186
132	175	230	216
160	220	280	256
200	270	340	321
220	300	385	353
250	350	450	400
315	430	535	500

### IP Ratings

IP65 - where 6 means complete protection against accidental contact with live or internal moving parts. Protection against the ingress of dust (dust tight). Where 5 means water projected by nozzle against the equipment from any direction shall have no harmful effect.

IP66 - where 6 means complete protection against accidental contact with live or internal moving parts. Protection against the ingress of dust (dust tight). Where 6 means water projected by powerful jets against the enclosure from any direction shall have no harmful effect.

IP69K - where 6 means complete protection against accidental contact with live or internal moving parts. Protection against the ingress of dust (dust tight). Where 9K means where water directed against the enclosure under extremely high pressure from any direction must not have any harmful effect. Water pressure of 100 bar. Water temperature of 80 deg C.

## The Range of Blue Line Switchgear

Technical Catalogues for the following products are available from our website. [www.krausnaimer.com.au](http://www.krausnaimer.com.au)

### Main Switches and Main Switches with Emergency Function 16 A-315 A

Maintenance Switches 20 A-315 A

500

Switch Disconnectors 20 A-315 A

According to IEC 60947 - 3, EN 60947 - 3, VDE 0660 part 107, IEC 60204, EN 60204 and VDE 0113

### CL SWitches 10 A-20 A

### C, CA and CAD Switches 10 A-315 A and L Switches 350 A-2400 A

C, CA and CAD switches are designed for universal application. They are recommended for instrument, isolator, double-throw and motor control.

100

L switches are designed for load and off-load applications. They are used to switch resistive or low inductive loads.

### Optional Extras and Enclosures

The complete product line, a large number of optional extras is available, including door interlocks, push-pull devices, cylinder and padlock attachments, control and indicator devices, AC motor drives, as well as enclosures, both insulated and metal.

101

### A and AD Switches 6 A-25 A

A and AD Switches have 4 contacts in each switching stage. These switches provide an extensive range of switch functions and require a minimum mounting depth. Up to 36 switching positions are possible, with availability of 48 contacts per 12 stage column.

110

### CG, CH and CHR Switches 10 A-25 A

Ultra compact CG, CH and CHR switches are ideally suited for control and instrumentation applications.

Switch terminals are 'finger-proof' and conveniently accessible for wiring and are delivered open. All CG4 switches offer specially designed gold plated contacts or H-bridges with 'cross-wire' contact systems, which facilitates their use in electronic circuitry and chemically aggressive environments.

120

### DH, DHR, DK and DKR Switches 6 A-16 A

DH, DHR, DK, and DKR switches incorporate unique corrosion resistant contacts that permit operation on system voltage as low as 1 V. They have fully enclosed and protected contacts which can be operated either by rotary and/or lateral handle movement. D switches are used in calibration and semiconductor circuits. They are also used for relay and contactor control.

130

### X Switches 80 A-630 A

X switches can be applied for load, tap and gang duties. They incorporate 6 contacts in each switching stage. Their compact design provides a minimum length dimension for mounting purpose.

140

### KG Switches 20 A-315 A and KH and KHR Switches 16 A-80 A

KC, KG, KH and KHR switches are excellent circuit interrupters. They have high through fault and fault making capacities and are especially designed for use as isolators and safety switches for machine tools, distribution panels and switchboards. KG ON/OFF switches offer unusually high dimensioned air and creepage distances between terminals which are designed for time saving 'straight-line' wiring. ON/OFF switches are available with up to 8 poles and double-throw switches are available with up to 4 poles.

150

KC switches offer spring cage terminals for greater termination security.

### Push Buttons and Pilot Lights, 22.5 mm Ø

A complete range of state-of-the-art push buttons and pilot lights represent an ideal combination of functional security economical efficiency in a modular design.

302

### Disconnectors for Photovoltaic

### Maintence Switches for EMC - Compliant Connection

Frequency regulated motors.

We reserve the right to make technical and dimensional changes without prior notice. Any errors or omissions are not binding.



# Kraus & Naimer Pty.Ltd.

## BLUE LINE switchgear

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Email: salesaus@krausnaimer.com

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# TECHNICAL DATA SHEET

**Equipment Type:** RTU

**Location:** RTU Section

**Model Numbers:** GE Fanuc

**Manufacturer:** GE

**Supplier:** Control Logic

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# *GE Fanuc Automation*

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*Programmable Control Products*

*Series 90<sup>TM</sup>-30/20/Micro PLC  
CPU Instruction Set*

*Reference Manual*

*GFK-0467M*

*May 2002*

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Notes merely call attention to information that is especially significant to understanding and operating the equipment.

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GEnet	ProLoop	Series One	Workmaster

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## Preface

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This manual describes the system operation, fault handling, and Logicmaster 90™ programming instructions for the Series 90™-30, Series 90-20 and Series 90 Micro programmable logic controllers. Series 90-30 PLCs, Series 90-20 PLCs, and Series 90 Micro PLCs are members of the Series 90 family of programmable logic controllers from GE Fanuc Automation.

## Revisions to This Manual

- Added the model 374 CPU, which supports connection to an Ethernet network through two built-in 10BaseT/100BaseTx auto-negotiating full-duplex Ethernet ports. Models 364 (release 9.10 and later) and 374 are the only Series 90-30 CPUs that support Ethernet Global Data. Note that the CPU374 is supported only by the Windows®-based programmers.
- Other corrections and clarifications as necessary.

## Related Publications

*Logicmaster™ 90 Series 90™-30/20/Micro Programming Software User's Manual* (GFK-0466).

*VersaPro™ Programming Software User's Guide* (GFK-1670)

*CIMPLICITY® Machine Edition Getting Started* (GFK-1868)

*Series 90™-30 Programmable Controller Installation Manual* (GFK-0356)

*Series 90™-20 Programmable Controller Installation Manual* (GFK-0551)

*Series 90™-30 I/O Module Specifications Manual* (GFK-0898)

*Series 90™ Programmable Coprocessor Module and Support Software User's Manual* (GFK-0255)

*Series 90™ PCM Development Software (PCOP) User's Manual* (GFK-0487)

*CIMPLICITY™ 90-ADS Alphanumeric Display System User's Manual* (GFK-0499)

*CIMPLICITY™ 90-ADS Alphanumeric Display System Reference Manual* (GFK-0641)

*Series 90™-30 and 90-20 PLC Hand-Held Programmer User's Manual* (GFK-0402)

*Power Mate APM for Series 90™-30 PLC—Standard Mode User's Manual* (GFK-0840)

*Power Mate APM for Series 90™-30 PLC—Follower Mode User's Manual* (GFK-0781)

*Motion Mate™ DSM302 for Series 90™-30 PLCs User's Manual* (GFK-1464)

*Series 90™-30 High Speed Counter User's Manual* (GFK-0293)

*Series 90™-30 Genius Communications Module User's Manual* (GFK-0412)

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*Series 90™-30 Genius™ Bus Controller User's Manual (GFK-1034)*

*Series 90™-70 FIP Bus Controller User's Manual (GFK-1038)*

*Series 90™-30 FIP Remote I/O Scanner User's Manual (GFK-1037)*

*Field Control™ Distributed I/O and Control System Genius™ Bus Interface Unit User's Manual (GFK-0825)*

*Series 90™ Micro Programmable Logic Controller User's Manual (GFK-1065)*

*Series 90™ PLC Serial Communications User's Manual (GFK-0582)*

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# *Chapter*

# *1*

## *Introduction*

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The Series 90-30, 90-20, and Micro PLCs are members of the GE Fanuc Series 90 family of Programmable Logic Controllers (PLCs). They are easy to install and configure, offer advanced programming features, and are compatible with the Series 90-70 PLCs.

The 341 and lower Series 90-30 PLCs and Series 90-20 PLC use an 80188 microprocessor. The 35x and 36x series of 90-30 PLCs use an 80386EX microprocessor. The 37x series of 90-30 PLCs use a 586 microprocessor. The Series 90 Micro PLC uses the H8 microprocessor. Both program execution and basic housekeeping tasks such as diagnostic routines, input/output scanners, and alarm processing are supported. The system firmware also contains routines to communicate with the programmer. These routines provide for the upload and download of application programs, return of status information, and control of the PLC.

In the Series 90-30 PLC, the application (user logic) program that controls the end process to which the PLC is applied is controlled by a dedicated Instruction Sequencer Coprocessor (ISCP). The ISCP is implemented in hardware in the Model 313 and higher and in software in the Model 311 systems, and the Micro PLC. The microprocessor and the hardware-based ISCP can execute simultaneously, allowing the microprocessor to service communications while the ISCP is executing the bulk of the application program; however, the microprocessor must execute the non-Boolean function blocks.

Faults occur in the Series 90-30 PLC, Series 90-20 PLC, and the Micro PLC when certain failures or conditions happen that affect the operation and performance of the system. These conditions may affect the ability of the PLC to control a machine or process. Other conditions may only act as an alert, such as a low battery signal to indicate that the voltage of the battery protecting the memory is low and should be replaced. The condition or failure is called a fault.

Faults are handled by a software alarm processor function that records the faults in either the PLC fault table or the I/O fault table. (Model 331 and higher CPUs also time-stamp the faults.) These tables can be displayed through the programming software on the PLC Fault Table and I/O Fault Table screens in Logicmaster 90-30/20/Micro software using the control and status functions.

### **Note**

Floating-point capabilities are **only** supported on the 35x and 36x series CPUs Release 9 or later, and on all releases of CPU352 and CPU374.

The CPU364 (release 9.10 or later) and the CPU374 are the only Series 90-30 CPUs that support Ethernet Global Data (EGD).

The Series 90-20 PLC provides a cost-effective platform for low I/O count applications. The primary objectives of the Series 90-20 PLC are as follows:

- To provide a small PLC that is easy to use, install, upgrade, and maintain.
- To provide a cost-effective family-compatible PLC.
- To provide easier system integration through standard communication hardware and protocols.

The Series 90 Micro PLC also provides a cost-effective platform for lower I/O count applications. The primary objectives of the Micro PLC are the same as those for the Series 90-20. In addition, the Micro offers the following:

- The Micro PLC has the CPU, power supply, inputs and outputs all built into one compact device.
- Most models also have a high speed counter.
- Because the CPU, power supply, and inputs and outputs are all built into one device, it is very easy to configure.

#### Note

For additional information, see the appendices in the back of this manual.

- Appendix A lists the memory size in bytes and the execution time in microseconds for each programming instruction.
- Appendix B describes how to interpret the message structure format when reading the PLC and I/O fault tables.
- Appendix C lists instruction mnemonics for searching or editing a program.
- Appendix D lists the special keyboard assignments used in the Logicmaster 90-30/20/Micro Software.
- Appendix E describes the use of floating-point math operations.

#### Note to Windows-Based PLC Programming Software Users

This manual was written for Logicmaster (a DOS-based PLC programming software) users. The Windows-based PLC software products, such as CIMPILITY® Machine Edition Logic Developer and VersaPro®, provide PLC instruction set information in the software's built-in on-line help system rather than in a manual. Users of the Windows-based programming software should be aware that instructions appear differently from the way they appear on a Logicmaster screen (they still work the same in the PLC). The online help system has the most accurate information about using the instruction set in the Windows-based programming software. For a summary of major differences between the two software types, refer to Appendix F.

*Chapter*  
**2**

## *System Operation*

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This chapter describes certain system operations of the Series 90-30, 90-20, and Micro PLC systems. These system operations include:

- A summary of PLC sweep sequences (Section 1).....2-2
- Program organization and user references/data (Section 2).....2-17
- Power-up and power-down sequences (Section 3) .....
- Clocks and timers (Section 4).....2-31
- System security through password assignment (Section 5).....2-35
- Series 90-30 I/O modules (Section 6).....2-38
- Series 90-30 I/O modules (Section 6).....2-40

## *Section 1: PLC Sweep Summary*

The logic program in the Series 90-30, 90-20, and Micro PLCs executes repeatedly until stopped by a command from the programmer or a command from another device. The sequence of operations necessary to execute a program one time is called a sweep. In addition to executing the logic program, the sweep includes obtaining data from input devices, sending data to output devices, performing internal housekeeping, servicing the programmer, and servicing other communications.

Series 90-30, 90-20, and Micro PLCs normally operate in **STANDARD PROGRAM SWEEP** mode. Other operating modes include **STOP WITH I/O DISABLED** mode, **STOP WITH I/O ENABLED** mode, and **CONSTANT SWEEP** mode. Each of these modes, described in this chapter, is controlled by external events and application configuration settings. The PLC makes the decision regarding its operating mode at the start of every sweep.

## Standard Program Sweep

**STANDARD PROGRAM SWEEP** mode normally runs under all conditions. The CPU operates by executing an application program, updating I/O, and performing communications and other tasks. This occurs in a repetitive cycle called the CPU sweep. There are seven parts to the execution sequence of the Standard Program Sweep:

1. Start-of-sweep housekeeping
2. Input scan (read inputs)
3. Application program logic solution
4. Output scan (update outputs)
5. Programmer communications
6. System communications
7. Diagnostics

All of these steps execute every sweep. Although the Programmer Communications Window opens each sweep, programmer services only occur if a board fault has been detected or if the programming device issues a service request; that is, the Programmer Communications Window first checks for work to do and exits if there is none. The sequence of the standard program sweep is shown in the following figure.

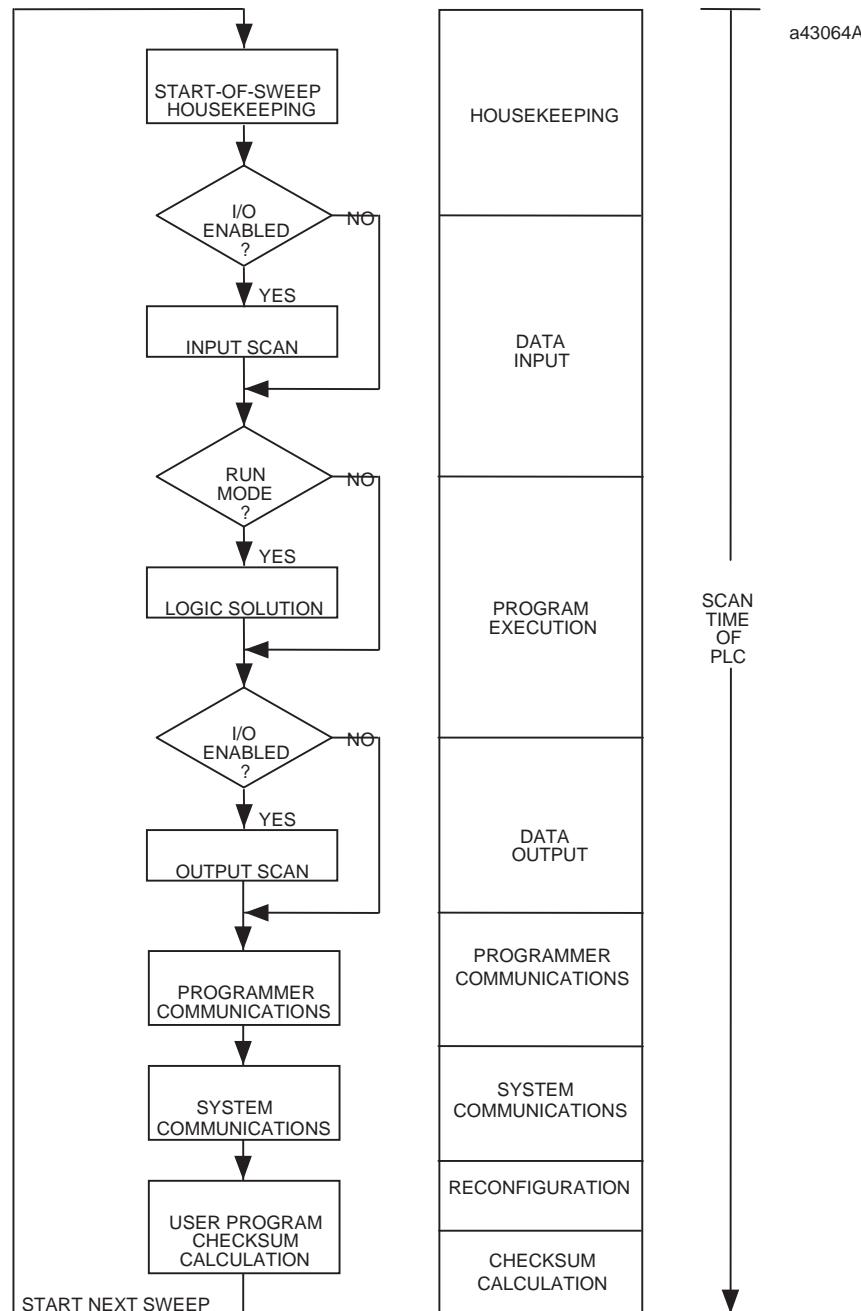


Figure 2-1. PLC Sweep

As shown in the PLC sweep sequence, several items are included in the sweep. These items contribute to the total sweep time as shown in the following table.

Table 2-1. Sweep Time Contribution

Sweep Element	Description	Time Contribution (milliseconds) <sup>4</sup>						
		Micro	211	311/313	331	34x	35x/36x	37x
Housekeeping	<ul style="list-style-type: none"> <li>Calculate sweep time</li> <li>Schedule start of next sweep</li> <li>Determine mode of next sweep</li> <li>Update fault reference tables</li> <li>Reset watchdog timer</li> </ul>	0.368	0.898	0.714	0.705	0.424	0.279	0.027
Data Input	Input data is received from input and option modules	Note 5	See Tables 2-2 and 2-3 for scan time contributions					
Program Execution	User logic is solved	Execution time is dependent upon the length of the program and the types of instructions used in the program. Instruction execution times are listed in Appendix A.						
Data Output	Output data is sent to output and option modules	1.656	See Tables 2-2 and 2-3 for scan time contributions					
Programmer and System Communications	Service requests from programming devices and intelligent modules are processed <sup>1</sup>	HHP	1.93	6.526	4.426	4.524	2.476	0.334
		Programmer	0.380	3.536	2.383	2.454	1.248	0.517
		PCM <sup>2</sup>	N/A	N/A	N/A	3.337	1.943	0.482
Reconfiguration	Slots with faulted modules and empty slots are monitored	N/A <sup>6</sup>	N/A	0.458	0.639	0.463	0.319	0.243
Diagnostics	Verify user program integrity (time contribution is the time required per word checksummed each sweep) <sup>3</sup>	N/A <sup>7</sup>	0.083	0.050	0.048	0.031	0.010	0.022

- The scan time contribution of external device service is dependent upon the mode of the communications window in which the service is processed. If the window mode is LIMITED, a maximum of 8 milliseconds for the 311, 313, 323, and 331 CPUs and 6 milliseconds for the 340 and higher CPUs will be spent during that window. If the window mode is RUN-TO-COMPLETION, a maximum of 50 milliseconds can be spent in that window, depending upon the number of requests which are presented simultaneously.
- These measurements were taken with the PCM physically present but not configured and with no application task running on the PCM.
- The number of words checksummed each sweep can be changed with the SVCREQ function block.
- These measurements were taken with an empty program and the default configuration. The Series 90-30 PLCs were in an empty 10-slot rack with no extension racks connected. Also, the times in this table assume that there is no periodic subroutine active; the times will be longer if a periodic subroutine is active.
- The data input time for the Micro PLC can be determined as follows: 0.365ms (fixed scan) + 0.036ms (filter time) x (total sweep time) / 0.5ms.
- Since the Micro PLC has a static set of I/O, reconfiguration is not necessary.
- Since the user program for the Micro PLC is in Flash memory, it will not be checked for integrity.

Table 2-2. I/O Scan Time Contributions (in milliseconds) for Series 90-30 35x, 36x and 37x CPUs

Module Type	35x and 36x Series CPUs			37x Series CPUs		
	Main Rack	Expansion Rack	Remote Rack	Main Rack	Expansion Rack	Remote Rack
8-point discrete input	.030	.055	.206	.030	.055	.206
16-point discrete input	.030	.055	.206	.030	.055	.206
32-point discrete input	.043	.073	.269	.048	.075	.272
8-point discrete output	.030	.053	.197	.024	.052	.198
16-point discrete output	.030	.053	.197	.030	.052	.199
32-point discrete output	.042	.070	.259	.047	.069	.258
Combination discrete input/output	.060	.112	.405	.052	.110	.408
4-channel analog input	.075	.105	.396	.085	.109	.403
2-channel analog output	.058	.114	.402	.046	.101	.393
16-channel analog input (current or voltage)	.978	1.446	3.999	.423	.700	1.741
8-channel analog output	1.274	1.988	4.472	.873	1.492	3.635
Combination analog input/output	1.220	1.999	4.338	.862	1.487	4.103
High Speed Counter	1.381	2.106	5.221	1.142	1.808	5.234
I/O Processor	1.574	2.402	6.388	1.270	2.125	6.269
Ethernet Interface (no connection)	.7129	2.067	3.681	.426	.795	2.302
Power Mate APM (1-axis)	1.527	2.581	6.388	1.236	2.073	6.032
Power Mate APM (2-axis)	1.807	2.864	7.805	1.539	2.439	7.369
DSM 302 *	40 AI, 6 AQ	2.143	3.315	9.527	1.801	2.963
	50AI, 9 AQ	2.427	3.732	11.092	2.075	3.373
	64 AI, 12 AQ	2.864	4.317	13.138	2.441	3.931
DSM314 *	1 Axis Configured	1.6	2.6	6.9	1.330	2.337
	2 Axes Configured	2.2	3.8	9.9	1.888	3.148
	3 Axes Configured	2.8	4.3	13.0	2.421	3.953
	4 Axes Configured	3.3	5.2	15.9	2.969	4.761
GCM	8 32-bit devices	8.826	16.932	21.179	7.386	9.520
GCM+	no devices	.567	.866	1.830	.457	.759
	32 64-word devices	19.497	25.588	80.871	17.036	24.390
GBC	no devices	.798	1.202	2.540	.544	.908
	16 64-word devices	29.976	40.570	131.702	26.976	38.564
PCM 311	not configured, or no application task	.476	N/A	N/A	.195	N/A
	running 20Kb application program	1.746	N/A	N/A	.538	N/A
ADC (no task)		.476	N/A	N/A	.193	N/A
I/O Link Master	no devices	.569	.865	1.932	.996	1.618
	sixteen 64-point devices	4.948	7.003	19.908	5.924	8.240
I/O Link Slave	32-point	.087	.146	.553	.095	.149
	64-point	.154	.213	.789	.165	.219
						.803

\* For applications where the DSM's contributions to scan time will affect machine operation you may need to use the Do I/O function block, and the Suspend I/O and Fast Backplane Status Access service requests to transfer necessary data to and from the Motion module without getting all the data every scan. For the DSM302, refer to the *Motion Mate DSM302 for Series 90-30 PLCs User's Manual*, GFK1464 for details. For the DSM314, refer to the *Motion Mate DSM314 for Series 90-30 PLCs User's Manual*, GFK1742 for details. NOTE: The DSM314 will only work with the CPUs 350, 352, 360, 363, 364, and 374 and only with CPU firmware version 10.00 or later.

Table 2-3. I/O Scan Time Contributions (in milliseconds) for the Series 90-30 CPU311 through CPU341

Module Type		CPU Model						
		311/313 /323	331			340/341		
			Main Rack	Expansion Rack	Remote Rack	Main Rack	Expansion Rack	Remote Rack
8-point discrete input		.076	.054	.095	.255	.048	.089	.249
16-point discrete input		.075	.055	.097	.257	.048	.091	.250
32-point discrete input		.094	.094	.126	.335	.073	.115	.321
8-point discrete output		.084	.059	.097	.252	.053	.090	.246
16-point discrete output		.083	.061	.097	.253	.054	.090	.248
32-point discrete output		.109	.075	.129	.333	.079	.114	.320
8-point combination input/output		.165	.141	.218	.529	.098	.176	.489
4-channel analog input		.151	.132	.183	.490	.117	.160	.462
2-channel analog output		.161	.138	.182	.428	.099	.148	.392
High-Speed Counter		2.070	2.190	2.868	5.587	1.580	2.175	4.897
Power Mate APM (1-axis)		2.330	2.460	3.175	6.647	1.750	2.506	5.899
Power Mate APM (2-axis)		3.181	3.647	4.497	9.303	2.154	3.097	7.729
DSM 302*	40 AI, 6 AQ	3.613	4.081	5.239	11.430	2.552	3.648	9.697
	50AI, 9 AQ	4.127	4.611	5.899	13.310	2.911	4.170	11.406
	64 AI, 12 AQ	4.715	5.276	6.759	15.747	3.354	4.840	13.615
GCM	no devices	.041	.054	.063	.128	.038	.048	.085
	8 64-point devices	11.420	11.570	13.247	21.288	9.536	10.648	19.485
GCM+	no devices	.887	.967	1.164	1.920	.666	.901	1.626
	32 64-point devices	4.120	6.250	8.529	21.352	5.043	7.146	20.052
PCM 311	not configured, or no application task	N/A	3.350	N/A	N/A	1.684	N/A	N/A
	read 128 %R as fast as possible	N/A	4.900	N/A	N/A	2.052	N/A	N/A
ADC 311		N/A	3.340	N/A	N/A	1.678	N/A	N/A
16-channel analog input (current or voltage)		1.370	1.450	1.937	4.186	1.092	1.570	3.796
I/O Link Master	no devices	1.910	2.030	1.169	1.925	.678	.904	1.628
	sixteen 64-point devices	6.020	6.170	8.399	21.291	4.992	6.985	20.010
I/O Link Slave	32-point	.206	.222	.289	.689	.146	.226	.636
	64-point	.331	.350	.409	1.009	.244	.321	.926

\* For applications where the DSM's contributions to scan time will affect machine operation you may need to use the Do I/O function block, and the Suspend I/O and Fast Backplane Status Access service requests to transfer necessary data to and from the Motion module without getting all the data every scan. Refer to the *Motion Mate DSM302 for Series 90-30 PLCs User's Manual*, GFK1464 for details. NOTE: The DSM314 is not supported by the 311 through 341 CPUs.

## Sweep Time Calculation

Table 2-1 lists the seven items that contribute to the sweep time of the PLC. The sweep time consists of fixed times (housekeeping and diagnostics) and variable times. Variable times vary according to the I/O configuration, size of the user program, and the type of programming device connected to the PLC.

### Example of Sweep Time Calculation

An example of the calculations for determining the sweep time for a Series 90-30 model 331 PLC are shown in the table below.

The modules and instructions used for these calculations are listed below:

- Input modules: five 16-point Series 90-30 input modules.
- Output modules: four 16-point Series 90-30 output modules.
- Programming instructions: A 1200-step program consisting of 700 Boolean instructions (LD, AND, OR, etc.), 300 output coils (OUT, OUTM, etc.), and 200 math functions (ADD, SUB, etc.).

Sweep Component	Calculation	Time Contribution		
		Without Programmer	With HHP	With Logicmaster
Housekeeping	0.705ms	0.705ms	0.705ms	0.705ms
Data Input	$0.055 \times 5 = 0.275\text{ms}$	0.275ms	0.275ms	0.275ms
Program Execution	$1000 \times 0.4\mu\text{s}^* + 200 \times 89\mu\text{s}^{**} + 18.2\text{ms}$	18.2ms	18.2ms	18.2ms
Data Output	$0.061 \times 4 = 0.244\text{ms}$	0.244ms	0.244ms	0.244ms
Programmer Service	0.4ms + programmer time + 0.6ms	0ms	4.524ms	2.454ms
Non-Programmer Service	None in this example	0ms	0ms	0ms
Reconfiguration	0.639ms	0.639ms	0.639ms	0.639ms
Diagnostics	0.048ms	0.048ms	0.048ms	0.048ms
PLC Sweep Time	Housekeeping + Data Input + Program Execution + Data Output + Programmer Service + Non-Programmer Service + Diagnostics	12.611ms	17.135ms	15.065ms

## PLC Sweep Details

This section discusses details of the major portions of the PLC Sweep:

1. Housekeeping
2. Input Scan
3. Application Program Logic Scan
4. Output Scan
5. Programmer Service
6. System Communications
7. Reconfiguration
8. Checksum Calculation

### 1. Housekeeping

The housekeeping portion of the sweep performs all of the tasks necessary to prepare for the start of the sweep. If the PLC is in **CONSTANT SWEEP** mode, the sweep is delayed until the required sweep time elapses. If the required time has already elapsed, the OV\_SWP %SA0002 contact is set, and the sweep continues without delay. Next, timer values (hundredths, tenths, and seconds) are updated by calculating the difference from the start of the previous sweep and the new sweep time. In order to maintain accuracy, the actual start of sweep is recorded in 100 microsecond increments. Each timer has a remainder field which contains the number of 100 microsecond increments that have occurred since the last time the timer value was incremented.

### 2. Input Scan

Scanning of inputs occurs during the input scan portion of the sweep, just prior to the logic solution. During this part of the sweep, all Series 90-30 input modules are scanned and their data stored in %I (discrete inputs) or %AI (analog inputs) memory, as appropriate. Any global data input received by a Genius Communications Module (GCM), an Enhanced Genius Communications Module (GCM+), or a Genius Bus Controller (GBC) is stored in %G memory.

Modules are scanned in ascending reference address order, starting with any installed Genius Module, then discrete input modules, and finally analog input modules.

If the CPU is in **STOP** mode and the CPU is configured to not scan I/O in **STOP** mode, the input scan is skipped.

### 3. Application Program Logic Scan or Solution

The application program logic scan occurs immediately following the completion of the input scan. The application program logic scan performs two main tasks: (1) solving/executing the program logic and (2) updating %Q, %AI, and %AQ output memory. (Output modules, however, are not updated until the output scan occurs). In general, ladder logic is solved from left to right and top to bottom, although this flow direction can be altered temporarily by subroutine calls and jumps. The

logic solution ends when an END instruction is encountered or when the default END OF PROGRAM LOGIC is reached.

The 313 and higher CPUs have an Instruction Sequence Coprocessor (ISCP) that executes the Boolean instructions, and an 80C188,80386 or AMD SC 520 microprocessor executes the timer, counter, and function blocks. In the Model 311 and 90-20 CPUs, the 80C188 executes all Boolean, timer, counter, and function block instructions. On the Micro, the H8 processor executes all Boolean and function blocks.

A list of execution times for each programming function can be found in Appendix A.

## 4. Output Scan

Outputs are scanned during the output scan portion of the sweep, immediately following the logic solution. Outputs are updated using data from %Q (for discrete outputs) and %AQ (for analog outputs) memory, as appropriate. If you have a Genius Communications Module or Genius Bus Controller that is configured to transmit global data, then data from %G memory is sent to the GCM, GCM+, or GBC. The Series 90-20 and Micro output scans include discrete outputs only.

During the output scan, all Series 90-30 output modules are scanned in ascending reference address order. The output scan is completed when all output data has been sent to all Series 90-30 output modules.

If the CPU is in the **STOP** mode and **IPScan-Stop** parameter on the CPU configuration screen is set to **NO**, the output scan is skipped.

### Caution

If the **IPScan-Stop** parameter on the CPU configuration screen is set to **YES**, real-world outputs may be turned ON even when the PLC is in **STOP** mode, because the PLC will write the current values in the output tables to the output modules during the Output Scan.

## 5. Programmer Communications Window

This part of the sweep is dedicated to communicating with the programmer. If there is a programmer attached, the CPU executes the programmer communications window. The programmer communications window will not execute if there is no programmer attached and no module to be configured in the system. Only one module is configured each sweep.

Support is provided for the Hand-Held Programmer and for other programmers that can connect to the serial port and use the Series Ninety Protocol (SNP) protocol. Support is also provided for programmer communications with intelligent option modules.

### Programmer Communications Window Modes

- **Limited Mode.** In the default Limited window mode, the CPU performs one operation for the programmer each sweep, that is, it honors one service request or response to one key press. If the programmer makes a request that requires more than 6 (or 8 depending on the CPU—see Note) milliseconds to process, the request processing is spread out over several

sweeps so that no sweep is impacted by more than 6 (or 8 depending on the CPU—see Note) milliseconds.

### Note

The time limit for the communications window is 6 milliseconds for the 340 and higher CPUs and 8 milliseconds for the 311, 313, 323, and 331 models.

- **Complete Mode.** In the Complete mode, the CPU will conduct programmer communications until they are complete or until 50 milliseconds elapses.

The following figure is a flow chart for the programmer communications portion of the sweep.

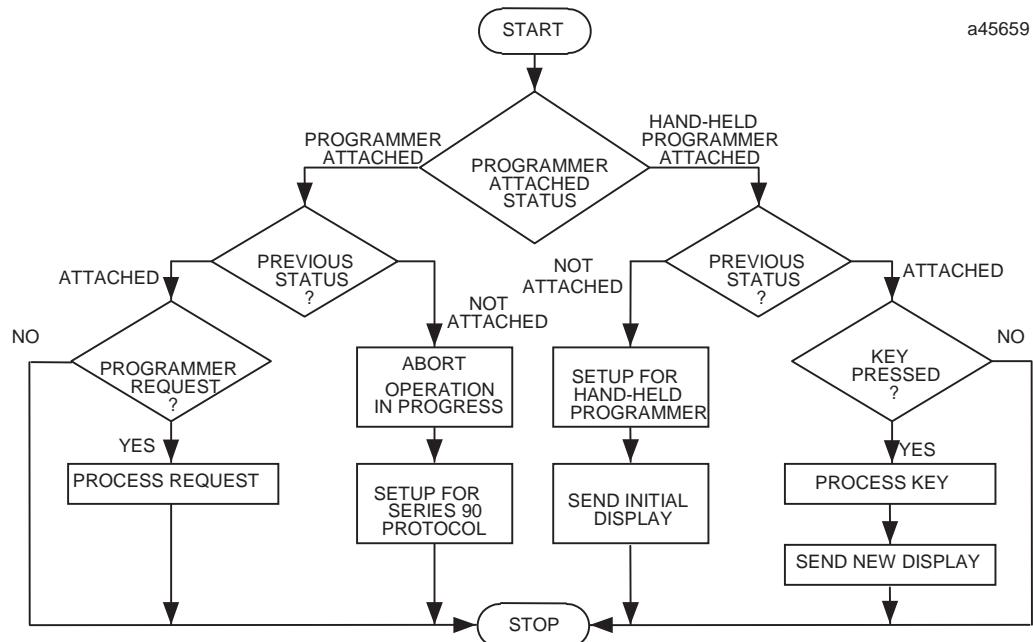


Figure 2-2. Programmer Communications Window Flow Chart

## 6. System Communications Window (Models 331 and Higher)

This is the part of the sweep where communications requests from intelligent option modules, such as the PCM or DSM, are processed (see flow chart). Requests are serviced on a first-come-first-served basis. However, since intelligent option modules are polled in a round-robin fashion, no intelligent option module has priority over any other intelligent option module.

In the default **Run-to-Completion** mode, the length of the system communications window is limited to 50 milliseconds. If an intelligent option module makes a request that requires more than 50 milliseconds to process, the request is spread out over multiple sweeps so that no one sweep is impacted by more than 50 milliseconds.

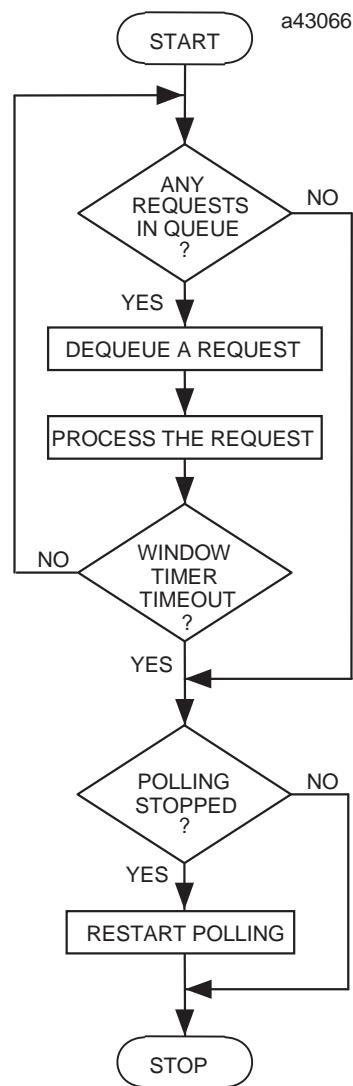


Figure 2-3. System Communications Window Flow Chart

## 7. Reconfiguration

During this portion of the sweep, the CPU checks the actual hardware lineup against the configured hardware lineup. Slots that are configured for a module but that are empty physically, or slots that contain faulted modules, will not be scanned by the CPU (i.e. the CPU will not read any input data from, and will not send any output data to that module or slot). During reconfiguration, if the CPU detects that a slot previously identified as containing a faulted module now has a good module, or that a configured module has been physically added to the PLC, it will begin scanning that module.

Reconfiguration enables the CPU to do the following:

- Recognize a legitimate change that you make in the configuration.
- Ignore potentially corrupted or inaccurate input data from faulted or missing modules.
- Avoid sending output data that could become corrupted by a faulted output module.

## 8. Checksum Calculation

A checksum calculation is performed on the user program at the end of every sweep. Since it would take too long to calculate the checksum of the entire program, you can specify the number of words from 0 to 32 to be checked on the CPU configuration screen.

If the calculated checksum does not match the reference checksum, the program checksum failure exception flag is raised. This causes a fault entry to be inserted into the PLC fault table and the PLC mode to be changed to **STOP**. If the checksum calculation fails, the programmer communications window is not affected. The default number of words to be checksummed is 8.

### PCM Communications with the PLC (Models 331 and Higher)

There is no way for intelligent option modules (IOM), such as the PCM, to interrupt the CPU when they need service. The CPU must poll (check periodically) each intelligent option module for service requests. This polling occurs asynchronously in the background during the sweep (see flow chart below).

When an intelligent option module is polled and sends the CPU a service request, the request is queued for processing during the system communications window.

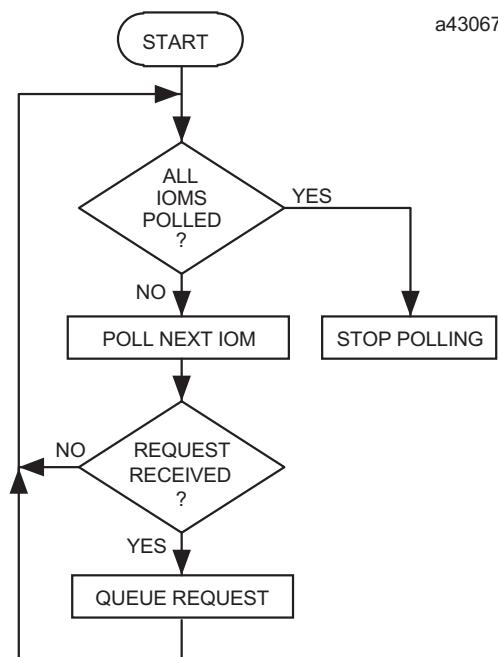


Figure 2-4. PCM Communications with the PLC

## Digital Servo Module (DSM) Communications with the PLC

The DSM302 and DSM314 are intelligent option modules that operate asynchronously with the Series 90-30 CPU module. Data is exchanged between the CPU and a DSM automatically via %Q, %I, %AQ, and %AI memory. A PLC CPU requires time to read and write the exchange data across the PLC backplane with the DSM module. Table 2-2 lists the sweep impact for the various possible DSM configurations. For additional timing considerations that apply to the DSM modules, refer to the following manuals:

- *Motion Mate DSM302 for Series 90-30 PLCs User's Manual*, GFK-1464.
- *Motion Mate DSM314 for Series 90-30 PLCs User's Manual*, GFK-1742.

## Standard Program Sweep Variations

In addition to the normal execution of the standard program sweep, certain variations can be encountered or forced. These variations, described in the following paragraphs, can be displayed and/or changed from the programming software.

### Constant Sweep Time Mode

In the standard program sweep, each sweep executes as quickly as possible with a varying amount of time consumed each sweep. An alternative to this is **CONSTANT SWEEP TIME** mode, where each sweep consumes the same amount of time. You can achieve this by setting the Configured Constant Sweep, which will then become the default sweep mode, thereby taking effect each time the PLC goes from **STOP** to **RUN** mode. You may set a **CONSTANT SWEEP TIME** mode value between 5 to 200 milliseconds for CPUs 311-341 or between 5 and 500 milliseconds for the 350-364 and 374 CPUs.

Due to variations in the time required for various parts of the PLC sweep, the constant sweep time should be set at least 10 milliseconds higher than the sweep time that is displayed on the status line when the PLC is in **NORMAL SWEEP** mode. This prevents the occurrence of extraneous oversweep faults.

Use the **CONSTANT SWEEP TIME** mode when I/O points or register values must be polled at a constant frequency, such as in control algorithms. Another reason might be to ensure that a certain amount of time elapses between the output scan and the next sweep's input scan, permitting inputs to settle after receiving output data from the program.

If the constant sweep timer expires before the sweep completes, the entire sweep, including the communications windows, is completed. However, an oversweep fault is logged at the beginning of the next sweep.

## Configuring Constant Sweep Mode

There are two ways to configure Constant Sweep Mode:

- In Logicmaster configuration software, the CPU configuration screen has configurable Sweep Mode and Sweep Timer parameters. After making your selections, you must store the configuration from the programmer to the PLC during **STOP** mode before the changes will take effect. Once stored, this configuration becomes the default sweep mode.
- In Logicmaster programming software, the PLC Sweep Table selection on the PLC Control and Status menu has Sweep Mode and Timing parameter selection options. The parameters on this screen can only be edited in **RUN** mode. Changes made from this screen are only stored to the PLC, not to the folder on your PC, and are only effective while the PLC remains in Run mode. Once the PLC stops, it assumes the default Sweep Mode, which becomes effective the next time the PLC goes into Run mode. This method for temporarily configuring the Sweep Mode is useful for system design and debug operations.

## PLC Sweep When in STOP Mode

When the PLC is in **STOP** mode, the application program is not executed. Communications with the programmer and intelligent option modules continue. In addition, faulted module polling and module reconfiguration execution continue while in **STOP** mode. For efficiency, the operating system uses larger “time-slice” values than those used in **RUN** mode (usually about 50 milliseconds per window). You can choose whether or not the I/O is scanned. I/O scans may execute in **STOP** mode if the **IOScan-Stop** parameter on the CPU detail screen is set to **YES**.

### Caution

If the **IPScan-Stop** parameter on the CPU detail screen is set to **YES**, real-world outputs may be turned ON even when the PLC is in **STOP** mode, because the PLC will write the current values in the output tables to the output modules during the Output Scan.

## Communication Window Modes

The default window mode for the programmer communication window is “Limited” mode. That means that if a request takes more than 6 milliseconds to process, it is processed over multiple sweeps, so that no one sweep is impacted by more than 6 milliseconds. For the 313, 323, and 331 CPUs, the sweep impact may be as much as 12 milliseconds during a **RUN**-mode store. The active window mode can be changed using the “Sweep Control” screen in Logicmaster—for instructions on changing the active window mode, refer to Chapter 5, “PLC Control and Status,” in the *Logicmaster 90<sup>TM</sup> Series 90<sup>TM</sup>-30/20/Micro Programming Software User’s Manual* (GFK-0466).

### Note

If the system window mode is changed to Limited, then option modules such as the PCM or GBC that communicate with the PLC using the system window will have less impact on sweep time, but response to their requests will be slower.

## Keylock Switch on 35x, 36x and 37x Series CPUs: Change Mode and Flash Protect

All 350—374 CPUs have a keylock switch (CPUs 311-341 do not); however, some versions of CPU firmware do not support all keylock switch features. These differences are discussed in this section. Note that the keylock switches on some of these CPUs are labeled ON/RUN and OFF/STOP, and on others are labeled ON and OFF. Regardless of the labeling, all of these keylock switches work as described below.

### Flash Memory Protection (Hard-Wired)

This hard-wired, non-configurable feature can be used to prevent Flash memory from being changed by unauthorized people (people without a key). When the keylock switch is in the ON position, Flash memory cannot be written to. Flash memory can only be written to when this switch is OFF. This keylock switch feature is always in effect, regardless of how the next two configurable features are set.

### Run/Stop (Configurable)

This configurable feature was introduced in CPU firmware release 7.00. It is set by the **R/S Switch** parameter on the CPU configuration screen. The **R/S Switch** parameter is set to *Disabled* by default. If the **R/S Switch** parameter is set to *Enabled*, you can stop the PLC by turning the keylock switch to OFF, and start the PLC by turning the switch to ON (if there are no faults). If faults exist, one of the following will happen:

- **If the PLC has a non-fatal fault**, turning the keylock switch from OFF to ON will cause the PLC to go into run mode, and the RUN light will turn on steady, but the fault tables will not be cleared.
- **If the PLC has a fatal fault**, turning the keylock switch from OFF to ON will cause the RUN light to flash on and off for a period of five seconds, and the PLC will not go into run mode. This flashing light indicates the presence of one or more fatal faults in the Fault Tables. You can try to clear the fault table faults by turning the keylock switch from OFF to ON again during the five-second period. (If the five-second period has expired, turning the keylock switch from OFF to ON will start another five-second period.) If the faults do not clear using this method, you will have to remedy the causes of the fatal faults before being able to resume operation. See Chapter 3 for fault details.

### Other Run/Stop Keylock Switch Considerations

- If the **R/S Switch** parameter is set to *Enabled* and the keylock switch is in the OFF position, the PLC will be in STOP mode, and the programming software cannot be used to place the PLC into RUN mode.
- If the **R/S Switch** parameter is set to *Enabled*, the keylock switch is in the ON position, and there are no fatal faults, the programming software can be used to toggle the PLC between the RUN and STOP modes.

- If the **R/S Switch** parameter is set to *Enabled*, the keylock switch is in the ON position, but the PLC is stopped, you can place the PLC into RUN mode by either turning the keylock switch to the OFF position and then back to ON, or by using the programming software.

## RAM Memory and Override Protection (Configurable)

This feature was introduced in CPU firmware release 8.00. It is set by the **Mem Protect** parameter on the CPU configuration screen. The **Mem Protect** parameter is set to *Disabled* by default.

If the **Mem. Protect** parameter is set to *Enabled*, and the keylock switch is in the ON position, the following is true:

- User RAM memory (program and configuration) cannot be changed.
- Discrete points cannot be overridden.
- The Time of Day (TOD) clock cannot be changed with the Hand-Held Programmer (however, the TOD clock can still be changed using the configuration software).

## Safeguard your Keys

Each new 350—374 CPU is shipped with two keys for the keylock switch. If you use one or more of the keylock switch protection features described above, we recommend you carefully safeguard your keys. If they are lost, misplaced, or stolen, you may be locked out from working on your PLC, and unauthorized persons may have access to it. You may want to purchase spare keys for backup purposes, or if more than two persons need access to the PLC. A keylock switch key kit, containing three sets of keys, can be purchased from a GE Fanuc distributor. When ordering, request catalog number 44A736756-G01. All 350—374 CPUs use the same key.

## Disabling Keylock Switch Features

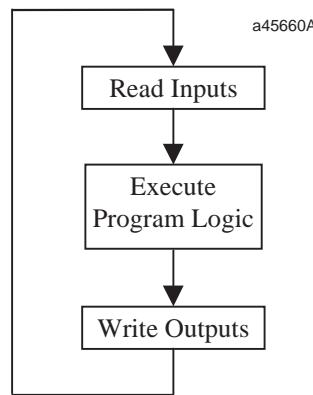
If you do not need to use any of the protection features of the keylock switch, you can choose to disable them all. To do so, leave the keylock switch set to the OFF position, and set the **R/S Switch** and **Mem. Protect** parameters (described above) to *Disabled* (their default setting). In this condition, all keylock switch protection features will be disabled, and you will not need to use a key to access the PLC.

## Section 2: Program Organization and User References/Data

The user memory size for the Series 90-30 programmable controllers is listed in the following table.

User Memory Size	
CPU Models	User Memory (Kbytes)
CPU311	6
CPU313, CPU323	12
CPU331	16
CPU340	32
CPU341	80
CPU350	80 (release 9.00 and later) 32 (prior to release 9.00)
CPU351, CPU352, CPU360, CPU363, CPU364, CPU374	240 (release 9.00 and later) 80 (prior to release 9.00)

Beginning with firmware release 9.00 CPUs, %R, %AI, and %AQ memory sizes for the 351, 352, 360, 363, 364 and 374 CPUs are configurable. (For details, refer to the *Logicmaster 90™ Series 90™-30/20/Micro Programming Software User's Manual*, GFK-0466K or later or the User's Manual for your programmer software). A program for the Series 90-20 programmable controller can be up to 2 KB in size for a Model 211 CPU, and the maximum number of rungs allowed per logic block (main or subroutine) is 3000. For Series 90-30 PLCs, the maximum block size is 80 kilobytes for C blocks and 16 kilobytes for LD and SFC blocks; however, in an SFC block, some of the 16 KB is used for the internal data block. As shown in the next figure, user program logic is executed repeatedly by the PLC while the PLC is in normal Run mode.



Refer to the *Series 90-30 Programmable Controller Installation and Hardware Manual*, GFK-0356, or the *Series 90-20 Programmable Controller User's Manual*, GFK-0551, for a listing of program sizes and reference limits for each model CPU.

All programs have a variable table that lists the variable and reference descriptions that have been assigned in the user program.

The block declaration editor lists subroutine blocks declared in the main program.

## Subroutine Blocks

A program can “call” subroutine blocks as it executes. A subroutine must be declared through the block declaration editor before a CALL instruction can be used for that subroutine. A maximum of 64 subroutine block declarations in the program and 64 CALL instructions are allowed for each logic block in the program. The maximum size of a subroutine block is 16 KB or 3000 rungs, but the main program and all subroutines must fit within the logic size constraints for that CPU model.

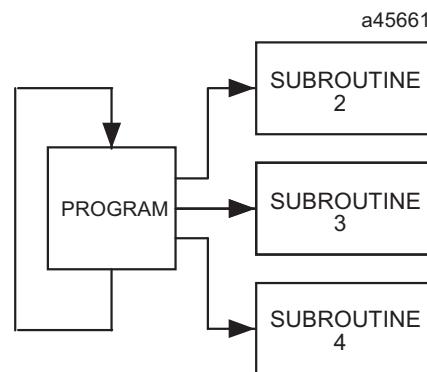
### Note

Subroutine blocks are not supported in the Series 90-20 PLC or the Micro PLC.

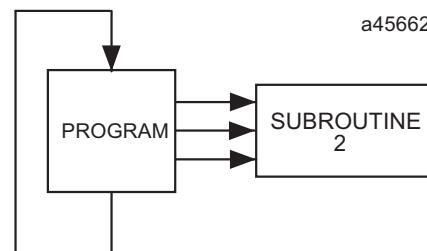
The use of subroutines is optional. Dividing a program into smaller subroutines can simplify programming, enhance understanding of the control algorithm, and possibly reduce the overall amount of logic needed for the program.

## Examples of Using Subroutine Blocks

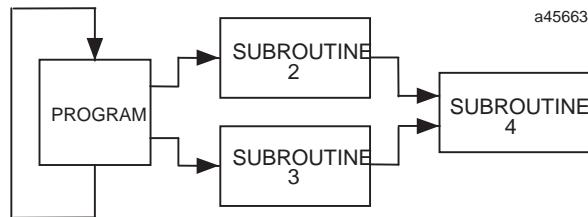
As an example, the logic for a program could be divided into three subroutines, each of which could be called as needed from the program. In this example, the program block might contain little logic, serving primarily to sequence the subroutine blocks.



A subroutine block can be used many times as the program executes. Logic which needs to be repeated several times in a program could be entered in a subroutine block. Calls would then be made to that subroutine block to access the logic. In this way, total program size is reduced.



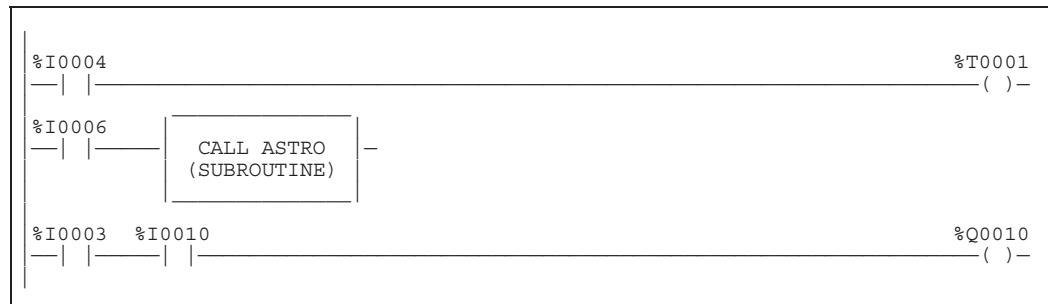
In addition to being called from the program, subroutine blocks can also be called by other subroutine blocks (this is called “nesting”). A subroutine block may even call itself.



The PLC will only allow eight nested calls before an “Application Stack Overflow” fault is logged and the PLC transitions to **STOP/Fault** mode. The call level nesting counts the main program as level 1.

## How Blocks Are Called

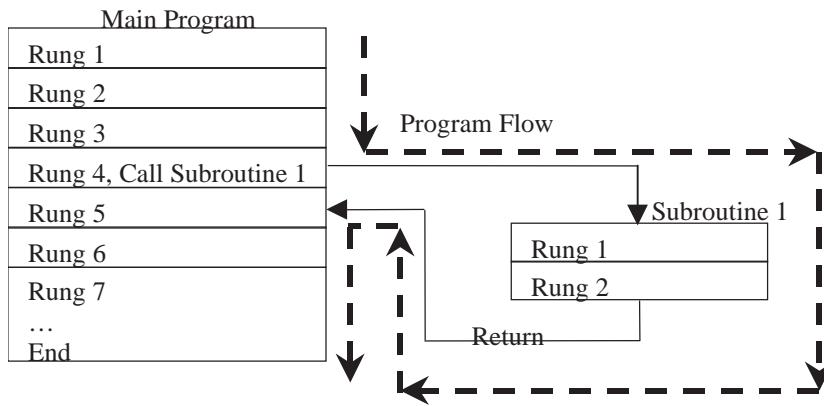
A subroutine block executes when called from program logic in a ladder program or from another subroutine block.



This example shows the subroutine CALL instruction as it will appear on the ladder logic screen.

## Execution Sequence in Programs Containing Subroutines

If a subroutine is called from a program or other subroutine, the called subroutine will execute to its end, then return control back to the program or subroutine that called it. Control will return to the rung following the rung that contains the subroutine call. In the example below, the heavy dotted line shows program flow (the order in which logic is executed). In this example, a simple two-rung subroutine is called from Rung 4 of the Main Program. After the two subroutine rungs are executed, program flow returns to the Main Program, starting with Rung 5.



## Periodic Subroutines

Version 4.20 or later of the 340 and higher CPUs support periodic subroutines. Please note the following restrictions:

1. Timer (TMR, ONDTR, and OFDTR) function blocks will not execute properly within a periodic subroutine. A DOIO function block within a periodic subroutine whose reference range includes references assigned to a Smart I/O Module (HSC, APM, DSM, Genius, etc.) will cause the CPU to lose communication with the module. The FST\_SCN and LST\_SCN contacts (%S1 and %S2) will have an indeterminate value during execution of the periodic subroutine. A periodic subroutine cannot call or be called by other subroutines.
2. The latency for the periodic subroutine (that is, the maximum interval between the time the periodic subroutine should have executed and the time it actually executes) can be around 0.35 milliseconds if there is no PCM, CMM, or ADC module in the main rack. If there is a PCM, CMM or ADC module in the main rack—even if it is not configured or used—the latency can be almost 2.25 milliseconds. For that reason, use of the periodic subroutine with PCM-based products is **not** recommended.

## User References

The data used in an application program is stored as either register or discrete references.

Table 2-4. Register References

Type	Description
%R	The prefix %R is used to assign system register references, which will store program data such as the results of calculations.
%AI	The prefix %AI represents an analog input register. This prefix is followed by the register address of the reference (for example, %AI0015). An analog input register holds the value of one analog input or other value.
%AQ	The prefix %AQ represents an analog output register. This prefix is followed by the register address of the reference (for example, %AQ0056). An analog output register holds the value of one analog output or other value.

## Note

All register references are retained across a power cycle to the CPU.

Table 2-5. Discrete References

Type	Description
%I	The %I prefix represents input references. This prefix is followed by the reference's address in the input table (for example, %I00121). %I references are located in the input status table, which stores the state of all inputs received from input modules during the last input scan. A reference address is assigned to discrete input modules using the configuration software or the Hand-Held Programmer. Until a reference address is assigned, no data will be received from the module. %I data can be retentive or non-retentive.
%Q	The %Q prefix represents physical output references. The coil check function of Logicmaster 90-30/20/Micro software checks for multiple uses of %Q references with relay coils or outputs on functions. Beginning with Release 3 of the software, you can select the level of coil checking desired (SINGLE, WARN MULTIPLE, or MULTIPLE). Refer to the Programming Software User's Manual, GFK-0466, for more information about this feature.  The %Q prefix is followed by the reference's address in the output table (for example, %Q00016). %Q references are located in the output status table, which stores the state of the output references as last set by the application program. This output status table's values are sent to output modules during the output scan.  A reference address is assigned to discrete output modules using the configuration software or the Hand-Held Programmer. Until a reference address is assigned, no data is sent to the module. A particular %Q reference may be either retentive or non-retentive. *
%M	The %M prefix represents internal references. The coil check function checks for multiple uses of %M references with relay coils or outputs on functions. Beginning with Release 3 of the software, you can select the level of coil checking desired (SINGLE, WARN MULTIPLE, or MULTIPLE). Refer to GFK-0466 for more information about this feature. A particular %M reference may be either retentive or non-retentive. *
%T	The %T prefix represents temporary references. Because these references are never checked for multiple coil use, they can be used many times in the same program, even when coil use checking is enabled. %T can be used to prevent coil use conflicts while using the cut/paste and file write/include functions. Because this memory is intended for temporary use, it is not retained through power loss or RUN-TO-STOP-TO-RUN transitions and cannot be used with retentive coils.
%S	The %S prefix represents system status references. These references are used to access special PLC data, such as timers, scan information, and fault information. System references include %S, %SA, %SB, and %SC references.  %S, %SA, %SB, and %SC can be used on any contacts.  %SA, %SB, and %SC can be used on retentive coils -(M)-.  %S can be used as word or bit-string input arguments to functions or function blocks.  %SA, %SB, and %SC can be used as word or bit-string input or output arguments to functions and function blocks.
%G	The %G prefix represents global data references. These references are used to access data shared among several PLCs. %G references can be used on contacts and retentive coils because %G memory is always retentive. %G cannot be used on non-retentive coils.

\* Retentiveness is based on the type of coil. For more information, refer to "Retentiveness of Data" on the next page.

## Nicknames

A user may, optionally, assign a nickname to a reference address. A nickname is useful because it can convey information to the user about the purpose or function of the address. For example, in a PLC system installed in a factory, output coil %Q0001 is used to energize a motor starter relay that controls a physical pump, commonly called “Pump Number 1” by the factory’s employees. Assigning the nickname PUMP1 to %Q0001 would help an employee who is troubleshooting the system to recognize the purpose of %Q0001.

Nicknames must begin with a letter and may be from one to seven characters long. To distinguish between a memory address (reference) and a nickname, a percent sign (%) is used as the first character of a memory address. So, for example, M1 is considered by the PLC to be a nickname, but %M1 is considered to be a memory address. For more information about nicknames, please see manual GFK-0466 (the Logicmaster user’s manual for the Series 90-30 PLC).

## Transitions and Overrides

The %I, %Q, %M, and %G user references have associated transition and override bits. %T, %S, %SA, %SB, and %SC references have transition bits, but not override bits. The CPU uses transition bits for counters and transitional coils. Note that counters do not use the same kind of transition bits as coils. Transition bits for counters are stored within the locating reference.

In the Model 331 and higher CPUs, override bits can be set. When override bits are set, the associated references cannot be changed from the program or the input device; they can only be changed on command from the programmer. CPU Models 323, 321, 313, and 311, and the Micro CPUs do not support overriding discrete references.

## Retentiveness of Data

Data is said to be retentive if it is saved by the PLC when the PLC is stopped. The Series 90 PLC preserves program logic, fault tables and diagnostics, overrides and output forces, word data (%R, %AI, %AQ), bit data (%I, %SC, %G, fault bits and reserved bits), %Q and %M data (unless used with non-retentive coils), and word data stored in %Q and %M. %T data is not saved. Although, as stated above, %SC bit data is retentive, the defaults for %S, %SA, and %SB are non-retentive.

%Q and %M references are non-retentive (that is, cleared at power-up when the PLC switches from **STOP** to **RUN**) whenever they are used with non-retentive coils. Non-retentive coils include coils —( )—, negated coils —(/)—, SET coils —(S)—, and RESET coils —(R)—.

When %Q or %M references are used with retentive coils, or are used as function block outputs, the contents are retained through power loss and **RUN**-TO-**STOP**-TO-**RUN** transitions. Retentive coils include retentive coils —(M)—, negated retentive coils —(/M)—, retentive SET coils —(SM)—, and retentive RESET coils —(RM)—.

The last time a %Q or %M reference is programmed on a coil instruction determines whether the %Q or %M reference is retentive or non-retentive based on the coil type. For example, if %Q0001 was last programmed as the reference of a retentive coil, the %Q0001 data will be retentive. However, if %Q0001 was last programmed on a non-retentive coil, the %Q0001 data will be non-retentive.

# Data Types

Table 2-6. Data Types

Type	Name	Description	Data Format
INT	Signed Integer	Signed integers use 16-bit memory data locations, and are represented in 2's complement notation. (Bit 16 is the sign bit.) The valid range of an INT data type is -32,768 to +32,767.	<b>Register 1</b>  16                    1 (16 bit positions)
DINT	Double Precision Signed Integer	Double precision signed integers are stored in 32-bit data memory locations (actually two consecutive 16-bit memory locations) and represented in 2's complement notation. (Bit 32 is the sign bit.) The valid range of a DINT data type is -2,147,483,648 to +2,147,483,647.	<b>Register 2</b>  32                    17 <b>Register 1</b>  16                    1 (Two's Complement Value)
BIT	Bit	A Bit data type is the smallest unit of memory. It has two states, 1 or 0. A BIT string may have length N.	
BYTE	Byte	A Byte data type has an 8-bit value. The valid range is 0 to 255 (0 to FF in hexadecimal).	
WORD	Word	A Word data type uses 16 consecutive bits of data memory; but, instead of the bits in the data location representing a number, the bits are independent of each other. Each bit represents its own binary state (1 or 0), and the bits are not looked at together to represent an integer number. The valid range of word values is 0 to FFFF.	<b>Register 1</b>  16                    1 (16 bit positions)
DWORD	Double Word	A Double Word data type has the same characteristics as a single word data type, except that it uses 32 consecutive bits in data memory instead of 16 bits. The valid range of double word values is 0 to FFFFFFFF.	<b>Register 2</b>  32                    17 <b>Register 1</b>  16                    1 (32 bit states)
BCD-4	Four-Digit Binary Coded Decimal	Four-digit BCD numbers use 16-bit data memory locations. Each BCD digit uses four bits and can represent numbers between 0 and 9. This BCD coding of the 16 bits has a legal value range of 0 to 9999.	<b>Register 1</b>  16    13    9    5    1 (4 BCD digits)
REAL	Floating Point	Real numbers use 32 consecutive bits (actually two consecutive 16-bit memory locations). The range of numbers that can be stored in this format is from ± 1.401298E-45 to ± 3.402823E+38.	<b>Register 2</b>  32                    17 <b>Register 1</b>  16                    1 (Two's Complement Value)

S = Sign bit (0 = positive, 1 = negative).

## System Status References

System status references in the Series 90 PLC are assigned to %S, %SA, %SB, and %SC memory. They each have a nickname. Examples of time tick references include T\_10MS, T\_100MS, T\_SEC, and T\_MIN. Examples of convenience references include FST\_SCN, ALW\_ON, and ALW\_OFF.

### Note

%S bits are read-only bits; do not write to these bits. You may, however, write to %SA, %SB, and %SC bits.

Listed below are system status references that can be used in an application program. When entering logic, either the reference or the nickname can be used. Refer to chapter 3, “Fault Explanations and Correction,” for more detailed fault descriptions and information on correcting the fault. You cannot use these special nicknames to name other memory references.

**Table 2-7. System Status References**

Reference	Nickname	Definition
%S0001	FST_SCN	Set to 1 when the current sweep is the first sweep.
%S0002	LST_SCN	Reset from 1 to 0 when the current sweep is the last sweep.
%S0003	T_10MS	0.01 second timer contact.
%S0004	T_100MS	0.1 second timer contact.
%S0005	T_SEC	1.0 second timer contact.
%S0006	T_MIN	1.0 minute timer contact.
%S0007	ALW_ON	Always ON.
%S0008	ALW_OFF	Always OFF.
%S0009	SY_FULL	Set when the PLC fault table fills up. Cleared when an entry is removed from the PLC fault table and when the PLC fault table is cleared.
%S0010	IO_FULL	Set when the I/O fault table fills up. Cleared when an entry is removed from the I/O fault table and when the I/O fault table is cleared.
%S0011	OVR_PRE	Set when an override exists in %I, %Q, %M, or %G memory.
%S0013	PRG_CHK	Set when background program check is active.
%S0014	PLC_BAT	Set to indicate a bad battery in a Release 4 or later CPU. The contact reference is updated once per sweep.
%S0017	SNPXACT	SNP-X host is actively attached to the CPU.
%S0018	SNPX_RD	SNP-X host has read data from the CPU.
%S0019	SNPX_WT	SNP-X host has written data to the CPU.
%S0020		Set ON when a relational function using REAL data executes successfully. It is cleared when either input is NaN (Not a Number).
%S0032		Reserved for use by the programming software.
%SA0001	PB_SUM	Set when a checksum calculated on the application program does not match the reference checksum. If the fault was due to a temporary failure, the discrete bit can be cleared by again storing the program to the CPU. If the fault was due to a hardware RAM failure, the CPU must be replaced.
%SA0002	OV_SWP	Set when the PLC detects that the previous sweep took longer than the time specified by the user. Cleared when the PLC detects that the previous sweep did not take longer than the specified time. It is also cleared during the transition from <b>STOP</b> to <b>RUN</b> mode. Only valid if the PLC is in <b>CONSTANT SWEEP</b> mode.

Reference	Nickname	Definition
%SA0003	APL_FLT	Set when an application fault occurs. Cleared when the PLC transitions from <b>STOP</b> to <b>RUN</b> mode.
%SA0009	CFG_MM	Set when a configuration mismatch is detected during system power-up or during a store of the configuration. Cleared by powering up the PLC when no mismatches are present or during a store of configuration that matches hardware.
%SA0010	HRD_CPU	Set when the diagnostics detects a problem with the CPU hardware. Cleared by replacing the CPU module.
%SA0011	LOW_BAT	Set when a low battery fault occurs. Cleared by replacing the battery and ensuring that the PLC powers up without the low battery condition.
%SA0014	LOS_IOM	Set when an I/O module stops communicating with the PLC CPU. Cleared by replacing the module and cycling power on the main rack.
%SA0015	LOS_SIO	Set when an option module stops communicating with the PLC CPU. Cleared by replacing the module and cycling power on the main rack.
%SA0019	ADD_IOM	Set when an I/O module is added to a rack. Cleared by cycling power on the main rack and when the configuration matches the hardware after a store.
%SA0020	ADD_SIO	Set when an option module is added to a rack. Cleared by cycling power on the main rack and when the configuration matches the hardware after a store.
%SA0027	HRD_SIO	Set when a hardware failure is detected in an option module. Cleared by replacing the module and cycling power on the main rack.
%SA0031	SFT_SIO	Set when an unrecoverable software fault is detected in an option module. Cleared by cycling power on the main rack and when the configuration matches the hardware.
%SB0010	BAD_RAM	Set when the CPU detects corrupted RAM memory at power-up. Cleared when the CPU detects that RAM memory is valid at power-up.
%SB0011	BAD_PWD	Set when a password access violation occurs. Cleared when the PLC fault table is cleared.
%SB0013	SFT_CPU	Set when the CPU detects an unrecoverable error in the software. Cleared by clearing the PLC fault table.
%SB0014	STOR_ER	Set when an error occurs during a programmer store operation. Cleared when a store operation is completed successfully.
%SC0009	ANY_FLT	Set when any fault occurs. Cleared when both fault tables have no entries.
%SC0010	SY_FLT	Set when any fault occurs that causes an entry to be placed in the PLC fault table. Cleared when the PLC fault table has no entries.
%SC0011	IO_FLT	Set when any fault occurs that causes an entry to be placed in the I/O fault table. Cleared when the I/O fault table has no entries.
%SC0012	SY_PRES	Set as long as there is at least one entry in the PLC fault table. Cleared when the PLC fault table has no entries.
%SC0013	IO_PRES	Set as long as there is at least one entry in the I/O fault table. Cleared when the I/O fault table has no entries.
%SC0014	HRD_FLT	Set when a hardware fault occurs. Cleared when both fault tables have no entries.
%SC0015	SFT_FLT	Set when a software fault occurs. Cleared when both fault tables have no entries.

**Note:** Any %S reference not listed here is reserved and must not be used in program logic.

## Function Block Structure

Each rung of logic is composed of one or more programming instructions. These may be simple relays or more complex functions.

### Format of Ladder Logic Relays

The programming software includes several types of relay functions. These functions provide basic flow and control of logic in the program. Examples include a normally open relay contact and a negated coil. Each of these relay contacts and coils has one input and one output. Together, they provide logic flow through the contact or coil.

Each relay contact or coil must be given a reference which is entered when selecting the relay. For a contact, the reference represents a location in memory that determines the flow of power into the contact. In the following example, if reference %I0122 is ON, power will flow through this relay contact.

```
%I0122
-| |-
```

For a coil, the reference represents a location in memory that is controlled by the flow of power into the coil. In this example, if power flows into the left side of the coil, reference %Q0004 is turned ON.

```
%Q0004
-( )-
```

The programming software and the Hand-Held Programmer both have a coil check function that checks for multiple uses of %Q or %M references with relay coils or outputs on functions.

### Format of Program Function Blocks (Instructions)

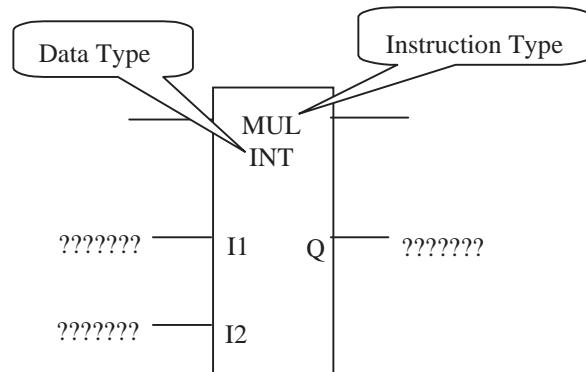
Some functions are very simple, like the Master Control Relay (MCR) function, which is shown with the abbreviated name of the function within brackets:

```
- [ MCR ] -
```

Other functions are more complex. They may have several places where you will enter information (parameter data) to be used by the function.

The example function block illustrated below is a multiplication (MUL) instruction. Its parts are typical of many function blocks. However, the number and types of parameters used can vary widely among the various type of function blocks. The upper part of the function block shows the name of the function. It may also show a data type, in this case, signed integer.

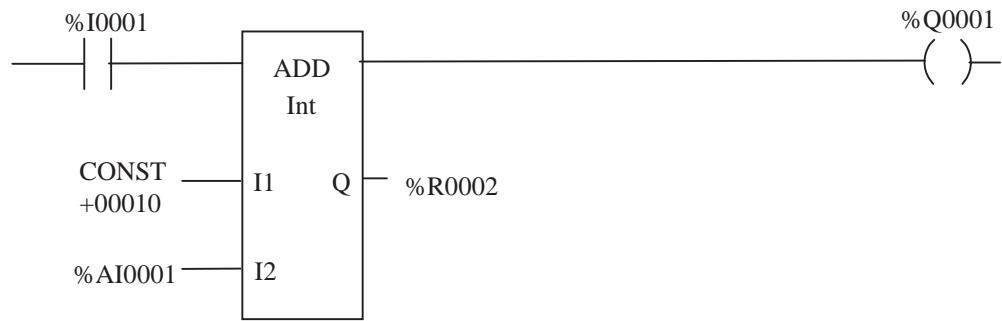
Many program functions (instructions) allow you to select the data type for the function after selecting the function. For example, the data type for the MUL function could be changed to double precision signed integer (D\_INT). Additional information on data types is provided earlier in this chapter.



## Function Block (Instruction) Parameters

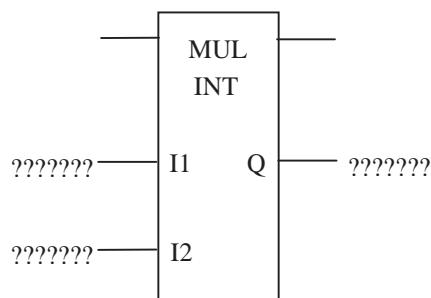
Each line entering the left side of a function block represents an input for that function. There are two forms of input used with function blocks, discrete and analog. Discrete inputs are either ON or OFF. In the figure below, the enabling contact %I0001 is an example of a discrete input. Analog inputs can be either constants or references. A constant is an explicit value. A reference is the memory address of a value. Generally, a reference is used if the input data is subject to change. For example, a reference might be the address of an input from an analog measuring device.

In the following example, input parameter I1 for an ADD function block is a constant, and input parameter I2 is a reference.



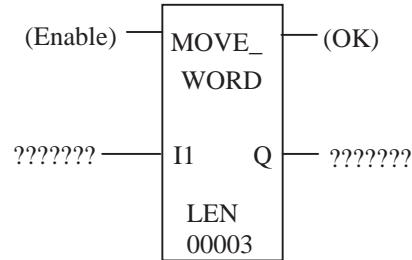
Each line exiting the right side of the function block represents an output. Outputs can be either discrete or analog. If analog, the value is placed into a register (reference). In the example above, the function block's OK output is discrete and it controls coil %Q0001. Its Q output, however, holds the resulting value from the math operation , so it is placed into a register, %R0002 in this example.

Where the question marks appear on the left of a function block, you will enter either the data itself, a reference location where the data is found, or a variable representing the reference location where the data is found. Where question marks appear on the right of a function block, you will usually enter a reference location for data to be output by the function block or a variable that represents the reference location for data to be output by the function block.

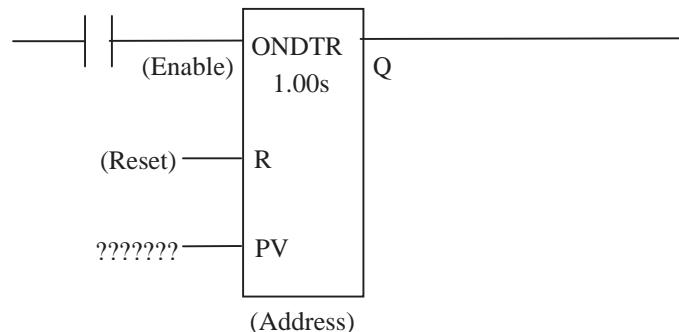


Most function blocks do not change input data; instead, they utilize input data in an operation and place the result of the operation in an output reference.

For functions that operate on groups of memory addresses (references), a length can be selected for the function. In the following function block, the LEN operand specifies the number of input words to be moved (3 in this example).

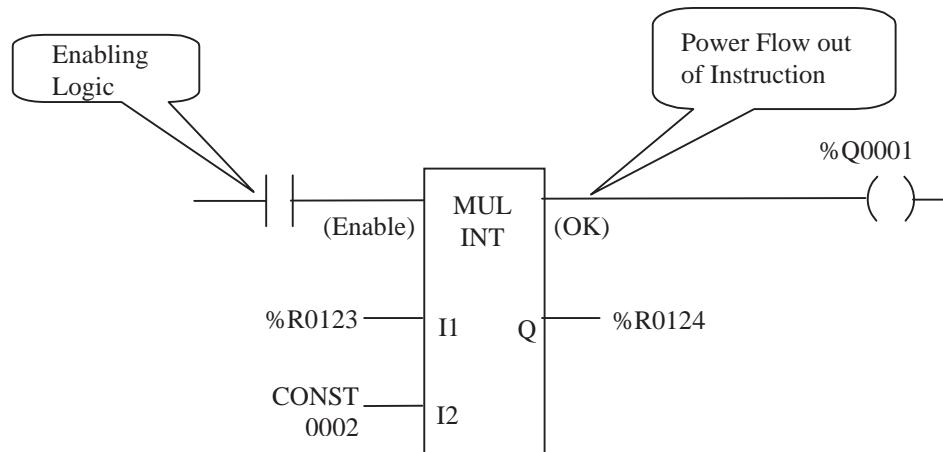


Timer, counter, BITSEQ, and ID functions require an address for the location of three words (registers) that store the current value, preset value, and a control word or “Instance” of the function. The first word of the three consecutive words appears on-screen below the function block, shown in the following figure as “(Address).”



## Power Flow In and Out of a Function

Power flows into a function block’s Enable input on the upper left through enabling logic. Most function blocks have a power flow output, called the “OK” output. If the function block executes properly, the OK output goes high and passes power flow out. If another device is connected to the OK output, such as the output coil shown below, that device is enabled. However, use of the OK output is optional for many function blocks, since their primary purpose is to obtain the result of the operation (multiplication in the example below) at the Q output.



### Note

If using Logicmaster programming software, function blocks cannot be tied directly to the left power rail. You can use %S7, the ALW\_ON (always on) bit with a normally open contact tied to the power rail to call a function every sweep.

Power flows out of the function block on the upper right. It may be passed to other program logic or to a coil (optional). Function blocks pass power when they execute successfully.

## *Section 3: Power-Up and Power-Down Sequences*

There are two possible power-up sequences in the Series 90-30 PLC; a cold power-up and a warm power-up. The CPU normally uses the cold power-up sequence. However, in a Model 331 or higher PLC system, if the time that elapses between a power-down and the next power-up is less than five seconds, the warm power-up sequence is used.

### Power-Up

A cold power-up consists of the following sequence of events. A warm power-up sequence skips Step 1.

1. The CPU will run self-diagnostics. This includes checking a portion of battery-backed RAM to determine whether or not the RAM contains valid data.
2. If an EPROM, EEPROM, or flash is present and the PROM power-up option in the PROM specifies that the PROM contents should be used, the contents of PROM are copied into RAM memory. If an EPROM, EEPROM, or flash is not present, RAM memory remains the same and is not overwritten with the contents of PROM.
3. The CPU interrogates each slot in the system to determine which boards are present.
4. The hardware configuration is compared with software configuration to ensure that they are the same. Any mismatches detected are considered faults and are alarmed. For example, if a module is specified in the software configuration but a different module is present in the actual hardware configuration, this condition is a fault and is alarmed.
5. If there is no software configuration, the CPU will use its built-in default configuration.
6. The CPU establishes the communications channel between itself and any intelligent modules.
7. In the final step of the execution, the mode of the first sweep is determined based on CPU configuration. Figure 2-5 on the next page shows the decision sequence for the CPU when it decides whether to copy from PROM or to power-up in **STOP** or **RUN** mode.

#### Note

Steps 2 through 7 above do not apply to the Series 90 Micro PLC. For information about the power-up and power-down sequences for the Micro, refer to the “Power-up and Power-down Sequences” section of Chapter 5, “System Operation,” in the *Series 90 Micro PLC User’s Manual* (GFK-1065).

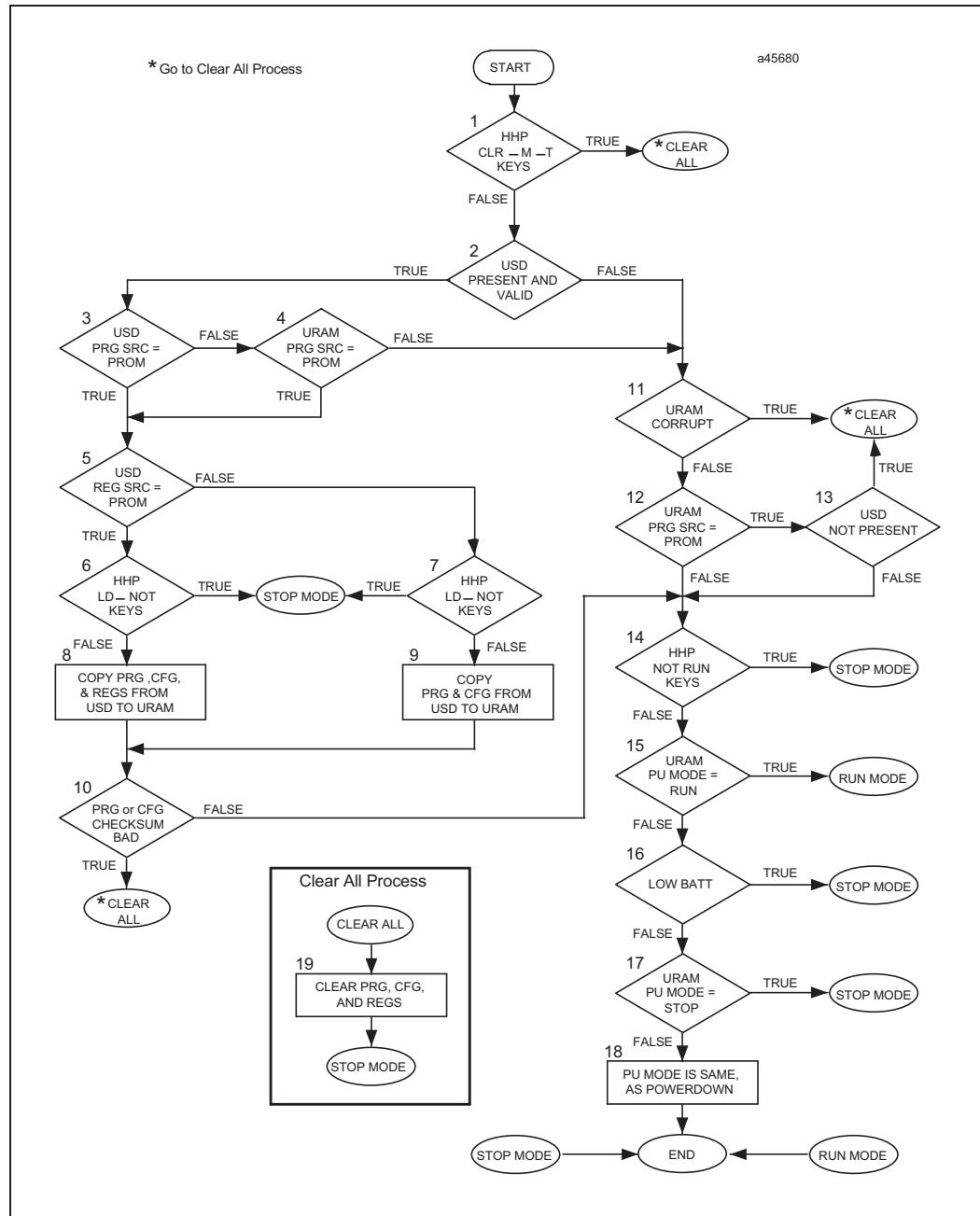


Figure 2-5. Power-Up Sequence

Prior to the START statement on the Power Up Flowchart, the CPU goes through power up diagnostics which test various peripheral devices used by the CPU and tests RAM. After completing diagnostics, internal data structures and peripheral devices used by the CPU get initialized. The CPU then determines if User Ram has been corrupted. If User Ram is corrupted, the user program and configuration are cleared out and defaulted and all user registers are cleared.

**FLOW CHART TERMS:**

PRG = User program (PRG SRC = Program Source)  
 CFG = User configuration  
 REGS = User registers (%I, %Q, %M, %G, %R, %AI, and %AQ references).  
 USD = User storage device, either an EPROM, EEPROM, or Flash device.  
 URAM = Non-volatile user ram which contains PRG, CFG, and REGS.  
 HHP = Hand-Help Programmer  
 PU = Power-up  
 CLR = Clear  
 BATT = Battery

**FLOW CHART EXPANDED TEXT:**

- (1) Are the <CLR> and <M\_T> keys being pressed on the HHP (Hand-Held Programmer) during power-up to clear all URAM?
- (2) Is the USD (user storage device) present and is the information in the USD valid?
- (3) Is the PRG SRC parameter in the USD set to Prom meaning to load the PRG (program logic) and CFG (configuration) from the USD device?
- (4) Is the PRG SRC parameter in the URAM set to Prom meaning to load the PRG and CFG from the USD device?
- (5) Is the REG SRC parameter in the USD set to Prom meaning to load the REGS (registers) from the USD device?
- (6 & 7) Are the <LD> and <NOT> keys being pressed on the HHP during power-up to keep the PRG, CFG, and REGS from being loaded from USD?
- (8) Copy PRG, CFG, and REGS from the USD to URAM.
- (9) Copy PRG and CFG from the USD to URAM.
- (10) Is the PRG or CFG checksums just loaded from USD invalid?
- (11) Is the URAM corrupted? Could be due to being powered down without a battery attached or a low battery. Could also be due to updating firmware.
- (12) Is the PRG SRC parameter in the URAM set to Prom meaning to load the PRG and CFG from the USD device?
- (13) Is the USD present? This check only applies to CPUs 311-341. The USD is assumed to be present for CPUs 350-364 and 374.
- (14) Are the <NOT> and <RUN> keys being pressed on the HHP during power-up to unconditionally power-up in Stop Mode?
- (15) Is the PWR UP parameter in URAM set to **RUN**?
- (16) Is the battery low?
- (17) Is the PWR UP parameter in URAM set to **STOP**?
- (18) Set the power up mode to what ever the power down mode was.
- (19) Clear PRG, CFG, and REGS.

**Note**

The first part of this chart on the previous page does not apply to the Series 90 Micro PLC. For information about the power-up and power-down sequences for the Micro, refer to the “Power-up and Power-down Sequences” section of Chapter 5, “System Operation,” in the *Series 90 Micro PLC User’s Manual* (GFK-1065).

## Power-Down

System power-down occurs when the power supply detects that incoming AC power has dropped for more than one power cycle or the output of the 5-volt power supply has fallen to less than 4.9 volts DC.

## Section 4: Clocks and Timers

Clocks and timers provided by the Series 90-30 PLC include an elapsed time clock, a time-of-day clock (Models 331, 340/341, 350-374, and the 28-point Micro), a watchdog timer, and a constant sweep timer. Three types of timer function blocks include an on-delay timer, an off-delay timer, and a retentive on-delay timer (also called a watch clock timer). Four system time-tick contacts cycle on and off for 0.01 second, 0.1 second, 1.0 second, and 1 minute intervals.

### Elapsed Time Clock

The elapsed time clock uses 100 microsecond “ticks” to track the time elapsed since the CPU powered on. The clock is not retentive across a power failure; it restarts on each power-up. Once per second the hardware interrupts the CPU to enable a seconds count to be recorded. This seconds count rolls over approximately 100 years after the clock begins timing.

Because the elapsed time clock provides the base for system software operations and timer function blocks, it can not be reset from the user program or the programmer. However, the application program can read the current value of the elapsed time clock by using Service Request 16.

### Time-of-Day Clock

The time of day in the 28-point Micro and Series 90-30 PLC Model 331 and higher is maintained by a hardware time-of-day clock. The time-of-day clock maintains seven time functions:

- Year (two digits)
- Month
- Day of month
- Hour
- Minute
- Second
- Day of week

The time-of-day (TOD) clock is battery-backed and maintains its present state across a power failure. However, unless you initialize the clock, the values it contains are meaningless. The application program can read and set the time-of-day clock using Service Request #7.

The time-of-day clock can also be read and set from the CPU configuration software and with the Hand-Held Programmer (HHP). However, starting with CPU (350-364) firmware release 8.00, if the CPU *Mem. Protect* parameter is set to *Enabled*, the HHP cannot change the TOD clock if the CPU keylock switch is in the ON position. Note that keylock protection features only apply to CPUs 350—374 (other CPUs do not have a keylock switch).

The time-of-day clock is designed to handle month-to-month and year-to-year transitions. It automatically compensates for leap years until the year 2079.

## Watchdog Timer

A watchdog timer in the Series 90-30 PLC is designed to catch catastrophic failure conditions that result in an unusually long sweep. The timer value for the watchdog timer is 200 milliseconds for CPUs 311-341, and 500 milliseconds for CPUs 350—374; this is a fixed value that cannot be changed. The watchdog timer always starts from zero at the beginning of each sweep.

For 331 and lower model 90-30 CPUs, if the watchdog timeout value is exceeded, the OK LED goes off; the CPU is placed in reset and completely shuts down; and outputs go to their default state. No communication of any form is possible, and all microprocessors on all boards are halted. To recover, power must be cycled on the rack containing the CPU. In the 90-20, Series 90 Micro and 340 and higher 90-30 CPUs, a watchdog timeout causes the CPU to reset, execute its powerup logic, generate a watchdog failure fault, and change its mode to **STOP**.

## Elapsed Power Down Timer

The elapsed power down timer is used to determine how long the PLC was powered off. When the PLC is powered off, it resets to 0 and starts to time. When the PLC is powered on, timing stops and the value is retained. Service Request #29, described in chapter 12, can be used to read the value of this timer.

### Note

This function is available only in the 331 or higher Series 90-30 CPUs.

## Constant Sweep Timer

The constant sweep timer controls the length of a program sweep when the Series 90-30 PLC operates in **CONSTANT SWEEP TIME** mode. In this mode of operation, each sweep consumes the same amount of time. The value of the constant sweep timer is set by the programmer and can be any value from 5 to the value of the watchdog timer. Constant Sweep Time default is 100 milliseconds. Typically, for most application programs, the input scan, application program logic scan, and output scan do not require exactly the same amount of execution time in each sweep.

If the constant sweep timer expires before the completion of the sweep and the previous sweep was not an oversweep, the PLC places an oversweep alarm in the PLC fault table. At the beginning of the next sweep, the PLC sets the OV\_SWP fault contact. The OV\_SWP contact is reset when the PLC is not in **CONSTANT SWEEP TIME** mode or the time of the last sweep did not exceed the constant sweep timer.

## Time-Tick Contacts

The Series 90 PLC provides four time-tick contacts with time durations of 0.01 second, 0.1 second, 1.0 second, and 1 minute. The state of these contacts only changes during the housekeeping portion of the PLC sweep. These contacts provide a pulse having an equal on and off time duration. The contacts are referenced as T\_10MS (0.01 second), T\_100MS (0.1 second), T\_SEC (1.0 second), and T\_MIN (1 minute).

The following timing diagram represents the on/off time duration of these contacts.

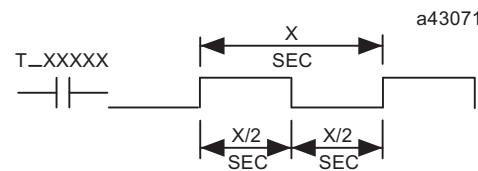


Figure 2-6. Time-Tick Contact Timing Diagram

## Section 5: System Security

Security in Series 90-30, Series 90-20, and in the Micro PLCs is designed to prevent unauthorized changes to the contents of a PLC. There are four security levels available in the PLC. The first level, which is always available, provides only the ability to read PLC data; no changes are permitted to the application. The other three levels have access to each level protected by a password.

Each higher privilege level permits greater change capabilities than the lower level(s). Privilege levels accumulate in that the privileges granted at one level are a combination of that level, plus all lower levels. The levels and their privileges are:

Privilege Level	Description
Level 1	Any data, except passwords may be read. This includes all data memories (%I, %Q, %AQ, %R, etc.), fault tables, and all program block types (data, value, and constant). No values may be changed in the PLC.
Level 2	This level allows write access to the data memories (%I, %R, etc.).
Level 3	This level allows write access to the application program in <b>STOP</b> mode only.
Level 4	This is the default level for systems that have no passwords set. The default level for a system with passwords is to the highest unprotected level. This level, the highest, allows read and write access to all memories as well as passwords in both <b>RUN</b> and <b>STOP</b> mode. (Configuration data cannot be changed in <b>RUN</b> mode.)

## Passwords

There is one password for each privilege level in the PLC. (No password can be set for level 1 access.) Each password may be unique; however, the same password can be used for more than one level. Passwords are one to four ASCII characters in length; they can only be entered or changed with the programming software or the Hand-Held Programmer.

A privilege level change is in effect only as long as communications between the PLC and the programmer are intact. There does not need to be any activity, but the communications link must not be broken. If there is no communication for 15 minutes, the privilege level returns to the highest unprotected level.

Upon connection to the PLC, the programming software requests the protection status of each privilege level from the PLC. The programming software then requests the PLC to move to the highest unprotected level, thereby giving the programming software access to the highest unprotected level without having to request any particular level. When the Hand-Held Programmer is connected to the PLC, the PLC reverts to the highest unprotected level.

## Privilege Level Change Requests

A programmer requests a privilege level change by supplying the new privilege level and the password for that level. A privilege level change is denied if the password sent by the programmer does not agree with the password stored in the PLC's password access table for the requested level. The current privilege level is maintained and no change will occur. If you attempt to access or modify information in the PLC using the Hand-Held Programmer without the proper privilege level, the Hand-Held Programmer will respond with an error message that the access is denied.

## Locking/Unlocking Subroutines

Subroutine blocks can be locked and unlocked using the block-locking feature of programming software. Two types of locks are available:

Type of Lock	Description
View	Once locked, you cannot zoom into that subroutine.
Edit	Once locked, the information in the subroutine cannot be edited.

A previously view locked or edit locked subroutine may be unlocked in the block declaration editor unless it is permanently view locked or permanently edit locked.

A search or search and replace function may be performed on a view locked subroutine. If the target of the search is found in a view locked subroutine, one of the following messages is displayed instead of logic:

`Found in locked block <block_name> (Continue/Quit)`

or

`Cannot write to locked block <block_name> (Continue/Quit)`

You may continue or abort the search.

Folders that contain locked subroutines may be cleared or deleted. If a folder contains locked subroutines, these blocks remain locked when the programming software Copy, Backup, and Restore folder functions are used.

## Permanently Locking a Subroutine

In addition to VIEW LOCK and EDIT LOCK, there are two types of permanent locks. If a PERMANENT VIEW LOCK is set, all zooms into a subroutine are denied. If a PERMANENT EDIT LOCK is set, all attempts to edit the block are denied.

### Caution

**The permanent locks differ from the regular VIEW LOCK and EDIT LOCK in that once set, they cannot be removed.**

Once a PERMANENT EDIT LOCK is set, it can only be changed to a PERMANENT VIEW LOCK. A PERMANENT VIEW LOCK cannot be changed to any other type of lock.

## Section 6: Series 90-30, 90-20, and Micro I/O System

The PLC I/O system provides the interface between the Series 90-30 PLC and user-supplied devices and equipment. Series 90-30 I/O modules plug directly into slots in Series 90-30 baseplates. The number of Series I/O modules supported depends upon the CPU model:

- CPU models 350—374 support up to 79 I/O modules. These CPUs support up to eight racks, which includes the CPU rack plus a total of seven expansion and/or remote racks.
- CPU models 331, 340, and 341, support up to 49 I/O modules. These CPUs support up to five racks, which includes the CPU rack plus a total of four expansion and/or remote racks.
- CPU models 311 and 313 (5-slot baseplates) support up to 5 Series 90-30 I/O modules. CPU model 323 (10-slot baseplate) supports up to 10 Series 90-30 I/O modules. These three CPUs do not support expansion or remote racks.

The I/O structure for the Series 90-30 PLC is shown in the following figure.

PLC I/O System

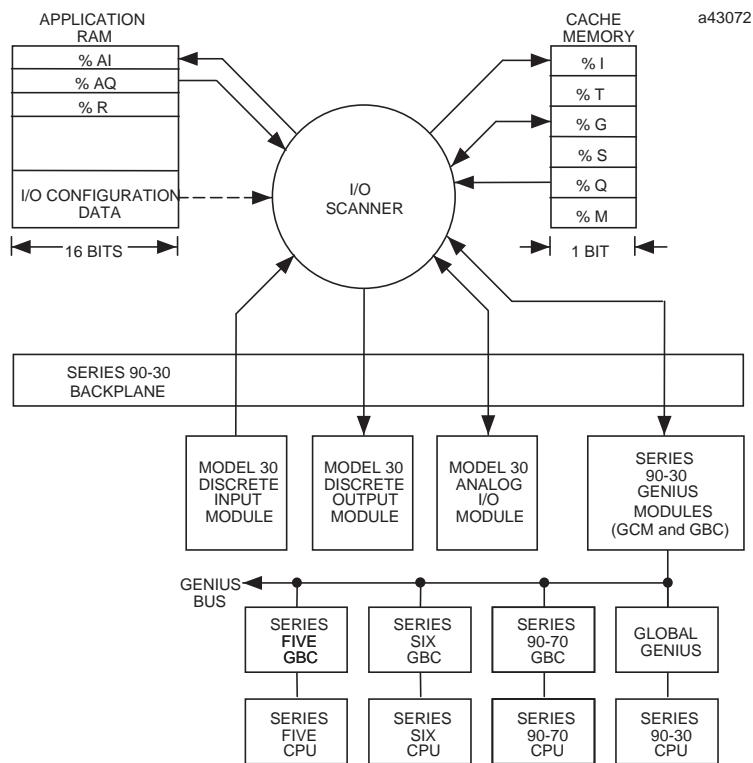


Figure 2-7. Series 90-30 I/O Structure

### Note

The drawing shown above is specific to the 90-30 I/O structure. Intelligent and option modules are not part of the I/O scan; they use the System Communication Window. For information about the 90-20 I/O structure, refer to the *Series 90™-20 Programmable Controller User's Manual* (GFK-0551). For information about the Micro PLC I/O structure, refer to the *Series 90™ Micro PLC User's Manual* (GFK-1065).

## Series 90-30 I/O Modules

Series 90-30 I/O modules are available as five types, discrete input, discrete output, analog input, analog output, and option modules. The following table lists the Series 90-30 I/O modules by catalog number, number of I/O points, and a brief description of each module.

### Note

Contact your local GE Fanuc distributor for availability of the modules listed.  
Refer to the “**Pub Number**” column for publications that contain the specifications and wiring information of each Series 90-30 I/O module.

Figure 2-8. Series 90-30 I/O Modules

Catalog Number	Points	Description	Pub Number
<i>Discrete Modules - Input</i>			
IC693MDL230	8	120 VAC Isolated	GFK-0898
IC693MDL231	8	240 VAC Isolated	GFK-0898
IC693MDL240	16	120 VAC	GFK-0898
IC693MDL241	16	24 VAC/DC Positive/Negative Logic	GFK-0898
IC693MDL630	8	24 VDC Positive Logic	GFK-0898
IC693MDL632	8	125 VDC Positive/Negative Logic	GFK-0898
IC693MDL633	8	24 VDC Negative Logic	GFK-0898
IC693MDL634	8	24 VDC Positive/Negative Logic	GFK-0898
IC693MDL640	16	24 VDC Positive Logic	GFK-0898
IC693MDL641	16	24 VDC Negative Logic	GFK-0898
IC693MDL643	16	24 VDC Positive Logic, FAST	GFK-0898
IC693MDL644	16	24 VDC Negative Logic, FAST	GFK-0898
IC693MDL645	16	24 VDC Positive/Negative Logic	GFK-0898
IC693MDL646	16	24 VDC Positive/Negative Logic, FAST	GFK-0898
IC693MDL652	32	24 VDC Position/Negative Logic	GFK-0898
IC693MDL653	32	24 VDC Positive/Negative Logic, FAST	GFK-0898
IC693MDL654	32	5/12 VDC (TTL) Positive/Negative Logic	GFK-0898
IC693MDL655	32	24 VDC Positive/Negative Logic	GFK-0898
IC693ACC300	8/16	Input Simulator	GFK-0898

Table 2-8. Series 90-30 I/O Modules - Continued

Catalog Number	Points	Description	Pub Number
<u><i>Discrete Modules - Output</i></u>			
IC693MDL310	12	120 VAC, 0.5A	GFK-0898
IC693MDL330	8	120/240 VAC, 2A	GFK-0898
IC693MDL340	16	120 VAC, 0.5A	GFK-0898
IC693MDL390	5	120/240 VAC Isolated, 2A	GFK-0898
IC693MDL730	8	12/24 VDC Positive Logic, 2A	GFK-0898
IC693MDL731	8	12/24 VDC Negative Logic, 2A	GFK-0898
IC693MDL732	8	12/24 VDC Positive Logic, 0.5A	GFK-0898
IC693MDL733	8	12/24 VDC Negative Logic, 0.5A	GFK-0898
IC693MDL734	6	125 VDC Positive/Negative Logic, 2A	GFK-0898
IC693MDL740	16	12/24 VDC Positive Logic, 0.5A	GFK-0898
IC693MDL741	16	12/24 VDC Negative Logic, 0.5A	GFK-0898
IC693MDL742	16	12/24 VDC Positive Logic, 1A	GFK-0898
IC693MDL750	32	12/24 VDC Negative Logic	GFK-0898
IC693MDL751	32	12/24 VDC Positive Logic, 0.3A	GFK-0898
IC693MDL752	32	5/24 VDC (TTL) Negative Logic, 0.5A	GFK-0898
IC693MDL753	32	12/24 VDC Positive/Negative Logic, 0.5A	GFK-0898
IC693MDL760	16	11 Pneumatic and five 24VDC Positive Logic, 0.5 A	GFK-1881
IC693MDL930	8	Relay, N.O., 4A Isolated	GFK-0898
IC693MDL931	8	Relay, BC, Isolated	GFK-0898
IC693MDL940	16	Relay, N.O., 2A	GFK-0898
<u><i>Input/Output Modules</i></u>			
IC693MDR390	8/8	24 VDC Input, Relay Output	GFK-0898
IC693MAR590	8/8	120 VAC Input, Relay Output	GFK-0898
<u><i>Analog Modules</i></u>			
IC693ALG220	4 ch	Analog Input, Voltage	GFK-0898
IC693ALG221	4 ch	Analog Input, Current	GFK-0898
IC693ALG222	16	Analog Input, Voltage	GFK-0898
IC693ALG223	16	Analog Input, Current	GFK-0898
IC693ALG390	2 ch	Analog Output, Voltage	GFK-0898
IC693ALG391	2 ch	Analog Output, Current	GFK-0898
IC693ALG392	8 ch	Analog Output, Current/Voltage	GFK-0898
IC693ALG442	4/2	Analog, Current/Voltage Combination Input/Output	GFK-0898

Table 2-8. Series 90-30 I/O Modules - Continued

Catalog Number	Description	Pub Number
<i>Option Modules</i>		
IC693APU300	High Speed Counter	GFK-0293
IC693APU301	Motion Mate APM Module, 1-Axis-Follower Mode	GFK-0781
IC693APU301	Motion Mate APM Module, 1-Axis-Standard Mode	GFK-0840
IC693APU302	Motion Mate APM Module, 2-Axis-Follower Mode	GFK-0781
IC693APU302	Motion Mate APM Module, 2-Axis-Standard Mode	GFK-0840
IC693MCS001/002*	Power Mate J Motion Control System (1 and 2 Axis)	GFK-1256
IC693DSM302	Motion Mate Digital Servo Module	GFK-1464
IC693DSM314	Motion Mate Digital Servo Module	GFK-1742
IC693APU305	I/O Processor Module	GFK-1028
IC693CMM321	Ethernet Communications Module	GFK-1541
IC693ADC311	Alphanumeric Display Coprocessor	GFK-0521
IC693BEM331	Genius Bus Controller	GFK-1034
IC693BEM320	I/O Link Interface Module (slave)	GFK-0631
IC693BEM321	I/O Link Interface Module (master)	GFK-0823
IC693CMM311	Communications Coprocessor Module	GFK-0582
IC693CMM301	Genius Communications Module	GFK-0412
IC693CMM302	Enhanced Genius Communications Module	GFK-0695
IC693PBM200	Profibus Master Module	GFK-2121
IC693PBS201	Profibus Slave Module	GFK-2193
IC693PCM300	PCM, 160K Bytes (35Kbytes User MegaBasic Program)	GFK-0255
IC693PCM301	PCM, 192K Bytes (47Kbytes User MegaBasic Program)	GFK-0255
IC693PCM311	PCM, 640K Bytes (190Kbytes User MegaBasic Program)	GFK-0255
IC693PTM100/101	Power Transducer Module (PTM)	GFK-1734
IC693TCM302/303	Temperature Control Module (TCM), eight-channel	GFK-1466

\* Obsolete. Listed for reference only.

## I/O Data Formats

Discrete inputs and discrete outputs are stored as bits in bit cache (status table) memory. Analog input and analog output data are stored as words and are memory resident in a portion of application RAM memory allocated for that purpose.

## Default Conditions for Series 90-30 Output Modules

At power-up, Series 90-30 discrete output modules default to outputs off. They will retain this default condition until the first output scan from the PLC. Analog output modules can be configured with a jumper located on the module's removable terminal block to either default to zero or retain their last state. Also, analog output modules may be powered from an external power source so that, even if the PLC has no power, the analog output modules will continue to operate in their selected default state.

## Diagnostic Data

Diagnostic bits are available in %S memory that will indicate the loss of an I/O module or a mismatch in I/O configuration. Diagnostic information is not available for individual I/O points. More information on fault handling can be in Chapter 3, “Fault Explanations and Correction.”

## Global Data

### Genius Global Data

The Series 90-30 PLC supports very fast sharing of data between multiple CPUs using Genius global data. The Genius Bus Controller, IC693BEM331 in CPU, version 5 and later, and the Enhanced Genius Communications Module, IC693CMM302, can broadcast up to 128 bytes of data to other PLCs or computers. They can receive up to 128 bytes from each of the up to 30 other Genius controllers on the network. Data can be broadcast from or received into any memory type, not just %G global bits.

The original Genius Communications Module, IC693CMM301, is limited to fixed %G addresses and can only exchange 32 bits per serial bus address from SBA 16 to 23. For new installations, we recommend this module not be used; instead, use the newer enhanced GCM, which has considerably more capability.

Global data can be shared between Series Five, Series Six, and Series 90 PLCs connected to the same Genius I/O bus.

### Ethernet Communications

The Model 364 CPU (release 9.0 and later) supports connection to an Ethernet network through either (but not both) of two built-in Ethernet ports. AAUI and 10BaseT ports are provided. The Model 374 CPU supports connection to an Ethernet network through two built-in 10BaseT/100BaseTx auto-negotiating full-duplex Ethernet ports.

Both the CPU364 and CPU374 support Ethernet Global Data (EGD), which is similar to Genius Global Data in that it allows one device (the producer) to transfer data to one or more other devices (the consumers) on the network. EGD is not supported by Logicmaster 90 software (requires a Windows-based programmer for Series 90 PLCs.)

## Series 90-20 I/O Modules

The following I/O modules are available for the Series 90-20 PLC. Each module is listed by catalog number, number of I/O points, and a brief description. The I/O is integrated into a baseplate along with the power supply. For the specifications and wiring information of each module, refer to chapter 5 in the *Series 90-20 Programmable Controller User's Manual*, GFK-0551.

Catalog Number	Description	I/O Points
IC692MAA541	I/O and Power Supply Base Module, 120 VAC In/120 VAC Out/120 VAC Power Supply	16 In/12 Out
IC692MDR541	I/O and Power Supply Base Module 24 VDC In/Relay Out/120 VAC Power Supply	16 In/12 Out
IC692MDR741	I/O and Power Supply Base Module 24V DC In/Relay Out/240 VAC Power Supply	16 In/12 Out
IC692CPU211	CPU Module, Model CPU 211	Not Applicable

## Configuration and Programming

Configuration is the process of assigning logical addresses, as well as other characteristics, to the hardware modules in the system. It can be done either before or after programming, using the configuration software or Hand-Held Programmer; however, it is recommended that configuration be done first. Refer to the User's Manual for your programming software for details on how to create, transfer, edit, and print programs. Chapters 4 through 12 describe the programming instructions that can be used to create ladder logic programs for the Series 90-30 and Series 90-20 programmable controllers.

*Chapter*  
**3**

## *Fault Explanation and Correction*

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This chapter is an aid to troubleshooting the Series 90-30, 90-20, and Micro PLC systems. It explains the fault descriptions, which appear in the PLC fault table, and the fault categories, which appear in the I/O fault table.

Each fault explanation in this chapter lists the fault description for the PLC fault table or the fault category for the I/O fault table. Find the fault description or fault category corresponding to the entry on the applicable fault table displayed on your programmer screen. Beneath it is a description of the cause of the fault along with instructions to correct the fault.

Chapter 3 contains the following sections:

Section	Title	Description	Page
1	Fault Handling	Describes the type of faults that may occur in the Series 90-30 and how they are displayed in the fault tables. Descriptions of the PLC and I/O fault table displays are also included.	3-2
2	PLC Fault Table Explanations	Provides a fault description of each PLC fault and instructions to correct the fault.	3-7
3	I/O Fault Table Explanations	Describes the Loss of I/O Module and Addition of I/O Module fault categories.	3-16

## Section 1: Fault Handling

### Note

This information on fault handling applies to systems programmed using Logimaster 90-30/20/Micro software.

Faults occur in the Series 90-30, 90-20, or Series 90 Micro PLC system when certain failures or conditions happen that affect the operation and performance of the system. These conditions, such as the loss of an I/O module or rack, may affect the ability of the PLC to control a machine or process. Or, a reported condition may only act as an alert, such as a low battery signal, which indicates that the memory backup battery needs to be changed. However, some conditions reported in the fault tables are not reports of failures. For example, if you were to add a new module to the PLC, this would be listed in the I/O fault table as “Addition of I/O Module.”

## Alarm Processor

A **fault** is the condition or failure itself. When a fault is received and processed by the CPU, it is called an **alarm**. The firmware in the CPU that handles these conditions is called the Alarm Processor. The user interface for the Alarm Processor is through the programming software. Any detected fault is recorded in a fault table and displayed on either the PLC fault table screen or the I/O fault table screen, as applicable.

## Classes of Faults

The Series 90-30, 90-20, and Micro PLCs detect several classes of faults. These include internal failures, external failures, and operational failures.

Fault Class	Examples
Internal Failures	Non-responding modules. Low battery condition. Memory checksum errors.
External I/O Failures	Loss of rack or module. Addition of rack or module.
Operational Failures	Communication failures. Configuration failures. Password access failures.

### Note

For information specific to Micro PLC fault handling, refer to the Series 90 *Micro PLC User's Manual* (GFK-1065).

# System Reaction to Faults

Hardware failures require that either the system be shut down or the failure be tolerated. I/O failures may be tolerated by the PLC system, but they may be intolerable by the application or the process being controlled. Operational failures are normally tolerated. Series 90-30, 90-20, and Micro PLC faults have two attributes:

Attribute	Description
Fault Table Affected	I/O Fault Table PLC Fault Table
Fault Action	Fatal Diagnostic Informational

## Fault Tables

Two fault tables are maintained in the PLC for logging faults, the I/O fault table for logging faults related to the I/O system and the PLC fault table for logging all other faults. The following table lists the fault groups, their fault actions, the fault tables affected, and the “name” for system discrete %S points that are affected.

Table 3-1. Fault Summary

Fault Group	Fault Action	Fault Table	Special Discrete Fault References			
Loss of or Missing I/O Module	Diagnostic	I/O	io_flt	any_flt	io_pres	los_iom
Loss of or Missing Option Module	Diagnostic	PLC	sy_flt	any_flt	sy_pres	los_sio
System Configuration Mismatch	Fatal	PLC	sy_flt	any_flt	sy_pres	cfg_mm
PLC CPU Hardware Failure	Fatal	PLC	sy_flt	any_flt	sy_pres	hrd_cpu
Program Checksum Failure	Fatal	PLC	sy_flt	any_flt	sy_pres	pb_sum
Low Battery	Diagnostic	PLC	sy_flt	any_flt	sy_pres	low_bat
PLC Fault Table Full	Diagnostic	—	sy_full			
I/O Fault Table Full	Diagnostic	—	io_full			
Application Fault	Diagnostic	PLC	sy_flt	any_flt	sy_pres	apl_flt
No User Program	Informational	PLC	sy_flt	any_flt	sy_pres	no_prog
Corrupted User RAM	Fatal	PLC	sy_flt	any_flt	sy_pres	bad_ram
Password Access Failure	Diagnostic	PLC	sy_flt	any_flt	sy_pres	bad_pwd
PLC Software Failure	Fatal	PLC	sy_flt	any_flt	sy_pres	sft_cpu
PLC Store Failure	Fatal	PLC	sy_flt	any_flt	sy_pres	stor_er
Constant Sweep Time Exceeded	Diagnostic	PLC	sy_flt	any_flt	sy_pres	ov_swp
Unknown PLC Fault	Fatal	PLC	sy_flt	any_flt	sy_pres	
Unknown I/O Fault	Fatal	I/O	io_flt	any_flt	io_pres	

## Fault Action

Faults can be fatal, diagnostic or informational.

Fatal faults cause the fault to be recorded in the appropriate table, any diagnostic variables to be set, and the system to be halted. Diagnostic faults are recorded in the appropriate table, and any diagnostic variables are set. Informational faults are only recorded in the appropriate table.

Possible fault actions are listed in the following table.

Table 3-2. Fault Actions

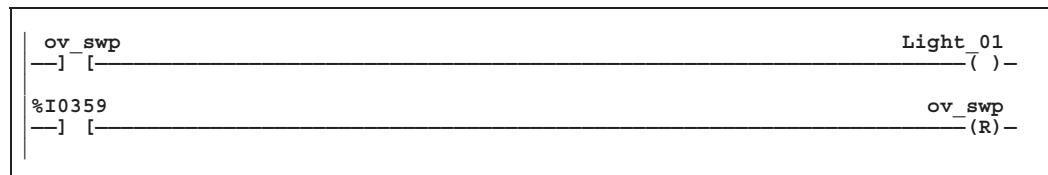
Fault Action	Response by CPU
Fatal	Log fault in fault table. Set fault references. Go to <b>STOP</b> mode.
Diagnostic	Log fault in fault table. Set fault references.
Informational	Log fault in fault table.

When a fault is detected, the CPU uses the fault action for that fault. Fault actions are not configurable in the Series 90-30 PLC, Series 90-20, or the Series 90 Micro PLC.

## Fault References

System fault references in the Series 90-30 are of one type - fault summary references. Fault summary references are set to indicate what fault occurred. The fault reference remains on until the PLC is cleared or until cleared by the application program.

An example of a system fault bit being set and then cleared is shown in the following figure. In this example, the coil, Light\_01, is turned on when system contact OV\_SWP (%SA0002) closes, which indicates that an oversweep occurred. The OV\_SWP contact and Light\_01 coil are turned off if contact %I0359 is closed, because closing %I0359 turns on reset coil OV\_SWP.



## System Status References

The alarm processor maintains the states of the 128 system status bits in %S memory. Many of these status references indicate where a fault has occurred and what type of fault it is. Status references are assigned to %S, %SA, %SB, and %SC memory, and each reference has a nickname. For example, status bit %SA0009 has a nickname of CFG\_MM, and it goes high to indicate a

configuration mismatch. These references are available for use in the application program as required. Refer to Chapter 2, “System Operation,” for a list of the system status references.

## Additional Fault Effects

Two faults described later in this chapter have additional effects associated with them. These effects are discussed in the following table.

Fault	Effect Description
PLC CPU Software Failure	When a PLC CPU software failure is logged, the Series 90-30 or 90-20 CPU immediately transitions into a special <b>ERROR SWEEP</b> mode. No activity is permitted in this mode. The only method of clearing this condition is to reset the PLC by cycling power.
PLC Sequence Store Failure	If, while performing a store to the PLC, communication between the PLC and the programmer is interrupted or any other failure occurs which terminates the download (store), the PLC Sequence Store Failure fault is logged. As long as this fault is present in the system, the PLC will not transition to <b>RUN</b> mode. To resume operation, the error must be cleared. This can be accomplished by clearing the fault on the applicable Fault Table Screen of the programming software.

## PLC Fault Table Display

The PLC Fault Table screen displays PLC faults such as password violations, PLC/configuration mismatches, parity errors, and communications errors.

Faults are stored in the PLC, so if the programming software is in the **OFFLINE** mode, no faults are displayed in this fault table. If the programming software is in either the **ONLINE** or **MONITOR** mode, PLC fault data is displayed. In **ONLINE** mode, faults can be cleared, although this feature may be password protected.

Once cleared, faults that are still present are not logged again in the table (except for the “Low Battery” fault) unless power is cycled or a new configuration is stored.

## I/O Fault Table Display

The I/O Fault Table screen displays I/O faults such as circuit faults, address conflicts, forced circuits, and I/O bus faults.

Faults are stored in the PLC, so if the programming software is in the **OFFLINE** mode, no faults are displayed in this fault table. If the programming software is in either the **ONLINE** or **MONITOR** mode, I/O fault data is displayed. In **ONLINE** mode, faults can be cleared, although this feature may be password protected.

Once cleared, faults that are still present are not logged again in the table unless power is cycled or a new configuration is stored.

# Accessing Additional Fault Information

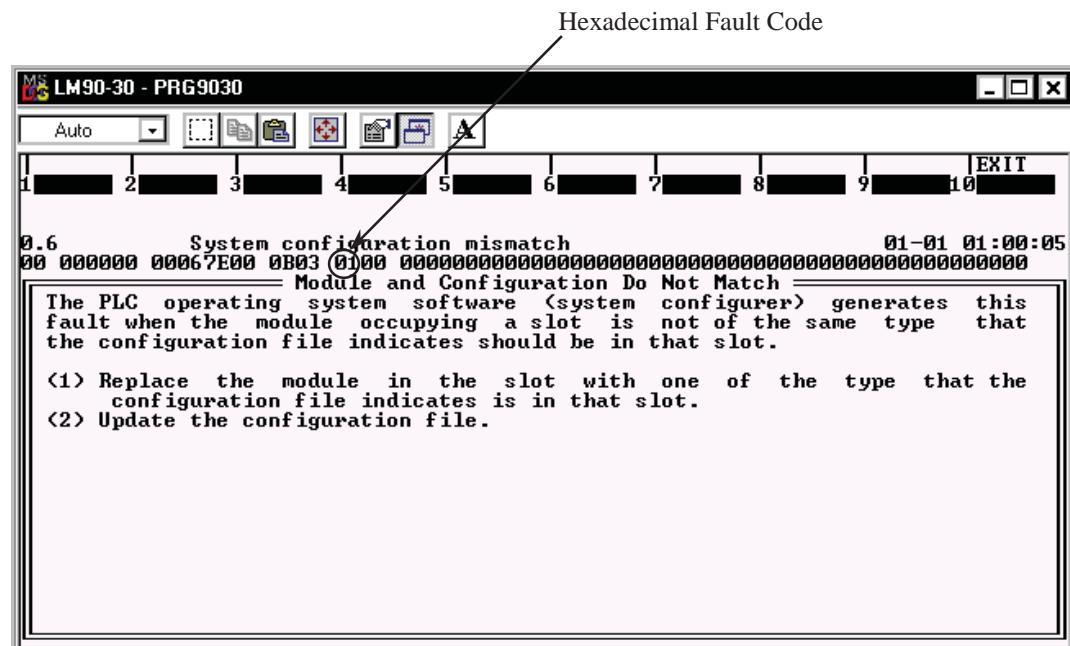
The fault tables contain basic information regarding the fault. Additional information pertaining to each fault can be displayed through the programming software. In addition, the programming software provides a hexadecimal fault code for each fault.

The last item, “Correction”, in each fault explanation in this chapter lists the action(s) to be taken to correct the fault. Note that the corrective action for some of the faults includes the statement:

Display the PLC Fault Table on the Programmer. Contact GE Fanuc Field Service, giving them all the information contained in the fault entry.

This second statement means that you must tell Field Service both the information readable directly from the fault table **and** the hexadecimal fault code. Field Service personnel will then give you further instructions for the appropriate action to be taken.

The following figure of a Logicmaster fault detail screen shows the additional fault information and hexadecimal fault code discussed above. (The fault code is the first two hexadecimal digits in the fifth group of number from the left.) To reach this screen, select a Fault Table fault (Loss of I/O Module) by using the keyboard cursor control arrow keys, and then “zoom” using the F10 key. To return to the Fault Table screen, press either the Escape key or the Shift and F10 key combination.



## Section 2: PLC Fault Table Explanations

Each fault explanation contains a fault description and instructions to correct the fault. Many fault descriptions have multiple causes. In these cases, the error code, displayed with the additional fault information, is used to distinguish different fault conditions sharing the same fault description. The error code is the first two hexadecimal digits in the fifth group (from the left) of numbers, as shown in the following example.

01	000000	01030100	0902	0200	000000000000
_____ Error Code (first two hex digits in fifth group)					

Some faults can occur because random access memory on the PLC CPU board has failed. These same faults may also occur because the system has been powered off and the battery voltage is (or was) too low to maintain memory. To avoid excessive duplication of instructions when corrupted memory may be a cause of the error, the correction simply states:

**Perform the corrections for Corrupted Memory.**

This means:

1. If the system has been powered off, replace the battery. Battery voltage may be insufficient to maintain memory contents.
2. Replace the PLC CPU board. The integrated circuits on the PLC CPU board may be failing.

The following table enables you to quickly find a particular PLC fault explanation in this section. Each entry is listed as it appears on the programmer screen.

Fault Description	Page
Loss of, or Missing, Option Module	3-8
Reset of, Addition of, or Extra, Option Module	3-8
System Configuration Mismatch	3-9
Option Module Software Failure	3-10
Program Block Checksum Failure	3-10
Low Battery Signal	3-10
Constant Sweep Time Exceeded	3-11
Application Fault	3-11
No User Program Present	3-12
Corrupted User Program on Power-Up	3-12
Password Access Failure	3-12
PLC CPU System Software Failure	3-13
Communications Failure During Store	3-15

## Fault Actions

- **Fatal** faults cause the PLC to enter a form of **STOP** mode at the end of the sweep in which the error occurred.
- **Diagnostic** faults are logged and corresponding fault contacts are set; the PLC stays in **RUN** mode.
- **Informational** faults are simply logged in the PLC fault table; the PLC stays in **RUN** mode.

### Loss of, or Missing, Option Module

The Fault Group **Loss of, or Missing Option Module** occurs when an option module fails to respond. The failure may occur at power-up if the module is missing or during operation if the module fails to respond. The fault action for this group is **Diagnostic**.

<b>Error Code:</b>	1, 42
<b>Name:</b>	Option Module Soft Reset Failed
<b>Description:</b>	PLC CPU unable to re-establish communications with option module after soft reset (such as pressing a Reset button) is tried.
<b>Correction:</b>	<ol style="list-style-type: none"> <li>(1) Repeat soft reset procedure recommended for this module.</li> <li>(2) Replace the option module.</li> <li>(3) Power off the system. Verify that the module is seated properly in the rack and that all cables are properly connected and seated.</li> <li>(4) Test or replace the cables.</li> </ol>
<b>Error Code:</b>	All Others
<b>Name:</b>	Module Failure During Configuration
<b>Description:</b>	The PLC operating software generates this error when a module fails during power-up or configuration store.
<b>Correction:</b>	<ol style="list-style-type: none"> <li>(1) Power off the system. Replace the module located in that rack and slot.</li> </ol>

### Reset of, Addition of, or Extra, Option Module

The Fault Group **Reset of, Addition of, or Extra Option Module** occurs when an option module (PCM, ADC, etc.) comes online, is reset, or a module is found in the rack, but none is specified in the configuration. The fault action for this group is **Diagnostic**.

<b>Correction:</b>	<ol style="list-style-type: none"> <li>(1) Update the configuration file to include the module.</li> <li>(2) Remove the module from the system.</li> </ol>
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## System Configuration Mismatch

The Fault Group **Configuration Mismatch** occurs when the module occupying a slot is different from that specified in the configuration file. The fault action is **Fatal**.

<b>Error Code:</b>	1
<b>Name:</b>	System Configuration Mismatch
<b>Description:</b>	The PLC operating software generates this fault when the module occupying a slot is not of the same type that the configuration file indicates should be in that slot, or when the configured rack type does not match the actual rack present.
<b>Correction:</b>	Identify the mismatch and reconfigure the module or rack.
<b>Error Code:</b>	6
<b>Name:</b>	System Configuration Mismatch
<b>Description:</b>	This is the same as error code 1 in that this fault occurs when the module occupying a slot is not of the same type that the configuration file indicates should be in that slot, or when the configured rack type does not match the actual rack present.
<b>Correction:</b>	Identify the mismatch and reconfigure the module or rack.
<b>Error Code:</b>	18
<b>Name:</b>	Unsupported Hardware
<b>Description:</b>	A PCM or PCM-type module is present in a CPU 311, 313, or 323 system, or in an expansion or remote rack.
<b>Correction:</b>	Physically correct the situation by removing the PCM or PCM-type module or install a CPU that does support the module. NOTE: These modules must reside only in a CPU rack and only with a CPU that supports them.
<b>Error Code:</b>	26
<b>Name:</b>	Module busy–config not yet accept by module
<b>Description:</b>	The module cannot accept new configuration at this time because it is busy with a different process.
<b>Correction:</b>	Allow the module to complete the current operation and re-store the configuration.
<b>Error Code:</b>	51
<b>Name:</b>	END Function Executed from Sequential Function Chart (SFC) Action
<b>Description:</b>	The placement of an END function in SFC logic or in logic called by SFC will produce this fault.
<b>Correction:</b>	Remove the END function from the SFC logic or logic being called by the SFC logic.

## Option Module Software Failure

The Fault Group **Option Module Software Failure** occurs when a non-recoverable software failure occurs on a PCM or ADC module. The fault action for this group is **Fatal**.

<b>Error Code:</b>	All
<b>Name:</b>	COMMREQ Frequency Too High
<b>Description:</b>	COMMREQs are being sent to a module faster than it can process them.
<b>Correction:</b>	Change the PLC program to send COMMREQs to the affected module at a slower rate.

## Program Block Checksum Failure

The Fault Group **Program Block Checksum Failure** occurs when the PLC CPU detects error conditions in program blocks received by the PLC (downloaded by the programming software). It also occurs when the PLC CPU detects checksum errors during power-up verification of memory or during **RUN** mode background checking. The fault action for this group is **Fatal**.

<b>Error Code:</b>	All
<b>Name:</b>	Program Block Checksum Failure
<b>Description:</b>	The PLC Operating Software generates this error when a program block is corrupted.
<b>Correction:</b>	(1) Clear PLC memory and retry the store. (2) Display the PLC fault table on the programmer. Contact GE Fanuc PLC Field Service, giving them all the information contained in the fault entry.

## Low Battery Signal

The Fault Group **Low Battery Signal** occurs when the PLC CPU detects a low battery on the PLC power supply or a module, such as the PCM, reports a low battery condition. The fault action for this group is **Diagnostic**.

<b>Error Code:</b>	0
<b>Name:</b>	Failed Battery Signal
<b>Description:</b>	The CPU module (or other module having a battery) battery is dead.
<b>Correction:</b>	Replace the battery. Do not remove power from the rack.

<b>Error Code:</b>	1
<b>Name:</b>	Low Battery Signal
<b>Description:</b>	A battery on the CPU, or other module has a low signal.
<b>Correction:</b>	Replace the battery. Do not remove power from the rack.

## Constant Sweep Time Exceeded

The Fault Group **Constant Sweep Time Exceeded** occurs when the PLC CPU operates in **CONSTANT SWEEP** mode, and it detects that the sweep has exceeded the constant sweep timer. The fault extra data contains the actual time of the sweep in the first two bytes and the name of the program in the next eight bytes. The fault action for this group is **Diagnostic**.

- |                    |   |
|--------------------|---|
| <b>Correction:</b> | (1) Increase constant sweep time.<br>(2) Remove logic from application program. |
|--------------------|---|

## Application Fault

The Fault Group **Application Fault** occurs when the PLC CPU detects a fault in the user program. The fault action for this group is **Diagnostic**, except when the error is a Subroutine Call Stack Exceeded, in which case it is **Fatal**.

<b>Error Code:</b>	7
<b>Name:</b>	Subroutine Call Stack Exceeded
<b>Description:</b>	Subroutine calls are limited to a depth of 8. A subroutine can call another subroutine which, in turn, can call another subroutine until 8 call levels are attained.
<b>Correction:</b>	Modify program so that subroutine call depth does not exceed 8.
<b>Error Code:</b>	1B
<b>Name:</b>	CommReq Not Processed Due To PLC Memory Limitations
<b>Description:</b>	No-wait communication requests can be placed in the queue faster than they can be processed (e.g., one per sweep). In a situation like this, when the communication requests build up to the point that the PLC has less than a minimum amount of memory available, the communication request will be faulted and not processed
<b>Correction:</b>	Issue fewer communication requests or otherwise reduce the amount of mail being exchanged within the system.
<b>Error Code:</b>	5A
<b>Name:</b>	User Shut Down Requested
<b>Description:</b>	The PLC operating software (function blocks) generates this informational alarm when Service Request #13 (User Shut Down) executes in the application program.
<b>Correction:</b>	None required. Information-only alarm.

## No User Program Present

The Fault Group **No User Program Present** occurs when the PLC CPU is instructed to transition from **STOP** to **RUN** mode or a store to the PLC and no user program exists in the PLC. The PLC CPU detects the absence of a user program on power-up. The fault action for this group is **Informational**.

<b>Correction:</b>	Download an application program before attempting to go to <b>RUN</b> mode.
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## Corrupted User Program on Power-Up

The Fault Group **Corrupted User Program on Power-Up** occurs when the PLC CPU detects corrupted user RAM. The PLC CPU will remain in **STOP** mode until a valid user program and configuration file are downloaded. The fault action for this group is **Fatal**.

<b>Error Code:</b>	1
<b>Name:</b>	Corrupted User RAM on Power-Up
<b>Description:</b>	The PLC operating software (operating software) generates this error when it detects corrupted user RAM on power-up.
<b>Correction:</b>	<ul style="list-style-type: none"> <li>(1) Reload the configuration file, user program, and references (if any).</li> <li>(2) Replace the battery on the PLC CPU.</li> <li>(3) Replace the expansion memory board on the PLC CPU.</li> <li>(4) Replace the PLC CPU.</li> </ul>
<b>Error Code:</b>	2
<b>Name:</b>	Illegal Boolean OpCode Detected
<b>Description:</b>	The PLC operating software (operating software) generates this error when it detects a bad instruction in the user program.
<b>Correction:</b>	<ul style="list-style-type: none"> <li>(1) Restore the user program and references (if any).</li> <li>(2) Replace the expansion memory board on the PLC CPU.</li> <li>(3) Replace the PLC CPU.</li> </ul>

## Password Access Failure

The Fault Group **Password Access Failure** occurs when the PLC CPU receives a request to change to a new privilege level and the password included with the request is not valid for that level. The fault action for this group is **Informational**.

<b>Correction:</b>	Retry the request with the correct password.
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## PLC CPU System Software Failure

Faults in the Fault Group **PLC CPU System Software Failure** are generated by the operating firmware of the Series 90-30, 90-20 or Micro PLC CPU. They can occur at many different points of system operation. When a **Fatal** fault occurs, the PLC CPU **immediately** transitions into a special **ERROR SWEEP** mode. No activity is permitted when the PLC is in this mode. The only way to clear this condition is to cycle power on the PLC. The fault action for this group is **Fatal**.

<b>Error Code:</b>	1 through B
<b>Name:</b>	User Memory Could Not Be Allocated
<b>Description:</b>	The PLC operating software (memory manager) generates these errors when software requests the memory manager to allocate or de-allocate a block or blocks of memory from user RAM that are not legal. These errors should not occur in released products; they are normally encountered only during the firmware development process at the factory.
<b>Correction:</b>	Display the PLC fault table on the programmer. Contact GE Fanuc PLC Field Service, giving them all the information contained in the fault entry.
<b>Error Code:</b>	D
<b>Name:</b>	System Memory Unavailable
<b>Description:</b>	The PLC operating software (I/O Scanner) generates this error when its request for a block of system memory is denied by the memory manager because no memory is available from the system memory heap. It is <i>Informational</i> if the error occurs during the execution of a DO I/O function block. It is <i>Fatal</i> if it occurs during power-up initialization or autoconfiguration.
<b>Correction:</b>	Display the PLC fault table on the programmer. Contact GE Fanuc PLC Field Service, giving them all the information contained in the fault entry.
<b>Error Code:</b>	E
<b>Name:</b>	System Memory Could Not Be Freed
<b>Description:</b>	The PLC operating software (I/O Scanner) generates this error when it requests the memory manager to de-allocate a block of system memory and the de-allocation fails. This error can only occur during the execution of a DO I/O function block.
<b>Correction:</b>	(1) Display the PLC fault table on the programmer. Contact GE Fanuc PLC Field Service, giving them all the information contained in the fault entry. (2) Perform the corrections for corrupted memory.
<b>Error Code:</b>	10
<b>Name:</b>	Invalid Scan Request of the I/O Scanner
<b>Description:</b>	The PLC operating software (I/O Scanner) generates this error when the operating system or DO I/O function block scan requests neither a full nor a partial scan of the I/O. This should <i>not</i> occur in a production system.
<b>Correction:</b>	Display the PLC fault table on the programmer. Contact GE Fanuc PLC Field Service, giving them all the information contained in the fault entry.
<b>Error Code:</b>	13
<b>Name:</b>	PLC Operating Software Error
<b>Description:</b>	The PLC operating software generates this error when certain PLC operating software problems occur. This error should not occur in released products; they are normally encountered only during the firmware development process at the factory.
<b>Correction:</b>	(1) Display the PLC fault table on the programmer. Contact GE Fanuc PLC Field Service, giving them all the information contained in the fault entry. (2) Perform the corrections for corrupted memory.

<b>Error Code:</b>	14, 27
<b>Name:</b>	Corrupted PLC Program Memory
<b>Description:</b>	The PLC operating software generates these errors when certain PLC operating software problems occur. These errors should not occur in released products; they are normally encountered only during the firmware development process at the factory.
<b>Correction:</b>	<ul style="list-style-type: none"> <li>(1) Display the PLC fault table on the programmer. Contact GE Fanuc PLC Field Service, giving them all the information contained in the fault entry.</li> <li>(2) Perform the corrections for corrupted memory.</li> </ul>
<b>Error Code:</b>	27 through 4E
<b>Name:</b>	PLC Operating Software Error
<b>Description:</b>	The PLC operating software generates these errors when certain PLC operating software problems occur. These errors should not occur in released products; they are normally encountered only during the firmware development process at the factory.
<b>Correction:</b>	Display the PLC fault table on the programmer. Contact GE Fanuc PLC Field Service, giving them all the information contained in the fault entry.
<b>Error Code:</b>	4F
<b>Name:</b>	Communications Failed
<b>Description:</b>	The PLC operating software (service request processor) generates this error when it attempts to comply with a request that requires backplane communications and receives a rejected response.
<b>Correction:</b>	<ul style="list-style-type: none"> <li>(1) Check the bus for abnormal activity.</li> <li>(2) Replace the intelligent option module to which the request was directed.</li> </ul>
<b>Error Code:</b>	50, 51, 53
<b>Name:</b>	System Memory Errors
<b>Description:</b>	The PLC operating software generates these errors when its request for a block of system memory is denied by the memory manager because no memory is available or contains errors.
<b>Correction:</b>	<ul style="list-style-type: none"> <li>(1) Display the PLC fault table on the programmer. Contact GE Fanuc PLC Field Service, giving them all the information contained in the fault entry.</li> <li>(2) Perform the corrections for corrupted memory.</li> </ul>
<b>Error Code:</b>	52
<b>Name:</b>	Backplane Communications Failed
<b>Description:</b>	The PLC operating software (service request processor) generates this error when it attempts to comply with a request that requires backplane communications and receives a rejected mail response.
<b>Correction:</b>	<ul style="list-style-type: none"> <li>(1) Check the bus for abnormal activity.</li> <li>(2) Replace the intelligent option module to which the request was directed.</li> <li>(3) Check parallel programmer cable for proper attachment.</li> </ul>
<b>Error Code:</b>	All Others
<b>Name:</b>	PLC CPU Internal System Error
<b>Description:</b>	An internal system error has occurred that should <b>not</b> occur in a production system.
<b>Correction:</b>	Display the PLC fault table on the programmer. Contact GE Fanuc PLC Field Service, giving them all the information contained in the fault entry.

## Communications Failure During Store

The Fault Group **Communications Failure During Store** occurs during the store of program blocks and other data to the PLC. If communications with the programming device performing the store is interrupted or any other failure occurs which terminates the load, this fault is logged. As long as this fault is present in the system, the controller will not transition to **RUN** mode.

This fault is *not* automatically cleared on power-up; the user must specifically order the condition to be cleared. The fault action for this group is **Fatal**. For additional information on this fault, please see the “Additional Fault Effects” section earlier in this chapter.

<b>Correction:</b>	Clear the fault and retry the download of the program or configuration file.
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## Section 3: I/O Fault Table Explanations

The I/O fault table reports data about faults in three classifications:

- Fault category.
- Fault type.
- Fault description.

The faults described on the following page have a fault category, but do not have a fault type or fault group.

Each fault explanation contains a fault description and instructions to correct the fault. Many fault descriptions have multiple causes. In these cases, the error code, displayed with the additional fault information obtained by pressing CTRL-F, is used to distinguish different fault conditions sharing the same fault description. (For more information about using CTRL-F, refer to Appendix B, “Interpreting Fault Tables,” in this manual.) The Fault Category is the first two hexadecimal digits in the fifth group of numbers, as shown in the following example.

02 1F0100 00030101FF7F 0302 0200 84000000000003	 _____ Fault Category (first two hex digits in fifth group)
---	--

The following table enables you to quickly find a particular I/O fault explanation in this section. Each entry is listed as it appears on the programmer screen.

## Loss of I/O Module

The Fault Category **Loss of I/O Module** applies to Model 30 discrete and analog I/O modules. There are no fault types or fault descriptions associated with this category. The fault action is **Diagnostic**.

<b>Description:</b>	The PLC operating software generates this error when it detects that a Model 30 I/O module is no longer responding to commands from the PLC CPU, or when the configuration file indicates an I/O module is to occupy a slot and no module exists in the slot.
<b>Correction:</b>	<ol style="list-style-type: none"> <li>(1) Replace the module.</li> <li>(2) Correct the configuration file.</li> <li>(3) Display the PLC fault table on the programmer. Contact GE Fanuc PLC Field Service, giving them all the information contained in the fault entry.</li> </ol>

## Addition of I/O Module

The Fault Category **Addition of I/O Module** applies to Model 30 discrete and analog I/O modules. There are no fault types or fault descriptions associated with this category. The fault action is **Diagnostic**.

<b>Description:</b>	The PLC operating software generates this error when an I/O module which had been faulted returns to operation.
<b>Correction:</b>	(1) No action necessary if the module was removed or replaced, or the remote rack was power cycled. (2) Update the configuration file or remove the module.
<b>Description:</b>	The PLC operating software generates this error when it detects a Model 30 I/O module in a slot which the configuration file indicates should be empty.
<b>Correction:</b>	(1) Remove the module if it is there by mistake. (2) Update and restore the configuration file to include the extra module if it is supposed to be there.

*Chapter*  
**4**

## *R*elay Functions

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This chapter explains the use of contacts, coils, and links in ladder logic rungs.

Function	Page
Coils and negated coils.	4-2
Normally open and normal closed contacts.	4-1
Retentive and negated retentive coils.	4-4
Positive and negative transition coils.	4-5
SET and RESET coils.	4-6
Retentive SET and RESET coils.	4-7
Horizontal and vertical links.	4-7
Continuation coils and contacts.	4-8

## Using Contacts

A contact is used to monitor the state of a reference. Whether the contact passes power flow depends on the state or status of the reference being monitored and on the contact type. A reference is ON if its state is 1; it is OFF if its state is 0.

Table 4-1. Types of Contacts

Type of Contact	Display	Contact Passes Power to Right
Normally Open	—   —	When reference is ON.
Normally Closed	—  / —	When reference is OFF.
Continuation Contact	<+> ———	If the preceding continuation coil is set ON.

## Using Coils

Coils are used to control discrete references such as %Q and %M memory types. Conditional logic must be used to control the flow of power to a coil. Coils cause action directly; they do not pass power flow to the right. If additional logic in the program should be executed as a result of the coil condition, an internal reference (contact) should be used for that coil or a continuation coil/contact combination may be used.

Coils are always located at the rightmost position of a line of logic. A rung may contain up to eight coils.

The type of coil used will depend on the type of program action desired. The states of retentive coils are saved when power is cycled or when the PLC goes from **STOP** to **RUN** mode. The states of non-retentive coils are set to zero when power is cycled or the PLC goes from **STOP** to **RUN** mode.

Table 4-2. Types of Coils

Type of Coil	Display	Power to Coil	Result
Normally Open	—(0)—	ON OFF	Sets reference ON. Sets reference OFF.
Negated	—(/)—	ON OFF	Sets reference OFF. Sets reference ON.
Retentive	—(M)—	ON OFF	Sets reference ON, retentive. Sets reference OFF, retentive.
Negated Retentive	—(/M)—	ON OFF	Sets reference OFF, retentive. Sets reference ON, retentive.
Positive Transition	—(↑)—	OFF→ON	If reference is OFF, sets it ON for one sweep.
Negative Transition	—(↓)—	ON←OFF	If reference is OFF, sets it ON for one sweep.
SET	—(S)—	ON OFF	Sets reference ON until reset OFF by —(R)—. Does not change the coil state.
RESET	—(R)—	ON OFF	Sets reference OFF until set ON by —(S)—. Does not change the coil state.
Retentive SET	—(SM)—	ON OFF	Sets reference ON until reset OFF by —(RM)—, retentive. Does not change the coil state.
Retentive RESET	—(RM)—	ON OFF	Sets reference OFF until set ON by —(SM)—, retentive. Does not change the coil state.
Continuation Coil	—<+>	ON OFF	Sets next continuation contact ON. Sets next continuation contact OFF.

## Normally Open Contact —| |—

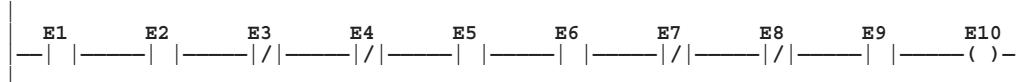
A normally open contact acts as a switch that passes power flow if the associated reference is ON (at logic 1).

## Normally Closed Contact —|||—

A normally closed contact acts as a switch that passes power flow if the associated reference is OFF (at logic 0).

### Example

The following example shows a rung with 10 elements having nicknames (see Chapter 2 for information on nicknames) from E1 to E10. Coil E10 is ON when reference E1, E2, E5, E6, and E9 are ON and references E3, E4, E7, and E8 are OFF.

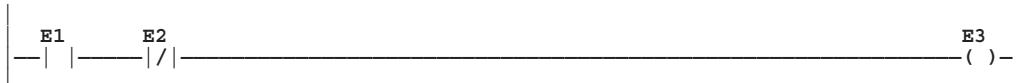


## Coil —( )—

A coil sets a discrete reference ON while it receives power flow. It is non-retentive; therefore, it cannot be used with system status references (%SA, %SB, %SC) or global Genius references (%G).

### Example

In the following example, coil E3 is ON when reference E1 is ON and reference E2 is OFF.

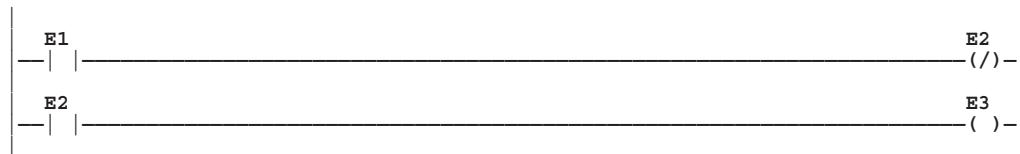


## Negated Coil -(/)-

A negated coil sets a discrete reference ON when it does not receive power flow. It is not retentive; therefore, it cannot be used with system status references (%SA, %SB, %SC), or global Genius references (%G).

### Example

In the following example, coil E3 is ON when reference E1 is OFF.



## Retentive Coil -(M)-

Like a normally open coil, the retentive coil sets a discrete reference ON while it receives power flow. The state of the retentive coil is retained across power failure. Therefore, it cannot be used with references from strictly non-retentive memory (%T).

## Negated Retentive Coil -(M/)-

The negated retentive coil sets a discrete reference ON when it does not receive power flow. The state of the negated retentive coil is retained across power failure. Therefore, it cannot be used with references from strictly non-retentive memory (%T).

## Positive Transition Coil -(↑)-

If the reference associated with a positive transition coil is OFF, when the coil receives power flow it is set to ON. Any contacts associated with that coil will change state for one PLC scan (sweep). (If the rung containing the coil is skipped on subsequent sweeps, it will remain ON.) This coil can be used as a one-shot.

Each reference should only be used as a transition coil once in the application program, so as to preserve the one-shot nature of the coil.

Transitional coils can be used with references from either retentive or non-retentive memory (%Q, %M, %T, %G, %SA, %SB, or %SC).

## Negative Transition Coil —(↓)—

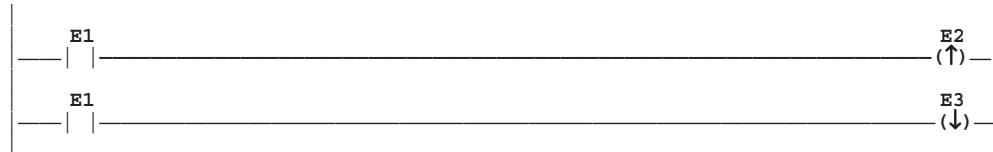
If the reference associated with this coil is OFF, when the coil stops receiving power flow, the reference is set to ON and any contacts associated with that coil will change state for one sweep.

A reference used with a transition coil should only be used as a coil once in the application program, so as to preserve the one-shot nature of the coil.

Transitional coils can be used with references from either retentive or non-retentive memory (%Q, %M, %T, %G, %SA, %SB, or %SC).

### Example

In the following example, when reference E1 goes from OFF to ON, coils E2 and E3 receive power flow, turning E2 ON for one logic sweep. When E1 goes from ON to OFF, power flow is removed from E2 and E3, turning coil E3 ON for one sweep.



## SET Coil —(S)—

SET and RESET are non-retentive coils that can be used to keep (“latch”) the state of a reference either ON or OFF. When a SET coil receives power flow, its reference stays ON (whether or not the coil itself continues to receive power flow) until the reference is reset by another coil.

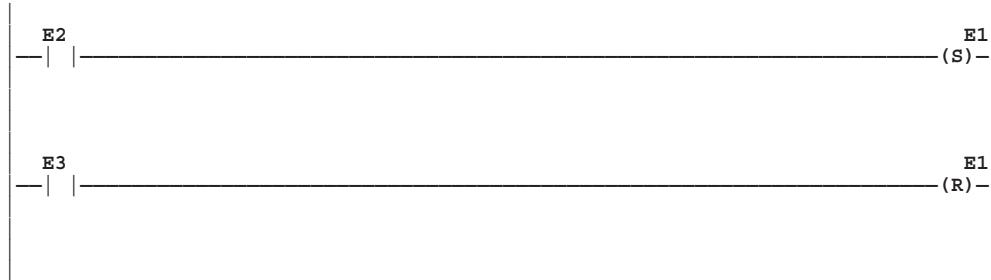
## RESET Coil —(R)—

The RESET coil sets a discrete reference OFF if the coil receives power flow. The reference remains OFF until the reference is reset by another coil. The last-solved SET coil or RESET coil of a pair takes precedence.

## Example

In the following example, the coil represented by E1(S) is turned ON if E2 turns ON. Even if E2 turns OFF, coil E1 stays ON until coil E1(R) is energized by E3.

NOTE: If both E2 and E3 were ON at the same time, coil E1 would be OFF. This is because rungs are scanned from top to bottom, so the status of the reset coil in the second rung is the last one to be written to the output table. If the order of the rungs was reversed, the set coil would be the last one scanned, so E1 would be ON if E2 and E3 were both ON at the same time.



### Note

When the level of coil checking is SINGLE, you can use a specific %M or %Q reference with only one Coil, but you can use it with one SET Coil and one RESET Coil simultaneously. When the level of coil checking is WARN MULTIPLE or MULTIPLE, then each reference can be used with multiple Coils, SET Coils, and RESET Coils. With multiple usage, a reference could be turned ON by either a SET Coil or a normal Coil and could be turned OFF by a RESET Coil or by a normal Coil.

## Retentive SET Coil —(SM)—

Retentive SET and RESET coils are similar to SET and RESET coils, but they are retained across power failure or when the PLC transitions from **STOP** to **RUN** mode. A retentive SET coil sets a discrete reference ON if the coil receives power flow. The reference remains ON until reset by a retentive RESET coil.

Retentive SET coils write an undefined result to the transition bit for the given reference. (Refer to the information on “Transitions and Overrides” in chapter 2, “System Operation.”)

## Retentive RESET Coil —(RM)—

This coil sets a discrete reference OFF if it receives power flow. The reference remains OFF until set by a retentive SET coil. The state of this coil is retained across power failure or when the PLC transitions from **STOP** to **RUN** mode.

Retentive RESET coils write an undefined result to the transition bit for the given reference. (Refer to the information on “Transitions and Overrides” in chapter 2, “System Operation.”)

## Links

Horizontal and vertical links, which appear as straight lines on-screen, are used to connect elements of a line of ladder logic between functions. Their purpose is to complete the flow of logic (“power”) from left to right in a line of logic.

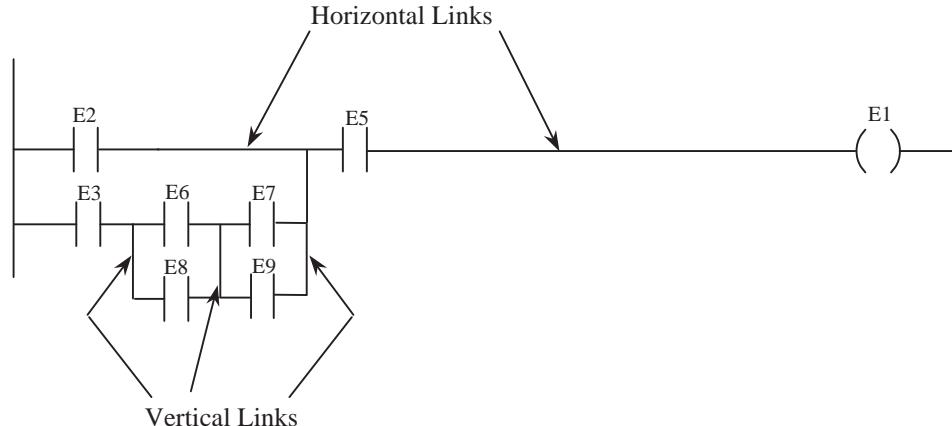
### Note

You can not use a horizontal link to tie a function or coil to the left power rail. You can, however, use %S7, the AWL\_ON (always on) system bit with a normally open contact tied to the power rail to call a function every sweep.

## Example

Several links are used in the following example:

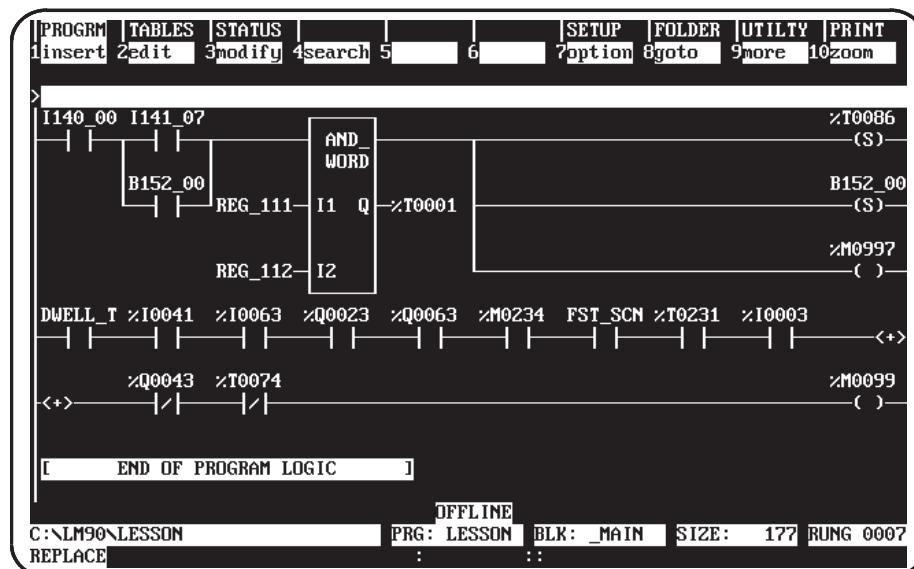
- Horizontal links connect contact E2 to contact E5, and contact E5 to coil E1.
- Vertical links connect contact E8 across contact E6, contact E9 across contact E7, and the right side of contacts E7/E9 to the junction of contacts E2 and E5.



## Continuation Coils (——<+>) and Contacts (<+>——)

Continuation coils (——<+>) and continuation contacts (<+>——) are used to continue relay ladder rung logic beyond the limit of ten columns. The state of the last executed continuation coil is the flow state that will be used on the next executed continuation contact. There needs to be a continuation coil before the logic executes a continuation contact. The state of the continuation contact is cleared when the PLC transitions from **Stop** to **Run**, and there will be no flow unless the transition coil has been set since going to **Run** mode.

There can be only one continuation coil and contact per rung; the continuation contact must be in column 1, and the continuation coil must be in column 10. An example continuation coil and contact are shown below:



*Chapter*  
**5**

## *Timers and Counters*

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This chapter explains how to use on-delay and stopwatch-type timers, up counters, and down counters. The data associated with these functions is retentive through power cycles.

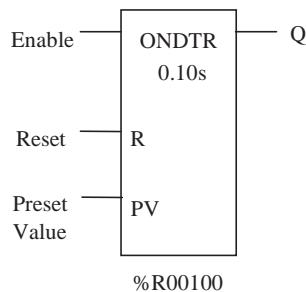
Abbreviation	Function	Page
ONDTR	Retentive On-Delay Timer	5-3
TMR	Simple On-Delay Timer	5-5
OFDT	Off-Delay Timer	5-8
UPCTR	Up Counter	5-11
DNCTR	Down Counter	5-13

## Function Block Data Required for Timers and Counters

Each timer or counter uses three words (registers) of %R memory to store the following information:

current value (CV)	word 1
preset value (PV)	word 2
control word	word 3

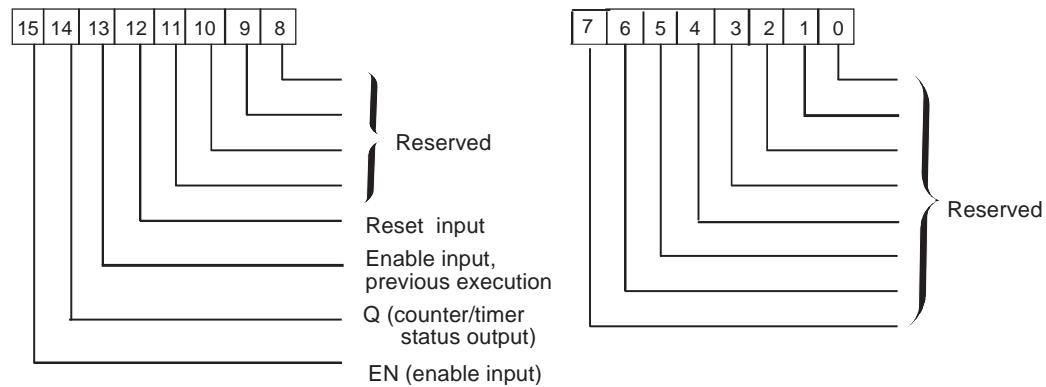
When you enter a timer or counter, you must enter a beginning address (the address for word 1) for this three-word block directly below the graphic representing the function. In the following example, this beginning address is %R00100.



### Note

Make sure that the addresses in the three-word block are not used elsewhere in your program (this duplicate use is called “overlapping”). Logicmaster does *not* check or warn you if register blocks overlap. Timers and counters will not work correctly if you overlap their three-word blocks.

The control word (the third word in the three-word block) stores the state of the Boolean inputs and outputs of its associated function block, as shown in the following format:



Bits 0 through 11 are reserved by the PLC for use in maintaining timer accuracy; these bits (0 through 11) are not used for counter function blocks.

### Note

Use care if you use the same address for the function's PV (Preset Value) input parameter as the second word in the three-word block. If PV is not a constant, the PV input normally is addressed to a different memory location than the second word. Some programmers choose to use the second word address for the PV input, such as using %R0102 when the three-word block starts at %R0101. This allows an application to change the PV while the timer or counter is running. Applications can read the first (CV) or third (Control) words, but the application cannot write to these values, because if they were written to, the function would not work.

### Special Note on Certain Bit Operations

**When using the Bit Test, Bit Set, Bit Clear or Bit Position function,** the bits are numbered 1 through 16, *NOT* 0 through 15 as shown above.

## ONDTR

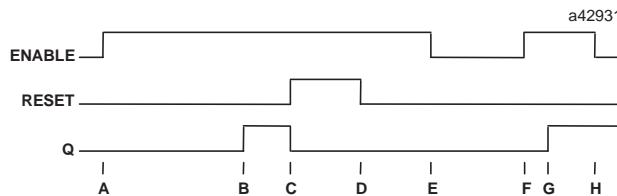
A retentive on-delay timer (ONDTR) increments while it receives power flow and holds its value when power flow stops. Time may be counted in tenths of a second (the default selection), hundredths of a second, or thousandths of a second. The range is 0 to +32,767 time units; therefore, the timing range is 0.001 to 3,276.7 seconds. The state of this timer is retentive on power failure; no automatic initialization occurs at power-up.

When the ONDTR first receives power flow, it starts accumulating time (current value). When this timer is encountered in the ladder logic, its current value is updated.

### Note

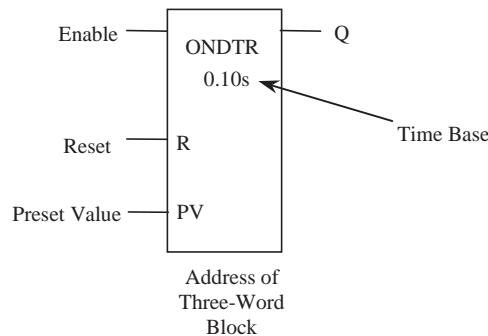
If multiple occurrences of the same timer with the same reference address are enabled during a CPU sweep, the current values of the timers will be the same.

When the current value equals or exceeds the preset value PV, output Q is energized. As long as the timer continues to receive power flow, it continues accumulating until the maximum value is reached. Once the maximum value is reached, it is retained and output Q remains energized regardless of the state of the enable input.



- A = ENABLE goes high; timer starts accumulating.
- B = CV reaches PV; Q goes high.
- C = RESET goes high; Q goes low, accumulated time is reset.
- D = RESET goes low; timer then starts accumulating again.
- E = ENABLE goes low; timer stops accumulating. Accumulated time stays the same.
- F = ENABLE goes high again; timer continues accumulating time.
- G = CV becomes equal to PV; Q goes high. Timer continues to accumulate time until ENABLE goes low, RESET goes high, or CV becomes equal to the maximum time.
- H = ENABLE goes low; timer stops accumulating time.

When power flow to the timer stops, the current value stops incrementing and is retained. Output Q, if energized, will remain energized. When the function receives power flow again, the current value again increments, beginning at the retained value. When reset R receives power flow, the current value is set back to zero and output Q is de-energized. On 35x, 36x, and 37x series PLCs, if the enable to the ONDTR is low, PV = 0 and reset R receives power-flow, then the output will be low. However, on the 311-341 PLCs, under these same conditions, the output will be high.



## Parameters

Parameter	Description
Address of Three-Word Block	<p>The ONDTR uses three consecutive words (registers) of %R memory to store the following:</p> <ul style="list-style-type: none"> <li>• Current value (CV) = word 1.</li> <li>• Preset value (PV) = word 2.</li> <li>• Control word = word 3.</li> </ul> <p>When you enter an ONDTR, you must enter an address for the location of the first of three consecutive words (registers) directly below the graphic representing the function (the use of the other two words is implied).</p> <p><b>Caution:</b> Do not write to these three words with other instructions. Overlapping these references will result in erratic operation of the timer.</p>
Enable	When enable receives power flow, the timer begins functioning.
R	Reset input. When R receives power flow, it resets the current value to zero. Input R, if used, must be connected by one or more contacts to the power rail. This requires that the ONDTR instruction be placed in the first position (left-most position) in the rung.
PV	Preset Value input. PV is the value to copy into the timer's preset value when the timer is enabled or reset. The timer will turn on the Q output when it times to the PV value.
Q	Output Q is energized when the current value (CV) is greater than or equal to the preset value (PV).
Time Base	This parameter may be programmed for time increment of tenths (0.1), hundredths (0.01), or thousandths (0.001) of seconds. This time base value is multiplied by the number in the Preset Value (PV) input parameter to determine the actual preset value.

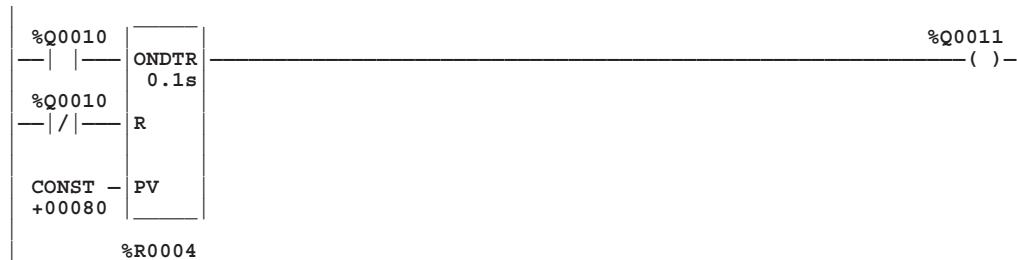
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
address								•				
enable	•											
R	•											
PV		•	•	•	•		•	•	•	•	•	•
Q	•											•

- Valid reference or place where power may flow through the function.

## Example

In the following example, a retentive on-delay timer is used to produce an output (%Q0011) that turns on 8.0 seconds after %Q0010 turns on, and turns off when %Q0010 turns off. This is because when %Q0010 turns off, its normally closed contact passes power to the reset (R) input. The 8.0 second time value is obtained by multiplying the PV value (80) times the time base value (0.1s).



## TMR

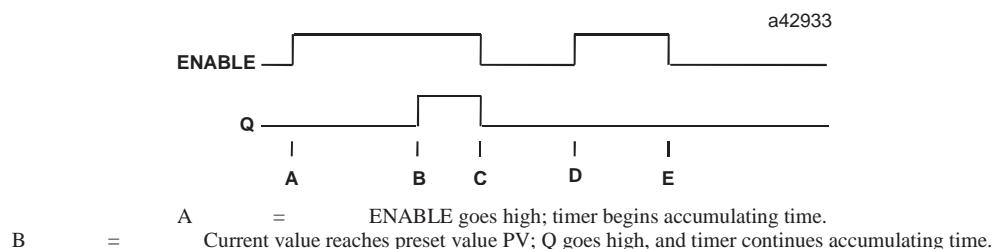
The simple on-delay timer (TMR) function increments while it receives power flow and resets to zero when power flow stops. Time may be counted in tenths of a second (the default selection), hundredths of a second, or thousandths of a second. The range is 0 to +32,767 time units, therefore the timing range is 0.001 to 3,276.7 seconds. The state of this timer is retentive on power failure; no automatic initialization occurs at power-up.

When the TMR receives power flow, the timer starts accumulating time (current value). The current value is updated when it is encountered in the logic to reflect the total elapsed time the timer has been enabled since it was last reset.

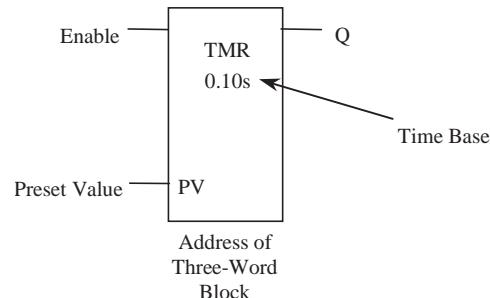
### Note

If multiple occurrences of the same timer with the same reference address are enabled during a CPU sweep, the current values of the timers will be the same.

The timer's elapsed time value (CV - current value) continues to accumulate as long as the enabling logic remains ON. When the current value (CV) equals or exceeds the preset value (PV), the function begins passing power flow to the right. The timer continues accumulating time until the maximum value (32,767 time units) is reached. When the enabling input transitions from ON to OFF, the timer stops accumulating time and the current value is reset to zero.



C = ENABLE goes low; Q goes low; timer stops accumulating time and current time is cleared.  
 D = ENABLE goes high; timer starts accumulating time.  
 E = ENABLE goes low before current value reaches preset value PV; Q remains low; timer stops accumulating time and is cleared to zero.



## Parameters

Parameter	Description
Address of Three-Word Block	<p>The TMR uses three consecutive words (registers) of %R memory to store the following:</p> <ul style="list-style-type: none"> <li>• Current value (CV) = word 1.</li> <li>• Preset value (PV) = word 2.</li> <li>• Control word = word 3.</li> </ul> <p>When you enter an ONDTR, you must enter an address for the location of the first of three consecutive words (registers) directly below the graphic representing the function (the use of the other two words is implied).</p> <p><b>Caution:</b> Do not write to these three words with other instructions. Overlapping these references will result in erratic operation of the timer.</p>
Enable	When enable receives power flow, the timer begins functioning. When the enable input goes off, the current value is reset to zero and Q is turned off.
PV	Preset Value input. PV is the value to copy into the timer's preset value when the timer is enabled or reset. The timer will turn on the Q output when it times to the PV value.
Q	Output Q is energized when the current value (CV) is greater than or equal to the preset value (PV).
Time Base	This parameter may be programmed for time increment of tenths (0.1), hundredths (0.01), or thousandths (0.001) of seconds. This time base value is multiplied by the number in the Preset Value (PV) input parameter to determine the actual preset value.

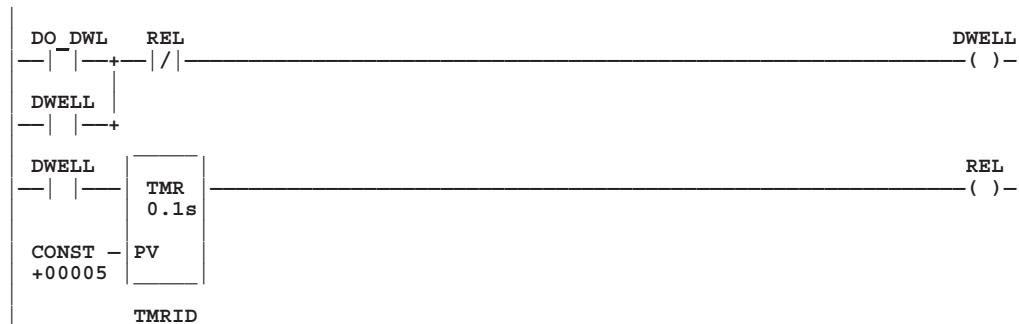
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
address								•				
enable	•											
PV		•	•	•	•		•	•	•	•	•	•
Q	•											•

- Valid reference or place where power may flow through the function.

## Example

In the following example, a TMR timer is used to control the length of time that coil DWELL is on. The timing process starts when the normally open (momentary) contact DO\_DWL turns on, which turns on coil DWELL. A DWELL contact keeps coil DWELL energized (“latched”) when contact DO\_DWL opens; also, another DWELL contact enables the timer. When the timer reaches its preset value of one-half second, coil REL energizes. The normally closed REL contact opens, interrupting the latched-on condition of coil DWELL, which turns off. The DWELL contact on the timer’s enable input opens, which interrupts power flow to the timer, resets its current value, and de-energizes coil REL. The circuit is then ready for another activation of contact DO\_DWL.



## OFDT

The off-delay timer's (OFDT) accumulated value increments while power flow is off, and resets to zero when power flow is on. Time may be counted in tenths of a second (the default selection), hundredths of a second, or thousandths of a second. The range is 0 to +32,767 time units, which gives a range of .001 to 3,276.7 seconds. The state of this timer is retentive on power failure; no automatic initialization occurs at power-up.

When the OFDT first receives power flow, it passes power to the right, and the current value (CV) is set to zero. (The OFDT uses word 1 [register] as its CV storage location—see the “Parameters” section on the next page for additional information.) The output remains on as long as the function receives power flow. If the function stops receiving power flow from the left, its output remains on temporarily, and the timer starts accumulating time in the current value; once the accumulated value reaches the preset value, the output turns off.

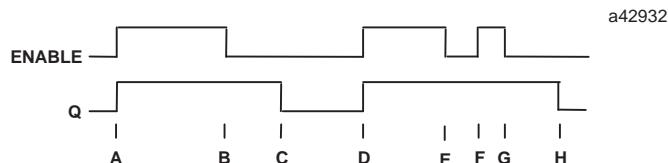
### Note

If multiple occurrences of the same timer with the same reference address are enabled during a CPU sweep, the current values of the timers will be the same.

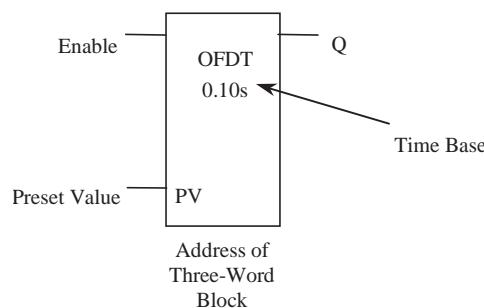
The OFDT does not pass power flow if the preset value is zero or negative.

Each time the function is invoked by turning off the enabling logic (at the enable input), the current value is updated to reflect the elapsed time since the timer was turned off. When the current value (CV) is equal to the preset value (PV), the function stops passing power flow to the right. When that occurs, the timer stops accumulating time—see Part C below.

When the function receives power flow again, the current value resets to zero.



- A = ENABLE and Q both go high ; timer is reset (CV = 0).
- B = ENABLE goes low; timer starts accumulating time.
- C = CV value equals PV value; Q goes low, and timer stops accumulating time.
- D = ENABLE goes high; timer is reset (CV = 0), Q goes high.
- E = ENABLE goes low; timer starts accumulating time, Q stays high.
- F = ENABLE goes high; timer is reset (CV = 0), Q stays high.
- G = ENABLE goes low; timer starts accumulating time, Q stays high.
- H = CV value equals PV value; Q goes low, and timer stops accumulating time.



When the OFDT is used in a program block that is *not* called every sweep, the timer accumulates time between calls to the program block unless it is reset. This means that it functions like a timer operating in a program with a much slower sweep than the timer in the main program block. For program blocks that are inactive for a long time, the timer should be programmed to allow for this catch-up feature. For example, if a timer in a program block is reset and the program block is not called (is inactive) for four minutes, when the program block is called, four minutes of time will already have accumulated. This time is applied to the timer when enabled, unless the timer is first reset.

## Parameters

Parameter	Description
Address of Three-Word Block	<p>The OFDT timer uses three consecutive words (registers) of %R memory to store the following:</p> <ul style="list-style-type: none"> <li>• Current value (CV) = word 1.</li> <li>• Preset value (PV) = word 2.</li> <li>• Control word = word 3.</li> </ul> <p>When you enter an OFDT, you must enter an address for the location of the first of three consecutive words (registers) directly below the graphic representing the function (the use of the other two words is implied).</p> <p><b>Caution:</b> Do not write to these three words with other instructions. Overlapping these references will result in erratic operation of the timer.</p>
Enable	While the enable input is on, output Q stays on, and the current value (CV) is held to zero. When the enable input turns off, the timer begins timing. When the current value (CV) reaches the preset value (PV), the timer stops timing, and Q turns off.
PV	Preset Value input. PV is the value to copy into the timer's preset value when the timer is enabled or reset. The timer will turn off the Q output when it times to the PV value.
Q	Output Q is energized (1) when the enable input is on and (2) while the current value (CV) is less than the preset value (PV) after the enable input turns off.
Time Base	This parameter may be programmed for time increment of tenths (0.1), hundredths (0.01), or thousandths (0.001) of seconds. This time base value is multiplied by the number in the Preset Value (PV) input parameter to determine the actual preset value.

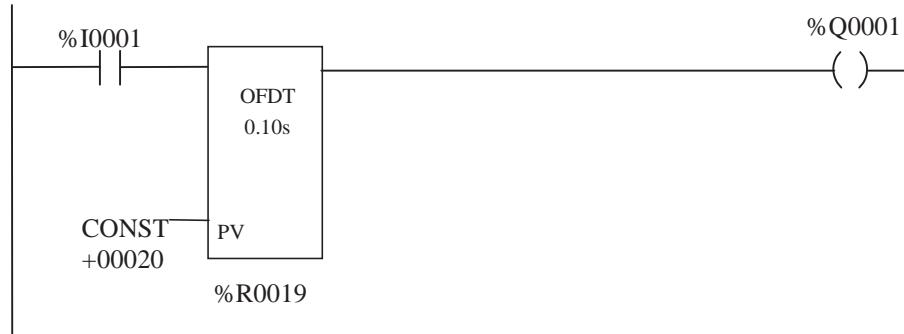
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
address								•				
enable	•											
PV	•	•	•	•	•		•	•	•	•	•	•
Q	•											•

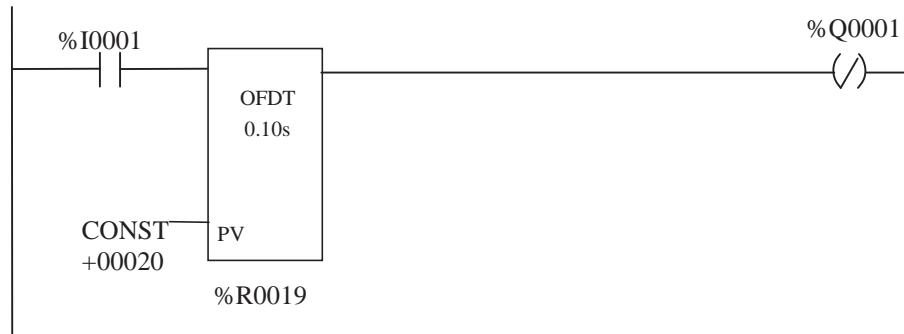
- Valid reference or place where power may flow through the function.

## Examples

In the following example, an OFDT timer turns on output coil %Q0001 whenever contact %I0001 is closed. After %I0001 opens, %Q0001 stays on for 2 seconds then turns off.



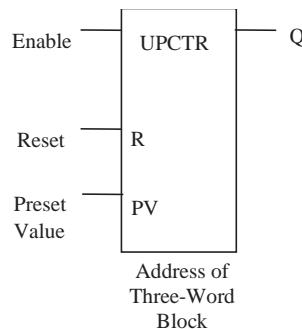
In the next example, the output action is reversed by the use of a negated output coil. In this circuit, an OFDT timer turns off negated output coil %Q0001 whenever contact %I0001 is closed. After %I0001 opens, %Q0001 stays off for 2 seconds then turns on.



## UPCTR

The Up Counter (UPCTR) function is used to count up to a designated value. The range is 0 to +32,767 counts. When the up counter reset is ON, the current value of the counter is reset to 0. Each time the enable input transitions from OFF to ON, the current value is incremented by 1. The current value can be incremented past the preset value PV. The output is ON whenever the current value is greater than or equal to the preset value.

The state of the UPCTR is retentive on power failure; no automatic initialization occurs at power-up.



## Parameters

Parameter	Description
Address of Three-Word Block	<p>The UPCTR Up Counter uses three consecutive words (registers) of %R memory to store the following:</p> <ul style="list-style-type: none"> <li>• Current value (CV) = word 1.</li> <li>• Preset value (PV) = word 2.</li> <li>• Control word = word 3.</li> </ul> <p>When you enter a UPCTR, you must enter an address for the location of the first of three consecutive words (registers) directly below the graphic representing the function (the use of the other two words is implied).</p> <p><b>Caution:</b> Do not write to these three words with other instructions. Overlapping these references will result in erratic operation of the timer.</p>
Enable	On each positive transition (off to on) of the enable input, the current count value (CV) is incremented by one.
PV	Preset Value input. PV is the value copied into the counter's preset value when the counter is enabled or reset. The counter will turn on the Q output when it counts up to the PV value. If the preset value is a constant, it must be a positive number between 0 and 32,767.
Q	Output Q is energized when the current count value (CV) is greater than or equal to the preset value (PV).
R	Reset Input. When the R input turns on, the current count value (CV) is reset to zero.

## Valid Memory Types

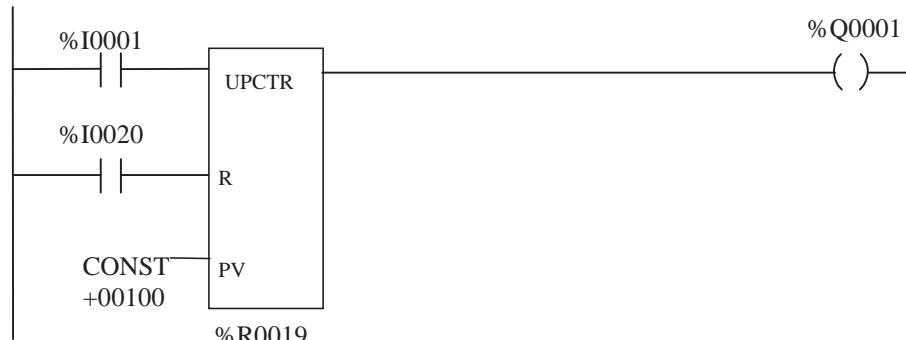
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
address								•				
enable	•											
R	•											
PV		•	•	•	•		•	•	•	•	•	•
Q	•											•

• Valid reference or place where power may flow through the function.

## Examples

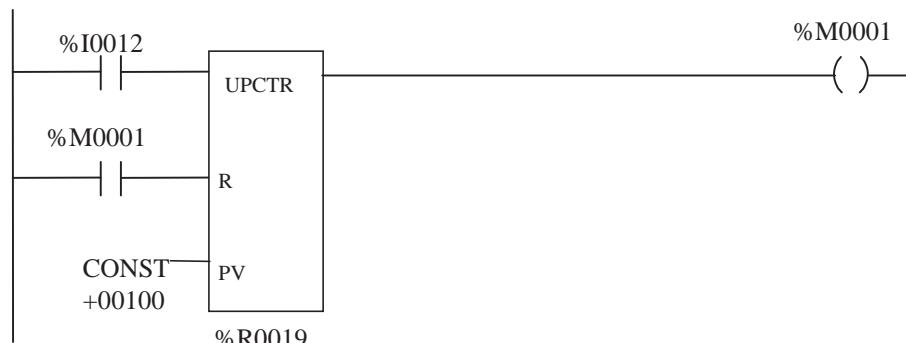
### Basic Counter Circuit

In the following example, the UPCTR will increment its current count value (CV) by one each time %I0001 transitions from off to on. The PV input sets the preset value to 100 counts. When the counter counts to 100, coil %Q0001 will be turned on. The counter will continue to count %I0001 transitions beyond its preset value (of 100) until it either reaches its maximum count value (32,767), or until %I0020 closes and resets the counter. %Q0001 will be on anytime the CV value is equal to or greater than the PV value.



### Self-Resetting Counter Circuit

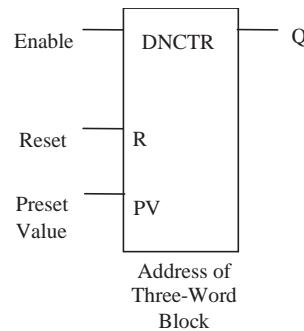
In the next example, every time input %I0012 transitions from OFF to ON, the UPCTR counter counts up by 1. Coil %M0001 is energized whenever 100 %I0012 transitions have been counted. Once %M0001 turns ON, the accumulated count is reset to zero by the %M0001 contact on the R input, and %M0001 will turn off.



## DNCTR

The Down Counter (DNCTR) function is used to count down from a preset value. The minimum preset value is zero; the maximum present value is +32,767 counts. The minimum current value is –32,768. When reset, the current value of the counter is set to the preset value PV. When the enable input transitions from OFF to ON, the current value is decremented by one. The output is ON whenever the current value is less than or equal to zero.

The current value of the DNCTR is retentive on power failure; no automatic initialization occurs at power-up.



## Parameters

Parameter	Description
Address of Three-Word Block	<p>The DNCTR Down Counter uses three consecutive words (registers) of %R memory to store the following:</p> <ul style="list-style-type: none"> <li>• Current value (CV) = word 1.</li> <li>• Preset value (PV) = word 2.</li> <li>• Control word = word 3.</li> </ul> <p>When you enter a DNCTR, you must enter an address for the location of the first of three consecutive words (registers) directly below the graphic representing the function (the use of the other two words is implied).</p> <p><b>Caution:</b> Do not write to these three words with other instructions. Overlapping these references will result in erratic operation of the counter.</p>
Enable	On each positive transition (off to on) of the enable input, the current count value (CV) is decremented by one.
PV	Preset Value input. PV is the value copied into the counter's preset value (PV) and current value (CV) registers when the counter is enabled or reset. The counter will turn on the Q output when it counts down from the current value to zero.
Q	Output Q is energized when the current count value (CV) is less than or equal to zero.
R	Reset Input. When the R input turns on, the current count value (CV) is reset to the preset value (PV, and output Q is turned off.

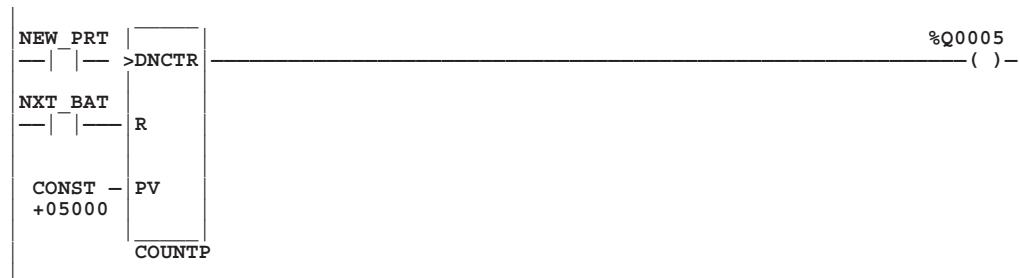
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
address								•				
enable	•											
R	•											
PV		•	•	•	•		•	•	•	•	•	•
Q	•											•

- Valid reference or place where power may flow through the function.

## Examples

In the following example, the down counter identified as COUNTP counts 5000 new parts before energizing output %Q0005.

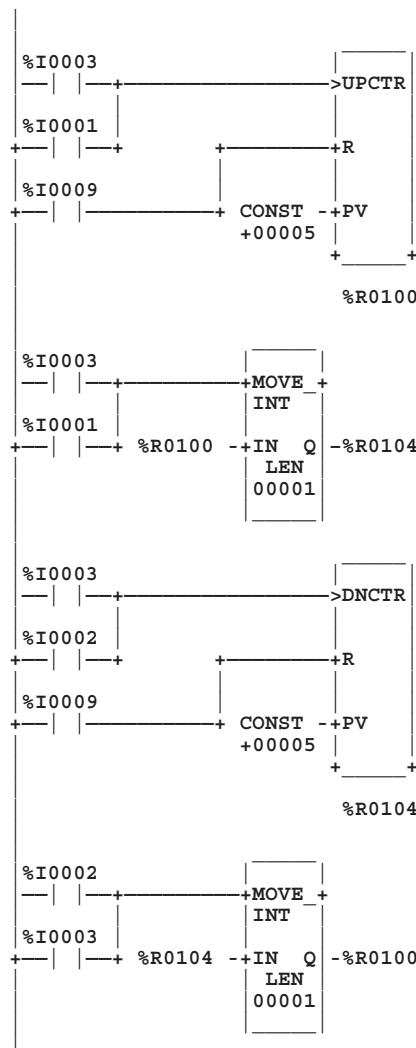


## Inventory Count Examples

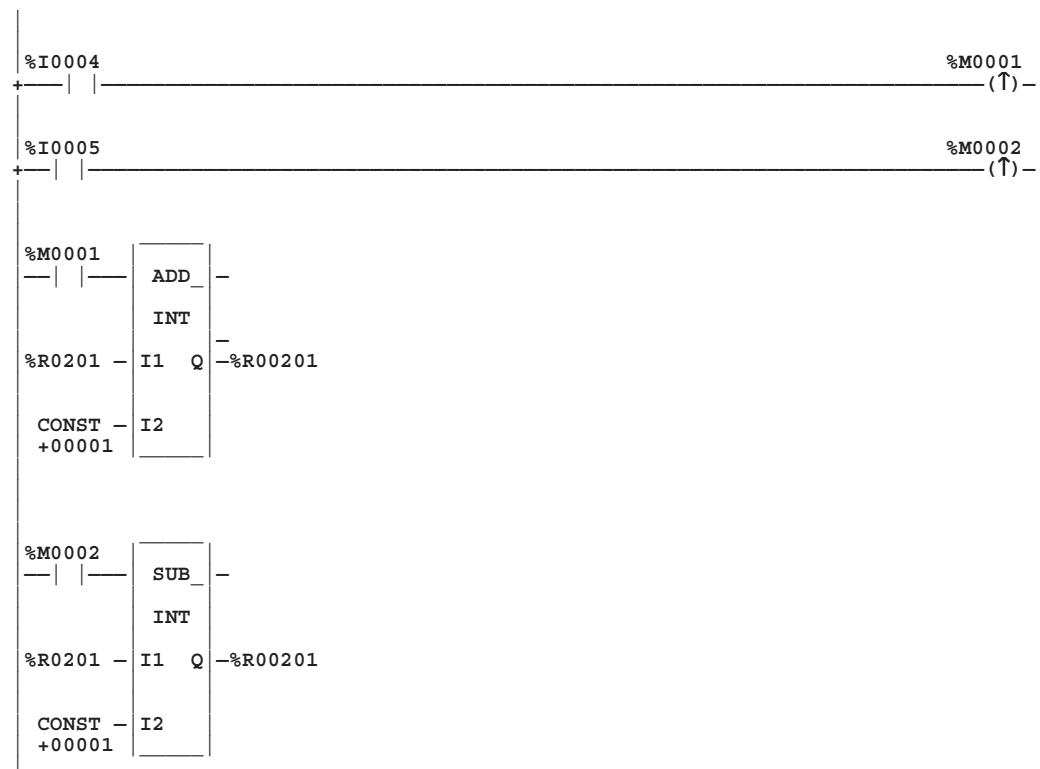
In the next example, the PLC is used to keep track of the number of parts contained in a temporary storage area. There are two ways of accomplishing this function using the Series 90-30/20/Micro instruction set.

The first method is to use an up/down counter pair with a shared register for the accumulated or current value. When the parts enter the storage area, the up counter increments by 1 (%I0001 closes), increasing the current value of the parts in storage by a value of 1. When a part leaves the storage area, the down counter decrements by 1 (%I0002 closes), decreasing the inventory storage value by 1. To avoid conflict with the shared register, both counters use different register addresses. When a register counts, its current value is moved to the current value register of the other counter.

In the following example, %I0001 increments the count, %I0002 decrements the count, %I0009 resets the count to zero, and %I0003, when on, holds the count at its current value regardless of what %I0001 and %I0002 do. The count value can be read from %R0100.



A second method to provide storage tracking, shown below, uses ADD and SUB functions that share a common register, %R00201, on their outputs. When the count increases (\$I0004 closes), the ADD instruction increments the value in %R00201. When the count decreases (%I0005 closes), the SUB instruction decrements the value in %R00201. In this case, transition coils are used to provide “one-shot” inputs to the ADD and SUB functions. If the enable inputs were not one-shot types, the ADD and SUB functions would execute once for every scan that they were enabled. (Transition coils are not needed with UPDTR and DNCTR functions since their enable inputs have a built-in transition function.) See Chapter 6 for details about the ADD and SUB functions.



*Chapter*  
**6**

## *Math Functions*

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This chapter describes the math functions of the Series 90-30/20/Micro Instruction Set:

Abbreviation	Function	Description	Page
ADD	Addition	Add two numbers.	6-2
SUB	Subtraction	Subtract one number from another.	6-2
MUL	Multiplication	Multiply two numbers.	6-2
DIV	Division	Divide one number by another, yielding a quotient.	6-2
MOD	Modulo Division	Divide one number by another, yielding a remainder.	6-7
SQRT	Square Root	Find the square root of an integer or real value.	6-9
SIN, COS, TAN, ASIN, ACOS, ATAN	Trigonometric Functions †	Perform the appropriate function on the real value in input IN.	6-11
LOG, LN EXP, EXPT	Logarithmic/Exponential Functions †	Perform the appropriate function on the real value in input IN.	6-13
RAD, DEG	Radian Conversion †	Perform the appropriate function on the real value in input IN.	6-15

† Trigonometric Functions, Logarithmic/Exponential Functions, and Radian Conversion functions are only available on the model 35x and 36x series CPUs, Release 9.00 or later, and on all releases of CPU352 and CPU37x.

### Note

Division and modulo division are similar functions that differ in their output; division finds a quotient, while modulo division finds a remainder.

## Standard Math Functions (ADD, SUB, MUL, DIV)

Math functions include addition, subtraction, multiplication, and division. When a function receives power flow, the appropriate math function is performed on input parameters I1 and I2. These parameters must be the same data type. Output Q is the same data type as I1 and I2.

### Rules for Math Functions

<b>Sign of Result</b>	Standard math rules for signed number arithmetic apply to determining the sign of the result.
<b>Addition</b>	The ADD instruction uses the formula $I1 + I2 = Q$ .
<b>Subtraction</b>	The SUB instruction uses the formula $I1 - I2 = Q$ .
<b>Multiplication</b>	The MUL instruction uses the formula $I1 \times I2 = Q$ .
<b>Division</b>	<p>The DIV instruction uses the formula <math>I1 \div I2 = Q</math>.</p> <p><b>For INT and DINT types.</b> DIV rounds down to a whole number quotient (any remainder is discarded) for the INT or DINT types; it does not round to the closest integer. For example, 53 divided by 5 = 10 (the remainder of 3 is discarded).</p> <p><b>For REAL type.</b> DIV produces a decimal number result for the Real type</p>
<b>Modulo Division</b>	The MOD instruction can only use types INT and DINT (REAL is not supported). The MOD instruction uses the formula $I1 \div I2 = Q$ . However, MOD produces only the remainder from the division operation and discards the quotient. For example, 53 divided by 5 = 3 (the quotient of 10 is discarded).

### Data Types for Math Functions

After you have programmed a math function, you can select the data type. The data type will appear on the function just below the function's name (see example in next figure). The three data types available for math functions are listed in the following table:

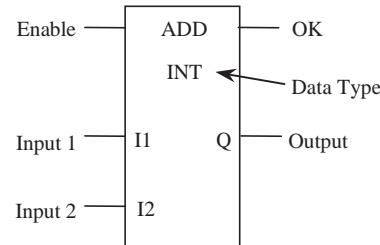
Data Type	Description
INT	Signed integer.
DINT	Double precision signed integer.
REAL*	Floating Point

\*REAL data type is only available on 35x and 36x series CPUs, Firmware Release 9.00 or later, and on all releases of CPU352 and CPU37X.

The default data type is signed integer. For more information on data types, please refer to Chapter 2, Section 2, "Program Organization and User References/Data."

If the operation of INT or DINT results in overflow, the output reference is set to its largest possible value for the data type. For signed numbers, the sign is set to show the direction of the

overflow. If the operation does not result in overflow (and the inputs are valid numbers), the ok output is set ON; otherwise, it is set OFF. If signed or double precision integers are used, the sign of the result depends on the signs of inputs I1 and I2.



## Parameters

Parameter	Description
enable	When the function is enabled, the operation is performed.
I1	I1 contains a constant or reference for the first value used in the operation. (I1 is on the left side of the mathematical equation, as in I1 — I2).
I2	I2 contains a constant or reference for the second value used in the operation. (I2 is on the right side of the mathematical equation, as in I1 — I2).
ok	The ok output is energized when the function is performed without overflow, unless an invalid operation occurs.
Q	Output Q contains the result of the operation.

## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
I1		o	o	o	o		o	•	•	•	•†	
I2		o	o	o	o		o	•	•	•	•†	
ok	•											•
Q		o	o	o	o		o	•	•	•		

• Valid reference or place where power may flow through the function.

o Valid reference for INT data only; not valid for DINT or REAL.

† When using Logicmaster, you will only be able to enter values between -32,768 and +32,767 for double precision signed integer operations. With VersaPro, you can enter full double precision values.

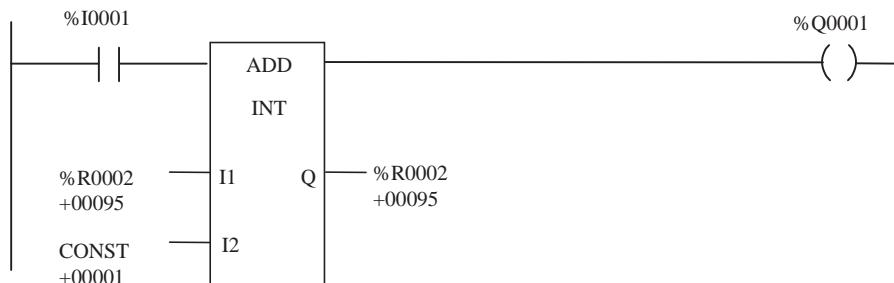
### Note

The default type is INT for 16-bit or single register operands. In Logicmaster, press **F10** to change the Types selection to DINT, 32-bit double word, or REAL (for the 35x, 36x, and 37x series CPUs only). PLC INT values occupy a single 16-bit register, %R, %AI or %AQ. DINT values require two consecutive registers with the low 16 bits in the first word and the upper 16 bits with the sign in second word. REAL values, in the 35x and 36x series CPU (Release 9.00 or later) and all releases of CPU352 and CPU37x, also occupy a 32-bit double register with the sign in the high bit followed by the exponent and mantissa.

## Math Function Examples

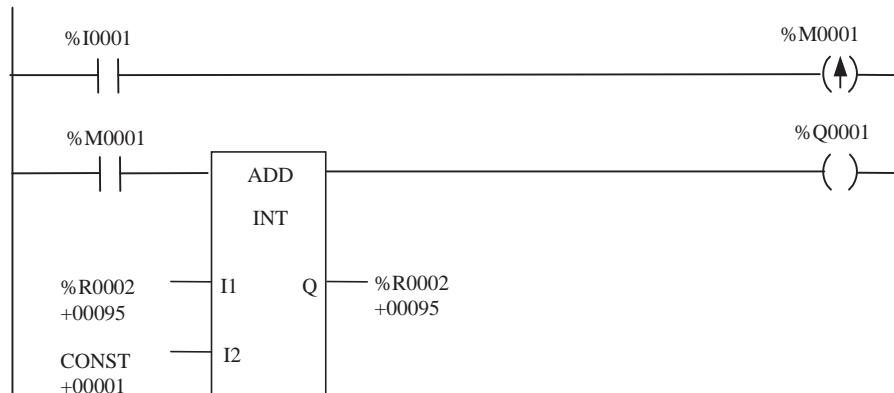
### ADD Circuit with a Problem

In the following example, an attempt was made to create a counter circuit that would count the number of times switch %I0001 closes. The running total is stored in register %R0002. The intent of this design is that when %I0001 closes, the ADD instruction adds one to the value in %R0002 (the input on I2) and places the new value right back into %R0002 (the output on Q). The problem with this design is that the ADD instruction will execute once every PLC scan while %I0001 is closed. So, for example, if %I0001 stays closed for five scans, the output will increment five times, even though %I0001 only closed once during that period. To correct this problem, the enable input to the ADD instruction should come from a transition (“one-shot”) coil, as shown in the second figure below.



In the following improved circuit, the %I0001 input switch controls a transition (“one-shot”) coil, %M0001, whose contact turns on the enable input of the ADD function for only one scan each time contact %I0001 closes. In order for the %M0001 contact to close again, contact %I0001 has to open and close again.

### Corrected ADD Circuit Design



## Math Functions and Data Types

Function	Operation	Displays as
ADD INT	$Q(16 \text{ bit}) = I1(16 \text{ bit}) + I2(16 \text{ bit})$	5-digit base 10 number with sign
ADD DINT	$Q(32 \text{ bit}) = I1(32 \text{ bit}) + I2(32 \text{ bit})$	8-digit base 10 number with sign
ADD REAL*	$Q(32 \text{ bit}) = I1(32 \text{ bit}) + I2(32 \text{ bit})$	7-digit base 10 number, sign and decimal
SUB INT	$Q(16 \text{ bit}) = I1(16 \text{ bit}) - I2(16 \text{ bit})$	5-digit base 10 number with sign
SUB DINT	$Q(32 \text{ bit}) = I1(32 \text{ bit}) - I2(32 \text{ bit})$	8-digit base 10 number with sign
SUB REAL*	$Q(32 \text{ bit}) = I1(32 \text{ bit}) - I2(32 \text{ bit})$	7-digit base 10 number, sign and decimal
MUL INT	$Q(16 \text{ bit}) = I1(16 \text{ bit}) * I2(16 \text{ bit})$	5-digit base 10 number with sign
MUL DINT	$Q(32 \text{ bit}) = I1(32 \text{ bit}) * I2(32 \text{ bit})$	8-digit base 10 number with sign
MUL REAL*	$Q(32 \text{ bit}) = I1(32 \text{ bit}) * I2(32 \text{ bit})$	7-digit base 10 number, sign and decimal
DIV INT	$Q(16 \text{ bit}) = I1(16 \text{ bit}) / I2(16 \text{ bit})$	5-digit base 10 number with sign
DIV DINT	$Q(32 \text{ bit}) = I1(32 \text{ bit}) / I2(32 \text{ bit})$	8-digit base 10 number with sign
DIV REAL*	$Q(32 \text{ bit}) = I1(32 \text{ bit}) / I2(32 \text{ bit})$	7-digit base 10 number, sign and decimal

\* 35x and 36x series CPUs only, Release 9 or later, and all releases of CPU352 and CPU37x.

### Note

The input and output data types must be the same for math functions. The MUL and DIV functions do not support a mixed mode as the Series 90-70 PLCs do.

For example, the MUL INT of two 16-bit inputs produces a 16-bit product, not a 32-bit product. Using MUL DINT for a 32-bit product requires both inputs to be 32-bit. The DIV INT divides a 16-bit I1 by a 16-bit I2 for a 16-bit result, while DIV DINT divides a 32-bit I1 by 32-bit I2 for a 32-bit result.

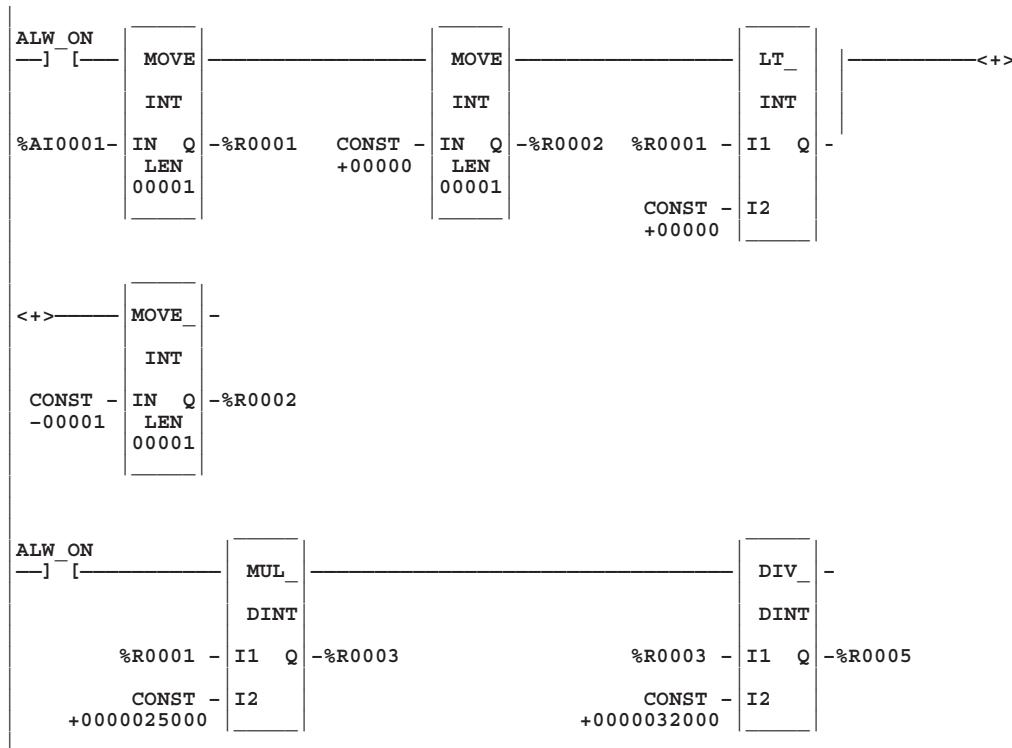
When enabled, these functions pass power if there is no math overflow. If an overflow occurs, the result is the largest value with the proper sign and no power flow.

Be careful to avoid overflows when using MUL and DIV functions. If you have to convert INT to DINT values, remember that the CPU uses standard 2's complement with the sign extended to the highest bit of the second (most significant) word. You must check the sign of the low 16-bit word and extend it into the second 16-bit word. If the most significant bit in a 16-bit INT low word is 0 (indicating positive value), move a 0 to the second word. If the most significant bit in a 16-bit word is 1 (indicating a negative value), move a -1 or hex 0FFFFh to the second word. Converting from DINT to INT is easier as the low 16-bit word (first register) is the INT part of a DINT 32-bit word. The upper 16 bits or second word should be either a 0 (positive) or -1 (negative) value or the DINT number is too big to convert to 16 bit.

## Example

A common application is to scale analog input values with a MUL operation followed by a DIV and possibly an ADD operation. A 0 to  $\pm 10$  volt analog input will place values of 0 to  $\pm 32,000$  in its corresponding %AI input register. Multiplying this input register using an INT MUL function will result in an overflow since an INT type instruction has an input and output range of 32,767 to  $-32,768$ . Using the %AI value as an input to a MUL DINT will also not work as the 32-bit I1 will combine 2 analog inputs at the same time. To solve this problem, you can move the analog input to the low word of a double register, then test the sign and set the second register to 0 if the sign tests positive or  $-1$  if negative. Then use the double register just created with a MUL DINT which gives a 32-bit result, and which can be used with a following DINT DIV function.

For example, the following logic could be used to scale a  $\pm 10$  volt input %AI1 to  $\pm 25000$  engineering units in %R5.



An alternate, but less accurate, way of programming this circuit using INT instructions involves placing the DIV instruction first, followed by the MUL instruction. The value of I2 for the DIV instruction would be 32, and the value of I2 for the MUL would be 25. This maintains the scaling proportion of the above circuit and keeps the values within the working range of the INT type instructions. However, the DIV instruction inherently discards any remainder value, so when the DIV output is multiplied by the MUL instruction, the error introduced by a discarded remainder is multiplied. The percent of error is non-linear over the full range of input values and is greater at lower input values.

By contrast, in the example above, the results are more accurate because the DIV operation is performed last, so the discarded remainder is not multiplied. If even greater precision is required, substitute REAL type math instructions in this example so that the remainder is not discarded.

## MOD (INT, DINT)

The Modulo (MOD) function is used to divide one value by another value of the same data type to obtain the remainder. The sign of the result is always the same as the sign of input parameter I1.

The MOD function operates on these types of data:

Data Type	Description
INT	Signed integer.
DINT	Double precision signed integer.

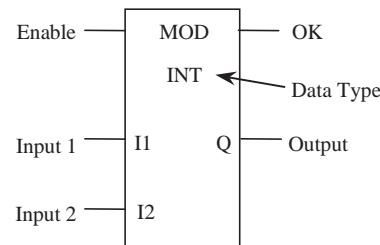
The default data type is signed integer; however, it can be changed after selecting the function. For more information on data types, please refer to chapter 2, section 2, ‘Program Organization and User References/Data.’

When the function receives power flow, it divides input parameter I1 by input parameter I2. These parameters must be the same data type. Output Q is calculated using the formula:

$$Q = I1 - ([I1 \text{ DIV } I2] * I2)$$

where DIV produces an integer number. Q is the same data type as input parameters I1 and I2.

OK is always ON when the function receives power flow, unless there is an attempt to divide by zero. In that case, it is set OFF.



## Parameters

Parameter	Description
Enable	When the function is enabled, the operation is performed.
I1	I1 contains a constant or reference for the value to be divided by I2.
I2	I2 contains a constant or reference for the value to be divided into I1.
OK	The ok output is energized when the function is performed without overflow.
Q	Output Q contains the remainder, if any, that results from dividing I1 by I2. If the value in I2 is an even multiple of I1, output Q will be zero, indicating no remainder.

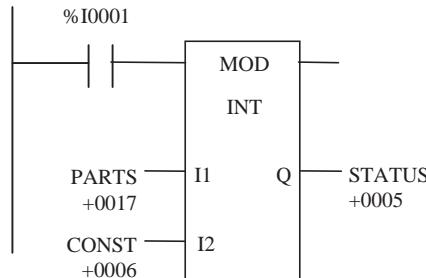
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
I1		o	o	o	o		o	•	•	•	•†	
I2		o	o	o	o		o	•	•	•	•†	
ok	•											•
Q		o	o	o	o		o	•	•	•		

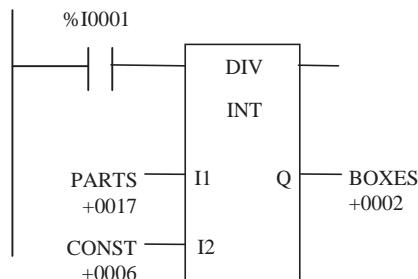
- Valid reference or place where power may flow through the function.
- o Valid reference for INT data only; not valid for DINT.
- † Constants are limited to values between -32,768 and +32,767 for double precision signed integer operations.

## Example

In the following example, boxes are being automatically filled with parts. One box holds six parts. This circuit determines the status of the current box being filled by using modulo division. When enabled, the MOD function divides the register (PARTS) holding the count of parts produced, by six. The output (STATUS) of the MOD instruction indicates how many parts (between 1 and 5) have been loaded into the current box. When the current box is full, the output at Q will equal zero; if the current box is only partially filled, the output will indicate the number of parts already in the box. The values in the example show that a total 17 parts have been produced and that the current box has five parts in it. (The other 12 parts filled two boxes.)



To determine the number of boxes filled, you could use the DIV instruction in the following circuit.



One possible problem with these circuits is that the register nicknamed PARTS can only hold a maximum of 32,767 counts. If you need to count higher than that, some additional logic will be required to (1) reset the PARTS register before it reaches maximum, (2) to capture the number of boxes filled before you reset the PARTS register, and (3) to reset the PARTS register when the STATUS register is zero so that its count stays accurate.

## SQRT (INT, DINT, REAL)

The Square Root (SQRT) function is used to find the square root of a value. When the function receives power flow, the value of output Q is set to the integer portion of the square root of the input IN. The output Q must be the same data type as IN.

The SQRT function operates on these types of data:

Data Type	Description
INT	Signed integer.
DINT	Double precision signed integer.
REAL	Floating Point.

For data types INT and DINT, only the whole number portion of the square root will be output. The fractional portion will be dropped. For example, the square root of 2 or 3 will be 1, and the square root of 5, 6, 7, or 8 will be 2.

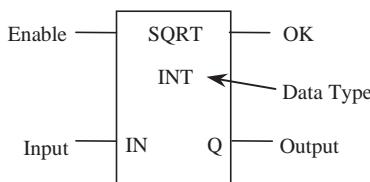
### Note

The REAL data type is only available on 35x and 36x series CPUs, Release 9.00 or later, and on all releases of CPU352 and CPU37x.

The default data type is signed integer; however, it can be changed after selecting the function. For more information on data types, please refer to chapter 2, section 2, “Program Organization and User References/Data.”

OK is set ON if the function is performed without overflow. If one of the following invalid operations occurs, OK is set OFF:

- IN < 0
- IN is NaN (Not a Number)



## Parameters

Parameter	Description
enable	When the function is enabled, the operation is performed.
IN	IN contains a constant or reference for the value whose square root is to be calculated. If IN is less than zero, the function will not pass power flow.
ok	The ok output is energized when the function is performed without overflow, unless an invalid operation occurs.
Q	Output Q contains the square root of IN. However, for INT and DINT, only the whole number portion will be kept; any fractional portion will be discarded.

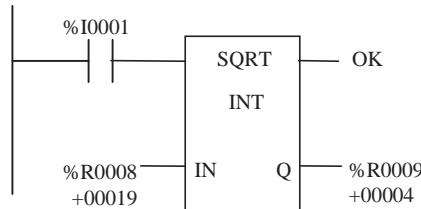
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN		o	o	o	o		o	•	•	•	•†	
ok	•											•
Q		o	o	o	o		o	•	•	•		

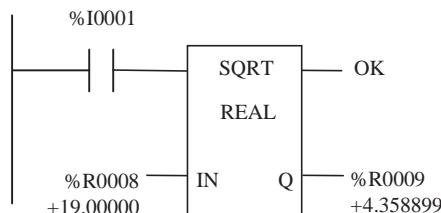
- Valid reference or place where power may flow through the function.
- o Valid reference for INT data only; not valid for DINT and REAL.
- † Constants are limited to values between -32,768 and +32,767 for double precision signed integer operations.

## Examples

In the following example, the square root of the integer number located at %R0008 is placed into the %R0009 register whenever %I0001 is ON.



As an alternative to the previous example, the same function can be performed with a REAL-type SQRT instruction, which gives a more precise result as shown in the next figure.



## Trig Functions (SIN, COS, TAN, ASIN, ACOS, ATAN)

The SIN, COS, and TAN functions are used to find the trigonometric sine, cosine, and tangent, respectively, of its input. When one of these functions receives power flow, it computes the sine (or cosine or tangent) of IN, whose units are radians, and stores the result in output Q. Both IN and Q are floating-point values.

The ASIN, ACOS, and ATAN functions are used to find the inverse sine, cosine, and tangent, respectively, of its input. When one of these functions receives power flow, it computes the designated function on the value at the IN input, and stores the result in output Q, whose units are radians. Both IN and Q are floating-point values.

The SIN, COS, and TAN functions accept a broad range of input values, where  $-2^{63} < \text{IN} < +2^{63}$ , ( $2^{63} \approx 9.22 \times 10^{18}$ ).

The ASIN and ACOS functions accept a narrow range of input values, where  $-1 \leq \text{IN} \leq 1$ . Given a valid value for the IN parameter, the ASIN\_REAL function will produce a result Q such that:

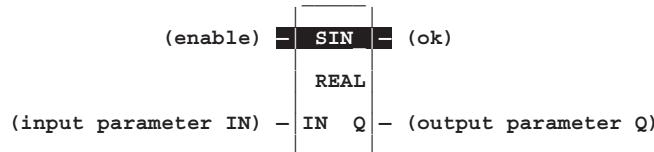
$$\text{ASIN}(\text{IN}) = -\frac{\pi}{2} \leq \text{Q} \leq \frac{\pi}{2}$$

The ACOS\_REAL function will produce a result Q such that:

$$\text{ACOS}(\text{IN}) = 0 \leq \text{Q} \leq \pi$$

The ATAN function accepts the broadest range of input values, where  $-\infty \leq \text{IN} \leq +\infty$ . Given a valid value for the IN parameter, the ATAN\_REAL function will produce a result Q such that:

$$\text{ATAN}(\text{IN}) = -\frac{\pi}{2} \leq \text{Q} \leq \frac{\pi}{2}$$



### Note

The TRIG functions are only available on the 35x and 36x series CPUs, Release 9 or later, and on all releases of CPU352 and CPU37x.

## Parameters

Parameter	Description
enable	When the function is enabled, the operation is performed.
IN	IN contains the constant or reference real value to be operated on.
ok	The ok output is energized when the function is performed without overflow, unless an invalid operation occurs and/or IN is NaN.
Q	Output Q contains the trigonometric value of IN.

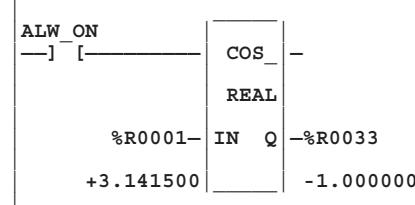
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN								•	•	•	•	
ok	•											•
Q								•	•	•		

- Valid reference or place where power may flow through the function.

## Example

In the following example, the COS of the value in %R0001 is placed in %R0033.

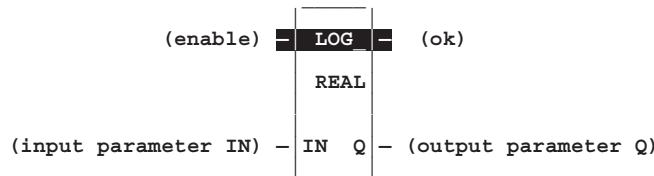


## Logarithmic/Exponential Functions (LOG, LN, EXP, EXPT)

The LOG, LN, and EXP functions have two input parameters and two output parameters. When the function receives power flow, it performs the appropriate logarithmic/exponential operation on the real value in input IN and places the result in output Q.

- For the LOG function, the base 10 logarithm of IN is placed in Q.
- For the LN function, the natural logarithm of IN is placed in Q.
- For the EXP function,  $e$  is raised to the power specified by IN and the result is placed in Q. (NOTE:  $e$  is a constant used in logarithmic calculations. It has an approximate value of 2.71828.)
- For the EXPT function, the value of input I1 is raised to the power specified by the value I2 and the result is placed in output Q. (The EXPT function has three input parameters and two output parameters.)

The ok output will receive power flow, unless IN is NaN (Not a Number) or is negative.



## Parameters

Parameter	Description
enable	When the function is enabled, the operation is performed.
IN	IN contains the real value to be operated on.
ok	The ok output is energized when the function is performed without overflow, unless an invalid operation occurs and/or IN is NaN or is negative.
Q	Output Q contains the logarithmic/exponential value of IN.

### Note

The LOG, LN, EXP and EXPT functions are only available on the 35x and 36x series CPUs, Release 9 or later, and on all releases of CPU352 and CPU37x.

### Note

When the input value, IN, for the EXP function is negative infinity ( $-\infty$ ), the function returns a value of 0, as expected. In this case, for the CPU352, the function does *not* pass power. For all other 90-30 CPUs, the function *does* pass power, even though the output is 0. (A value of  $-\infty$  results from dividing a negative value by zero. It will appear on a Logictmaster screen as -OVERFLOW.)

## Valid Memory Types

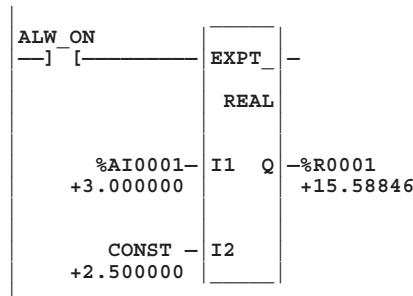
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN*								•	•	•	•	
ok	•											•
Q							•	•	•			
I1*							•	•	•	•		
I2*							•	•	•	•		

\* For the EXPT function, input IN is replaced by input parameters I1 and I2.

• Valid reference or place where power may flow through the function.

## Example

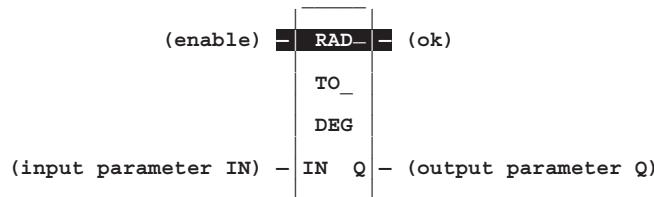
In the following example, the value of %AI0001, +3.000000, is raised to the power of +2.500000, and the result, +15.58846, is placed in %R0001.



## Radian Conversion (RAD, DEG)

When the function receives power flow, the appropriate conversion (RAD\_TO\_DEG or DEG\_TO\_RAD, i.e., Radian to Degree or vice versa) is performed on the real value in input IN and the result is placed in output Q.

The ok output will receive power flow unless IN is NaN (Not a Number).



### Parameters

Parameter	Description
enable	When the function is enabled, the operation is performed.
IN	IN contains the real value to be operated on.
ok	The ok output is energized when the function is performed without overflow, unless IN is NaN.
Q	Output Q contains the converted value of IN.

### Note

The Radian conversion functions are only available on the 35x and 36x series CPUs, Release 9 or later, or on all releases of CPU352 and CPU37x.

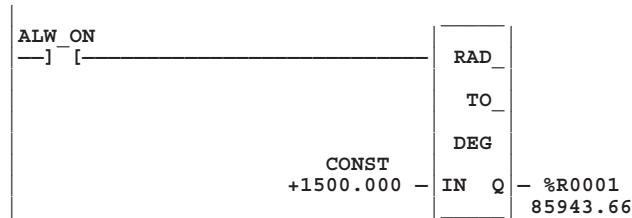
### Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN								•	•	•	•	
ok	•											•
Q								•	•	•		

- Valid reference or place where power may flow through the function.

## Example

In the following example, +1500 is converted to DEG and is placed in %R0001.



*Chapter***7***Relational Functions*

Relational functions are used to determine the relationship of two values. This chapter describes the following relational functions:

<b>Abbreviation</b>	<b>Function</b>	<b>Description</b>	<b>Page</b>
EQ	Equal	Test two numbers for equality.	7-2
NE	Not Equal	Test two numbers for non-equality.	7-2
GT	Greater Than	Test for one number greater than another.	7-2
GE	Greater Than or Equal	Test for one number greater than or equal to another.	7-2
LT	Less Than	Test for one number less than another.	7-2
LE	Less Than or Equal	Test for one number less than or equal to another.	7-2
RANGE	Range	Determine whether a number is within a specified range (available for Release 4.5 or higher CPUs).	7-4

## Standard Relational Functions (EQ, NE, GT, GE, LT, LE)

When the function receives power flow, it compares input parameter I1 to input parameter I2, which must be of the same data type. Relational functions operate on these types of data:

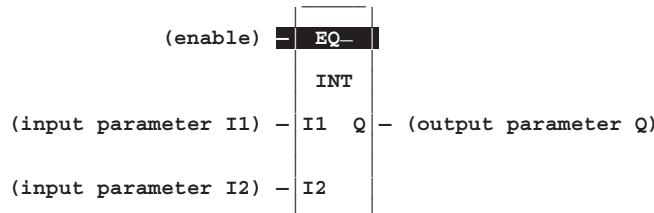
Data Type	Description
INT	Signed integer.
DINT	Double precision signed integer.
REAL	Floating Point (not available for the RANGE function)

### Note

The REAL data type is only available on the 35x and 36x series CPUs, Release 9 or later, and on all releases of CPU352 and CPU37x. The %S0020 system bit is set ON when a relational function using REAL data executes successfully. It is cleared when either input is NaN (Not a Number). The Range function block does not accept REAL type.

The default data type is signed integer. To compare either signed integers, double precision signed integers, or real numbers select the new data type after selecting the relational function. To compare data of other types or of two different types, first use the appropriate conversion function (described in chapter 11, “Conversion Functions”) to change the data to one of the supported types.

If input parameters I1 and I2 match the specified relationship, output Q receives power flow and is set ON (1); otherwise, it is set OFF (0).



## Parameters

Parameter	Description
enable	When the function is enabled, the operation is performed.
I1	I1 contains a constant or reference for the first value to be compared. (I1 is on the left side of the relational equation, as in I1 < I2).
I2	I2 contains a constant or reference for the second value to be compared. (I2 is on the right side of the relational equation, as in I1 < I2).
Q	Output Q is energized when I1 and I2 match the specified relation.

### Note

I1 and I2 must be valid numbers, i.e., cannot be NaN (Not a Number).

## Expanded Description

Function	Description
Equal	When enabled, if the value at input I1 is equal to the value at input I2, output Q is energized.
Not Equal	When enabled, if the value at input I1 is NOT equal to the value at input I2, output Q is energized.
Greater Than	When enabled, if the value at input I1 is greater than the value at input I2, output Q is energized.
Greater Than or Equal	When enabled, if the value at input I1 is greater than or equal to the value at input I2, output Q is energized.
Less Than	When enabled, if the value at input I1 is less than the value at input I2, output Q is energized.
Less Than or Equal	When enabled, if the value at input I1 is less than or equal to the value at input I2, output Q is energized.

## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
I1		o	o	o	o		o	•	•	•	•†	
I2		o	o	o	o		o	•	•	•	•†	
Q	•											•

• Valid reference or place where power may flow through the function.

o Valid reference for INT data only; not valid for DINT or REAL.

† Constants are limited to integer values (+32,767 to -32,768) for double precision signed integer operations when programmed with Logicmaster PLC software. When programmed with VersaPro software, full double precision signed integer values are allowed.

## Example

In the following example, two double precision signed integers, %R00100/101 and %R00102/103, are compared whenever enable contact %I0001 is on. If the value at input I1 is less than or equal to the value at input I2, coil %Q00002 will be turned on. In the following example, coil %Q00002 is turned off, since I1 is greater than I2.



## RANGE (INT, DINT, WORD)

The RANGE function is used to determine if a value is between the range of two numbers.

### Note

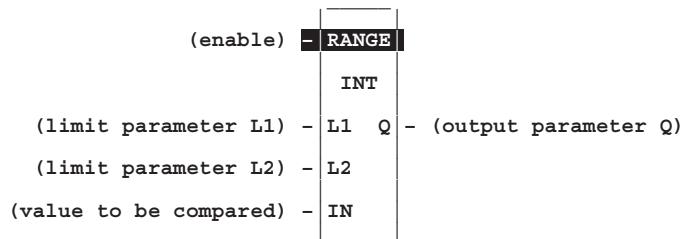
**This function is available *only* to Release 4.41 or later CPUs.**

The RANGE function operates on these types of data (REAL type is not supported in the RANGE function):

Data Type	Description
INT	Signed integer.
DINT	Double precision signed integer.
WORD	Word data type.

The default data type is signed integer; however, it can be changed after selecting the function. For more information on data types, please refer to chapter 2, section 2, “Program Organization and User References/Data.”

When the function is enabled, the RANGE function block will compare the value in input parameter IN against the range specified by limit parameters L1 and L2. When the value is within the range specified by L1 and L2, inclusive, output parameter Q is set ON (1). Otherwise, Q is set OFF (0).



### Note

Limit parameters L1 and L2 represent the end points of a range. There is no minimum/maximum or high/low connotation assigned to either parameter. Thus, a desired range of 0 to 100 could be specified by assigning 0 to L1 and 100 to L2 or 0 to L2 and 100 to L1.

## Parameters

Parameter	Description
enable	When the function is enabled, the operation is performed.
L1	L1 contains the start point of the range.
L2	L2 contains the end point of the range.
IN	IN contains the value to be compared against the range specified by L1 and L2.
Q	Output Q is energized when the value in IN is within the range specified by L1 and L2, inclusive.

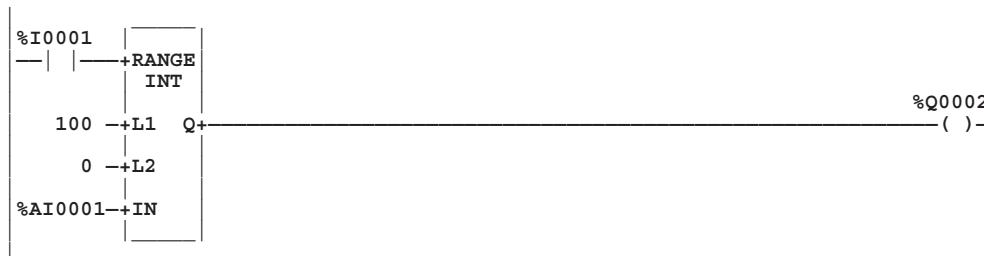
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
L1		o	o	o	o		o	•	•	•	•‡	
L2		o	o	o	o		o	•	•	•	•‡	
IN		o	o	o	o		o	•	•	•		
Q	•											•

- Valid reference or place where power may flow through the function.
- o Valid reference for INT or WORD data only; not valid for DINT.
- ‡ Constants are limited to integer values for double precision signed integer operations.

## Example 1

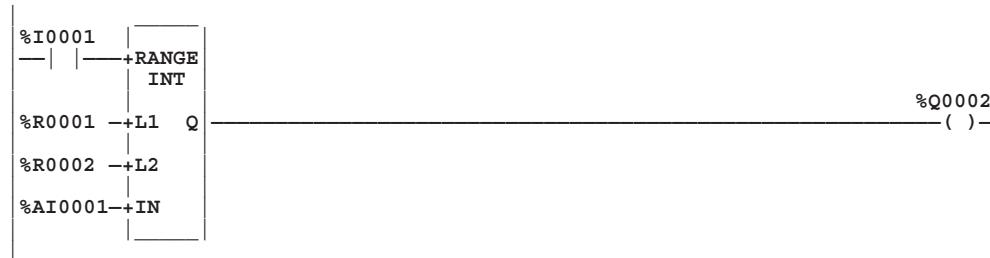
In the following example, %AI0001 is checked to be within a range specified by two constants, 0 and 100.



RANGE Truth Table for Example 1				
Enable State %I0001	L1 Value Constant	L2 Value Constant	IN Value %AI0001	Q State %Q0001
ON	100	0	< 0	OFF
ON	100	0	0 — 100	ON
ON	100	0	> 100	OFF
OFF	100	0	Any value	OFF

## Example 2

In this example, %AI0001 is checked to be within a range specified by two register values.



RANGE Truth Table for Example 2				
Enable State %I0001	L1 Value %R0001	L2 Value %R0002	IN Value %AI0001	Q State %Q0001
ON	500	0	< 0	OFF
ON	500	0	0 — 500	ON
ON	500	0	> 500	OFF
OFF	500	0	Any value	OFF

*Chapter*  
**8**

## *Bit Operation Functions*

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Bit operation functions perform comparison, logical, and move operations on bit strings. The AND, OR, XOR, and NOT functions are limited to operating on a single word. The remaining bit operation functions may operate on multiple words, with a maximum string length of 256 words. All bit operation functions require the WORD data type.

Although data must be specified in 16-bit increments, these functions operate on data as a continuous string of bits, with bit 1 of the first word being the Least Significant Bit (LSB). The last bit of the last word is the Most Significant Bit (MSB). For example, if you specified three words of data beginning at reference %R0100, it would be operated on as 48 contiguous bits.

%R0100	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	← bit 1 (LSB)
%R0101	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	
%R0102	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	

↑  
(MSB)

### Note

Overlapping input and output reference address ranges in multi-word functions may produce unexpected results.

The following bit operation functions are described in this chapter:

Abbreviation	Function	Description	Page
AND	Logical AND	If a bit in bit string I1 and the corresponding bit in bit string I2 are both 1, place a 1 in the corresponding location in output string Q.	8-3
OR	Logical OR	If a bit in bit string I1 and/or the corresponding bit in bit string I2 are both 1, place a 1 in the corresponding location in output string Q.	8-3
XOR	Logical exclusive OR	If a bit in bit string I1 and the corresponding bit in string I2 are different, place a 1 in the corresponding location in the output bit string.	8-5
NOT	Logical invert	Set the state of each bit in output bit string Q to the opposite state of the corresponding bit in bit string I1.	8-7
SHL	Shift Left	Shift all the bits in a word or string of words to the left by a specified number of places.	8-8
SHR	Shift Right	Shift all the bits in a word or string of words to the right by a specified number of places.	8-8
ROL	Rotate Left	Rotate all the bits in a string a specified number of places to the left.	8-10
ROR	Rotate Right	Rotate all the bits in a string a specified number of places to the right.	8-57
BTST	Bit Test	Test a bit within a bit string to determine whether that bit is currently 1 or 0.	8-12
BSET	Bit Set	Set a bit in a bit string to 1.	8-14
BCLR	Bit Clear	Clear a bit within a string by setting that bit to 0.	8-14
BPOS	Bit Position	Locate a bit set to 1 in a bit string.	8-16
MSKCMP	Masked Compare	Compare the contents of two separate bit strings with the ability to mask selected bits (available for Release 4.5 or higher CPUs).	8-18

## AND and OR (WORD)

For each scan that it is enabled, an AND or OR function compares the state of each bit in bit string I1 with the corresponding bit in bit string I2, beginning at the least significant bit in each.

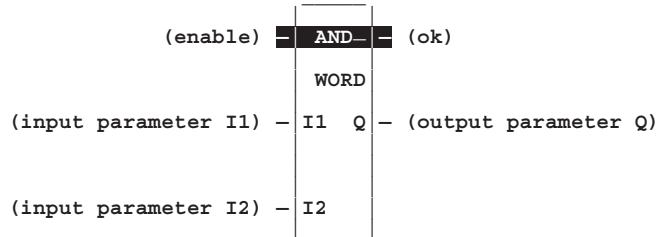
For each two bits compared for the AND function, if both are 1, then a 1 is placed in the corresponding location in output string Q. If either or both bits are 0, then a 0 is placed in string Q in that location.

The AND function is useful for building masks or screens, where only certain bits are passed through (those that are opposite a 1 in the mask), and all other bits are set to 0. The function can also be used to clear the selected area of word memory by ANDing the bits with another bit string known to contain all 0s. The I1 and I2 bit strings specified may overlap.

For each two bits examined for the OR function, if either or both bits are 1, then a 1 is placed in the corresponding location in output string Q. If both bits are 0, then a 0 is placed in string Q in that location.

The OR function is useful for combining strings, and to control many outputs through the use of one simple function block. The function is the equivalent of two relay contacts in parallel for each bit position in the string. It can be used to drive indicator lamps directly from input states, or superimpose blinking conditions on status lights.

The function passes power flow to the right whenever power is received.



## Parameters

Parameter	Description
enable	When the function is enabled, the operation is performed.
I1	I1 contains a constant or reference for the first word of the first string.
I2	I2 contains a constant or reference for the first word of the second string.
ok	The ok output is energized whenever enable is energized.
Q	Output Q contains the result of the operation.

## Valid Memory Types

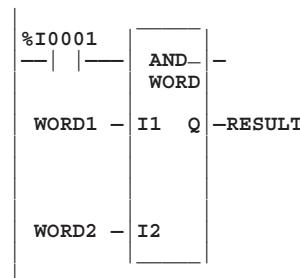
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
I1		•	•	•	•	•	•	•	•	•	•	
I2		•	•	•	•	•	•	•	•	•	•	
ok	•											•
Q		•	•	•	•	•	•†	•	•	•	•	

• Valid reference or place where power may flow through the function.

† %SA, %SB, or %SC only; %S cannot be used.

## Example

In the following example, whenever input %I0001 is set, the 16-bit strings represented by nicknames WORD1 and WORD2 are examined. The results of the Logical AND are placed in output string RESULT.



WORD1 (I1) 

0	0	0	1	1	1	1	1	1	1	0	0	1	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

WORD2 (I2) 

1	1	0	1	1	1	0	0	0	0	0	0	1	1	1	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

RESULT (Q) 

0	0	0	1	1	1	0	0	0	0	0	0	1	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

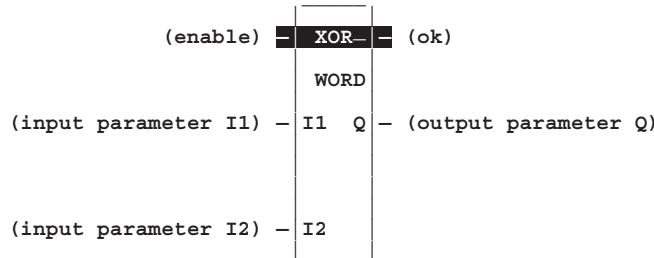
## XOR (WORD)

The Exclusive OR (XOR) function is used to compare each bit in the bit string at input I1 with the corresponding bit in the bit string at input I2. If the corresponding bits are different, a 1 is placed in the corresponding position in the output bit string.

The XOR function is useful for comparing two bit strings, or to flash a group of bits on and off at the rate of one ON state per two scans.

For each scan that the XOR is enabled, it compares each bit in string I1 with the corresponding bit in string I2, beginning at the least significant bit in each string. In a comparison, if only one is a logic 1, then a 1 is placed in the corresponding location in bit string Q. The XOR function passes power flow to the right whenever power is received.

If string I2 and output string Q begin at the same reference, a 1 placed in string I1 will cause the corresponding bit in string I2 to alternate between 0 and 1, changing state with each scan as long as power is received. Longer cycles can be programmed by switching the enable input to the function at twice the desired rate of flashing; for this application, the enable input should go high for one scan long (use a contact from a one-shot type coil or self-resetting timer circuit).



## Parameters

Parameter	Description
enable	When the function is enabled, the operation is performed.
I1	I1 contains a constant or reference for the first word to be XORed.
I2	I2 contains a constant or reference for the second word to be XORed.
ok	The ok output is energized whenever enable is energized.
Q	Output Q contains the result of I1 XORed with I2.

## Valid Memory Types

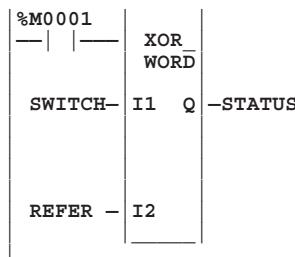
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
I1		•	•	•	•	•	•	•	•	•	•	
I2		•	•	•	•	•	•	•	•	•	•	
ok	•											•
Q		•	•	•	•	•†	•	•	•	•		

• Valid reference or place where power may flow through the function.

† %SA, %SB, or %SC only; %S cannot be used.

## Example of an Alarm Circuit Using an XOR

In the following example, whenever enable contact %M0001 is on, the 16-bit string nicknamed SWITCH is compared to a reference bit string, nicknamed REFER. The SWITCH bit string is a group of bits that represent the on/off status of alarm switch contacts. The REFER bit string represents the normal or non-alarm status of these bits. If the state of any SWITCH bit is different from its corresponding REFER bit, their corresponding output at Q goes to logic 1. Under normal (no alarm) conditions, the value of the word nicknamed STATUS will be zero.



Bit Position	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
I1 (SWITCH)	0	1	0	1	1	1	1	0	1	1	0	0	0	0	0	0
I2 (REFER)	0	0	0	1	1	1	1	1	1	1	0	0	1	0	0	0
Q (STATUS)	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0

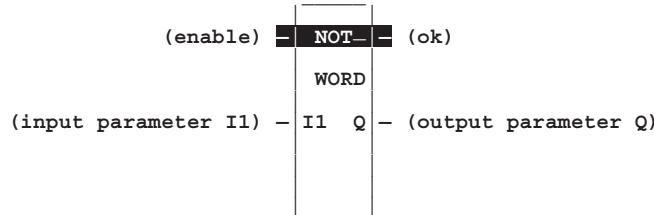
The data in STATUS could be used as an input to a Not Equal (NE) function, which would compare the word nicknamed STATUS to a constant of zero. If STATUS does not equal zero, the NE turns on its output, indicating the presence of an alarm.

The bits in STATUS that are equal to logic 1 can be identified with the BPOS (Bit Position) function, which would search the bits in STATUS and report the position (a number between 1 and 16) of the first bit (starting at bit 1) it encounters that is at logic 1. In the example above, the BPOS would output the number 4, indicating the fourth bit is a logic 1. To test for more than one bit, you could store a record of bit 4, use a BCLR (Bit Clear) function to clear bit 4, then repeat the BPOS test to find the next bit that is equal to logic 1 (bit 9 in the example above). This process can be repeated until no more non-zero bits are found. Note that the BCLR and BPOS functions are discussed in detail elsewhere in this chapter.

## NOT (WORD)

The NOT function is used to set the state of each bit in the output bit string Q to the opposite of the state of the corresponding bit in bit string I1.

The NOT function executes and passes power flow for each scan that it's enable input is on.



### Parameters

Parameter	Description											
enable	When the function is enabled, the operation is performed.											
I1	I1 contains the constant or reference for the word to be negated.											
ok	The ok output is energized whenever enable is energized.											
Q	Output Q contains the NOT (negation) of I1.											

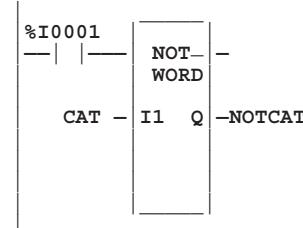
### Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
I1		•	•	•	•	•	•	•	•	•	•	
ok	•											•
Q		•	•	•	•	•	•†	•	•	•	•	

- Valid reference or place where power may flow through the function. † %SA, %SB, or %SC only; %S cannot be used.

### Example

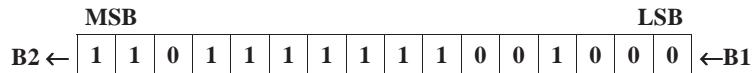
In the following example, whenever input %I0001 is set, the bit string represented by the nickname NOTCAT is set to the inverse of bit string CAT, as seen in the truth table below.



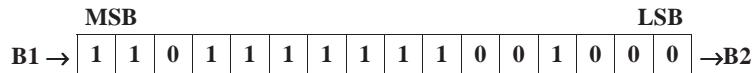
CAT	1	1	0	1	0	1	0	0	1	1	0	1	0	0	0	1
NOTCAT	0	0	1	0	1	0	1	1	0	0	1	0	1	1	1	0

## SHL and SHR (WORD)

The Shift Left (SHL) function is used to shift all the bits in a word or group of words to the left by a specified number of places. When the shift occurs, the specified number of bits is shifted out of the output string to the left. As bits are shifted out of the high end of the string, the same number of bits is shifted in at the low end.



The Shift Right (SHR) function is used to shift all the bits in a word or group of words a specified number of places to the right. When the shift occurs, the specified number of bits is shifted out of the output string to the right. As bits are shifted out of the low end of the string, the same number of bits is shifted in at the high end.



A string length of 1 to 256 words can be selected for either function.

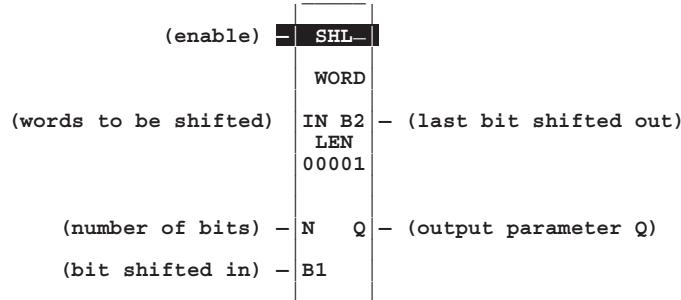
If the number of bits to be shifted (N) is greater than the number of bits in the array (LEN) \* 16, or if the number of bits to be shifted is zero, then the array (Q) is filled with copies of the input bit (B1), and the input bit is copied to the B2 output. If the number of bits to be shifted is zero, then no shifting is performed; the input array is copied into the output array; and input bit B1 is copied to the B2 output.

The bits being shifted into the beginning of the string are specified via input parameter B1, which requires a contact to the power rail. If a length greater than 1 has been specified as the number of bits to be shifted, each of the bits is filled with the same value (0 or 1) of B1. The B1 input can be controlled by

- An ALW\_ON (%S07) contact, which holds B1 permanently at logic 1.
- An ALW\_OFF (%S06) contact, which holds B1 permanently at logic 0.
- A contact from an internal coil such as %M or %Q that lets you change the value.
- A %I contact that lets you change the value from an input contact.

The SHL or SHR function passes power flow to the right, unless the number of bits specified to be shifted is zero.

Output Q is the shifted copy of the input string. If you want the input string to be shifted, the output parameter Q must use the same memory location as the input parameter IN. The SHL/SRH instructions execute each scan that their enable input is on. Output B2 holds the value of the last bit shifted out; for example, if four bits were shifted, B2 would contain be the value (either 1 or 0) of the fourth bit shifted out.



## Parameters

Parameter	Description
enable	When enable is logic 1, the shift is performed.
IN	IN contains the address of the first word to be shifted.
N	N contains the number of places (bit positions) that the array is to be shifted.
B1	B1 contains the bit value (0 or 1) to be shifted into the array.
B2	B2 contains the bit value (0 or 1) of the last bit shifted out of the array.
Q	Output Q contains the first word of the shifted array.
LEN	LEN is the number of words (1 – 256) in the array to be shifted.

## Valid Memory Types

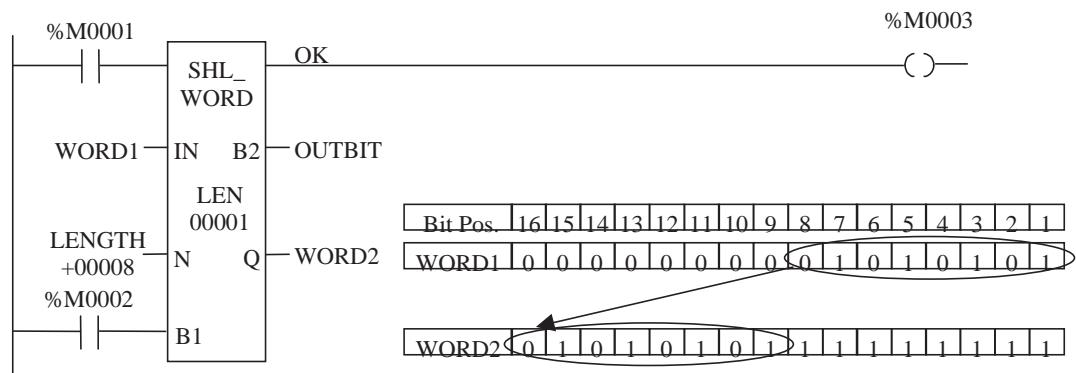
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN		•	•	•	•	•	•	•	•	•		
N		•	•	•	•		•	•	•	•	•	
B1	•											
B2	•											•
Q		•	•	•	•	•†	•	•	•	•		

• Valid reference or place where power may flow through the function.

† %SA, %SB, or %SC only; %S cannot be used.

## Example

In the following example, when input %M0001 is on, the SHL makes a copy of the bit string at IN (nicknamed WORD1). Then, in the copy, it shifts all bits to the left by 8 bit positions (specified by the value at N). The bits from bit positions 9-16 are shifted out (discarded), and the bits that were in positions 1-8 now occupy bit positions 9-16. Bit positions 1-8, which were “vacated” when bits 1-8 were shifted, are filled with ones because, for this example, contact %M0002 is closed, making the B1 input equal to logic 1. Finally, the shifted/filled word is written to the address at output Q (nicknamed WORD2). The original WORD1 at IN is not changed. Output B2 equals zero since the last bit shifted out was logic zero (the bit that occupied bit position 9), and coil %M0003 is on because the function worked correctly and therefore produced power flow at its OK output.



## ROL and ROR (WORD)

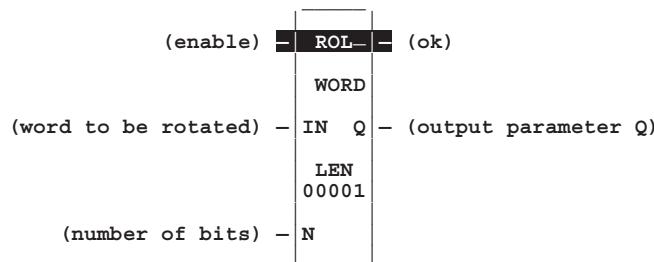
The Rotate Left (ROL) function rotates all the bits in a string a specified number of places to the left. When rotation occurs, the specified number of bits is rotated out of the input string to the left and back into the string on the right.

The Rotate Right (ROR) function rotates all bits in a string a specified number of places to the right. When rotation occurs, the specified number of bits is rotated out of the input string to the right and back into the string on the left.

A string length of 1 to 256 words can be selected for either function.

The number of places specified for rotation at input N must be more than zero and less than the number of bits in the string. Otherwise, no movement occurs and no power flow is generated.

The rotation result is placed in output string Q. If you want the input string to be rotated, the output parameter Q must use the same memory location as the input parameter IN. The rotate function executes each scan that the enable input is on.



## Parameters

Parameter	Description
enable	When the enable input is on, the rotation is performed.
IN	IN contains the address of the first word to be rotated.
N	N contains the number of places (bit positions) that the array is to be rotated.
ok	The ok output is energized when the rotation function is enabled and the rotation length (at N) is greater than zero but is not greater than the array size.
Q	Output Q contains the first word of the rotated array.
LEN	LEN is the number of words (1 – 256) in the array to be rotated.

## Valid Memory Types

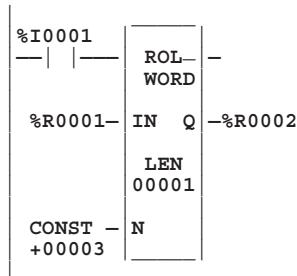
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN		•	•	•	•	•	•	•	•	•		
N		•	•	•	•	•		•	•	•	•	
ok	•											•
Q		•	•	•	•	•	•†	•	•	•		

- Valid reference or place where power may flow through the function.

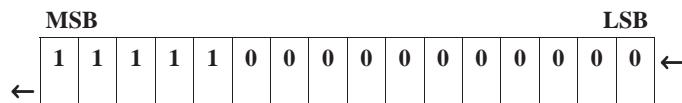
† %SA, %SB, or %SC only; %S cannot be used.

## Example

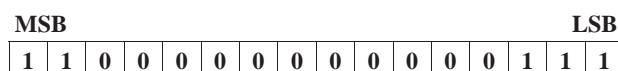
In the following example, whenever enable input %I0001 is on, the ROL makes a copy of the input string at IN. Then, in the copy, it rotates the input bit string 3 bits (specified by the value of input N) and places the result in %R0002. After execution of this function, the input bit string %R0001 is unchanged. However, if you wish to rotate the input string, use the same reference address for IN and Q.



**%R0001:**



**%R0002 (after rotation occurs):**



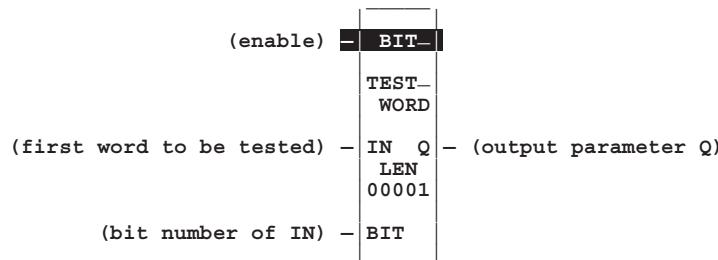
## BTST (WORD)

The Bit Test (BTST) function is used to test a bit within a bit string to determine whether that bit is currently 1 or 0. The result of the test is placed in output Q.

Each sweep power is received, the BTST function sets its output Q to the same state as the specified bit. If a register rather than a constant is used to specify the bit number, the same function block can test different bits on successive sweeps. If the value of BIT is outside the range specified by the following formula, then Q is set OFF.

Formula:  $1 \leq \text{BIT} \leq (16 * \text{LEN})$

A string length of 1 to 256 words can be selected.



## Parameters

Parameter	Description
enable	When the function is enabled, the bit test is performed.
IN	IN contains the first word of the data to be operated on.
BIT	BIT contains the bit number of IN that should be tested. Valid range is $(1 \leq \text{BIT} \leq (16 * \text{LEN}))$ .
Q	Output Q is energized if the bit tested was a 1.
LEN	LEN is the number of words in the string to be tested.

### Note

**When using the Bit Test, Bit Set, Bit Clear or Bit Position function,** the bits are numbered 1 through 16, *NOT* 0 through 15.

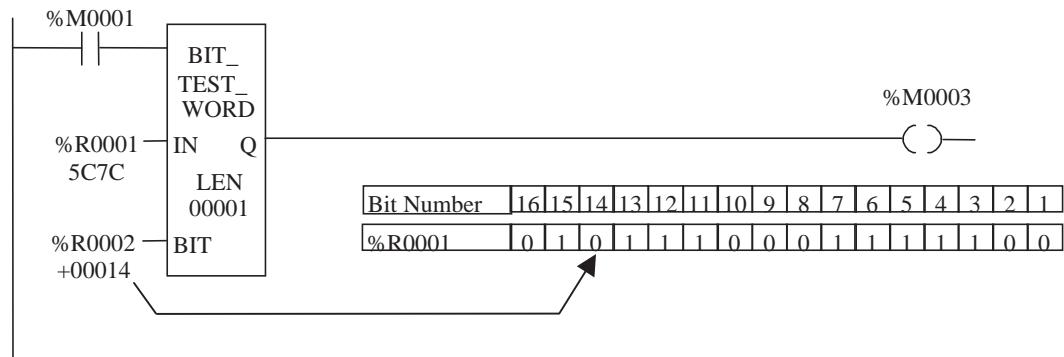
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN		•	•	•	•	•	•	•	•	•		
BIT		•	•	•	•			•	•	•	•	
Q	•											•

- Valid reference or place where power may flow through the function.

## Example

In the following example, whenever enable input %M0001 is on, bit 14 in word %R0001 is tested (bit 14 is specified by the value in %R0002). Since bit 14 is zero in the value shown for %R0001 (5C7C), output Q does not turn on. Note that this function can only be a WORD type; therefore, any memory address used at IN will appear on a Logicmaster screen in hexadecimal format. However, the value at BIT will appear in integer format regardless of whether a constant or memory address is used.

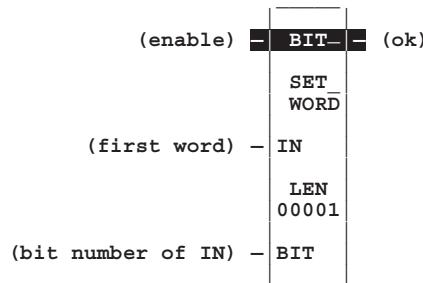


## BSET and BCLR (WORD)

The Bit Set (BSET) function is used to set a bit in a bit string to 1. The Bit Clear (BCLR) function is used to clear a bit within a string by setting that bit to 0.

Each sweep that power is received, the function sets the specified bit to 1 for the BSET function or to 0 for the BCLR function. If a variable (register) rather than a constant is used to specify the bit number, the same function block can set different bits on successive sweeps.

A string length of 1 to 256 words can be selected. The function passes power flow to the right, unless the value for BIT is outside the range ( $1 \leq \text{BIT} \leq (16 * \text{LEN})$ ). Then, ok is set OFF. For example, if LEN is set to 1, then the length of the bit string to be tested is 16. If, in this case, the number at BIT was 17 or higher, it would be out of range, so the ok output would not come on.



## Parameters

Parameter	Description
enable	When the enable input is on, the bit operation is performed.
IN	IN contains the address of the first word of the bit string to be operated on.
BIT	BIT contains the bit number of IN that should be set or cleared. Valid range is ( $1 \leq \text{BIT} \leq (16 * \text{LEN})$ ).
ok	The ok output is energized whenever enable is energized, unless the value at the BIT input is outside the valid range.
LEN	LEN is the number of words in the bit string whose starting address is configured at IN..

### Note

**When using the Bit Test, Bit Set, Bit Clear or Bit Position function,** the bits are numbered 1 through 16, *NOT* 0 through 15.

## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN		•	•	•	•	†	•	•	•	•		
BIT		•	•	•	•		•	•	•	•	•	
ok	•											•

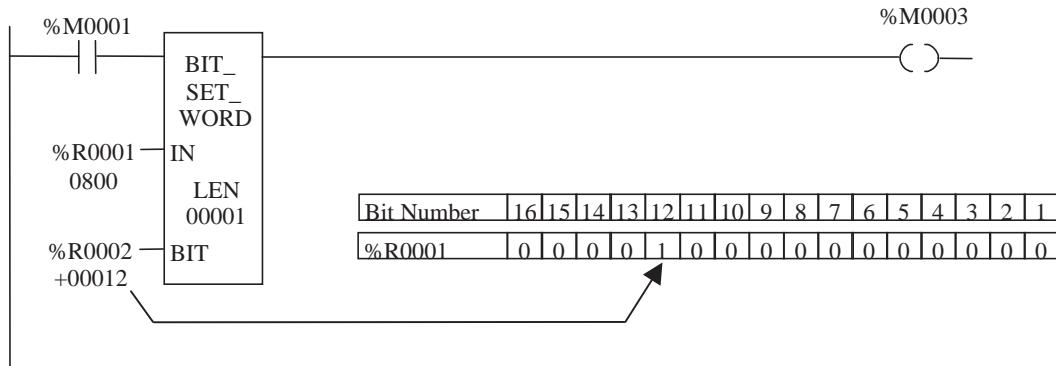
• Valid reference or place where power may flow through the function.

† %SA, %SB, or %SC only; %S cannot be used.

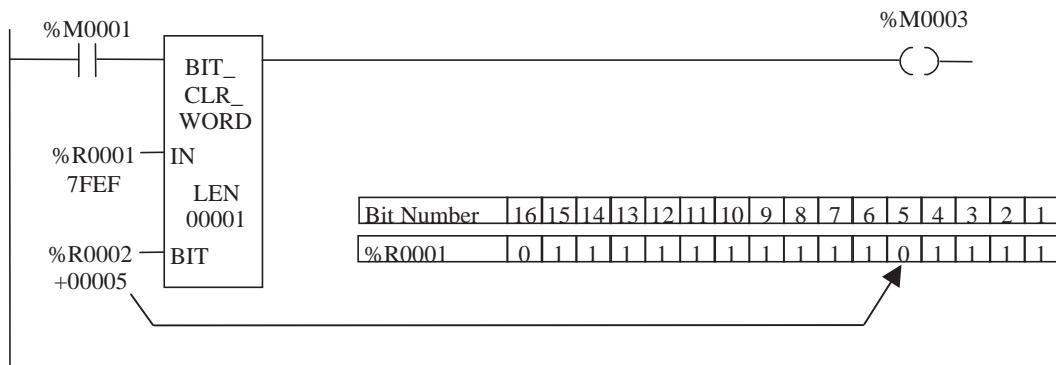
## Examples

Note that the Bit Set and Bit Clear functions can only be WORD types; therefore, any memory address used at IN will appear on a Logicmaster screen in hexadecimal format. However, the value at BIT will appear in integer format whether a constant or memory address is used.

In the following example, when input %M0001 is on, bit 12 (specified by the BIT input) of the string beginning at reference %R0001 (the address at the IN input) is set to 1 (set).



In the next example, when input %M0001 is on, bit 5 (the value of the BIT input) of the string beginning at reference %R0001 (the address at the IN input) is set to 0 (cleared).



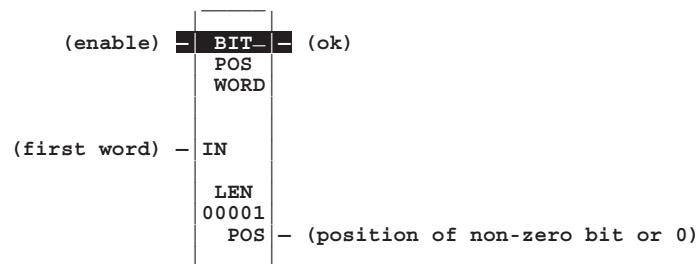
## BPOS (WORD)

The Bit Position (BPOS) function is used to locate in a bit string, a bit whose value is logic 1.

Each sweep that the function is enabled, it scans the bit string starting at IN. When the function stops scanning, either a bit equal to 1 has been found or the entire length of the string has been scanned.

POS is set to the position within the bit string of the first non-zero bit; POS is set to zero if no non-zero bit is found.

A string length of 1 to 256 words can be selected. The function passes power flow to the right whenever enable is ON.



### Parameters

Parameter	Description
enable	When the enable input is on, a bit search operation is performed.
IN	IN contains the first word of the bit string to be operated on.
ok	The ok output is energized whenever enable is energized.
POS	The position of the first non-zero bit found, or zero if a non-zero bit is not found.
LEN	LEN is the number of words in the bit string.

### Note

**When using the Bit Test, Bit Set, Bit Clear or Bit Position function,** the bits are numbered 1 through 16, *NOT* 0 through 15.

## Valid Memory Types

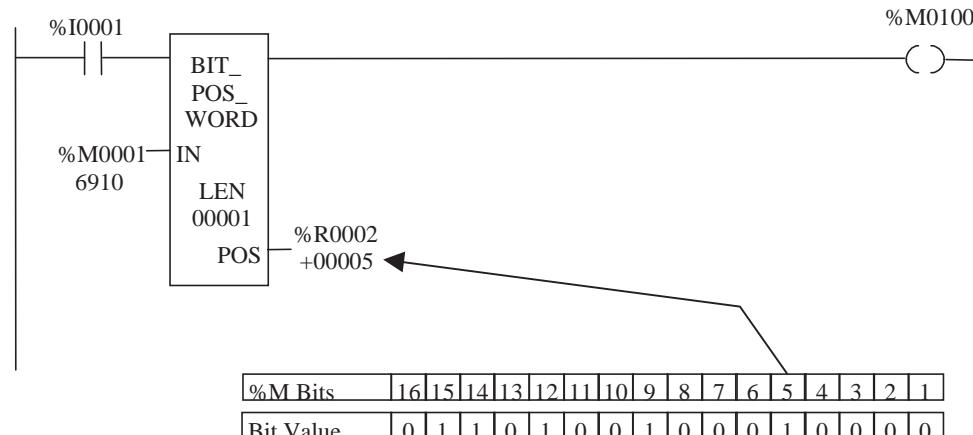
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN		•	•	•	•	•	•	•	•	•		
POS		•	•	•	•			•	•	•		
ok	•											•

- Valid reference or place where power may flow through the function.

## Example

Note that the Bit Position function can only be a WORD type; therefore, any memory address used at IN will appear on a Logictmaster screen in hexadecimal format. However, the value at POS will appear in integer format. Logictmaster displays the first 16 bits at IN in hexadecimal format.

In the following example, if %I0001 is on, the bit string starting at %M0001 is searched until a bit equal to 1 is found, or until the entire bit string has been searched. Coil %M0100 is turned on. If a bit equal to 1 is found, its location within the bit string is written to %R0002; otherwise a value of 0 is written to %R0002. In the example shown, bit 5 is the first logic 1 encountered by the search (which starts at bit 1), so the value written to %R0002 is 5.



## MSKCMP (WORD, DWORD)

The Masked Compare (MSKCMP) function (*available for Release 4.41 or later CPUs*) is used to compare the contents of two separate bit strings with the ability to mask selected bits. The length of the bit strings to be compared is specified by the LEN parameter (where the value of LEN specifies the number of 16-bit words for the MSKCMP word-type function or 32-bit words for the MSKCMP double-word type function).

When its enable input is on, the function compares the bits in the first string with the corresponding bits in the second string. Comparison continues until a miscompare is found, or until the end of the string is reached. The function executes each scan that the enable input is on, so, for many applications, a “one-shot” contact is used for the enable input.

The BIT input is used to store the bit number where the next comparison should start (where a 0 indicates the first bit in the string). The BN output is used to store the bit number where the last comparison occurred (where a 1 indicates the first bit in the string). Using the same reference for BIT and BN causes the compare to start at the next bit position after a miscompare; or, if all bits compared successfully upon the next invocation of the function block, the compare starts at the beginning.

If you want to start the next comparison at some other location in the string, you can enter different references for BIT and BN. If the value of BIT is a location that is beyond the end of the string, BIT is reset to 0 before starting the next comparison.

### If All Bits in I1 and I2 are the Same

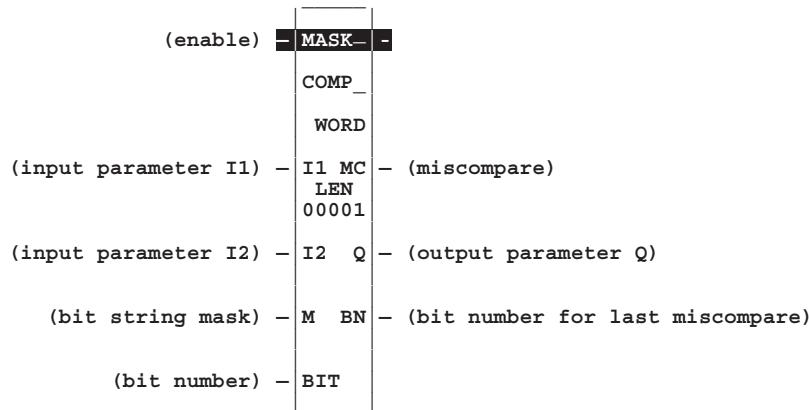
If all corresponding bits in strings I1 and I2 match, the function sets the “miscompare” output MC to 0 and BN to the highest bit number in the input strings. The comparison then stops. On the next invocation of MSKCMP, BN will be reset to 0.

### If a Miscompare is Found

When the two bits currently being compared are not the same, the function checks the correspondingly numbered bit in string M (the mask). If the mask bit is a 1, the miscompare is ignored and the comparison continues until it reaches another miscompare or the end of the input strings.

If a miscompare is detected and the corresponding mask bit is a 0, the function does the following:

1. Sets the corresponding mask bit in M to 1.
2. Sets the miscompare (MC) output to 1.
3. Updates the output bit string Q to match the new content of mask string M.
4. Sets the bit number output (BN) to the number of the miscompared bit.
5. Stops the comparison.



## Parameters

Parameter	Description								
enable	Permissive logic to enable the function.								
I1	Reference for the first bit string to be compared.								
I2	Reference for the second bit string to be compared.								
M	Reference for the bit string mask.								
BIT	Reference for the bit number where the next comparison should start.								
MC	Goes to a logic 1 for one scan if a miscompare has occurred. A set coil can be used on this output if it is desired to "capture" the output beyond one scan.								
Q	Output copy of the mask (M) bit string.								
BN	Number of the bit where the last compare occurred.								
LEN	LEN is the number of words in the bit string.								

## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
I1		o	o	o	o	o	o	•	•	•		
I2		o	o	o	o	o	o	•	•	•		
M		o	o	o	o	o†	o	•	•	•		
BIT	•	•	•	•	•	•	•	•	•	•	•	
LEN											•‡	
MC	•											•
Q		o	o	o	o	o†	o	•	•	•		
BN			•	•	•	•	•	•	•	•		

• Valid reference or place where power may flow through the function.

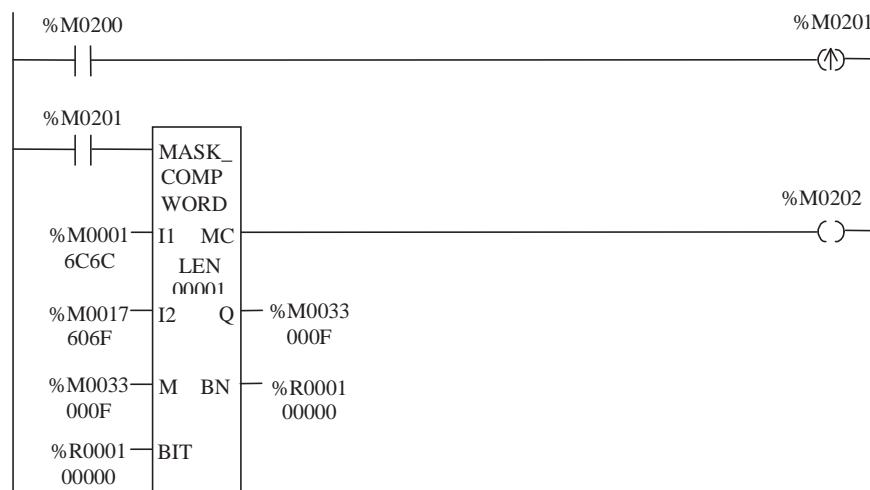
o Valid reference for WORD data only; not valid for DWORD.

† %SA, %SB, %SC only; %S cannot be used.

‡ Max const value of 4095 for WORD and 2047 for DWORD.

## Example 1 – MSKCMP Instruction

When %M0200 closes, the contact from the %M0201 transition coil closes for one scan, which enables the MSKCMP function to execute once. %M0001 through %M0016 (I1) are compared with %M0017 through %M0032 (I2). %M0033 through %M0048 (M) contains the mask value. The value in %R0001 (BIT) determines at which bit position (0) the comparison starts within the two input strings at I1 and I2.



### Condition Before the First MSKCMP Execution

The contents of the input references before the MSKCMP executes are as follows:

%M Bits	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Input 1(I1)	0	1	1	0	1	1	0	0	0	1	1	0	1	1	0	0

%M Bits	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
Input 2(I2)	0	1	1	0	1	1	0	1	0	1	1	0	1	1	1	1

%M Bits	48	47	46	45	44	43	42	41	40	39	38	37	36	35	35	33
Mask (M/Q)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1

BIT/BN (%R0001) = 0

MC (%M0202) = OFF

## Condition After the First MSKCMP Execution

The following table shows the contents of the Mask (M/Q) references after the MSKCMP executes one time. (I1 and I2 are still at the values shown above.) Since the ninth bit produced a miscompare, the ninth bit (%M0041) in the Mask string is set to logic 1, BIT/BN contains a value of 9, and the MC output turned on for one scan. Although the first and second bit positions are not equal, they do not produce a miscompare because the mask bits are 1 for these positions.

%M Bits	48	47	46	45	44	43	42	41	40	39	38	37	36	35	35	33
Mask (M/Q)	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	1

BIT/BN (%R0001) = 9

MC (%M0202) = ON (for one scan)

## Example 2 - Fault Detection with a Masked Compare Function

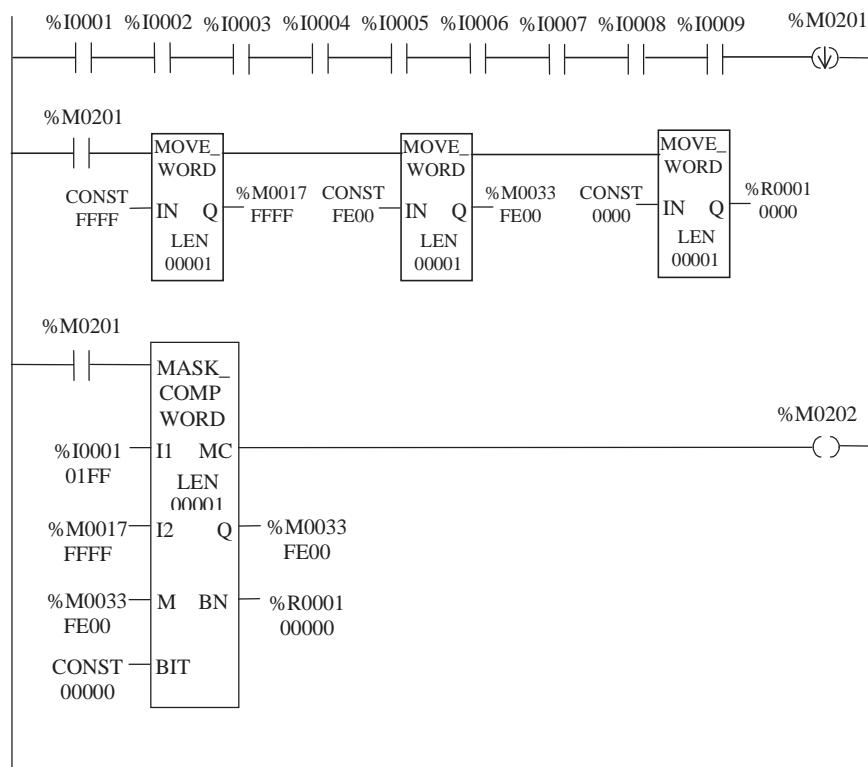
Intermittent problems can be difficult to troubleshoot. One example is when several switches are arranged in a series circuit that energizes a fault relay. Under normal conditions, all switches are closed and the fault relay is energized (a “fail-safe” arrangement). When a fault occurs, one of the contacts opens and the fault relay drops out. If the faulted contact remains open, a troubleshooter will be able to easily determine which switch caused the fault. However, sometimes a contact only opens for a brief time, perhaps for less than a second, then closes again. This causes the fault relay to drop out briefly and shut down the process. Since the contact closes again, everything appears normal.

To help with such a problem, the following circuit acts as a “fault catcher” in that it detects which contact opened and stores its number in a register. In the first rung, contacts from the input switches, which are each wired to an input module point (%I1 – %I9), are programmed in series to energize %M0021, a negative transition coil.

The second rung initializes the MSKCMP so it is ready to capture the fault. The first Move instruction writes all logic ones to the I2 input of the MSKCMP. The second Move writes values of 1 to bits 10—16 of the mask word (so that these bits are ignored), since only the first nine bits of the compared words (the MSKCMP uses full words) are needed for switches %I0001—%I0009. The third Move zeroes the output register, %R0001, so it is ready to report the latest fault.

During normal operation, the first nine bits on input I1 of the MSKCMP are at logic 1 since the switches are all closed. Input I2 is initialized with all logic 1s since that is the normal condition to which the input switches are compared. The mask has 1s in bits 10—16 because these bits are not used since there are nine input switches. When a switch opens, %M0201’s contacts close for one scan. This causes the initializing moves to occur in the second rung, and in the third rung, the MSKCMP is enabled. The MSKCMP compares the input switches against the logic 1s at its I2 input, identifies which switch is logic 0 (open), and writes the bit number of the open switch to the BN (%R0001) output. The bits are numbered from 1—9 beginning with %I1. For example, if %I4 were to open, %R0001 would contain the number 4.

Note that, in this circuit, if a switch opens and closes again, coil %M0201 drops out and picks back up, but the number of the switch that opened will be stored in %R0001. However, if a switch opens again, for example, the machine operator pushes an emergency stop button or opens a safety gate, the masked compare activates again and writes the number of the latest switch opening in %R0001. This means that the equipment should be left untouched after the fault occurs until the value in %R0001 can be checked. If this is not practical, an additional Move instruction could be used.



*Chapter*  
**9**

## *Data Move Functions*

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Data move functions provide basic data move capabilities. This chapter describes the following data move functions:

<b>Abbreviation</b>	<b>Function</b>	<b>Description</b>	<b>Page</b>
MOVE	Move	Copy data as individual bits. The maximum length allowed is 256 words, except MOVE_BIT is 256 bits. Data can be moved into a different data type without prior conversion.	9-2
BLKMOV	Block Move	Copy a block of seven constants to a specified memory location. The constants are input as part of the function.	9-5
BLKCLR	Block Clear	Replace the content of a block of data with all zeros. This function can be used to clear an area of bit (%I, %Q, %M, %G, or %T) or word (%R, %AI, or %AQ) memory. The maximum length allowed is 256 words.	9-7
SHFR	Shift Register	Shift one or more data words into a table. The maximum length allowed is 256 words.	9-8
BITSEQ	Bit Sequencer	Perform a bit sequence shift through an array of bits. The maximum length allowed is 256 words.	9-11
COMMREQ	Communications Request	Allow the program to communicate with an intelligent module, such as a Genius Communications Module or a Programmable Coprocessor Module.	9-15

## MOVE (BIT, INT, WORD, REAL)

Use the MOVE function to copy data (as individual bits) from one location to another. Because the data is copied in bit format, the new location does not need to be the same data type as the original location.

The MOVE function has two input parameters and two output parameters. When the function is enabled, it copies data from input parameter IN to output parameter Q as bits. If data is moved from one location in discrete memory to another, (for example, from %I memory to %T memory), the transition information associated with the discrete memory elements is updated to indicate whether or not the MOVE operation caused any discrete memory elements to change state. Data at the input parameter does not change unless there is an overlap in the input and output references.

For the BIT type there is another consideration. If a BIT array specified on the Q parameter does not encompass all of the bits in a byte, the transition bits associated with that byte (which are not in the array) will be cleared when the MOVE\_BIT receives power flow.

Input IN can be either a reference for the data to be moved or a constant. If a constant is specified, then the constant value is placed in the location specified by the output reference. For example, if a constant value of 4 is specified for IN, and the length (LEN) equals 1, then 4 is placed in the memory location specified by Q. If the length is greater than 1 and a constant is specified, then the constant is placed in the memory location specified by Q and the locations following, up to the length specified. For example, if the constant value 9 is specified for IN and the length equals 4, then 9 is placed in the memory location specified by Q and also in the three locations following.

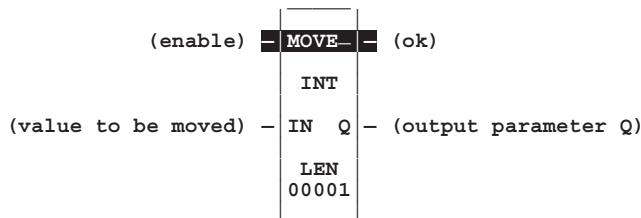
The LEN operand specifies the number of:

- Words to be moved for MOVE\_INT and MOVE\_WORD.
- Bits to be moved for MOVE\_BIT.
- Real numbers to be moved for MOVE\_REAL.

### Note

The REAL data type is only available on 35x and 36x series CPUs, Release 9 or later, and all releases of CPU352 and 37x.

The function passes power to the right whenever power is received.



## Parameters

Parameter	Description	
enable	When the function is enabled, the move is performed.	
IN	IN contains the value to be copied (moved). For MOVE_BIT, any discrete reference may be used; it does not need to be byte aligned. However, a 16-bit value, beginning with the reference address specified, is displayed on the Logicmaster screen.	
ok	The ok output is energized whenever the function is enabled.	
Q	When the move is performed, the value at IN is copied to Q. For MOVE_BIT, any discrete reference may be used; it does not need to be byte aligned. However, a 16-bit value, beginning with the reference address specified, is displayed on the Logicmaster screen.	
LEN	LEN specifies the number of words or bits to be moved. For MOVE_WORD and MOVE_INT, LEN must be between 1 and 256 words. For MOVE_BIT, when IN is a constant, LEN must be between 1 and 16 bits; otherwise, LEN must be between 1 and 256.	

### Note

On 351, 352, 36x and 37x series CPUs, the MOVE\_INT and MOVE\_WORD functions do not support overlapping of IN and Q parameters, where the IN reference is less than the Q reference. For example, with the following values: IN=%R0001, Q=%R0004, LEN=5 (words), the %R0007 and %R0008 contents will be indeterminate; however, using the following values: Q=%R0001, IN=%R0004, LEN=5 (words) will yield valid contents.

Also, please note that only 35x and 36x series CPUs (Release 9.00 and later), and all releases of CPU35 and 37x have Floating Point capabilities and are therefore the only Series 90-30 CPUs capable of MOVE\_REAL.

## Valid Memory Types

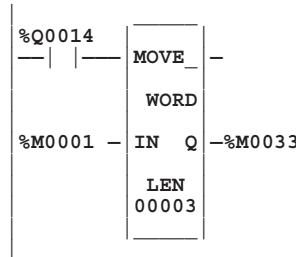
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN		•	•	•	•	o	•	•	•	•	•	
ok	•											•
Q		•	•	•	•	o†	•	•	•	•		

**Note:** For REAL data, the only valid types are %R, %AI, and %AQ.

- Valid reference for BIT, INT, or WORD data, or place where power may flow through the function.  
For MOVE\_BIT, discrete user references %I, %Q, %M, and %T need not be byte aligned.
- o Valid reference for BIT or WORD data only; not valid for INT.
- † %SA, %SB, %SC only; %S cannot be used.

## Example 1 - Overlapping Addresses (only for CPUs 311-341)

When enable input contact %Q0014 is ON, 48 bits are moved from memory location %M0001 to memory location %M0033. Even though the destination overlaps the source for 16 bits, the move is done correctly (except for the 35x and 35x CPUs as noted previously).



### Before using the Move function:

INPUT (%M0001 through %M0048)

	1															
%M0016	1	1	1	1	0	0	0	0	1	1	1	1	1	0	0	0
%M0032	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
%M0048	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

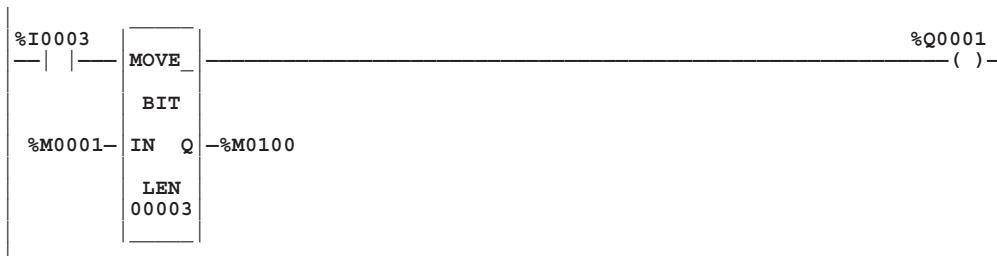
### After using the Move function:

OUTPUT (%M0033 through %M0080)

	33															
%M0048	1	1	1	1	0	0	0	0	1	1	1	1	1	0	0	0
%M0064	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
%M0080	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

## Example 2 – for all CPUs

In this example, whenever %I0003 is on, the values in the three bits %M0001, %M0002, and %M0003 are moved to %M0100, %M0101, and %M0102, respectively, and coil %Q0001 is turned on.



## BLKMOV (INT, WORD, REAL)

Use the Block Move (BLKMOV) function to copy a block of seven constants to a specified location.

### Note

The REAL data type is only available on 35x and 36x series CPUs, Release 9 or later, and all releases of CPU352 and 37x.

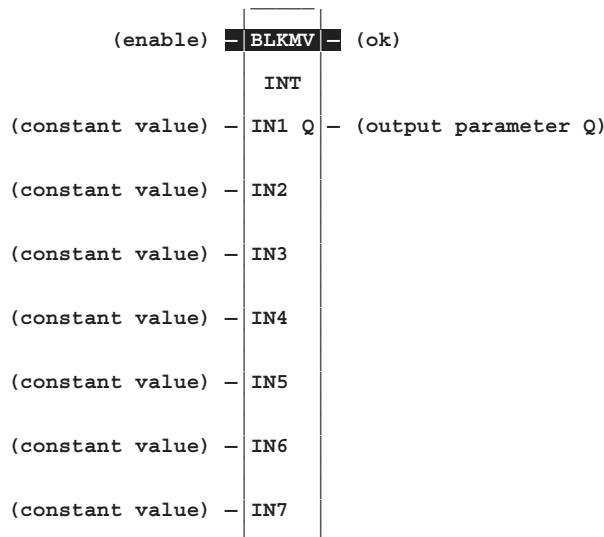
The BLKMOV function has eight input parameters and two output parameters. When the function receives power flow, it copies the constant values into consecutive locations, beginning at the destination specified in output Q. Output Q cannot be the input of another program function.

### Note

For BLKMOV\_INT, the values of IN1 — IN7 are displayed as signed decimals.

For BLKMOV\_WORD, IN1 — IN7 are displayed in hexadecimal. For BLKMOV\_REAL, IN1— IN7 are displayed in Real format.

The function passes power to the right whenever it is enabled.



## Parameters

Parameter	Description
enable	When the function is enabled, the block move is performed.
IN1— IN7	IN1 through IN7 contain seven constant values.
ok	The ok output is energized whenever the function is enabled.
Q	Output Q contains the first integer of the moved array. IN1 is moved to Q.

## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN1 — IN7											•	
ok	•											•
Q		•	•	•	•	o†	•	•	•	•		

**Note:** For REAL data, the only valid types are %R, %AI, and %AQ.

• Valid reference for place where power may flow through the function.

o Valid reference for WORD data only; not valid for INT or REAL.

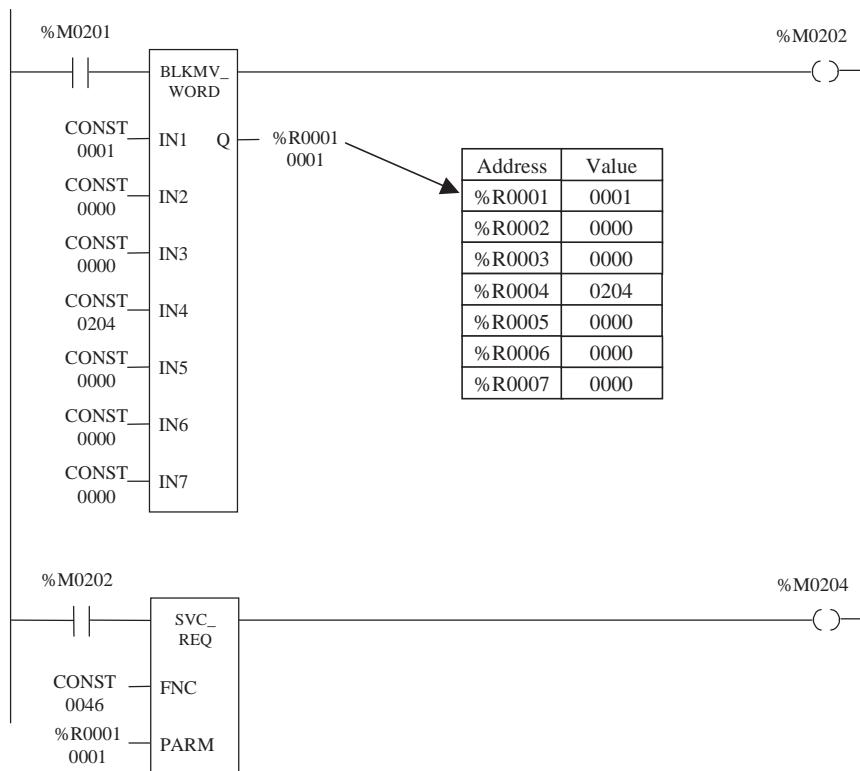
† %SA, %SB, %SC only; %S cannot be used.

### Note

Floating Point capabilities exist only on 35x and 36x series CPUs, Release 9 or later, and all releases of CPU352 and 37x. These 90-30 CPUs are the only ones capable of BLKMOV\_REAL.

## Example

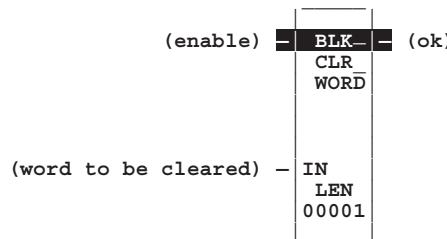
In the following example, when input enable contact %M0201 is on, the BLKMOV function copies the seven input constants into memory locations %R0001 (specified at output Q) through %R0007. If the BLKMOV executes successfully, it turns on its OK output, which energizes %M0202. In turn, an %M0202 contact enables the Service Request function in the next rung, which uses %R0001 through %R0007 as its parameter block. (See Chapter 12 for more information on Service Request instructions.)



## BLKCLR (WORD)

Use the Block Clear (BLKCLR) function to fill a specified block of data with zeros.

The BLKCLR function has two input parameters and one output parameter. When the function receives power flow, it writes zeros into the memory location beginning at the reference specified by IN. When the data to be cleared is from discrete memory (%I, %Q, %M, %G, or %T), the transition information associated with the references is also cleared. The function passes power to the right.



### Parameters

Parameter	Description	
enable	When the function is enabled, the array is cleared.	
IN	IN contains the first word of the array to be cleared.	
ok	The ok output is energized whenever the function is enabled.	
LEN	LEN must be between 1 and 256 words.	

### Valid Memory Types

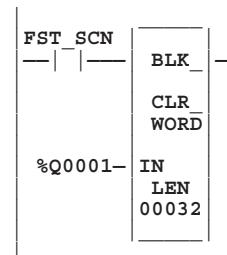
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN		•	•	•	•	•†	•	•	•	•		
ok	•											•

• Valid reference or place where power may flow through the function.

† %SA, %SB, %SC only; %S cannot be used.

### Example

In the following example, at power-up, 32 words of %Q memory (512 points) beginning at %Q0001 are filled with zeros.



## SHFR (BIT, WORD)

Use the Shift Register (SHFR) function to shift one or more data words or data bits from a reference location into a specified area of memory. For example, one word might be shifted into an area of memory with a specified length of five words. As a result of this shift, another word of data would be shifted out of the end of the memory area.

### Note

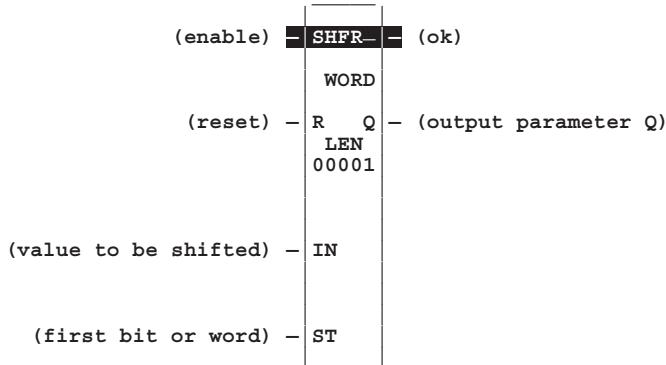
When assigning reference addresses, overlapping input and output reference address ranges in multi-word functions may produce unexpected results.

The SHFR function has four input parameters and two output parameters. The reset input (R) takes precedence over the function enable input. When the reset is active, all references beginning at the shift register (ST) up to the length specified for LEN, are filled with zeros.

If the function receives power flow and reset is not active, each bit or word of the shift register is moved to the next highest reference. The last element in the shift register is shifted into Q. If Q has a unique address, the data shifted out of Q is discarded. However, if IN and Q are given the same address, the data will re-circulate in the shift register. The highest reference of the shift register element of IN is shifted into the vacated element starting at ST. The contents of the shift register are accessible throughout the logic program because they are all contained in addressable memory.

The function passes power to the right whenever power is received through the enable logic.

The function will execute once each scan while it is enabled; so it may be beneficial to use a “one-shot” type enable contact from a transition coil if it is desired to just shift one time for a given contact closure.



## Parameters

Parameter	Description
enable	When the enable input is on and the R input is off, the shift is performed. Note that the SHFR will execute once for each scan that it is enabled.
R	When the R input is on, the shift register located at ST is filled with zeros.
IN	IN contains the value to be shifted into the first bit or word of the shift register. For SHFR_BIT, any discrete reference may be used; it does not need to be byte aligned. However, 16 bits, starting with the reference address specified, are displayed online.
ST	ST contains the first bit or word of the shift register. For SHFR_BIT, any discrete reference may be used; it does not need to be byte aligned. However, 16 bits, starting with the reference address specified, are displayed online.
ok	The ok output is energized whenever the enable input is on and the R input is off.
Q	Output Q contains the bit or word shifted out of the shift register. For SHFR_BIT, any discrete reference may be used; it does not need to be byte aligned. However, 16 bits, starting with the reference address specified, are displayed online.
LEN	LEN determines the length of the shift register. For SHFR_WORD, LEN must be between 1 and 256 words. For SHFR_BIT, LEN must be between 1 and 256 bits.

## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
R	•											
IN		•	•	•	•	•	•	•	•	•	•	
ST		•	•	•	•	•†	•	•	•	•		
ok	•											•
Q		•	•	•	•	•†	•	•	•	•		

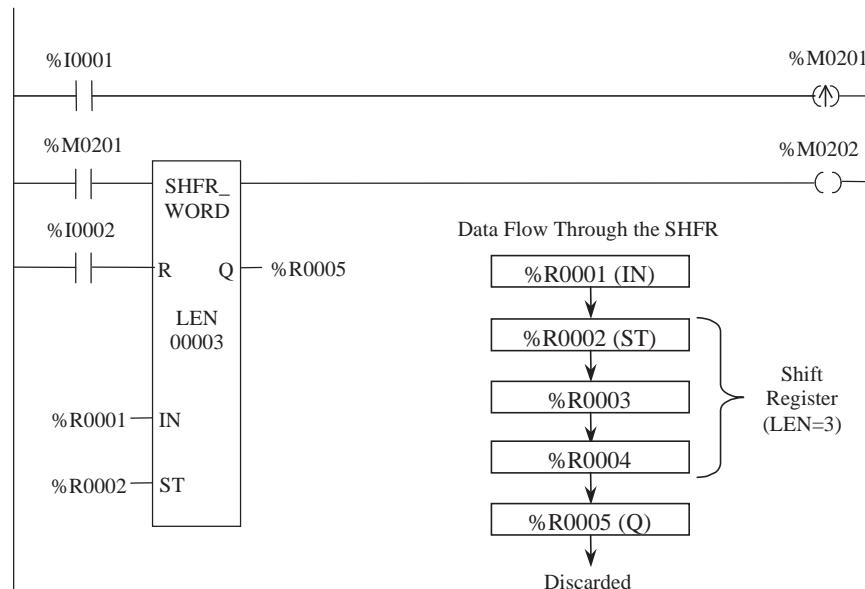
- Valid reference for BIT or WORD data, or place where power may flow through the function.  
For SHFR\_BIT, discrete user references %I, %Q, %M, and %T need not be byte aligned.

† %SA, %SB, %SC only; %S cannot be used.

## Example 1

In this example, the shift register operates on three (LEN=3) memory locations, %R0002 through %R0004. When the reset contact %I0002 is on, the three shift register words are set to zero.

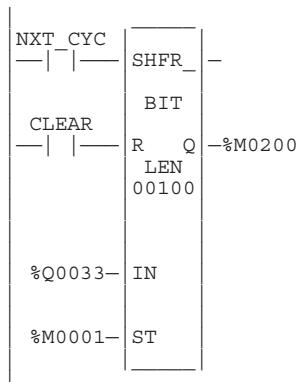
When contact %I0001 closes, the %M0201 contact at the SHFR's enable input closes for one scan. This shifts the data in %R0004 into output Q's address, %R0005 (the data that was in %R0005 is discarded). The data in %R0003 shifts into %R0004; the data in %R0002 shifts into %R0003, and the data in %R0001 (IN) shifts into %R0002 (ST). This data flow is shown in the figure below. If desired, data can be re-circulated by using the same address at IN and Q.



## Example 2

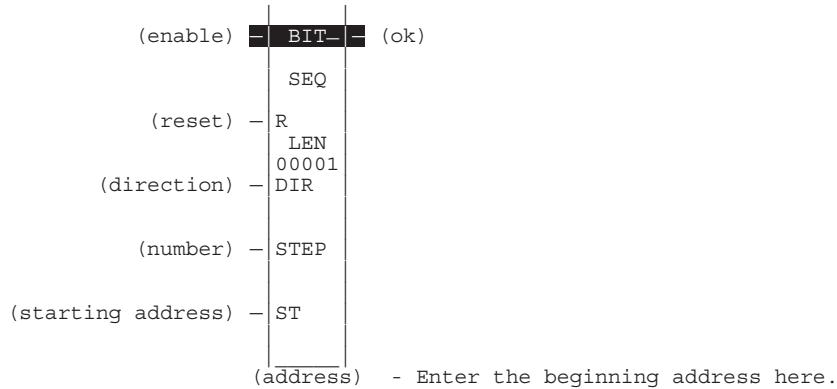
In Example 2, the shift register is a BIT type. With a LEN of 100, it operates on memory locations %M0001 through %M0100. When the reset reference CLEAR is active, the SHFR function fills %M0001 through %M0100 with zeros.

When NXT\_CYC (a “one-shot” contact from a transition coil) is on and CLEAR is off, the SHFR function shifts the data in %M0001 through %M0100 up one bit. The bit in %Q0033 is shifted into %M0001 while the bit shifted out of %M0100 is written to Q (%M0200). The previous value of Q is discarded.



## BITSEQ (BIT)

The Bit Sequencer (BITSEQ) function shifts a single logic 1 bit sequentially in a circular path through an array of bits. When the bit is shifted to the end of the array, it will wrap around to the other end of the array on the next shift and continue from there. The BITSEQ function has five input parameters and one output parameter.



### Enable Input Requirement

The Bit Sequencer's Enable input requires a transition from logic zero to logic one in order for the function to execute one shift, and it will not execute again until it receives another positive-going Enable input transition. Therefore, using the contact from a positive transition coil for the Enable input is unnecessary.

### R (Reset) Input

When this input is on, the Bit Sequencer will not execute.

The reset input (R) overrides the enable (EN) and always resets the sequencer. When R is active, the current step number is set to the value specified in the STEP number parameter and all other bits are set to 0. If no STEP number is specified (STEP=0), the step is set to bit 1 and all other bits are set to 0.

When EN is active and R is not active, the bit pointed to by the current step number is cleared. The current step number is either incremented or decremented, based on the DIR (direction) parameter. Then, the bit pointed to by the new step number is set to 1.

### STEP Input

- When the step number is being incremented and it goes outside the range of ( $1 \leq \text{step number} \leq \text{LEN}$ ), it is set back to 1.
- When the step number is being decremented and it goes outside the range of ( $1 \leq \text{step number} \leq \text{LEN}$ ), it is set to LEN.

The parameter ST is optional. If it is not used (it is left equal to its default of zero), the BITSEQ operates as described above, except that no bits are set or cleared. Basically, the BITSEQ then just cycles the current step number through its legal range.

## DIR (Direction) Input

The direction of bit rotation can be changed by turning the DIR input on or off. If on, the bit is incremented through the array. If off, the bit is decremented.

## ST (Starting Address) Input and LEN (Length) Parameter

The ST input contains a memory location for the starting address of the sequencer array. The length of the array, in bits, is set by the LEN parameter. For example, if ST is %M0001 and LEN equals 16, the array is composed of %M0001 through %M0016. If ST is a %R address, then LEN determines how many consecutive bits in %R memory are included in the array. For example, if ST is %R0004, and LEN equals eight, only the first eight bits of register %R will be used in the array; the last eight bits of %R0004 will be ignored by the Bit Sequencer.

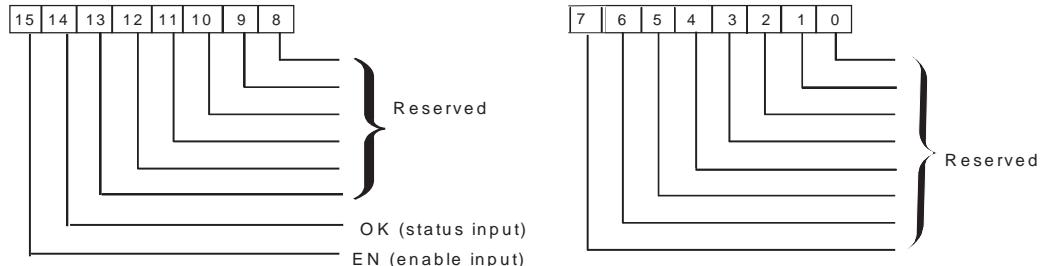
## Control Block Memory Required for a Bit Sequencer

Each bit sequencer uses three words (registers) of %R memory to store the following information:

current step number	word 1
length of sequence (in bits)	word 2
control word	word 3

When you program a bit sequencer with Logicmaster, you must enter a beginning address for these three words (registers) directly below the graphic representing the function (see example on next page).

The control word stores the state of the Boolean inputs and outputs of its associated function block, as shown in the following format:



### Note

Bits 0 through 13 are not used in the Control Block. Also, note that bits need to be entered as 1 through 16, **NOT** 0 through 15 in the STEP parameter.

## Parameters

Parameter	Description
address	Address is the location of the bit sequencer's current step, length, and the last enable and ok statuses.
enable	When the function is enabled, if it was not enabled on the previous sweep and if R is not energized, the bit sequence shift is performed.
R	When R is energized, the bit sequencer's step number is set to the value in STEP (default = 1), and the bit sequencer is filled with zeros, except for the current step number bit.
DIR	When DIR is energized, the bit sequencer's step number is incremented prior to the shift. Otherwise, it is decremented.
STEP	When R is energized, the step number is set to this value.
ST	ST contains the first word of the bit sequencer.
ok	The ok output is energized whenever the function is enabled.
LEN	LEN must be between 1 and 256 bits.

### Note

Coil checking for the BITSEQ function checks 16 bits from the ST parameter, even when LEN is less than 16.

## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
address								•				
enable	•											
R	•											
DIR	•											
STEP		•	•	•	•		•	•	•	•	•	•
ST		•	•	•	•	•†	•	•	•	•		•
ok	•											•

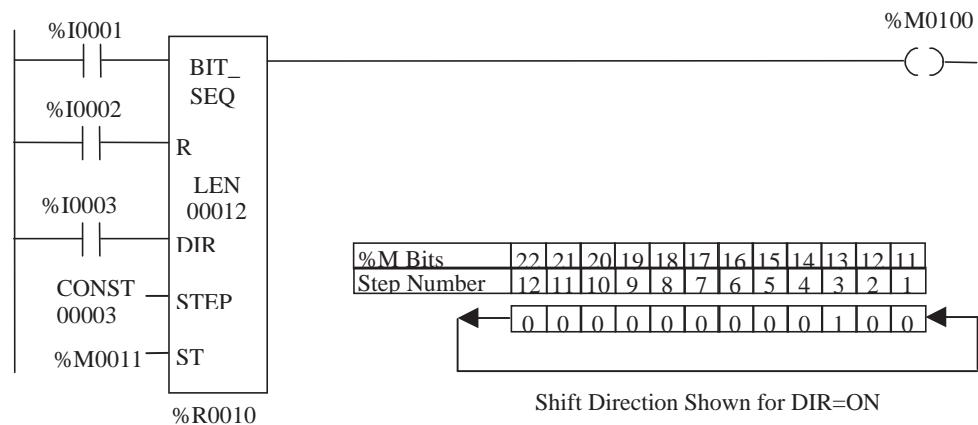
• Valid reference or place where power may flow through the function.

† SA, %SB, %SC only; %S cannot be used

## Example

In the following example, the Bit Sequencer operates on bits %M0011 (specified in the ST input) through %M0022 (since LEN equals twelve). Its three-word control block is stored in registers %R0010, %R0011, and %R0012. When %I0002 (on the R input) is on, the sequencer is reset, which means that the bit for step three (specified in the STEP input) will be set to logic one and all other bits will be set to zero.

When %I0001 goes to logic 1 (with %I0002 off), the bit for step number 3 is cleared and either the bit for step number 4 will be set if DIR is on, or the bit for step number 2 will be set if DIR is off.



## COMMREQ

Use the Communication Request (COMMREQ) function if the program needs to communicate with an intelligent module, such as a Genius Communications Module or a Programmable Coprocessor Module.

### Note

The information presented on the following pages shows the general format of the COMMREQ function. You will need additional information to program the COMMREQ for each type of device. Programming requirements for each module that uses the COMMREQ function are described in the module's documentation.

The COMMREQ function has three input parameters and one output parameter. When the COMMREQ function receives power flow, a command block of data is sent to the intelligent module. The command block begins at the reference specified using the parameter IN. The rack and slot # of the intelligent module are specified in SYSID.

The COMMREQ may either send a message and wait for a reply, or send a message and continue without waiting for a reply. If the command block specifies that the program will not wait for a reply, the command block contents are sent to the receiving device and the program execution resumes immediately. (The timeout value is ignored.) This is referred to as **NOWAIT** mode.

If the command block specifies that the program will wait for a reply, the command block contents are sent to the receiving device and the CPU waits for a reply. The maximum length of time the PLC will wait for the device to respond is specified in the command block. If the device does not respond within that time, program execution resumes. This is referred to as **WAIT** mode.

The Function Faulted (FT) output may be set ON if:

1. The specified target (SYSID) is not present in that location.
2. The specified task (TASK) number is not valid for the targeted device
3. The data length is 0 (in the Command Block).
4. The device's status pointer address (part of the Command Block) does not exist. This may be due to an incorrect memory type selection, or an address within that memory type that is out of range.

## Command Block

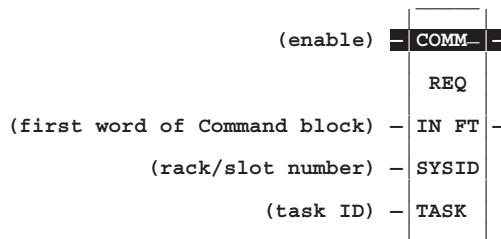
The Command Block provides information to the targeted intelligent module. It contains the command number to be performed as well as any data to be transferred.

The address of the Command Block is specified at the IN input to the COMMREQ function. This address may be in any word-oriented area of memory (%R, %AI, or %AQ). The length of the command block depends on the type of module targeted by the COMMREQ and the amount of data to be sent.

The command block has the following structure:

Length (in words)	address
Wait/No Wait Flag	address + 1
Status Pointer Memory	address + 2
Status Pointer Offset	address + 3
Idle Timeout Value	address + 4
Maximum Communication Time	address + 5
	address + 6
Data Block	to address + 133

Information required for the command block can be placed in command block memory using an appropriate programming function such as a Block Move or a series of Moves.



## Parameters

Parameter	Description
enable	While the enable input is on, the communications request is performed once per scan. If it is not desirable to send the COMMREQ multiple times, the enable input should be a contact from a Transition Coil.
IN	IN contains the starting address of the first word of the command block.
SYSID	SYSID contains the rack number (most significant byte) and slot number (least significant byte) of the targeted module.
TASK	TASK contains the task ID of the process on the targeted module.
FT	The FT (fault) output is energized if an error is detected processing the COMMREQ.

## Note

The Series 90-30 COMMREQ does **not** have an OK output.

## Valid Memory Types

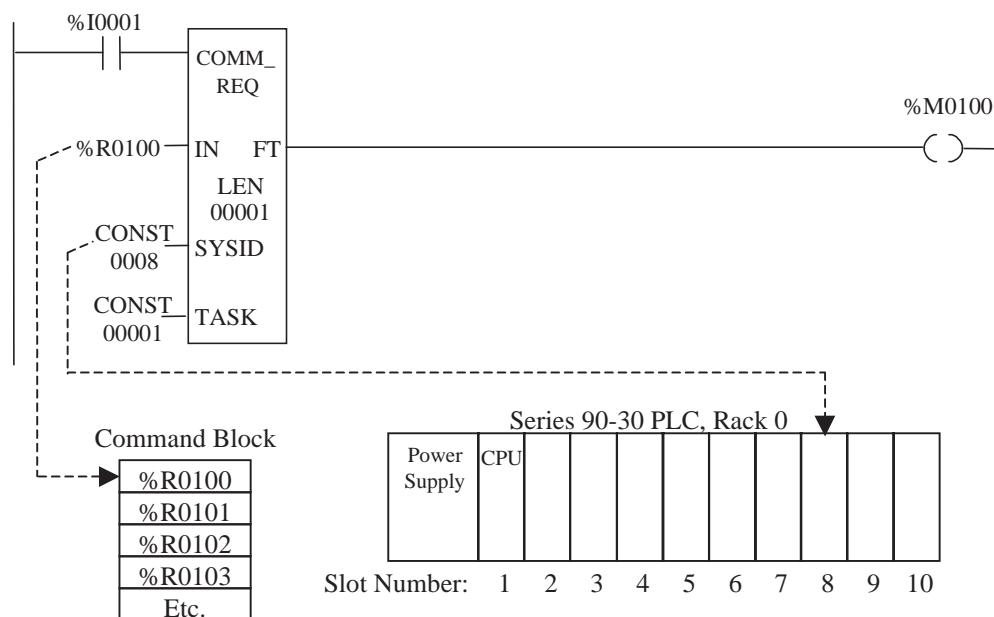
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN								•	•	•		
SYSID		•	•	•	•		•	•	•	•	•	
TASK								•	•	•	•	
FT	•											•

- Valid reference or place where power may flow through the function.

## Example

In the following example, when enable input %I0001 is on, a command block starting at %R0100 (specified at the IN input) is sent to communications task 1 (TASK input = 1) in the module located at rack 0, slot 8 (SYSID=0008) of the PLC. If an error occurs while processing the COMMREQ, the Fault (FT) output turns on, which turns on %M0100.

Notice that the address at input IN specifies the starting address of the Command Block. Also, the hex. number at SYSID specifies the rack and slot number of the targeted module; the high byte refers to the rack number and the low byte refers to the slot number. Therefore, the SYSID of 0008 in the example refers to rack 00 and slot 08, as shown. Rack 0 (zero) always refers to the main or CPU rack, so if the targeted module was in an expansion or remote rack, the high byte of SYSID would contain a non-zero number that corresponds to the configured rack number where the targeted module is located.



*Chapter  
10*

## *Table Functions*

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Table instructions are used to perform the following functions:

Abbreviation	Function	Description	Page
ARRAY_MOVE	Array Move	Copy a specified number of data elements from a source array to a destination array.	10-2
SRCH_EQ	Search Equal	Search for all array values equal to a specified value.	10-7
SRCH_NE	Search Not Equal	Search for all array values not equal to a specified value.	10-7
SRCH_GT	Search Greater Than	Search for all array values greater than a specified value.	10-7
SRCH_GE	Search Greater Than or Equal	Search for all array values greater than or equal to a specified value.	10-7
SRCH_LT	Search Less Than	Search for all array values less than a specified value.	10-7
SRCH_LE	Search Less Than or Equal	Search for all array values less than or equal to a specified value.	10-7

The maximum length allowed for these functions is 32,767 bytes or words, or 262,136 bits (bits are available for ARRAY\_MOVE only).

Table functions operate on these types of data:

Data Type	Description
INT	Signed integer.
DINT	Double precision signed integer.
BIT *	Bit data type.
BYTE	Byte data type.
WORD	Word data type.

\* Only available for ARRAY\_MOVE.

The default data type is signed integer. The data type can be changed after selecting the specific data table function in the ladder logic software. To compare data of other types or of two different types, first use the appropriate conversion function (described in chapter 11, “Conversion Functions”) to change the data to one of the data types listed above.

## ARRAY\_MOVE (INT, DINT, BIT, BYTE, WORD)

### Arrays and Data Elements Defined

For the purpose of this discussion, an **array** is a grouping of contiguous addressable PLC memory, such as %R0100 through %R0120. A **data element** is the data held in one unit of array memory. For example, if an array is a Bit type, then each data element is held in a single bit of memory, such as %M0001 (or it could be a single bit in register-type memory). Or, if an array is a Word type, then each data element is held in a 16-bit word of memory, such as %R0100 (or it could be 16 consecutive %I bits). See the “Valid Memory Types” table for more information on this.

### Index Numbers

Each data element of an array has a reference number called an **index** number, which is automatically assigned by the PLC. The index number indicates the data element’s position in the array. The data elements are numbered in ascending order, starting with the lowest memory address in the array, which is assigned index number one.

For example, the following Word-type array has a starting address of %R0105. It has ten data elements, whose index numbers are 1 through 10.

Address	Index No.
%R0105	1
%R0106	2
%R0107	3
%R0108	4
%R0109	5
%R0110	6
%R0111	7
%R0112	8
%R0113	9
%R0114	10

### The Array Move Instruction

Use the Array Move function to copy a specified number of data elements from a source array to a destination array. Each array referenced by an Array Move instruction has an equal number of data elements. The Array Move allows the relative locations involved in the move to be different between the source and destination arrays. For example, three data elements, starting at index 5 in the source array, may be copied to three data elements in the destination array starting at index 7.

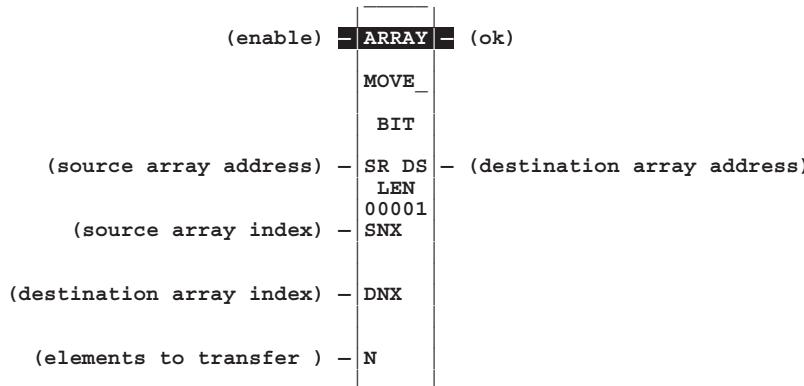
The ARRAY\_MOVE function has five input parameters and two output parameters. When the function is enabled, the number of data elements in the count indicator (N) are copied from the input array starting with the indexed location specified at the SNX input. The data elements are written to the output array starting with the indexed location specified at DNX. The LEN operand specifies the number of elements that make up each array.

For ARRAY\_MOVE\_BIT, when word-oriented memory is selected for the parameters of the source array and/or destination array starting address, the least significant bit of the specified word is the first bit of the array. The value displayed on the Logicmaster screen contains 16 bits, regardless of the length of the array.

The indices in an ARRAY\_MOVE instruction are 1-based. In using an ARRAY\_MOVE, no element outside either the source or destination arrays (as specified by their starting address and length) may be referenced.

The ok output will receive power flow, unless one of the following conditions occurs:

- Enable is OFF.
- (N + SNX – 1) is greater than LEN. This formula is used by the PLC to ensure that no element outside the source array is referenced.
- (N + DNX – 1) is greater than LEN. This formula is used by the PLC to ensure that no element outside the destination array is referenced.
- SNX or DXN = 0.



## Parameters

Parameter	Description
enable	When the enable input is on, the Array Move operation is performed.
SR	SR contains the starting address of the source array. For ARRAY_MOVE_BIT, any reference may be used; it does not need to be byte aligned. However, 16 bits, beginning with the reference address specified, are displayed on the Logicmaster screen.
SNX	SNX contains the index number in the source array of the first data element to be copied.
DNX	DNX contains the index number in the destination array of the first element to be copied to.
N	The number of data elements to be copied.
ok	The ok output is energized whenever enable is energized.
DS	DS contains the starting address of the destination array. For ARRAY_MOVE_BIT, any reference may be used; it does not need to be byte aligned. However, 16 bits, beginning with the reference address specified, are displayed online.
LEN	LEN specifies the number of data elements, starting at SR and DS, that make up each array.

## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
SR		o	o	o	o	Δ†	o	•	•	•		
SNX		•	•	•	•		•	•	•	•	•	
DNX		•	•	•	•		•	•	•	•	•	
N		•	•	•	•		•	•	•	•	•	
ok	•											•
DS		o	o	o	o	†	o	•	•	•		

• Valid reference or place where power may flow through the function.

For ARRAY\_MOVE\_BIT, discrete user references %I, %Q, %M, and %T need not be byte aligned.

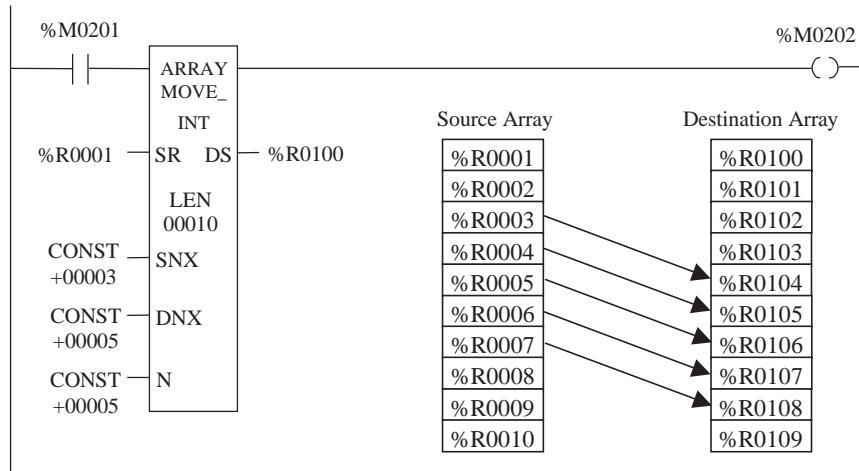
o Valid reference for INT, BIT, BYTE, or WORD data only; not valid for DINT.

Δ Valid data type for BIT, BYTE, or WORD data only; not valid for INT or DINT.

† %SA, %SB, %SC only; %S cannot be used.

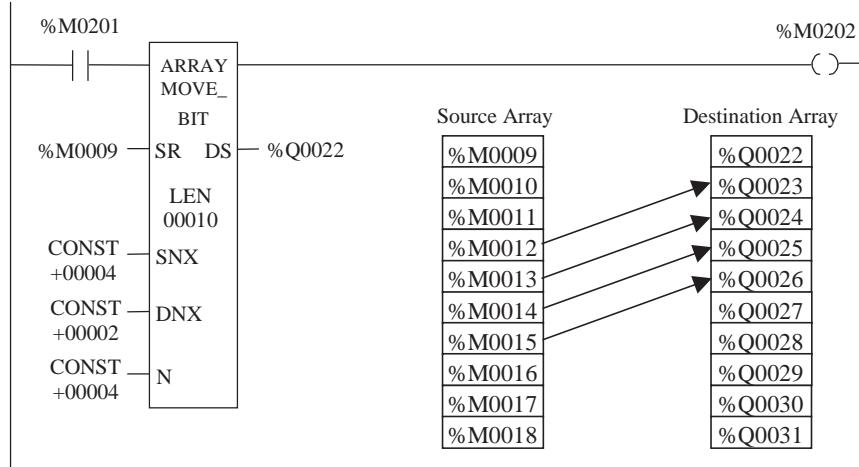
## Example 1

In this example, both arrays are INT types that are 10 elements (integers) long, specified by LEN=10. Their starting addresses are specified at SR and DS. When enable contact %M0201 is on, five data elements (specified by N=5) are copied from the source array to the destination array. The five copied data elements of the source array start with index number 3, since SNX=3. The locations copied to in the destination array start with index number 5, since DNX=5. So %R0003 through %R0007 of the source array are read and then copied into %R0104 through %R0108 of the destination array.



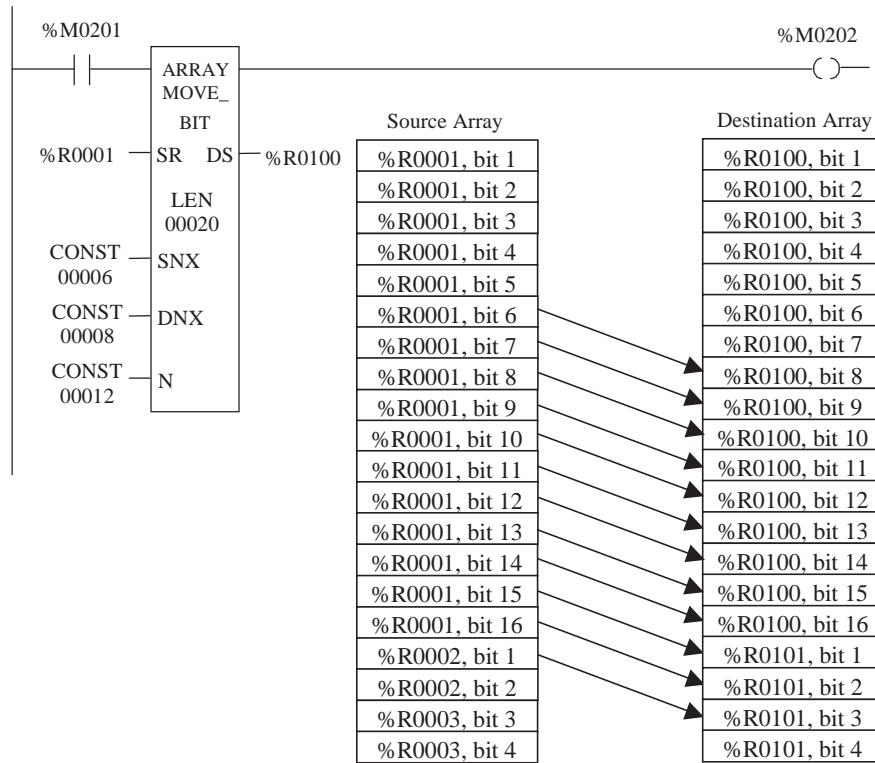
## Example 2

In this example, both arrays are BIT types that are 10 elements (bits) long, specified by LEN=10. Their starting addresses are specified at SR and DS. When enable contact %M0201 is on, four data elements (specified by N=4) are copied from the source array to the destination array. The four copied data elements of the source array start with index number 4, since SNX=4. The locations copied to in the destination array start with index number 2, since DNX=2. So %M0012 through %M0015 of the source array are read and then copied into %Q0023 through %Q0026 of the destination array.



## Example 3

In this example, both arrays are BIT types that are 20 elements (bits) long, specified by LEN=20. Their starting addresses are specified at SR and DS. When enable contact %M0201 is on, 12 data elements (specified by N=12) are copied from the source array to the destination array. The 12 copied data elements of the source array start with index number 6, since SNX=6. The locations copied to in the destination array start with index number 8, since DNX=8. So %R0001, bit 6 through %R0002, bit 1 of the source array are read and then copied into %R0100, bit 8 through %R0101, bit 3 of the destination array.



## Search Functions

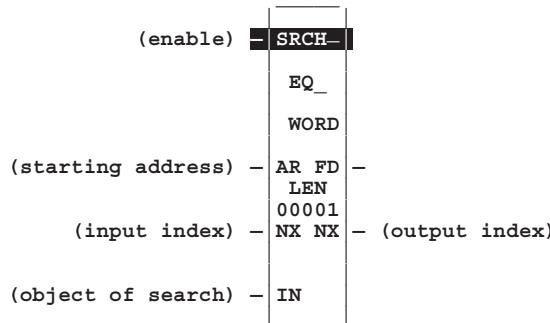
Use the appropriate Search function listed below to search for all array values for that particular operation.

Abbreviation	Function	Description
SRCH_EQ	Search Equal	Search for all array values equal to a specified value.
SRCH_NE	Search Not Equal	Search for all array values not equal to a specified value.
SRCH_GT	Search Greater Than	Search for all array values greater than a specified value.
SRCH_GE	Search Greater Than or Equal	Search for all array values greater than or equal to a specified value.
SRCH_LT	Search Less Than	Search for all array values less than a specified value.
SRCH_LE	Search Less Than or Equal	Search for all array values less than or equal to a specified value.

Each function has four input parameters and two output parameters. When the function receives power, the array is searched starting at (AR + input NX). This is the starting address of the array (AR) plus the index into this array (input NX).

The search continues until the array element of the search object (IN) is found or until the end of the array is reached. If an array element is found, output parameter (FD) is set ON and output parameter (output NX) is set to the relative position of this element within the array. If no array element is found before the end of the array is reached, then output parameter (FD) is set OFF and output parameter (output NX) is set to zero.

The valid values for input NX are 0 to LEN — 1. NX should be set to zero to begin searching at the first element. This value increments by one at the time of execution. Therefore, the values of output NX are 1 to LEN. If the value of input NX is out-of-range, (< 0 or  $\geq$  LEN), its value is set to the default value of zero.



## Parameters

Parameter	Description
enable	When the enable input is on, the operation is performed.
AR	AR contains the starting address of the array to be searched (the target array).
Input NX	Input NX contains an index number (in the target array) where the search is to begin.
IN	IN contains the object to be searched for.
Output NX	If the object of the search is found, its location in the array (its index number) will be written here.
FD	This output turns on to indicate that the searched for object has been found in the array.
LEN	LEN specifies the number of elements starting at AR that make up the array to be searched. It may be 1 to 32,767 bytes or words.

## Valid Memory Types

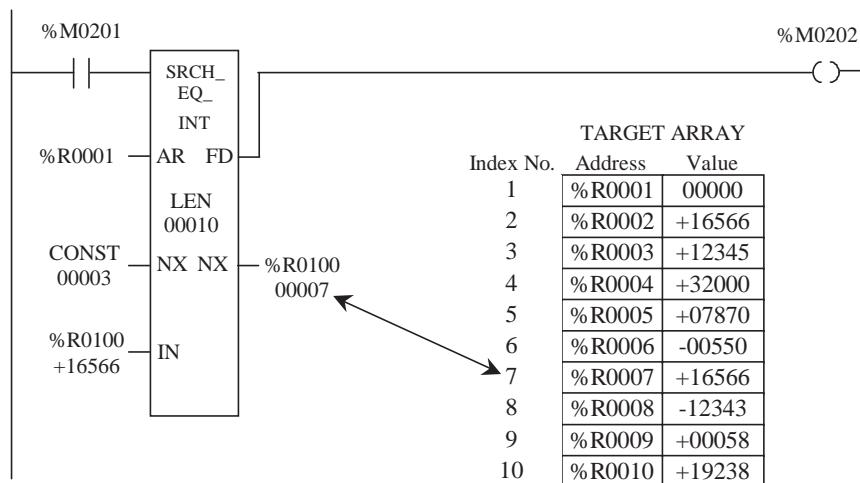
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
AR		o	o	o	o	Δ	o	•	•	•		
NX in		•	•	•	•		•	•	•	•	•	
IN		o	o	o	o	Δ	o	•	•	•	•	
NX out		•	•	•	•		•	•	•	•		
FD	•											•

- Valid reference or place where power may flow through the function.
- o Valid reference for INT, BYTE, or WORD data only; not valid for DINT.
- Δ Valid reference for BYTE or WORD data only; not valid for INT or DINT.

## Example 1

The SRCH\_EQ function (INT type) in this example searches the block of memory that starts at %R0001 (specified at AR) and continues through %R0010 (LEN=10). The value to be searched for, defined at IN, is +16566. Input NX, with a value of 3, indicates that the search is to begin at the fourth data element in the array since the NX value is incremented by 1 when the function executes.

When enable contact %M0201 is on, the SRCH\_EQ function searches the specified array, starting at index number 4, for a value equal to the value at IN, +16566. It finds this value in %R0007, which has an index number of 7, so it writes the number 7 into the output NX at %R0100. It also turns on output FD, which indicates that it found the search object in the array. Note that although address %R0002 also contains the searched-for value of +16566, this data element was not included in the search because the input NX parameter value of 3 specified that the search start with the fourth data element, which is %R0004.



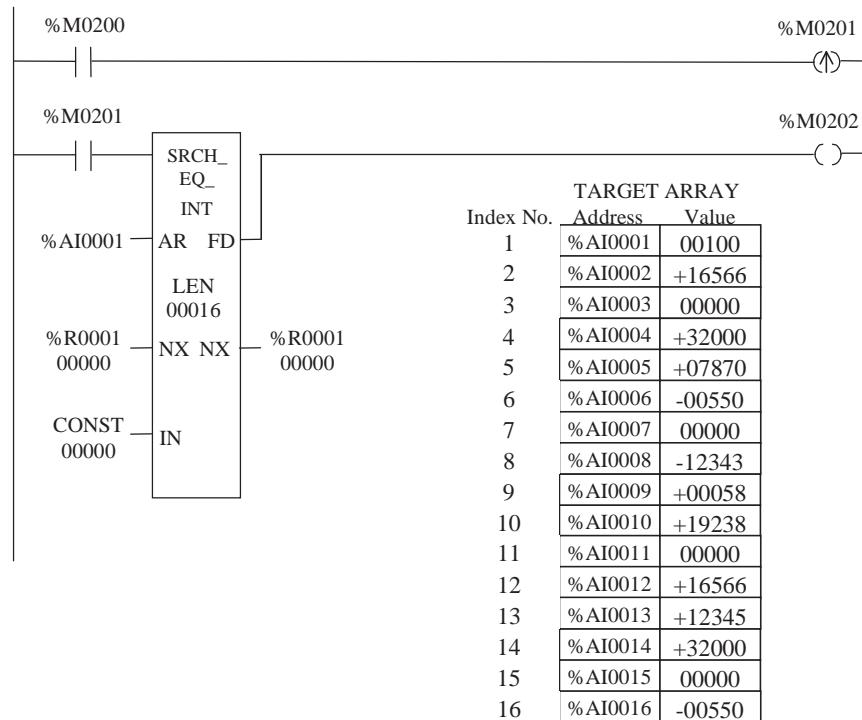
## Example 2

The array in this example starts at %AI0001 (specified at AR) and continues through %AI0016 (LEN=16). The value to be searched for, defined at IN, is +16566. The input NX, with a starting value of 0, indicates that the search is to begin at the first data element in the array since the NX value increments by 1 when the function executes.

When %M0200 closes for the first time, the function executes its first search, starting with data element 1, for a value equal to the value at IN, 00000. It finds this value in %AI0003, which has an index number of 3, so it writes the number 3 into the output NX and input NX, which both have the reference address of %R0001. It also turns on output FD, which indicates that it found the search object in the array.

When %M0200 closes the second time, the input NX value, which is now set to 3, increments by 1, so the second search begins at the fourth array element, %AI0004. The target value of 00000 is now found in %AI0007, the seventh data element, so the number 7 is written to %R0001. Each succeeding search follows this pattern, until the fifth search, in which no target is found. Since no target is found, a 0 is written to %R0001, which will ensure that the search will start at the beginning of the array the next time the search is initiated.

Search No.	Search Starts at Data Element	Search Results (in %R0001)
1	1	3
2	4	7
3	8	11
4	12	15
5	16	0



*Chapter*  
**11**

## *Conversion Functions*

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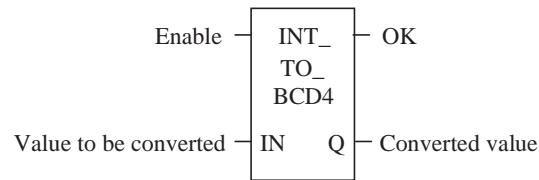
Use the conversion functions to convert a data item from one number type to another. Many programming instructions, such as math functions, must be used with data of one type. This section describes the following conversion functions:

Abbreviation	Function	Description	Page
BCD-4	Convert to BCD-4	Convert a signed integer to 4-digit BCD format.	11-2
INT	Convert to Signed Integer	Convert BCD-4 or REAL to signed integer.	11-3
DINT	Convert to Double Precision Signed Integer	Convert REAL to double precision signed integer format.	11-5
REAL	Convert to REAL	Convert INT, DINT, BCD-4, or WORD to REAL.	11-7
WORD	Convert to WORD	Convert REAL to WORD format.	11-9
TRUN	Truncate	Round the real number toward zero.	11-11

## →BCD-4 (INT)

The Convert to BCD-4 function is used to output the 4-digit BCD equivalent of signed integer data. The original data is not changed by this function. Data can be converted to BCD format to drive BCD-encoded LED displays or presets to external devices such as high-speed counters.

When the function receives power flow, it performs the conversion, making the result available via output Q. The function passes power flow when power is received, unless the specified conversion would result in a value that is outside the range 0 to 9999.



### Parameters

Parameter	Description	
enable	When the function is enabled, the conversion is performed.	
IN	IN contains a reference for the integer value to be converted to BCD-4.	
ok	The ok output is energized when the function is performed without error.	
Q	Output Q contains the BCD-4 form of the original value in IN.	

### Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN		•	•	•	•		•	•	•	•		•
ok	•											•
Q		•	•	•	•		•	•	•	•		

- Valid reference or place where power may flow through the function.

### Example

In the following example, when input %I0002 is set and no errors exist, the integer at input location %M0017 through %M0032 is converted to four BCD digits, and the result is stored in memory locations %Q0033 through %Q0048. Coil %M0032 turns on to verify successful conversion.



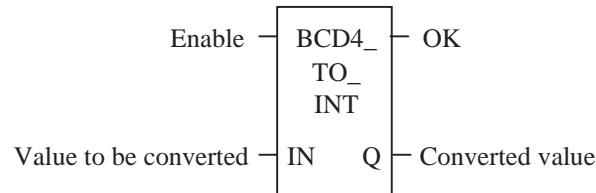
## —>INT (BCD-4, REAL)

The Convert to Signed Integer function is used to output the integer equivalent of BCD-4 or REAL data. The original data is not changed by this function.

### Note

The REAL data type is only available on 35x and 36x series CPUs, Release 9 or later, and on all releases of CPU352 and CPU37x.

When the function receives power flow, it performs the conversion, making the result available via output Q. The function always passes power flow when power is received, unless the data is out of range.



## Parameters

Parameter	Description	
enable	When the enable input is on, the conversion is performed.	
IN	IN contains a reference for the BCD-4, REAL, or Constant value to be converted to integer.	
ok	The ok output is energized whenever enable is energized, unless the data is out of range or NaN (Not a Number).	
Q	Output Q contains the integer form of the original value in IN.	

## Valid Memory Types

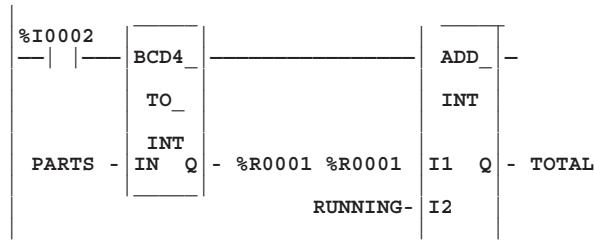
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN		•	•	•	•		•	•	•	•	•	
ok	•											•
Q		•	•	•	•		•	•	•	•		

**Note:** For REAL data, the only valid types are %R, %AI, and %AQ.

• Valid reference or place where power may flow through the function.

## Example 1 – BCD4 to Integer

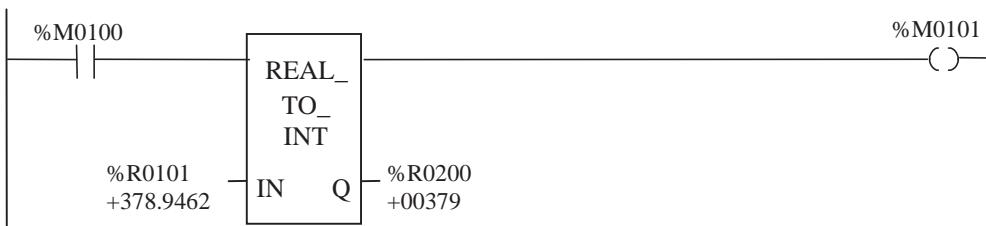
In the following example, whenever input %I0002 is set, the BCD-4 value in PARTS is converted to a signed integer and placed in %R0001. In the following ADD function, %R0001 is added to the signed integer value represented by the reference RUNNING. The sum is output by the ADD function to the reference TOTAL.



## Example 2 – Real to Integer

This example shows conversion of a real number at %R0101 to an integer number at %R0200. When the enable input contact %M0100 is on, the conversion takes place. Note that during the conversion, the real number is rounded to the nearest integer. If the decimal portion of the real number is 0.5 or greater, the resulting integer is rounded up by a value of 1. If the decimal portion of the real number is less than 0.5, this decimal portion is discarded and the integer number is not rounded up. In the example below, real value 378.9462 is rounded up to integer value 379.

If rounding is not wanted, use the REAL\_TRUN\_INT function, which truncates the decimal portion of the real number, regardless of its value, during the conversion.



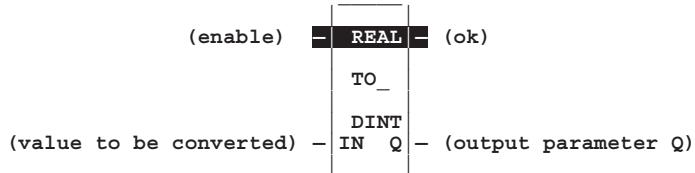
## —>DINT (REAL)

The Convert to Double Precision Signed Integer function is used to output the double precision signed integer equivalent of real data. The original data is not changed by this function.

### Note

The REAL data type is only available on 35x and 36x series CPUs, Release 9 or later, and on all releases of CPU352 and CPU37x.

When the function receives power flow, it performs the conversion, making the result available via output Q. The function always passes power flow when power is received, unless the real value is out of range.



## Parameters

Parameter	Description	
enable	When the function is enabled, the conversion is performed.	
IN	IN contains a reference for the value to be converted to double precision integer.	
ok	The ok output is energized whenever enable is energized, unless the real value is out of range.	
Q	Q contains the double precision signed integer form of the original value in IN.	

### Note

It is possible for a loss of precision to occur when converting from REAL to DINT since the REAL has 24 significant bits.

## Valid Memory Types

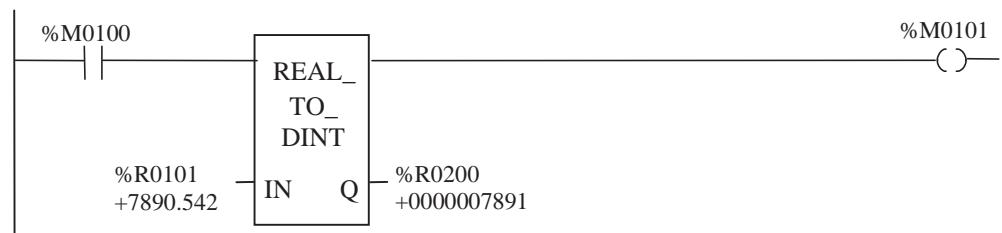
Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN		o	o	o	o		o	•	•	•	•	
ok	•											•
Q								•	•	•		

- Valid reference or place where power may flow through the function.

## Example

In the following example, whenever enable input %M0100 is on, the real value at input location %R0101 is converted to a double precision signed integer, and the result is placed in location %R0200. Note that during the conversion, the real number is rounded to the nearest integer. If the decimal portion of the real number is 0.5 or greater, the resulting integer is rounded up by a value of 1. If the decimal portion of the real number is less than 0.5, this decimal portion is discarded and the integer number is not rounded up. In the example below, real value 7890.542 is rounded up to double integer value 7891.

If rounding is not wanted, use the REAL\_TRUN\_DINT function, which truncates the decimal portion of the real number, regardless of its value, during the conversion.



## —>REAL (INT, DINT, BCD-4, WORD)

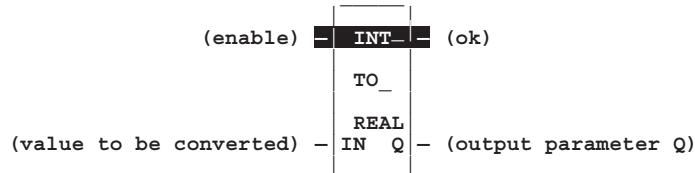
The Convert to Real function is used to output the real value of the input data. The original data is not changed by this function.

When the function receives power flow, it performs the conversion, making the result available via output Q. The function passes power flow when power is received, unless the specified conversion would result in a value that is out of range.

It is possible for a loss of precision to occur when converting from DINT to REAL since the number of significant bits is reduced to 24.

### Note

This function is only available on 35x and 36x series CPUs, Release 9 or later, and on all releases of CPU352 and CPU37x.



## Parameters

Parameter	Description	
enable	When the function is enabled, the conversion is performed.	
IN	IN contains a reference for the integer value to be converted to REAL.	
ok	The ok output is energized when the function is performed without error.	
Q	Q contains the REAL form of the original value in IN.	

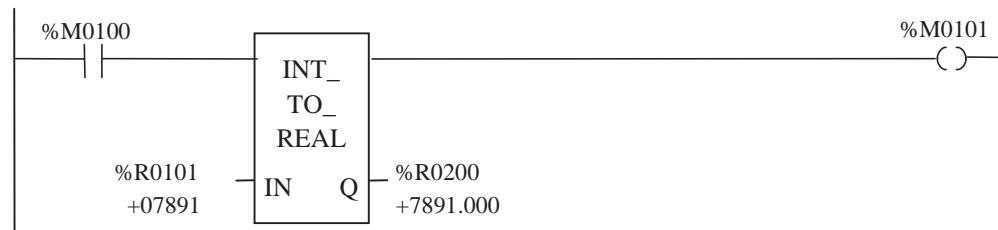
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN		o	o	o	o		o	•	•	•	•	
ok	•											•
Q								•	•	•		

- Valid reference or place where power may flow through the function.
- o Not valid for DINT\_TO\_REAL.

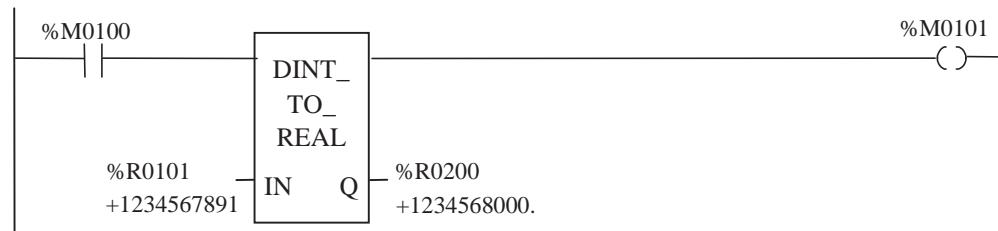
## Example 1 - Integer to Real Conversion

In the following example, the integer value of input IN is +07891. The resulting value placed in %R0200 after the conversion to real format is +7891.000.



## Example 2 – Double Integer to Real Conversion

In the following example, the double integer value of input IN is +1234567891. The resulting value placed in %R0200 after the conversion to real format is +1234568000. Note that a double integer number has 10 significant places, but a real number has only 7 significant places; therefore, an integer number is rounded to 7 significant places during the conversion to a real number. In the example shown, the four least significant digits, 7891, of the double integer number are rounded to 8000 in the four least significant digits of the real number.



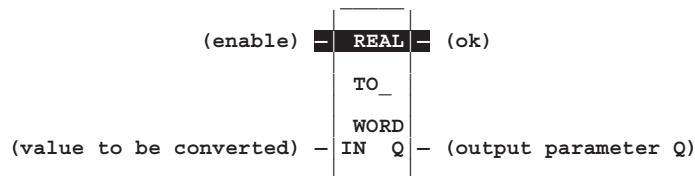
## —>WORD (REAL)

The Convert to WORD function is used to output the WORD equivalent of real data. The original data is not changed by this function.

### Note

This function is only available on the 35x, 36x, and 37x series CPUs.

When the function receives power flow, it performs the conversion, making the result available via output Q. The function passes power flow when power is received, unless the specified conversion would result in a value that is outside the range 0 to FFFFh.



## Parameters

Parameter	Description	
enable	When the function is enabled, the conversion is performed.	
IN	IN contains a reference for the value to be converted to WORD.	
ok	The ok output is energized when the function is performed without error.	
Q	Q contains the unsigned integer form of the original value in IN.	

## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN								•	•	•	•	
ok	•											•
Q		•	•	•	•		•	•	•	•		

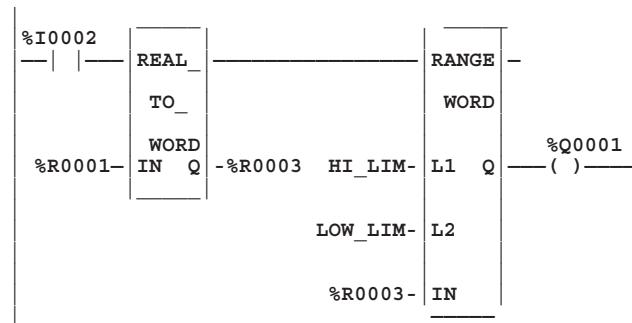
- Valid reference or place where power may flow through the function.

## Example – Real to Word Conversion

In this example, since the RANGE function is not available as a REAL type, the real value in %R0001 is first converted to a word value (at %R0003), which is then used as the input to the following RANGE WORD function.

The table below shows the values at the various inputs and outputs for the following figure.

Item	Value or State
%R0001	15767.83
%R0003	3A89h (15,768 decimal)
HI LIM	4E20h (20,000 decimal)
LOW LIM	2710h (10,000 decimal)
Q1	ON



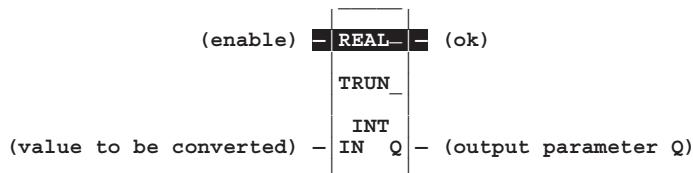
## TRUN (INT, DINT)

The Truncate function is used to round a real number toward zero. During the conversion, all numbers to the right of the decimal place are discarded in the output number. The original number is not changed by this function.

### Note

The 35x and 36x series CPUs (Release 9.00 or later and all releases of CPU352), and 37x are the only Series 90-30 CPUs with floating point capability; therefore, the TRUN function has no applicability for other 90-30 CPUs.

When the function receives power flow, it performs the conversion, making the result available via output Q. For CPU 352, the function passes power flow when power is received, unless the specified conversion would result in a value that is out of range or unless IN is NaN (Not a Number). For all other 35x and 36x/37x series CPUs, the function does *not* pass power.



## Parameters

Parameter	Description
Enable	When the function is enabled, the conversion is performed.
IN	IN contains a reference for the real value to be truncated.
Ok	The ok output is energized when the function is performed without error, unless the value is out of range or IN is NaN.
Q	Q contains the truncated INT or DINT value of the original value in IN.

### Note

It is possible for a loss of precision to occur when converting from REAL to DINT since the REAL has 24 significant bits.

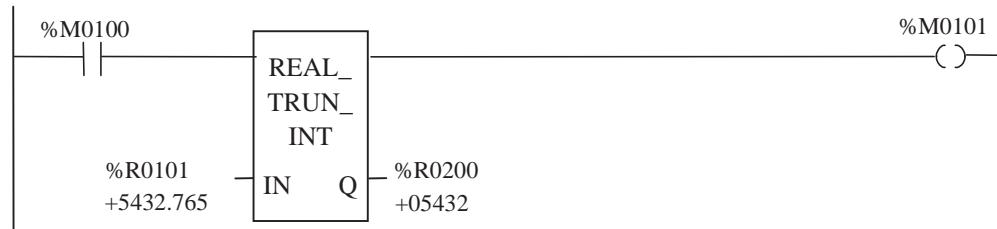
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
IN								•	•	•	•	
ok	•											•
Q		o	o	o	o		o	•	•	•		

- Valid reference or place where power may flow through the function.
- o Valid for REAL\_TRUN\_INT only.

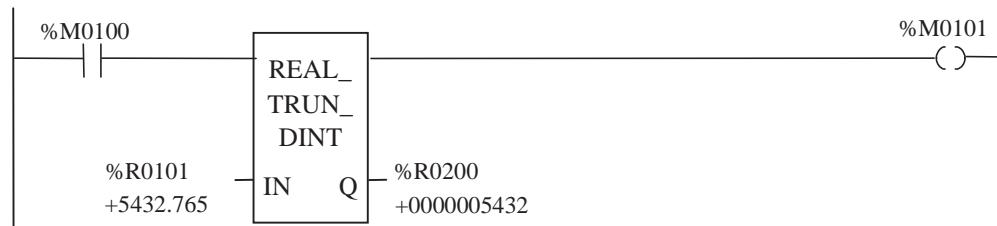
## Example 1 – Truncate Real to Integer with Output Coil for CPU352

In the following example, the value at %R0101 is truncated (the decimal portion is discarded) and the resulting integer value of +05432 is placed into %R0200. If a CPU352 were used, %M0101 would turn on, indicating a successful conversion. If any other 35x, 36x, or 37x CPU is used, no power flow is produced at the OK output, so no output coil would be programmed.



## Example 2 – Truncate Real to Double Integer with Output Coil for CPU352

In the following example, the value at %R0101 is truncated (the decimal portion is discarded) and the resulting double integer value of +0000005432 is placed into %R0200. If a CPU352 were used, %M0101 would turn on, indicating a successful conversion. If any other 35x, 36x, or 37x CPU is used, no power flow is produced at the OK output, so no output coil would be programmed.



*Chapter*  
**12**

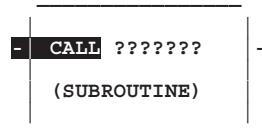
## *Control Functions*

This chapter describes the control functions, which can be used to limit program execution and alter the way the CPU executes the application program. Refer to Chapter 2, section 1, “PLC Sweep Summary,” for information on the CPU sweep.

Function	Description	Page
CALL	Causes program execution to go to a specified subroutine block.	12-2
DOIO	For one sweep, immediately services a specified range of inputs or outputs. (All inputs or outputs on a module are serviced if any reference locations on that module are included in the DO I/O function. Partial I/O module updates are not performed.) Optionally, a copy of the scanned I/O can be placed in internal memory, rather than the real input points.	12-3
SER	Sequential Event Recorder— collects a series of samples. A function control block contains user-supplied configuration of function block execution, sample configuration and operation parameters.	12-8
END	Provides a temporary end of logic. The program executes from the first rung to either the last rung or the END instruction, whichever is encountered first. This instruction is useful for debugging purposes, but it is not permitted in SFC programming (refer to the Note on page 12-8).	12-23
MCR and MCRN	Programs a Master Control Relay. An MCR causes all rungs between the MCR and its subsequent ENDMCR to be executed without power flow. Logicmaster 90-30/20/Micro software supports two forms of the MCR function, a nested form (MCRN) and a non-nested form (MCR).	12-24
ENDMCR and ENDMCRN	Indicates that the subsequent logic is to be executed with normal power flow. Logicmaster 90-30/20/Micro software supports two forms of the ENDMCR function, a nested form (ENDMCRN) and a non-nested form (ENDMCR).	12-30
JUMP and JUMPN	Causes program execution to jump to a specified location (indicated by a LABEL, see below) in the logic. Logicmaster 90-30/20/Micro software supports two forms of the JUMP function, a non-nested form (JUMP) and a nested form (JUMPN).	12-31
LABEL and LABELN	Specifies the target location of a JUMP instruction. Logicmaster 90-30/20/Micro software supports two forms of the LABEL function, a non-nested form (LABEL) and a nested form (LABELN).	12-33
COMMENT	Places a comment (rung explanation) in the program. After programming the instruction, the text can be typed in by “zooming” into the instruction (use F10 key to zoom).	12-34
SVCREQ	Requests a special PLC service. (See list of service requests on page 12-35.)	12-35
PID	Provides two PID (proportional/integral/derivative) closed-loop control algorithms: • Standard ISA PID algorithm (PIDISA). • Independent term algorithm (PIDIND).	12-70

## CALL

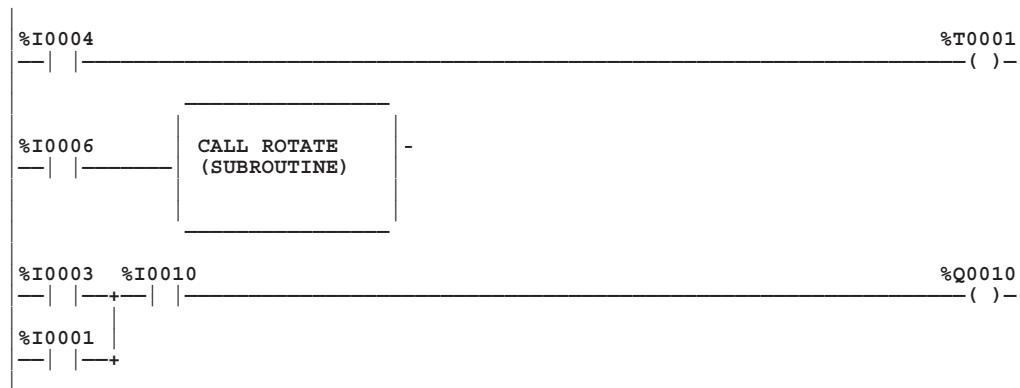
Use the CALL function to cause program execution to go to a specified subroutine block.



When the CALL function receives power flow, it causes the scan to go immediately to the designated subroutine block and execute it. After the subroutine block execution is complete, control returns to the rung in the logic immediately following the CALL instruction.

### Example

In the following example, the CALL instruction is programmed to call the subroutine named ROTATE when contact %I0006 is on. (Note that before you can enter a subroutine name in a CALL instruction, the subroutine name must already exist in the Block Declarations table.) By positioning the cursor within the CALL instruction, you can press **F10** to zoom into the subroutine to view the subroutine logic. Once a subroutine is called, program execution will branch to the subroutine, which will execute to completion, then pass program execution over to the rung following the calling rung. In the example below, the subroutine is called from the second rung, so when the subroutine finishes executing, the program scan will resume with the third rung.



### Note

Micro PLCs do not accommodate subroutines; therefore, the CALL function is inappropriate for use with a Micro PLC.

## DOIO

The DO I/O (DOIO) function is used to update specified inputs or outputs for one scan while the program is running. The DOIO function can also be used to update selected I/O during the program in addition to the normal I/O scan. Under normal circumstances, the input tables are updated during the input scan portion of the PLC sweep and will not be updated again until the next sweep. The output tables are updated during the logic solution portion of the PLC sweep, but the output modules are not updated until the logic solution portion is finished. With the DO I/O function, updates of the input tables and output modules can be forced during the logic solution portion of the scan. This capability allows you to read input changes and write to outputs more quickly than is possible with the normal PLC scan. Refer to Chapter 2 for more information about the PLC sweep.

If input references are specified, the function allows the most recent values of inputs to be obtained (written to the input tables) for program logic. If output references are specified, DO I/O updates output modules based on the most current values stored in I/O memory. I/O is serviced in increments of entire I/O modules; the PLC adjusts the references, if necessary, while the function executes.

### Use with Input Modules

The DOIO function has four input parameters and one output parameter. When the function receives power flow and input references are specified, the input points at the starting reference (ST) and ending at END are scanned. If a reference is specified for ALT, a copy of the new input values is placed in memory, beginning at that reference, and the applicable input table is not updated. ALT must be the same size as the reference type scanned. If a discrete reference is used for ST and END, then ALT must also be discrete. If no reference is specified for ALT, the applicable input table is updated.

### Use with Output Modules

When the DOIO function receives power flow and output references are specified, the output points at the starting reference (ST) and ending at END are written to the output modules. If outputs should be written to the output modules from internal memory, other than %Q or %AQ, the beginning reference can be specified for ALT. The range of outputs written to the output modules is specified by the starting reference (ST) and the ending reference (END).

Execution of the function continues until either all inputs in the selected range have reported, or all outputs have been serviced on the I/O modules. Program execution then returns to the next function following the DO I/O.

### Use with Option Modules

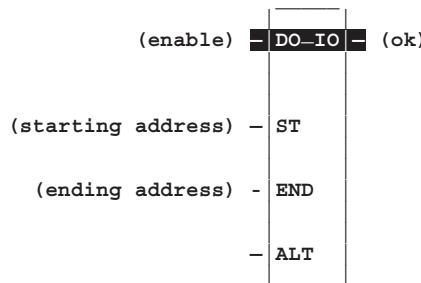
If the range of references includes an option module (HSC, APM, etc.), then all of the input data (%I and %AI) or all of the output data (%Q and %AQ) for that module will be scanned. The ALT parameter is ignored while scanning option modules. Also, if it is desired to use the DOIO with an Enhanced GCM module (IC693CMM302), the requirement in the following note must be met.

#### Note

The DOIO function **can only** be used with an Enhanced GCM module (IC693CMM302) in systems with Release 9.0 and later CPUs.

The function passes power to the right whenever power is received, unless:

- Not all references of the type specified are present within the selected range.
- The CPU is not able to properly handle the temporary list of I/O created by the function.
- The range specified includes I/O modules that are associated with a “Loss of I/O” fault.



## Parameters

Parameter	Description
enable	When the enable input is on, a limited input or output scan is performed.
ST	ST is the starting address of a group of input or output points or words to be serviced.
END	END is the ending address of the group of input or output points or words to be serviced.
ALT	For the input scan, ALT specifies the address to store scanned input point/word values. For the output scan, ALT specifies the address to get output point/word values from to send to the I/O modules. For Model 331 and later CPUs, the ALT parameter can have an effect on speed of DOIO function block execution (see Note below and the section on the enhanced DO I/O function for 331 and later CPUs later in this chapter). <b>If the ALT function is not used, this input should be left blank; if a constant value of 0 is programmed for ALT, the CPU may experience Watchdog Timeout Errors.</b>
ok	The ok output is energized when the input or output scan completes normally.

### Note

An Enhanced DOIO function is available for Model 331 and later CPUs. In the Enhanced DOIO, the ALT parameter can be used to enter the slot number of a single discrete input or output module in the main rack. This Enhanced DOIO function will execute in 80 microseconds instead of the 236 microseconds required when the DOIO is programmed without the ALT parameter. No error checking is performed to prevent overlapping reference addresses or module type mismatches. See the “Enhanced DO I/O Function” section later in this chapter for details.

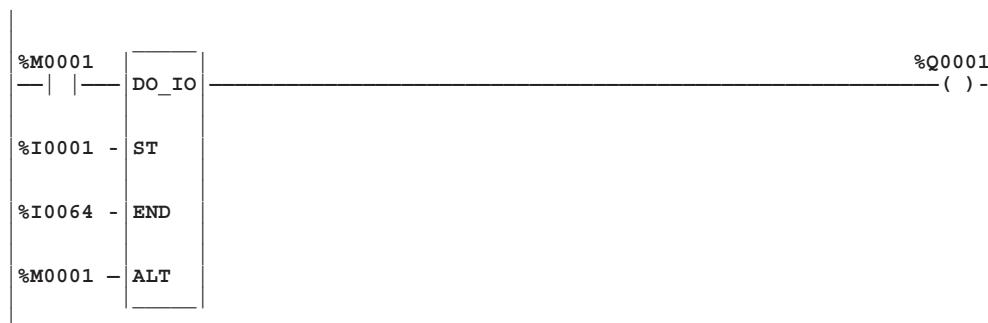
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
ST		•	•						•	•		
END		•	•						•	•		
ALT		•	•	•	•		•	•	•	•		•
ok	•											•

- Valid reference or place where power can flow through the function.

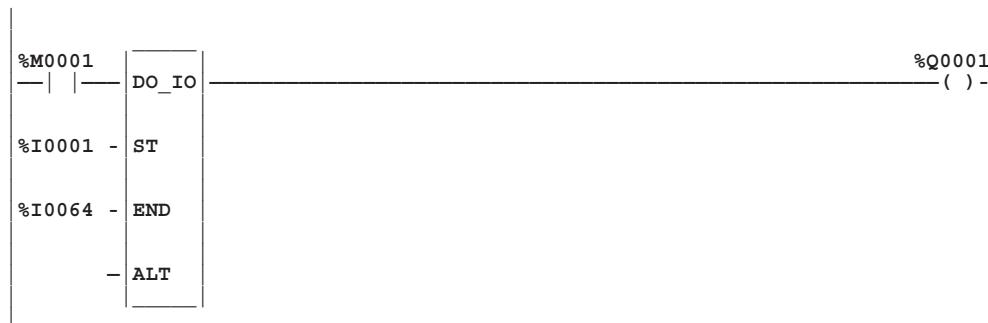
## Input Example 1

In the following example, when enabling input %M0001 turns ON, references %I0001 (specified at ST) through %I0064 (specified at END) are scanned and %Q0001 is turned on. A copy of the scanned inputs is placed in internal memory from reference %M0001 (specified at ALT) through %M0064. Because an alternate location was specified at ALT, the %I input table is not updated by the DO\_IO. This form of the function can be used to compare the current values of input points with their previous values (i.e. their values at the beginning of the logic solution scan).



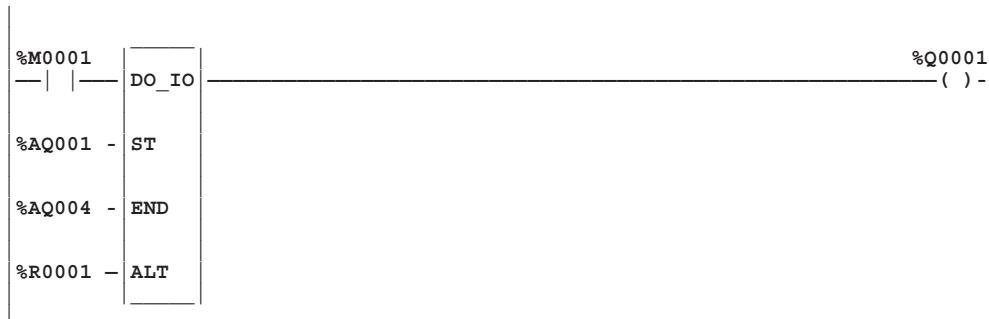
## Input Example 2

In the following example, when enabling input %M0001 is ON, references %I0001 (specified at ST) through %I0064 (specified at END) are scanned and %Q0001 is turned on. Since no alternate memory location is specified at ALT, the scanned input values are used by the DO\_IO to update the input table from reference %I0001 to %I0064. This form of the function allows input points to be scanned and updated one or more times during the logic solution portion of the CPU sweep. Note that when the ALT input is not used, it should be left blank as shown. Do not place a zero on the ALT input because that will cause Watchdog Timer faults.



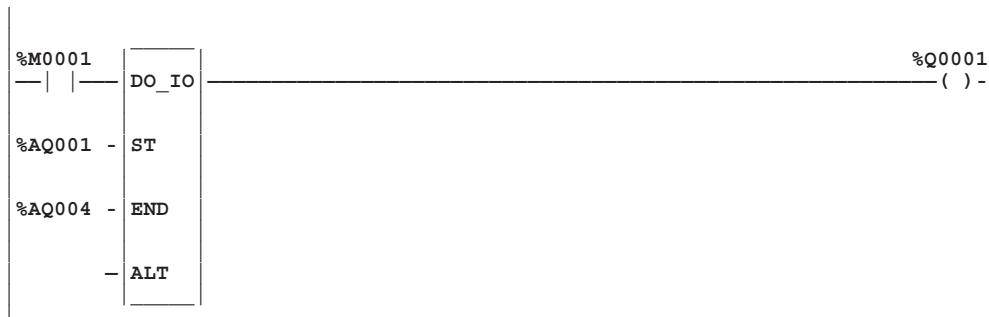
## Output Example 1

In the following example, when enabling input %M0001 is ON, the values of analog output channels %AQ001 (specified at ST) through %AQ004 (specified at END) are written to references %R0001 (specified at ALT) through %R0004 respectively, and %Q0001 is turned on. Because the %R0001 alternate location was specified at ALT, the values at %AQ001 through %AQ004 are not written to the analog output modules by the DO\_IO.



## Output Example 2

In the following example, when the enabling input %M0001 is ON, the values at references %AQ001 through %AQ004 are written to analog output channels %AQ001 through %AQ004 on the applicable analog output modules, and %Q0001 is turned on. The DO\_IO updates the analog output modules because no alternate memory location is specified at ALT. Note that when the ALT input is not used, it should be left blank as shown. Do not place a zero on the ALT input because that will cause Watchdog Timer faults.



## Enhanced DO I/O Function for 331 and Later CPUs

### Caution

**Programs containing an Enhanced DO I/O should not be loaded by a version of Logicmaster 90-30/20 software earlier than 4.01.**

An enhanced version of the DO I/O (DOIO) function is available for Release 4.20 or later, of Models 331 and later CPUs. This enhanced version of the DOIO function can only be used on a single discrete input or discrete output 8-point, 16-point, or 32-point module.

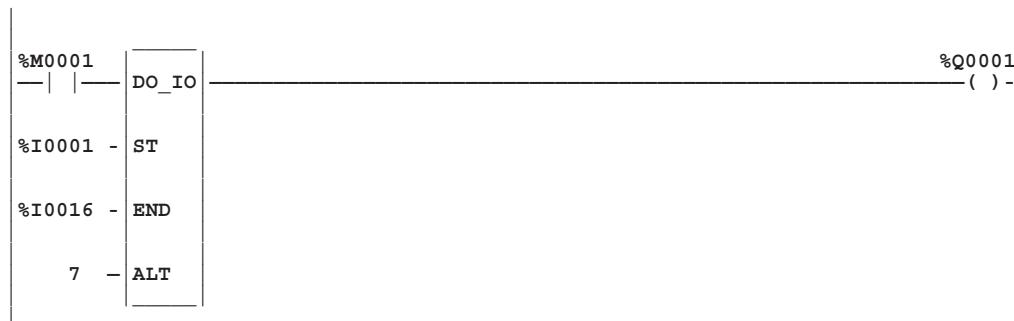
The ALT parameter identifies the slot in the main rack of the target module. For example, a constant value of 2 at ALT indicates that the module in slot 2 is targeted. The ST and END parameters set the range of memory to be acted upon.

### Note

The only checking associated with the enhanced DOIO function block is a basic check of the target module's condition.

The enhanced DOIO function only applies to modules located in a modular CPU rack. Therefore, the ALT parameter must be between 2 and 5 for a 5-slot rack or 2 and 10 for a 10-slot rack.

The start (ST) and end (END) references must be either %I or %Q. These references specify the first and last reference the module is configured for. For example, if a 16-point input module is configured at %I0001 through %I0016 in slot 7 of a 10-slot main (CPU) rack, the ST parameter must be %I0001, the END parameter must be %I0016, and the ALT parameter must be 10, as shown below:



The following table compares the execution times of a normal DOIO function block for an 8-point, 16-point, or 32-point discrete input/output module with those of an enhanced DOIO function block.

Module	Normal DOIO Execution Time	Enhanced DOIO Execution Time
8-Pt Discrete Input Module 8-Pt Discrete Output Module	224 microseconds 208 microseconds	67 microseconds 48 microseconds
16-Pt Discrete Input Module 16-Pt Discrete Output Module	224 microseconds 211 microseconds	68 microseconds 47 microseconds
32-Pt Discrete Input Module 32-Pt Discrete Output Module	247 microseconds 226 microseconds	91 microseconds 50 microseconds

## SER (Sequential Event Recorder)

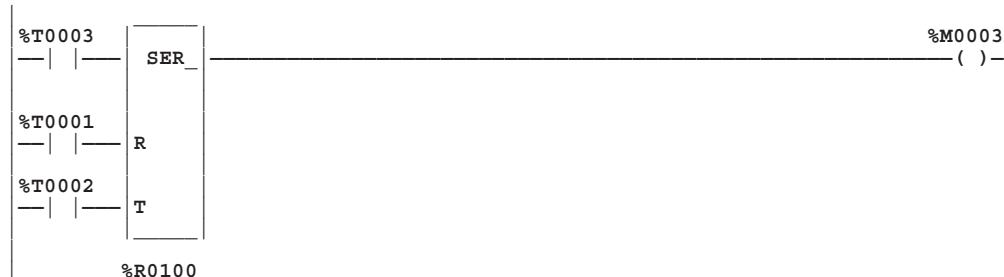
**Requires CPUs 35x or 36x with Firmware 9.00 or later, or CPU37x**

- The SER (Sequential Event Recorder) function block collects a series of discrete samples (it only works with discrete data). An SER function block collects up to 32 contiguous or non-contiguous bits per sample when the Enable input receives power flow.
  - Each SER can capture up to 1024 samples, with up to 32 bits per sample.
  - If the SER function block is embedded in a periodic subroutine, sampling rate is based on the periodic subroutine execution rate.
  - Only the trigger sample is time stamped. The trigger sample can be time-stamped in BCD (maximum resolution is 1second) or POSIX format (maximum resolution is 10ms). The time stamp is only placed once at the trigger point. The SER does not support more than one time stamp per recording.
  - The SER can be configured for pre-, mid-, or post-trigger modes. (See page 12-14.)
  - SER operation is configured by a function control block that you can create using a series of Block Move (BLKMOV) commands. (See page 12-10.)
  - An input module may be optionally specified that will be scanned each time the SER executes. This helps ensure that the data captured from the specified module is as up-to-date as possible.

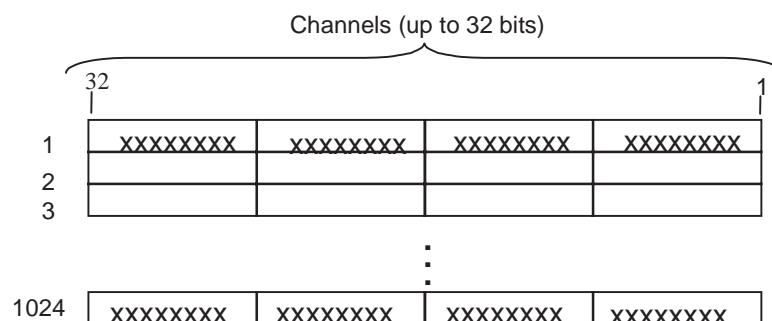
## Note

PLC-to-PLC synchronization is not supported.

The SER function block has one output and three inputs: enable, reset (R), and trigger (T).



As shown below, 8, 16, 24, or 32 channels may be configured, with each channel representing a discrete point. Also, up to 1024 samples may be specified.



## Parameters

Parameter	Description
enable	Whenever the function is enabled and the reset input is off, the SER function block collects one sample from all configured channels.
R	When the reset input receives power flow, the SER function is reset regardless of the state of the enable input. Sample Buffer, Trigger Sample Offset, Trigger Time, and Current Sample Offset are all cleared to zero. The function block remains in the reset state until power flow is removed from the reset input. The OK output is turned off while in the reset state. When the power flow is removed from the reset input, sampling resumes.
T	If the Trigger Input mode is selected and the function block is enabled, when the trigger input goes on, the SER to transition to the triggered state. The Trigger Time, Trigger Sample Offset, and a data sample are recorded. The trigger sample will be recorded regardless of the number of samples taken. Once triggered, the event recorder continues sampling until the Number of Samples After Trigger is satisfied, at which time it stops collecting samples until power flow is seen on the reset input. If Trigger Mode is set to Full Buffer, the trigger signal is ignored. For information on configuring Trigger Mode, see “Function Control Block” on page 12-10.
Starting Reference	The 78-word function control block array begins at this reference. The function control block defines function block execution, sample configuration, and operation parameters. For details, see “Function Control Bloc” on page 12-10
ok	The ok output is energized when the trigger conditions are satisfied (specified by the Trigger Mode parameter), and all sampling is complete. The output continues to receive power flow regardless of the state of the enable input until the reset receives power flow.

## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
Control Block								•				
R	•											
T	•											
ok	•											•

- Valid reference or place where power can flow through the function.

## Function Control Block

The function control block is a 78-word array that defines information about the data capture and trigger mechanism for the SER function. In a particular program, only one Sequential Event Recorder function block can be associated with each function command block and data block.

Perform the following steps to configure parameters for the SER function block:

1. Set up the stored values for the array as defined in the table below. You can use block moves to initialize the registers, or initialize the data in the register table and store the table before activating the SER function.
2. Add the SER function block to your ladder logic.

### Note

If you require x channels where x is not equal to 8, 16, 24, but is less than 32, you must select a number of channels which is greater than x and a multiple of 8, and fill in a null channel description for the unused channels. A null channel description has a segment selector of 0xFFh, a length parameter equal to the number of unused channels, and a 0 offset.

Word	Parameter	Description
0 (starting reference)	Status	<p>Read only variable that indicates the current state of the SER function block. Additional information is provided in Status Extra Data, (Word 1). <b>Note:</b> If an error is detected in the Control Block, the status will be set to 6, the OK output will be cleared, and no action will occur. Settings for Status include:</p> <ul style="list-style-type: none"> <li>0 = Reset</li> <li>1 = Inactive</li> <li>2 = Active</li> <li>3 = Triggered</li> <li>4 = Complete</li> <li>5 = Overrun Error</li> <li>6 = Parameter error</li> </ul>
1	Status Extra Data	A read-only variable that provides additional state information about the SER function. See “Status Extra Data States” on page 12-12 for settings for this parameter.
2	Trigger Mode	<p>Defines conditions for the SER function block to transition to the triggered state. Valid settings are:</p> <ul style="list-style-type: none"> <li>0 = Trigger Input mode</li> <li>1 = Full Buffer mode</li> </ul> <p>In Trigger Input mode, if the function block is enabled, a time stamp is generated when the Trigger signal is activated. Sampling continues until the Number of Samples After Trigger value has been satisfied. When this occurs, the OK output is activated.</p> <p>In Full Buffer mode, the Trigger signal is ignored. When the function block is enabled, sampling continues until the sample buffer is filled. When this happens the OK output is activated. The Number of Samples parameter sets buffer size.</p>
3	Trigger Time Format	Determines how the Trigger Time will be displayed. For BCD display, set this parameter to 0. For POSIX display, set this parameter to 1. (For details, see page 12-17.)
4—7	Reserved	Words 4 through 7 are reserved and should be set to zero.

Word	Parameter	Description
8	Number of Channels (bits per sample)	Specifies the number of bits of data that will be sampled and copied to the sample buffer for each execution of the function block. Valid choices are 8, 16, 24, or 32 bits. Any unused channels must be configured with a null channel description. (See Words 14—77.) For example, if 19 bits are needed, you must configure 24 and specify that the last five are null.
9	Number of Samples	Specifies the sample buffer size. Valid choices are 1 to 1024 samples. (Actual buffer size in bits is Number of Samples times Number of Channels.)
10	Number of Samples After Trigger	Specifies the number of samples that are collected after the trigger condition becomes true. This parameter can be set to a value between 0 and the Number of Samples. This parameter is valid only when the Trigger Mode is set to zero (Trigger Input).
11	Input Module Slot	Specifies the location in the main rack (Rack 0) of an input module that will be scanned each time the SER executes. If the value is 0, no module is scanned. When an input module is scanned, its values are stored locally and the values of the reference addresses configured for the module are not affected. To store values from the scanned input module into the data block sample buffer, a channel description must be provided. If the module is not present or is faulted at the time of the scan, the data returned will be zero. A fault will not be logged in the fault table if this occurs; fault indication will be left to the IO scanner.
12	Data Block Segment Selector (Memory Type)	Specifies the data type allocated for the Data Block. For example, if you wanted use the %R memory type, you would enter 08 for this parameter. Valid settings for this parameter include: %R (08h), %AI (0Ah), %AQ (0Ch). For details on the data block, see page 12-13.
13	Data Block Offset	Specifies the starting reference for the Data Block. This parameter is zero based. For example, if you wanted to begin at %R0100, you would enter 99 for this parameter. Be sure to allow enough memory for the entire data block.
14—77	Channel Descriptions	Specifies the reference location (Segment Selector, Length and Offset) associated with a particular channel. There can be from 1 to 32 channel descriptions, depending upon the number of channels being sampled and data length. Data is returned in the order defined in this section.
	Channel Segment Selector/Length	Entered as a hexadecimal value, this word defines the segment selector and data length (in bits). MSB = Segment Selector. LSB = Data Length. The data length is useful for samples that are contiguous.  The Segment Selector can be set to any discrete data type: %I (46h), %Q (48h), %M (4Ch), %T (4Ah), %G (56h), %S (54h), %SA (4Eh), %SB (50h), %SC (52h), Null Selector (FFh), and Input Module Selector (00h).
	Channel Offset	The length parameter can range from 1—32, but the sum of all of the lengths must not be greater than the Number of Channels parameter. A length greater than 1 allows multiple contiguous channels to be configured with a single channel description.  Entered as a hexadecimal value, this word defines the BIT offset for the data type or input module specified in the Segment Selector. This offset is zero-based. The range for this parameter varies, depending on the Segment Selector (data type and length). The offset indicates the location within the data table or input module at which to sample.

## Status Extra Data States

The Status Extra Data (Word 1 in the function control block) provides additional state information for the SER function.

Value	State	Description
0	Reset State	The Reset input is receiving power flow. Sample Buffer, Trigger Sample Offset, Trigger Time, and Current Sample Offset are all cleared to zero. The output is held to no power flow. Transition to the <b>Inactive State</b> occurs when the reset power flow is removed. Status Extra Data has no significance and will be cleared to zero.
1	Inactive	State between the Reset State and the Active State. No actions are performed in this state. The SER output is held to no power flow. Transition to the Active State occurs when the function block receives enable power flow.
2	Active	The Enable input has received power flow, but the function block is not reset, in error, or triggered. One sample is recorded for each execution when the function block is enabled. The output is held to no power flow. The Trigger condition (specified by the Trigger Mode parameter) is monitored and will cause transition to the Triggered State if conditions are true. If more than the “Number of Samples” have been taken, Status Extra Data will be set to 0x01, otherwise it will be 0x00.
3	Triggered	State if the trigger condition defined by Trigger Mode is true. Additional Samples are taken depending upon the trigger mode and parameter settings. The output is held to no power flow. Transition to the Complete state will occur when all sampling is complete. If more than the “Number of Samples” have been taken, Status Extra Data will be set to 0x01, otherwise it will be 0x00.
4	Complete	All sampling is complete. The output receives power flow. Only transition to the Reset State is allowed. If more than the “Number of Samples” have been taken then Status Extra Data will be set to 0x01, otherwise it will be 0x00.
5	Overrun Error	The Control/Data Block has exceeded the end of its memory type. The output is held to no power flow. Only transition to the Reset State is allowed. Status Extra Data has no significance and will be cleared to zero.
6	Parameter Error	There is an error in the function control block or other operation parameters. The output is held to no power flow. Only transition to the Reset State is allowed. The Status Extra Data word contains the offset into the control block at which the parameter error occurred.
7	Status Error	The Status Parameter is invalid. The output is held to no power flow. Only transition to the Reset State is allowed. The invalid status value will be stored in the Status Extra Data location in the Control Block.

## SER Data Block Format

The SER Data Block contains the sample buffer, sample offsets, and trigger information. This information is supplied by the CPU and you should only read from this data area. It is your responsibility to allocate enough register space for the Data Block. The block format is as follows:

Word*	Parameter Description
0	<p>Current sample offset number. References the location where the most recent sample was placed. The parameter is zero-based. Valid ranges are -1 to 1023.</p> <p>Register Location of Sample = (Num Bytes per Sample) * (Offset Parameter)/2 + (Sample Buffer Starting Register).</p> <p><b>Note:</b> This value is not valid until a sample is taken. This value is set to -1 when the SER function is reset through the Reset input.</p>
1	<p>Trigger sample offset number. References the storage location of the sample obtained when the trigger condition transitioned to the True state. The parameter is zero-based. Valid ranges are 0 to 1023.</p> <p>Register Location of Sample = (Num Bytes per Sample) * (Offset Parameter)/2 + (Sample Buffer Starting Register).</p> <p><b>Note:</b> This value is not valid until the trigger condition is met. This value is set to 0 when the SER function is reset (through the reset input).</p>
2 through 5	<p>Trigger Time: Indicates the time, according to the Time of Day clock within the PLC, that the trigger condition transitioned to the true state within the function block. The time value can be displayed in BCD format (default) or POSIX format. The format is determined by the <i>Trigger Time Format</i> parameter in the Control Block. This value is initialized to zero upon activation of the reset input.</p>
6 to end of sample buffer.	<p>Sample Buffer. The area of memory that holds the data samples. This area is set to zero when the reset parameter is energized. The sample buffer size varies, depending on the number of channels and sample size. The sample buffer is a circular buffer – when the last location is written, the next sample will overwrite the sample in the first register.</p> <p>End of sample buffer = <math>5 + (\{[(\# \text{ of samples to be taken}) * (\# \text{ of channels to be sampled} / 8)] + 1\} / 2)</math></p>

\*Offset from starting reference defined by Data Block Segment Selector (Word 12) and Data Block Offset (Word 13) in Function Control Block.

## SER Operation

If the SER is enabled when scanned, it reads the configured sample points and puts them in a circular list. After the configured number of samples is taken, the output is turned on. The transition of the output can be used to record the time that the last sample is taken or to initiate additional sampling. (See “Sampling Modes.”)

The SER function block must be reset (enable the Reset input power flow) before sampling is started. Resetting initializes the data block area. If the function block status is not reset, it will execute with the current values in the data block, causing the current sample offset to be incorrect and invalid data in the data block.

The Control Block of the SER function block is scanned every time the function block is executed in the Reset, Active, or Triggered State. If you change a configuration parameter in the Control Block during program execution, the change takes effect the next time the SER function block associated with that Control Block is scanned. If an error is encountered, operation stops and the

function block goes to the appropriate error state. You must correct the error and then reset the function block (enable the Reset input power flow) to begin sampling again.

If you select an input module to be scanned the PLC will *not* verify that the module is a Discrete Input Module, or that Channel Descriptions associated with the module have valid lengths and offsets based upon the module size. You must correctly set up the sampling of an Input Module. Although multiple channel descriptions can target an input module, the module is still only scanned once per function block execution.

The SER function block can be placed in the normal user logic program or within a periodic subroutine. If placed in the user logic program, the resolution of the interval between scans is the resolution of the scan time, which can vary depending on the number and types of functions active on any particular scan. If placed in an interrupt subroutine, the interval can be set to as little as 1ms, and the resolution will be highly repeatable at 1ms with little jitter.

Execution time of one function block with a 1ms periodic subroutine can consume up to 50% of the CPU's resources. You should not plan on execution of more than two SER functions within a 1ms periodic subroutine.

## Sampling Modes

The SER sampling mode is determined by the Trigger Mode (Word 2 in the Function Control Block) and Number of Samples After Trigger (Word 10) parameters. You will need to interpret the contents of the sample buffer based on how you configured these parameters.

The following table summarizes how the sampling modes are determined.

Mode	Word 2	Word 10
Pre-Trigger	0	0
Mid-Trigger	0	From 1 to (Number of Samples – 1)
Post-Trigger	0	equal to Number of Samples (specified in Word 9)
Full Buffer	1	Word 10 and trigger input signal are ignored

## Trigger-Controlled Sampling

In order to configure pre-, mid-, and post-trigger sampling modes, Trigger Mode (Word 2 = 0) must be selected. The sampling mode is controlled by the Number of Samples After Trigger value (Word 10). In all cases, sampling starts when the Enable signal goes high. When the Trigger signal goes high, sampling continues until the number specified in the Number of Samples After Trigger parameter is collected. The SER's OK Output signal goes high when sampling is completed.

If more than the configured Number of Samples (Word 9) is collected before the Number of Samples After Trigger condition is satisfied, the buffer “wraps around,” meaning that the SER returns to the beginning of the buffer and overwrites the initial samples.

When the trigger first transitions from off to on, the trigger time is placed in a configured location.

### Pre-Trigger

**Collects samples continuously until trigger is detected.**

To configure this mode, set Word 10 to a value of 0, so that when the trigger signal is activated, sampling stops and a time stamp is generated. (All samples are collected before the trigger.)

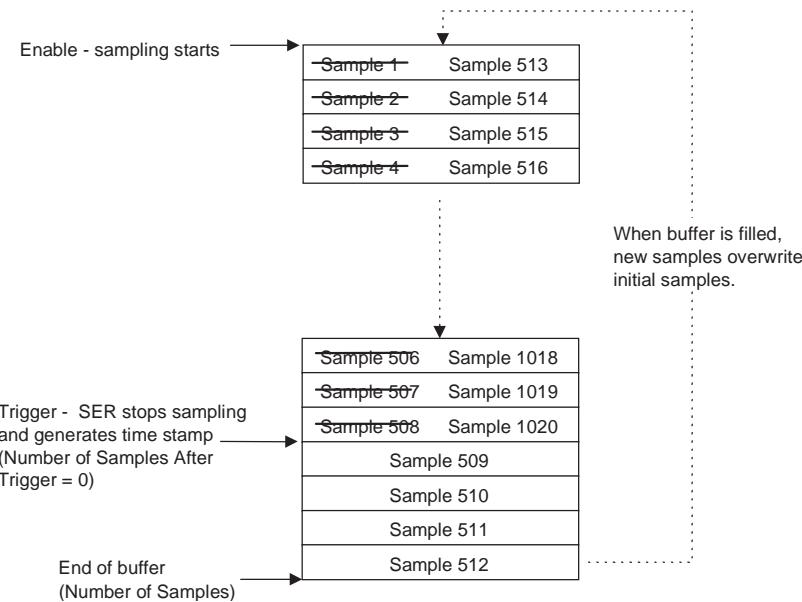


Figure 12-1. Example of Pre-Trigger SER Sampling (for 512 Samples)

### Mid-Trigger

**Collects samples continuously until Number of Samples After Trigger has been collected.**

To configure this mode, set Word 10 to a value between 1 and the (Number of Samples – 1). When the trigger signal is activated, sampling continues until the configured number has been collected. In the following example, Number of Samples After Trigger is 12. When sampling is complete, the buffer will contain 500 pre-trigger samples and 12 post-trigger samples.

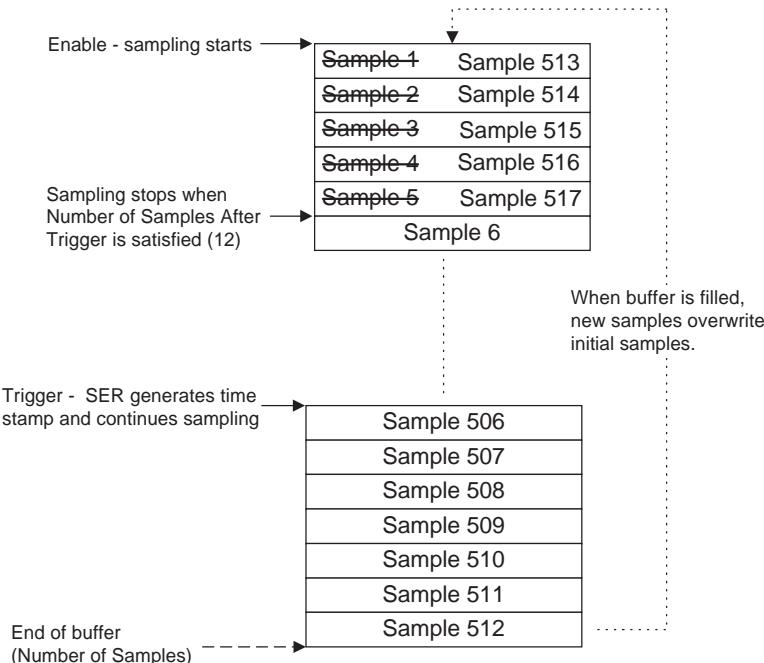


Figure 12-2. Example of Mid-Trigger SER Sampling (for 512 Samples)

### Post-Trigger

**Collects sample continuously until Number of Samples is reached.**

To configure this mode, set Word 10 to a value equal to the Number of Samples (Word 9). When the trigger signal is activated, sampling continues until the configured number has been collected. (Note: all samples are collected after the trigger.)

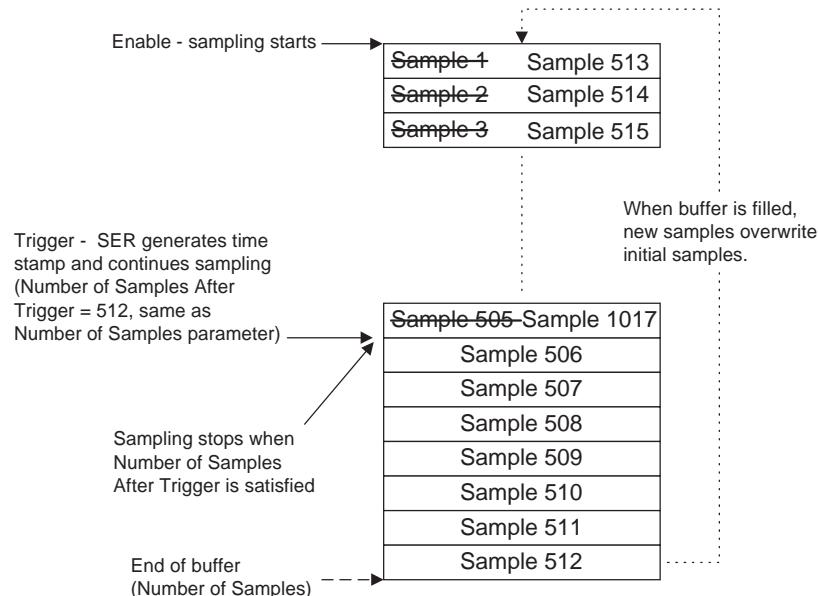


Figure 12-3. Post-Trigger SER Sampling (for 512 samples)

### Full Buffer (Trigger Does Not Control Sampling)

If the Trigger Mode is set to 1, the Number of Samples After Trigger parameter (Word 10) is ignored and the Trigger input signal has no effect on function block operation. When the function block is enabled, sampling continues until the Number of Samples (Word 9) is collected, filling the sample buffer. When the buffer is full, sampling stops, a Trigger time stamp is generated, and the function block OK output goes high.

## SER Function Block Trigger Timestamp Formats

BCD Format		
Data Block Word No.	Contents (High Byte/Low Byte)	Suggested Viewing Format
Word 2	Month/Year	Hex. (MMYY)
Word 3	Hours/Day of Month	Hex. (HHDD)
Word 4	Seconds/Minutes	Hex. (SSMM)
Word 5	Not Used	All zeros

POSIX Format		
Data Block Word No.	Contents	Suggested Viewing format
Words 2 and 3	Number of Seconds Since January 1, 1970	Dint
Words 4 and 5	Number of Nano-Seconds into next Second	Dint

### Example

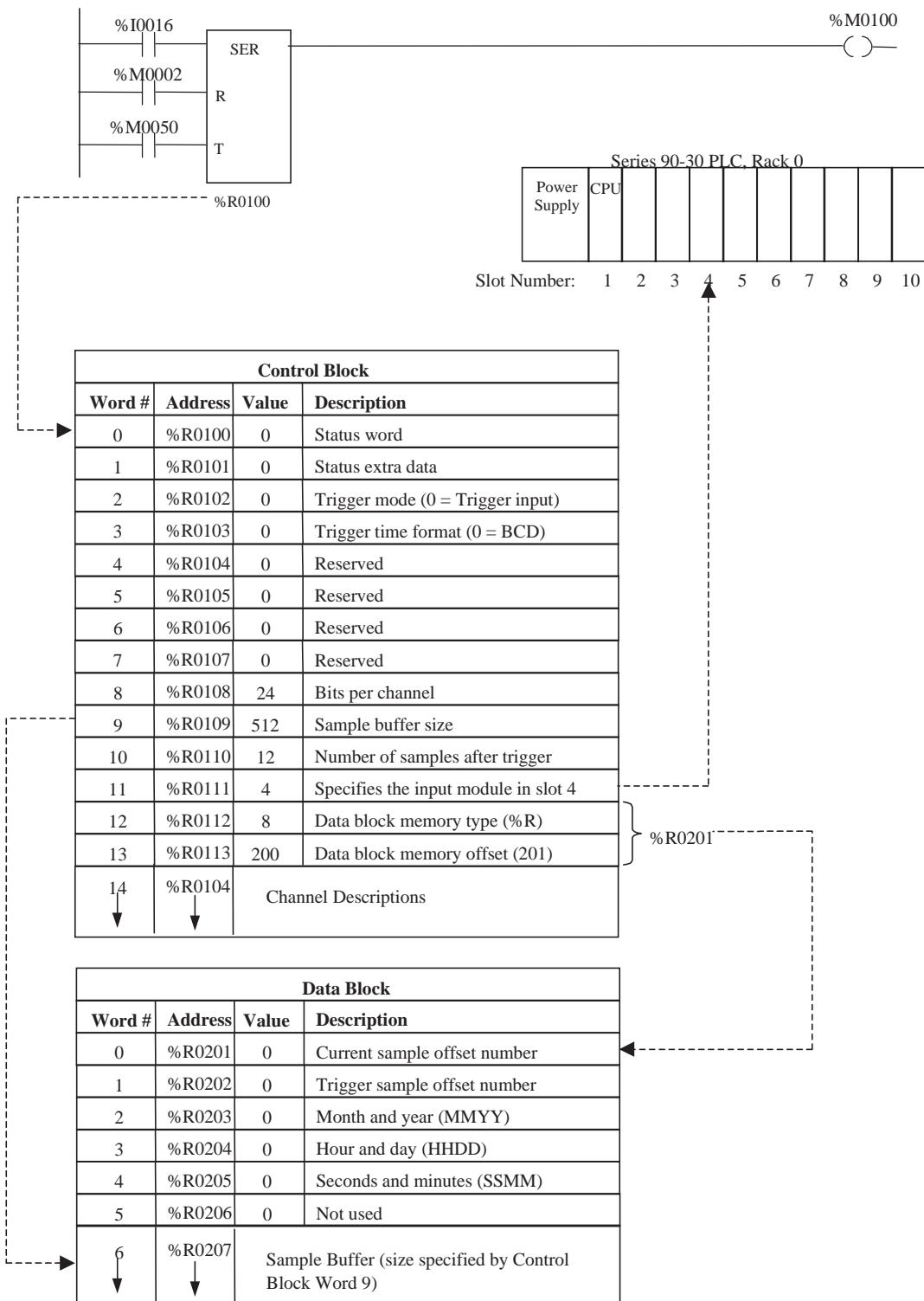
The next two tables show how the trigger time of November 3, 1998 at 8:34:05.010 a.m. would appear in BCD and in POSIX formats in a data block that starts at %R0201 (Word 0).

November 3, 1998 at 8:34:05.010 a. m. in BCD Format		
Register	Parameter	Value (hex)
%R0203	Month/Year	1198
%R0204	Hours/Day of Month	0803
%R0205	Seconds/Minutes	0534
%R0206	Unused	0000

November 3, 1998 at 8:34:05.010 a. m. in POSIX Format			
Register	Parameter	Value (decimal)	Value (hex)
%R0203/R0204	Seconds	910,082,045	363EBFFD
%R0205/R0206	Nano-seconds	010,000,000	00989680

## SER Example

The following shows the interrelationships, of the ladder logic instruction, the control block in PLC memory, and the affected Input module in the PLC. The control block has been set up as described in Table 12-1.



## Function Control Block Example

In this example, a 16-point discrete input module in rack 0, slot 4, has been specified (in Word 11) as the target to sample. It has been executing long enough that 572 samples (512 + 60) have been taken. The Enable input is receiving power flow, but the Reset and Trigger inputs are not.

Table 12-1. Function Control Block for SER Example

Word	Register	Parameter	Value (dec)	Value (hex)	Description
0	%R0100	Status	2	0002	Function block is in the Active state. This means the function block is executing normally, and taking a sample each time the function block is encountered in program logic.
1	%R0101	Status Extra Data	1	0001	The extra status data indicates that more than 512 samples have been taken and thus the sample buffer has already wrapped at least once.
2	%R0102	Trigger mode	0	0000	The event recorder is configured to trigger based on the Trigger input.
3	%R0103	Trigger Time Format	0	0000	0=BCD
4	%R0104	Reserved	0	0000	The Reserved parameters are always set to 0.
5	%R0105	Reserved	0	0000	
6	%R0106	Reserved	0	0000	
7	%R0107	Reserved	0	0000	
8	%R0108	# of channels	24	0018	Each sample consists of 24 bits (3 bytes) of data.
9	%R0109	# of samples to be taken	512	0200	Sample buffer size is 512 samples. Note that the sample buffer equals $512 \times (24/8) = 1536$ bytes or 768 words. (Each sample is 3 bytes long as specified in Word 8 above.)
10	%R0110	# of samples after trigger	12	000C	The number of samples to be collected after the trigger occurs is 12.
11	%R0111	Input module slot	4	0004	The input module in rack 0, slot 4 will be scanned when the SER executes so that its current values are available for sampling by the SER.
12	%R0112	Data Block Segment Selector	8	0008	The data segment is 0x08 (%R).
13	%R0113	Data Block Offset	200	00C8	This offset of 200 places the start of the data block at %R0201. The offset is a zero-based value, but the register tables begin at %R0001. Therefore, the data block starting point is %R0001 + 200 = %R0201.

Continued on Next Page

Word	Register	Parameter	Value (dec)	Value (hex)	Description
<b>Channel Descriptions</b>		The remaining words contain the channel descriptions. In this example six channel descriptions have been defined.			
14	%R0114	Set. Sel. : Length	17921	4601	Channel description 1: The first channel description selects the %I Segment with a length of 1, and an offset of 0. This chooses %I0001 for channel 1.
15	%R0115	Offset	0	0000	
16	%R0116	Seg. Sel. : Length	-253	FF03	Channel description 2: The second channel description selects the NULL Selector with length of 3, and offset of 0. The NULL selector causes channels 2 - 4 to be ignored or "skipped." These channels will always contain a sample value of Zero.
17	%R0117	Offset	0	0000	
18	%R0118	Seg. Sel. : Length	3	0003	Channel description 3: The third channel description selects the Input Module Selector with a length of 3 and offset of 12. The Input Module Selector causes samples to be taken from the input module. This channel description chooses the values in points 13, 14, and 15 of the input module for channels 5 - 7.
19	%R0119	Offset	12	0012	
20	%R0120	Seg. Sel. : Length	18434	4802	Channel description 4: The fourth channel description selects the %Q Segment with a Length of 2, and offset of 8. This chooses %Q0009 and %Q0010 for channels 8 and 9.
21	%R0121	Offset	8	0008	
22	%R0122	Seg. Sel. : Length	8	0008	Channel description 5: The fifth channel description is another Input Module Selector. It has a length of 8, and offset of 0. This causes the values for points 1 to 8 of the input module to be placed in channels 10 - 17.
23	%R0123	Offset	0	0000	
24	%R0124	Seg. Sel. : Length	-249	FF07	Channel description 6: The sixth channel description is another NULL Selector. It has a Length of 7, and offset of 0. This NULL channel description causes channels 18 - 24 to be filled with zeros. This last channel description is required to pad the sample buffer out to the 24 bits specified in the number of channels parameter. Since all 24 channels are configured, no more channel descriptions are needed.
25	%R0125	Offset	0	0000	

**Channel Configuration for Above Example**

32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
U	U	U	U	U	U	U	U	N	N	N	N	N	N	N	C8	C7	C6	C5	C4	C3	C2	C1	%Q 10	%Q 09	C15	C14	C13	N	N	N	%I 01

U = Unused, N = Null, C prefix indicates channel number on configured Input module (for example, C0 = input point 1, C15 = input point 16)

## Example Sample Contents

Table 12-2 summarizes the values contained in a single sample based upon the channel descriptions in the sample control block. This is based on the example screen capture shown on the following page. Note in this example that bits 1 – 16 are contained in %R00207 and bits 17 – 24 are part of %R00208.

Table 12-2. Sample Contents for SER Example

Channel Number	Channel Contents	Value
1	%I0001	1
2 - 4	Zeros	000
5	Input Module Point 13	1
6	Input Module Point 14	1
7	Input Module Point 15	1
8	%Q0009	0
9	%Q0010	0
10 - 17	Input Module Points 1 - 8	100100010
18 - 24	Zeros	0000000

## Data Block for Control Block Example

Table 12-3 lists the format of the data block resulting from the example control block given on page 12-19. Note that it begins at register 201 as described by the segment offset parameters (Words 12 and 13) in the control block.

Table 12-3. Data Block for SER Control Block Example

Offset	Register	Parameter Description	Value (dec)	Value (hex)
0	%R0201	Current sample offset #	59	003B
1	202	Trigger sample offset #	0	0000
2 - 5	203 – 206	Trigger time (BCD)	0 0 0 0	0000 0000 0000 0000
6 - 768	207 – 975	Sample Buffer	sample data	sample data

Current sample offset is 59, meaning that the 59th sample is the last sample placed in the sample buffer. With 3 bytes per sample, the current offset is actually at  $59 * 3 = 177$  bytes or the high byte of the 89th register. Since the trigger conditions have not been met, the trigger sample and trigger time are 0 and the output is not set. The sample buffer contains 512 samples where 59 is the newest sample and 60 is the oldest sample.

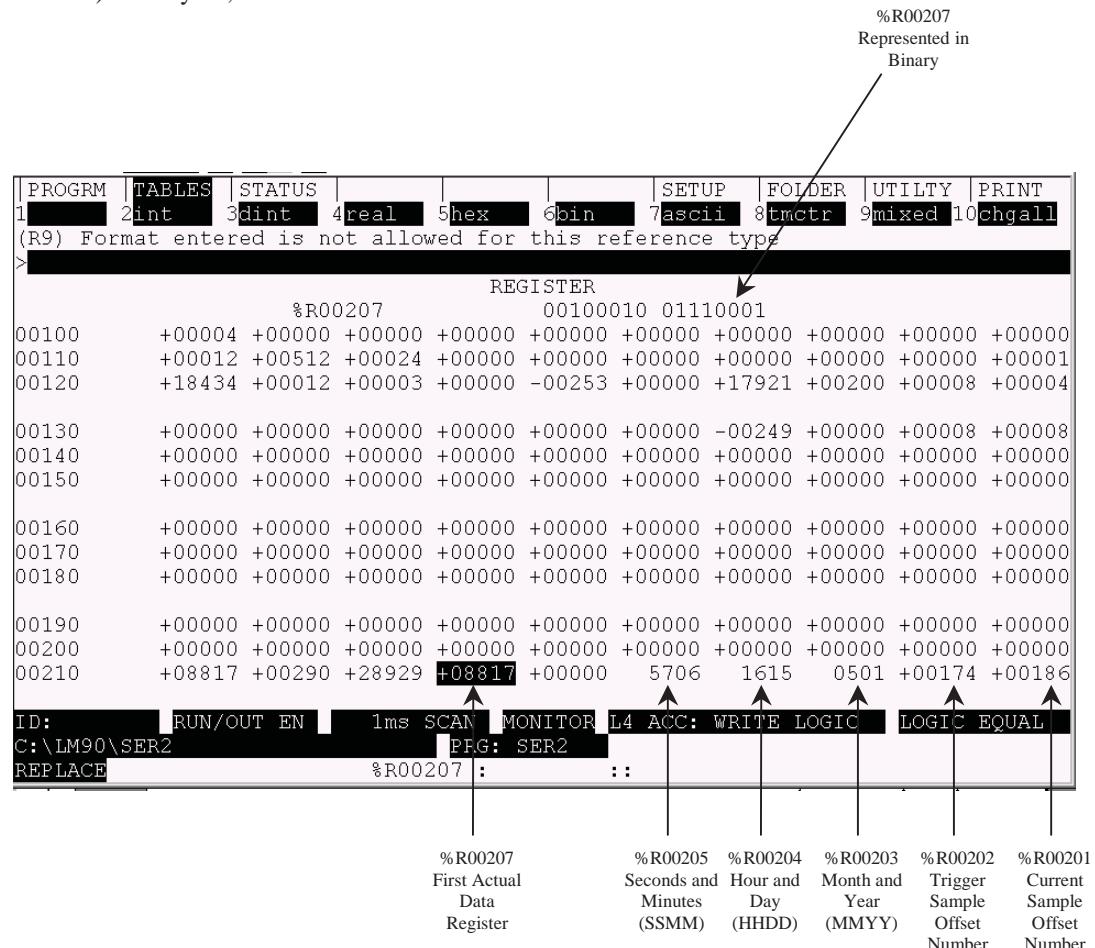
## Example Data Capture

### Examining the Captured Data

The following screen snap was taken after a trigger. The Control Block starts at %R00100, and the Data Area starts at %R00201. The cursor is positioned on %R00207 as noted near the top and bottom of the screen.

%R00207 is the first register in the data block that actually holds the measured input data. Note that its integer value (-21855) has little meaning in this context; however, by placing your cursor on %R00207, its value is displayed in binary near the top of the screen. Using this binary format, you can determine the states of the bits configured in the Channel Descriptions portion of the control block.

Registers %R00203 through %R00205 give the time and date, in 24-hour format, as 16:06 (and 57 seconds) on May 15, 2001.



## END

The END function provides a temporary end of logic. The program executes from the first rung to either the last rung or to the END function, whichever is encountered first.

The END function unconditionally terminates program execution. There can be nothing after the end function in the rung. No logic beyond the END function is executed, and control is transferred to the beginning of the program for the next sweep. Note that in runs past the END marker, inputs will appear to turn on and off, but outputs will not be updated. Although a normal condition, this will appear to be a problem if it isn't apparent that an END marker precedes the affected runs.

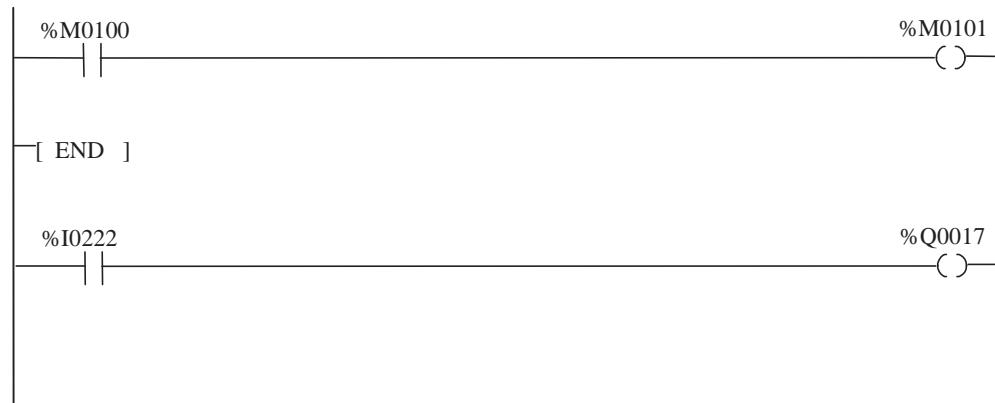
The END function is useful for debugging purposes because it allows you to isolate a section of logic. It does this by preventing any logic that follows it from being executed.

Logicmaster programming software provides, by default, an [ END OF PROGRAM LOGIC ] marker after the last rung of logic to indicate the end of program execution. This marker is used if no END function is programmed in the logic.

—[ END ]

## Example

In the following example, the rung containing contact %I0222 and coil %Q0017, and any rungs after it, will not be executed because of the presence of the END instruction.



### Note

Placing an END function in SFC logic or in logic called by SFC logic produces an “END Function Executed from SFC Action” fault in Release 7 or later CPUs. (In pre-Release 7 CPUs, it did not work correctly, but no Fault was generated.) For information about this fault, refer to the “System Configuration Mismatch” part of Chapter 3, Section 2.

## MCRN/MCR

### Overview of MCR and MCRN

A Master Control Relay (MCR/MCRN) function must be used with a corresponding End Master Control Relay (ENDMCR/ENDMCRN) function. Both functions must have the same name. The MCR/MCRN must have an enable contact between it and the power rail. All rungs between an enabled MCR/MCRN and its corresponding ENDMCR/ENDMCRN function are executed without power flow to coils. The ENDMCR/ENDMCRN function associated with the MCR/MCRN causes normal program execution to resume. Unlike the JUMP instruction, an MCR/MCRN can only occur in the forward direction. An ENDMCR/MCRN instruction must appear later in a program than its corresponding MCR/MCRN instruction.

The following controls are imposed on logic controlled by an enabled MCR/MCRN:

- Timers do not increment or decrement. Any TMR type timer is reset (accumulator is set to zero). For an ONDTR timer, the accumulator is “frozen” at the value that was current when the MCR/MCRN was enabled.
- Power flow does not occur for any instruction. Normal outputs are off; negated outputs are on.
- Instructions do not update their outputs. For example, an ADD instruction will not produce a current sum in its Q output register, a Move will not copy its current input value to its output, a Shift Register will not shift data, etc. The values in these output registers will be frozen at the values that were present when the MCR/MCRN was enabled.

#### Note

When an MCR/MCRN is energized, the logic it controls is evaluated and contact status is displayed, but no outputs are energized. If you are not aware that an MCR/MCRN is controlling the logic being observed, this might appear to be a faulty condition. To indicate that a range of ladder logic is under MCR/MCRN control, Logicmaster displays a double power rail on the ladder logic screen. This double power rail appears regardless of whether or not the MCR/MCRN is enabled.

Logicmaster 90-30/20/Micro software supports two forms of the Master Control Relay function, an older, non-nested (MCR) and a newer, nested form (MCRN).

## CPU Compatibility

CPU Type	Supported Form
CPU311 – CPU341, Release 1	Use only the non-nested form (MCR)
CPU311 – CPU341, Release 2 and later	Use only the nested form (MCRN)
35x, 36x, and 37x series CPUs	Use only the nested form (MCRN)

## Possible MCRN Compatibility Problem

When converting a CPU340 or CPU341 program to run in a 35x/36x/37x series CPU, it is possible to see a “Feature not Supported” error (“Nesting Levels Exceeded”) from Logicmaster 90. This would occur when the converted program is stored to a 35x/36x/37x CPU if more than eight levels of MCRN nesting is used in the original program.

The MCRN instructions are actually function block instructions in the CPU340/341, which means they are executed in CPU firmware and not executed by the embedded Boolean Coprocessor (BCP). The nesting limit for the function block was set to 256. This limit is many more levels than you would generally use. When the 35x/36x/37x CPU series was designed, the MCRN instructions were moved to the BCP to improve CPU performance (function block instructions execute slower than BCP counterparts). At that time a tradeoff of nesting levels and performance was made and the BCP3 used in 35x/36x/37x CPUs implemented eight levels of nesting, which are normally more than users require. So, Logicmaster 90 enforces eight levels of nesting when the program conversion is performed, and if there are more than eight levels used, a “Nesting Levels Exceeded” message is issued.

Therefore, if you have more than eight MCR nesting levels in a CPU340/341 program, it will require a modification to work in a 35x/36x/37x CPU. You might consider using Jump statements instead.

## Nesting an MCRN

An MCRN function can be placed anywhere within a program, as long as it is properly nested with respect to other MCRNs, and does not occur in the range of any non-nested MCR or non-nested JUMP.

If an MCRN/ENDMCRN pair is nested within another MCRN/ENDMCRN pair, it must be contained completely within the other pair. Up to eight levels of nesting are allowed. For an example, see page 12-28.

There can be multiple MCRN functions corresponding to a single ENDMCRN (except for the 35x/36x/37x series CPUs as noted below). Each MCRN as well as the ENDMCRN must have the same name. This is analogous to the nested JUMP, where you can have multiple JUMPs to the same LABEL. For a comparison of the JUMP function and the MCR function, refer to the “Differences Between MCRs and Jumps” section below.

### Note

Use only one MCRN for each ENDMCRN with 35x, 36x and 37x series CPUs.

## MCR Operation

There can be only one MCR instruction for each ENDMCR instruction. The range for non-nested MCRs and ENDMCRs cannot overlap or contain the range of any other MCR/ENDMCR pair or any JUMP/LABEL pair of instructions. Non-nested MCRs cannot be within the scope of any JUMP/LABEL pair.

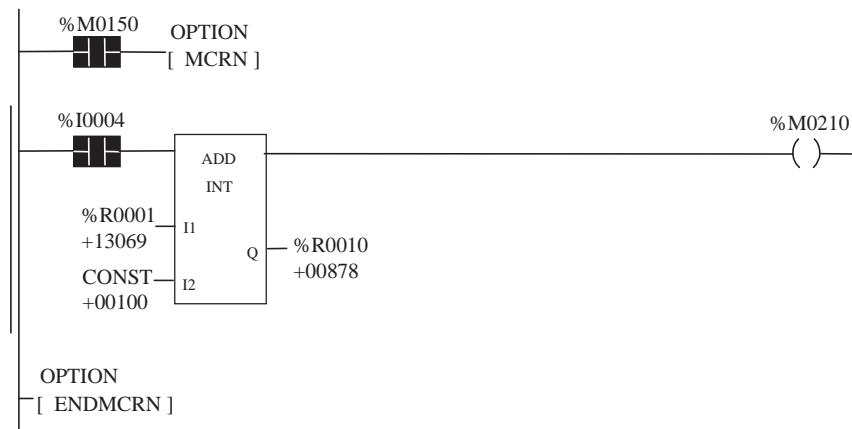
### Parameters

Both forms of the MCR function have the same parameters. They both have an enable Boolean input EN and a name that identifies the MCR. This name is used again with an ENDMCR instruction. Neither the MCR nor the MCRN function has any outputs; there can be nothing after an MCR in a rung.

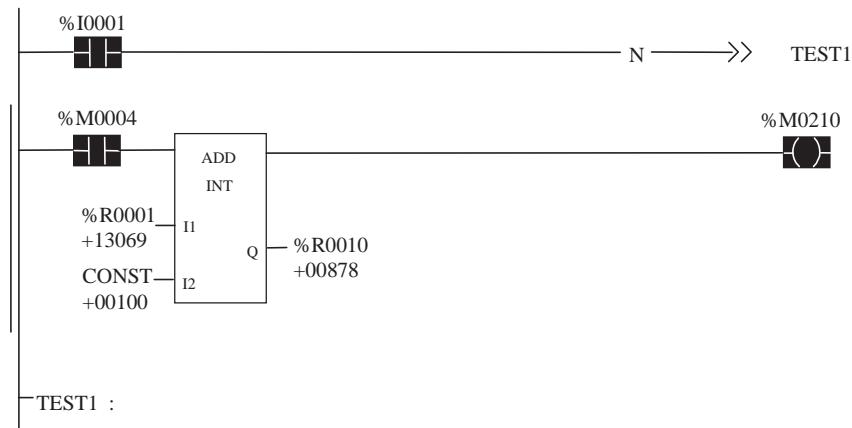
????????  
[ MCR ]                  or                  ???????  
    - [ MCRN ]

## Differences Between MCR/MCRN and JUMP

With an MCR function, function blocks within the scope of the MCRN are evaluated *without power flow*, and coils *are not energized*. In the following example, when %M0150 is ON, the MCRN is enabled. When the MCRN is enabled, even if %I004 is ON, the ADD function block is evaluated *without* power flow (i.e., it does not add 100 to %R0001), and %M0210 does not receive power flow. Status of contacts such as %I0004 and values in registers used on inputs, such as %R0001, will update on the Logicmaster screen, but registers on outputs under control of the MCRN, such as %R0010, will be frozen at their current values when the MCRN is enabled.



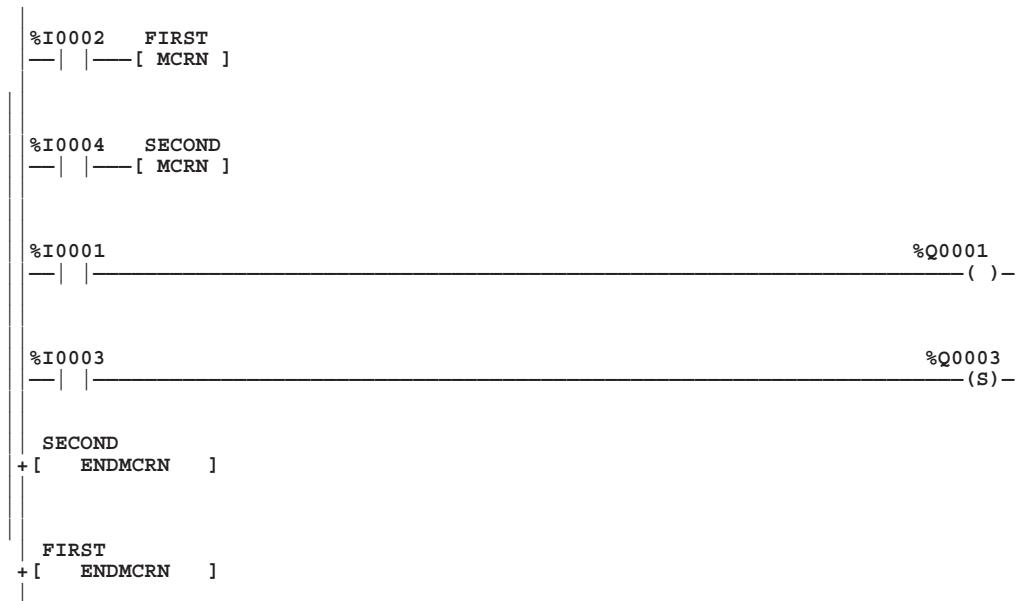
With a JUMP function, any function blocks between the JUMP and the LABEL *are not* evaluated, and coils *are not affected*. In the following example, when %I0001 is ON, the JUMP named TEST1 is enabled. Since the logic between the JUMP and the LABEL is skipped, %M0210 is unaffected (i.e., if it was ON, it remains ON; if it was OFF, it remains OFF). Status of contacts such as %M0004 and values in registers used on inputs, such as %R0001, will update on the Logicmaster screen, but registers on outputs under control of the JUMP, such as %R0010, will be frozen at their current values when the JUMP is enabled.



## Example 1

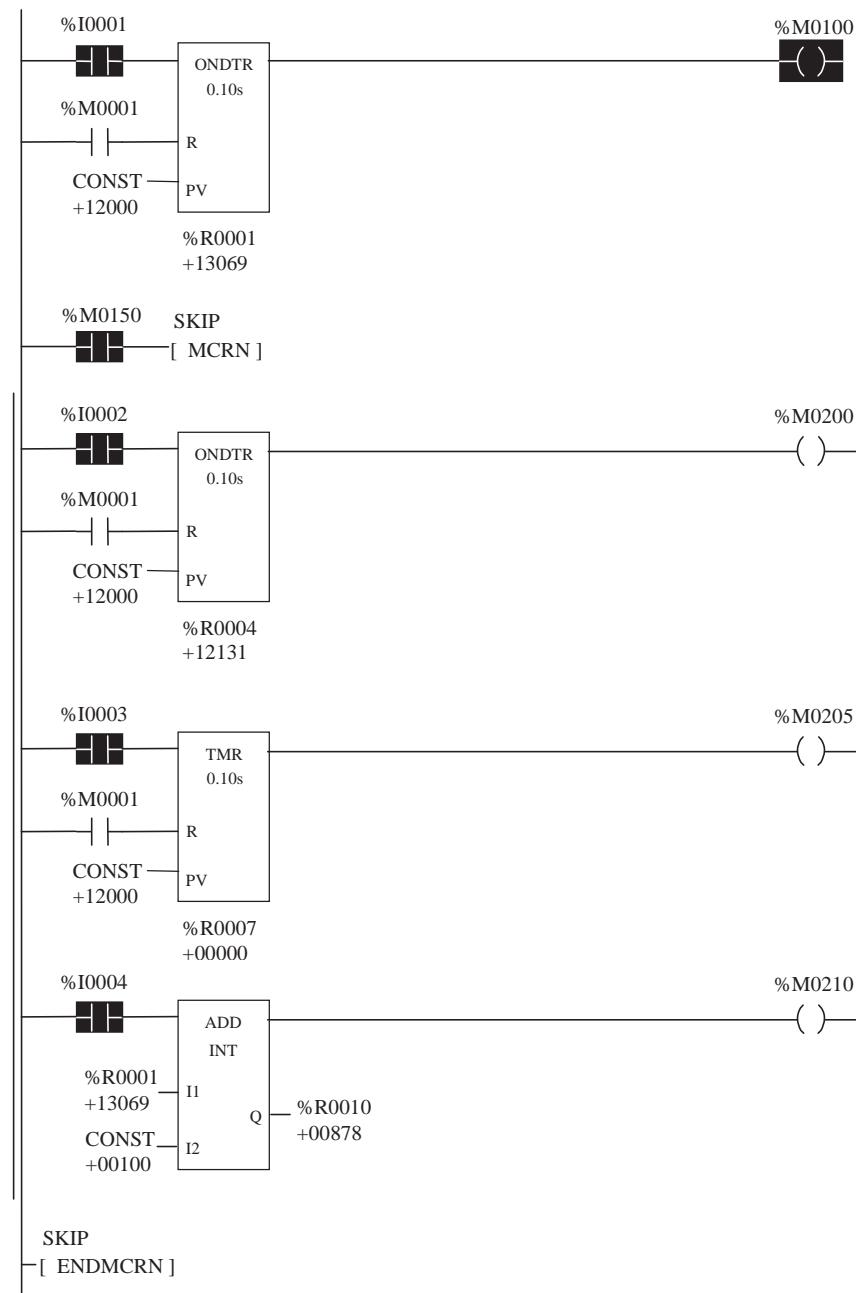
The following example shows an MCRN named “Second” nested inside the MCRN named “First.” Whenever %I0002 allows power flow into the MCRN function, program execution will continue without power flow to the coils until the associated ENDMCRN is reached. If %I0001 and %I0003 are ON, %Q0001 is turned OFF and %Q0003 remains ON.

To aid in troubleshooting ladder programs, a double power rail identifies logic that is within the control range of an MCR.



## Example 2

In the following example, the first rung is functioning normally. However, the MCRN named SKIP is controlling the rest of the rungs, which have a double power bar to indicate this. In the first rung controlled by the MCRN, the ONDTR timer's accumulated value (%R0004) is frozen, and even though it reached its preset value, its output (%M0200) is not energized. In the following rung, the TMR has been reset by the MCRN. Its accumulated value (%R0007) is held at zero and its output (%M0205) is not energized. In the next rung, the ADD instruction's output is frozen (its output at %R0010 is not the sum of its inputs) and its power flow coil (%M0210) is not energized. Note, however, that the status of contacts and values of input registers (such as %R0001 on the ADD instruction I1 input) are updated on-screen within the MCRN control area.

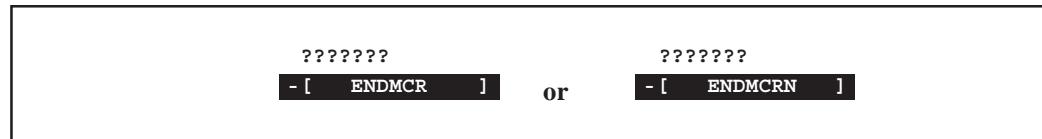


## ENDMCRN/ENDMCR

Use the End Master Control Relay ENDMCR/ENDMCRN function to resume normal program execution after an MCR/MCRN function. When the MCR associated with the ENDMCR is active, the ENDMCR causes program execution to resume with normal power flow. When the MCR associated with the ENDMCR is not active, the ENDMCR has no effect.

Logicmaster 90-30/20/Micro software supports two forms of the ENDMCR function, a non-nested and a nested form. The non-nested form, ENDMCR, must be used with the non-nested MCR function, MCR. The nested form, ENDMCRN, must be used with the nested MCR function, MCRN.

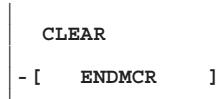
The ENDMCR function has a negated Boolean input EN. The instruction enable must be provided by the power rail; execution cannot be conditional. The ENDMCR function also has a name, which identifies the ENDMCR and associates it with the corresponding MCR(s). The ENDMCR function has no outputs; there can be nothing before or after an ENDMCR instruction in a rung.



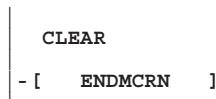
### Example

In the following examples, an ENDMCR instruction is programmed to terminate the MCR named "CLEAR."

Example of a non-nested ENDMCR



Example of a nested ENDMCR:



## JUMP

Use the JUMP instruction to cause a portion of the program logic to be bypassed. Program execution will continue at the LABEL specified. When the JUMP is active, all coils within its scope are left at their previous states. This includes coils associated with timers, counters, latches, and relays.

Logicmaster 90-30/20/Micro software supports two forms of the JUMP instruction, a non-nested and a nested form. The non-nested form has been available since Release 1 firmware for the CPU311-CPU341 CPUs, and has the form —————>>LABEL01, where LABEL01 is the name of the corresponding non-nested LABEL instruction.

For non-nested JUMPs, there can be only a single JUMP instruction for each LABEL instruction. The JUMP can be either a forward or a backward JUMP.

The range for non-nested JUMPs and LABELs cannot overlap the range of any other JUMP/LABEL pair or any MCR/ENDMCR pair of instructions. Non-nested JUMPs and their corresponding LABELs cannot be within the scope of any other JUMP/LABEL pair or any MCR/ENDMCR pair. In addition, an MCR/ENDMCR pair or another JUMP/LABEL pair cannot be within the scope of a non-nested JUMP/LABEL pair.

### Note

The non-nested form of the JUMP instruction is the only JUMP instruction that can be used in a Release 1 Series 90-30 PLC. The nested JUMP function can be used (and is suggested for use) for all new applications.

Also, please note that the 35x/36x/37x series CPUs support only nested jumps.

The nested form of the JUMP instruction has the form —————N————>>LABEL01, where LABEL01 is the name of the JUMP and its corresponding nested LABEL instruction. The nested JUMP is available in Release 2 and later releases of Logicmaster 90-30/20/Micro software and PLC firmware.

A nested JUMP instruction can be placed anywhere within a program, as long as it does not occur in the range of any non-nested MCR or non-nested JUMP.

There can be multiple nested JUMP instructions corresponding to a single nested LABEL. Nested JUMPs can be either forward or backward JUMPs.

Both forms of the JUMP instruction are always placed in columns 9 and 10 of the current rung line; there can be nothing after the JUMP instruction in the rung. Power flow jumps directly from the instruction to the rung with the named label.

Non-nested JUMP:



Nested JUMP:

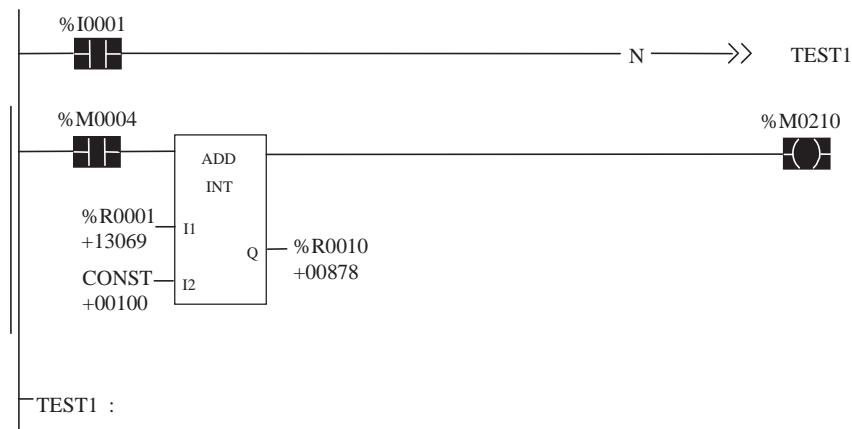


**Caution**

To avoid creating an endless loop with backward JUMP instructions, a backward JUMP must contain a way to make it conditional.

## Examples

In the following example, whenever contact %I0001 turns on, the JUMP named TEST1 is enabled, and power flow is jumped ahead to the TEST1 LABEL. Since the logic between the JUMP and the LABEL is skipped, %M0210 is unaffected (i.e., if it was ON, it remains ON; if it was OFF, it remains OFF). Status of contacts such as %M0004 and values in registers used on inputs, such as %R0001, will update on the Logicmaster screen, but registers on outputs under control of the JUMP, such as %R0010, will be frozen at their current values when the JUMP is enabled. Note the use of the double power rail in the section of logic located between the JUMP and its LABEL.



## LABEL

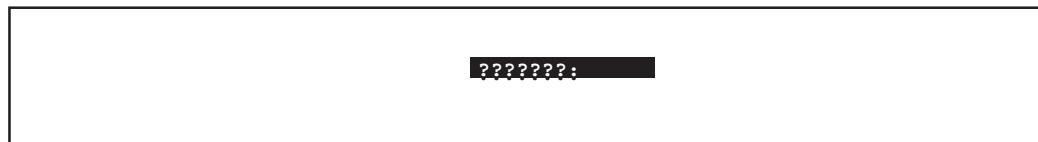
The LABEL instruction functions as the target destination of a JUMP. Use the LABEL instruction to resume normal program execution after a JUMP instruction.

There can be only one LABEL with a particular label name in a program. Programs without a matched JUMP/LABEL pair can be created and stored to the PLC, but cannot be executed.

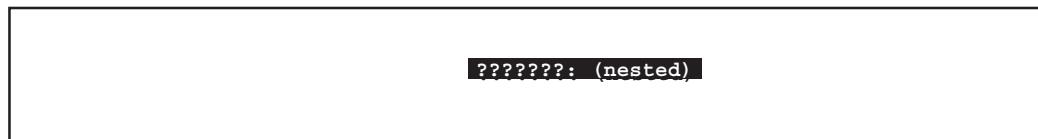
Logicmaster 90-30/20/Micro software supports two forms of the LABEL function, a non-nested and a nested form. For example, the non-nested form, LABEL01 :, must be used with the non-nested JUMP function, \_\_\_\_\_>>LABEL01; the nested form, LABEL01 :(nested), must be used with the nested JUMP function, \_\_\_\_\_N\_\_\_\_>>LABEL01.

The LABEL instruction has no inputs and no outputs. Also, there can be nothing either before or after a LABEL in a rung.

Non-nested LABEL:

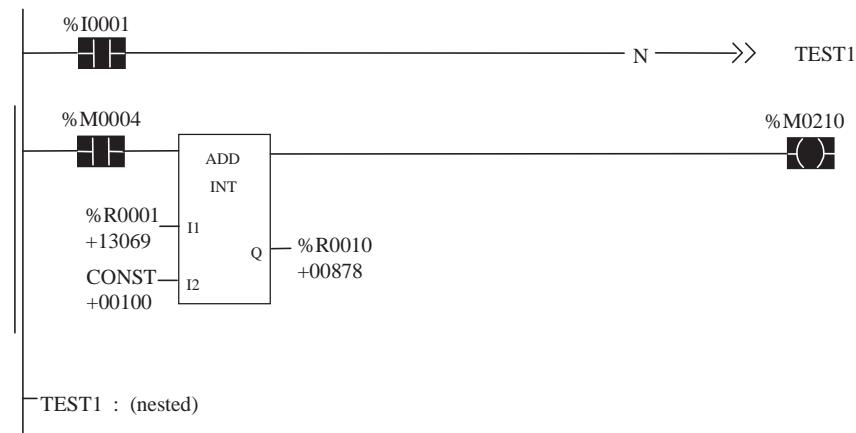


Nested LABEL:



## Example

In the following example, when JUMP TEST1 is enabled, the scan skips ahead to the TEST1 :(nested) LABEL, which means that the rung in-between the JUMP and LABEL is not scanned.



## COMMENT

Comments are useful for adding explanations, notes, revision level information, etc. to your ladder program. Use of comments is highly recommended because they provide valuable information to those who may have to troubleshoot or update the system in the future. Also, since human memories are imperfect, comments are valuable references for even the creator of the ladder program.

### Note

To conserve PLC memory, annotations (comments, nicknames, and descriptions) are not written to the PLC. Therefore, to view these annotations, you must have a copy of the original program folder (which includes the annotations) on your computer. Then, when you connect your computer to the PLC, the links to the annotations will automatically be made by your programming software.

### Creating a Standard Comment

A comment can have up to 2048 characters of text. In Logicmaster, it is represented in the ladder logic like this:

**(\* COMMENT \*)**

#### Creating a Comment

1. Create a new rung. A COMMENT rung cannot have any other logic besides the COMMENT instruction.
2. Insert the COMMENT, which is found in the Control group of instructions.
3. Accept the rung by pressing the Escape key.
4. Move the cursor over the (\* COMMENT \*) instruction just created and press the Zoom key (F10) to enter the comment editor screen.
5. Type in your comment text. Note that the lines do not automatically wrap in the comment editor. You must press the Enter key at the end of a line to begin typing on the next line.
6. When finished, press Escape key to exit the comment editor and save the comment.

Once created, COMMENT text can be read or edited by moving the cursor to (\* COMMENT \*) and selecting Zoom (F10). Rung Comments can also be printed from Logicmaster's Print menu.

### Creating a Long Comment for use in Logicmaster Printouts

In Logicmaster longer text can be included in printouts using an annotation text file:

1. Create the comment (see previous section for comment creation details):
  - A. Enter comment text to the point where the text from the other file should begin.
  - B. On a new line, enter \I (or \i), the drive letter followed by a colon, a backslash, the subdirectory or folder, a backslash, and the file name, as shown in this example:  
**\I d:\text\commnt1**  
(Drive designation is not necessary if the file is on the same drive as the program folder.)
  - C. Press Escape to exit the comment editor and save the comment text.
2. Open a text processor and create a text file.
3. Save the text file in a .txt format, giving it the file name entered in the comment, and saving it on the drive and in the path specified in the comment.

## SVCREQ

The Service Request instruction is a general purpose instruction that can perform a wide variety of special instructions (services) that are not available as individual function blocks. Use the Service Request (SVCREQ) function to request one of the following special PLC services:

Table 12-4. Service Request Functions

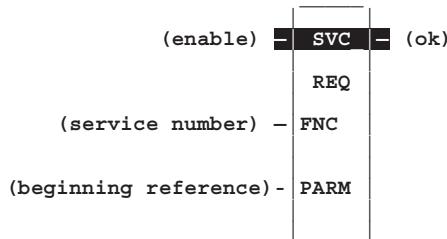
Function	Description
1	Change/Read Constant Sweep Timer.
2	Read Window Values.
3	Change Programmer Communications Window Mode and Timer Value.
4	Change System Comm. Window Mode and Timer Value.
6	Change/Read Checksum Task State and Number of Words to Checksum.
7	Change/Read Time-of-Day Clock.
8	Reset Watchdog Timer.
9	Read Sweep Time from Beginning of Sweep.
10	Read Folder Name.
11	Read PLC ID.
12	Read PLC Run State.
13	Shut Down the PLC.
14	Clear Fault Tables.
15	Read Last-Logged Fault Table Entry.
16	Read Elapsed Time Clock.
18	Read I/O Override Status.
23	Read Master Checksum.
24	Reset Smart Module
26/30	Interrogate I/O.
29	Read Elapsed Power Down Time.
45	Skip Next Output and Input Scan. (Suspend I/O.)
46	Access Fast Backplane Status.
48	Reboot After Fatal Fault Auto Reset
49	Auto Reset Statistics

## SVC REQ Overview

The SVCREQ function has three input parameters and one output parameter. When the SVCREQ receives power flow, the PLC is requested to perform the function FNC indicated. Parameters for the function begin at the reference given for PARM. The SVCREQ function passes power flow unless an incorrect function number, incorrect parameters, or out-of-range references are specified. Additional causes for failure are described on the pages that follow.

The reference given for PARM can represent any type of word memory (%R, %AI, or %AQ). This reference is the first of a group that make up the “parameter block” for the function. Successive 16-bit locations store additional parameters. The total number of references required will depend on the type of SVCREQ function being used.

Parameter blocks can be used both as inputs for the function and as the location where data is output after the function executes. Therefore, data returned by the function is accessed at the same location specified for PARM.



## Parameters

Parameter	Description
enable	When enable is on, the service request is performed.
FNC	Each type of Service Request has a unique function number, which must be programmed at the FNC input. FNC may contain either a constant or a reference address that contains the function number of the requested service.
PARM	PARM contains the beginning reference for the parameter block for the requested service.
ok	The ok output is energized when the function is performed without error.

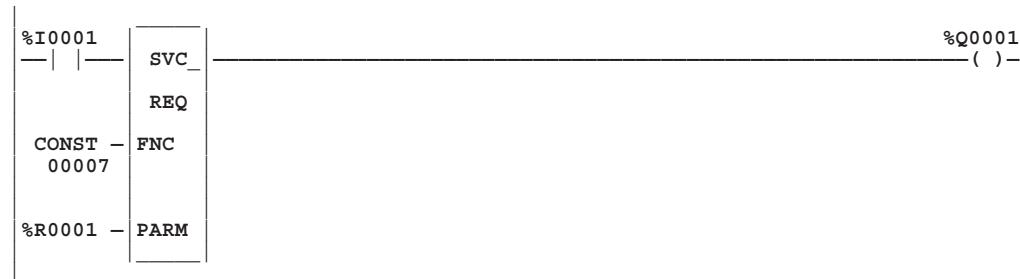
## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
FNC		•	•	•	•		•	•	•	•	•	
PARM		•	•	•	•		•	•	•	•		
ok	•											•

- Valid reference or place where power can flow through the function.

## Example

In the following example, when enable contact %I0001 is ON, SVCREQ function number 7, specified at input FNC, is performed. The function's parameter block starts at %R0001 (specified at PARM). Output coil %Q0001 is set ON if the operation succeeds.



## SVCREQ #1: Change/Read Constant Sweep Timer

Beginning with 90-30 CPU Release 8.0, use SVCREQ function #1 to:

- Disable **CONSTANT SWEEP** mode.
- Enable **CONSTANT SWEEP** mode and use the old timer value.
- Enable **CONSTANT SWEEP** mode and use a new timer value.
- Set a new timer value only.
- Read **CONSTANT SWEEP** mode state and timer value.

### Note

Of the CPUs discussed in this manual, Service Request 1 is supported *only* by 90-30 CPUs, beginning with Release 8.0.

The parameter block has a length of two words.

To disable **CONSTANT SWEEP** mode, enter SVCREQ function #1 with this parameter block:

0	address
ignored	address + 1

To enable **CONSTANT SWEEP** mode, enter SVCREQ function #1 with this parameter block:

1	address
0 or timer value	address + 1

### Note

If the timer should use a new value, enter it in the second word. If the timer value should not be changed, enter 0 in the second word. If the timer value does not already exist, entering 0 will cause the function to set the OK output to OFF.

To change the timer value without changing the selection for sweep mode state, enter SVCREQ function #1 with this parameter block:

2	address
new timer value	address + 1

To read the current timer state and value without changing either, enter SVCREQ function #1 with this parameter block:

3	address
ignored	address + 1

### Note

After using SVCREQ function #1 with the parameter block on the previous page, Release 8 and higher CPUs will provide the return values 0 for Normal Sweep, 1 for Constant Sweep. Do not confuse this with the *input* values shown below.

Successful execution will occur, unless:

1. A number other than 0, 1, 2, or 3 is entered as the requested operation:

0	Disable <b>CONSTANT SWEEP</b> mode.
1	Enable <b>CONSTANT SWEEP</b> mode.
2	Set a new timer value only.
3	Read <b>CONSTANT SWEEP</b> mode and timer value. (See Note above).

2. The time value is greater than 2550 ms (2.55 seconds).
3. Constant sweep time is enabled with no timer value programmed, or with an old value of 0 for the timer.

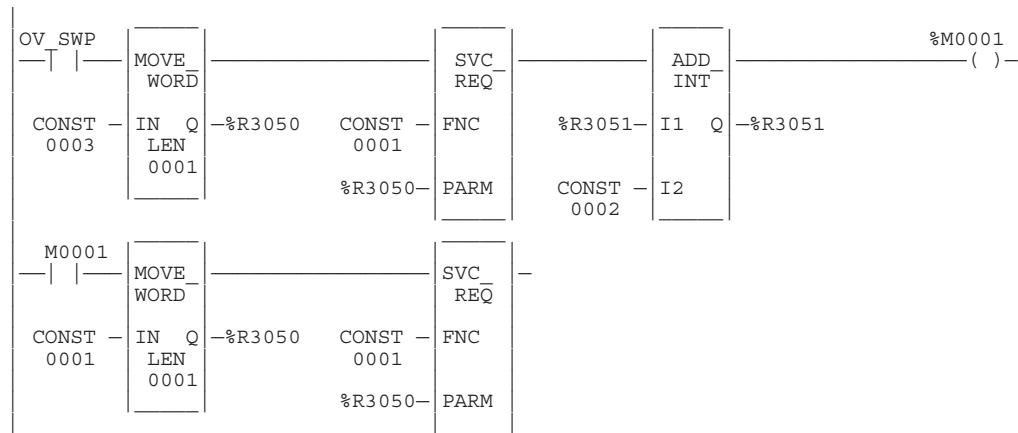
After the function executes, the function returns the timer state and value in the same parameter block references:

0 = Disabled	address
1 = enabled	
current timer value	address + 1

If word address + 1 contains the hexadecimal value FFFF, no timer value has ever been programmed.

## Example

This example shows logic in a program block. When enabling contact OV\_SWP is set, the constant sweep timer is read, the timer is increased by two milliseconds, and the new timer value is sent back to the PLC. The parameter block is in local memory at location %R3050. Because the MOVE and ADD functions require three horizontal contact positions, the example logic uses discrete internal coil %M0001 as a temporary location to hold the successful result of the first rung line. On any sweep in which OV\_SWP is not set, %M0001 is turned off.



## SVCREQ #2: Read Window Values

Use SVCREQ function #2 to obtain the current window mode time values for the programmer communications window and the system communications window.

### Note

Of the CPUs discussed in this manual, Service Request 2 is supported only by 90-30 CPUs, beginning with Release 8.0.

There are three modes for each window:

Mode Name	Value	Description
Limited Mode	0	The execution time of the window is limited to its respective default value or to a value defined using SVCREQ function #3 for the programmer communications window or SVCREQ function #4 for the systems communications window. The window will terminate when it has no more tasks to complete.
Constant Mode	1	Each window will operate in a <b>RUN TO COMPLETION</b> mode, and the PLC will alternate between the two windows for a time equal to the sum of each window's respective time value. If one window is placed in <b>CONSTANT</b> mode, the remaining two windows are automatically placed in <b>CONSTANT</b> mode. If the PLC is operating in <b>CONSTANT WINDOW</b> mode and a particular window's execution time is not defined using the associated SVCREQ function, the default time for that window is used in the constant window time calculation.
Run to Completion Mode	2	Regardless of the window time associated with a particular window, whether default or defined using a service request function, the window will run until all tasks within that window are completed.

A window is disabled when the time value is zero.

The parameter block has a length of three words:

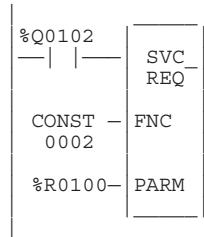
	High Byte		Low Byte	
	Mode	Value in ms	address	address + 1
	Mode	Value in ms		
	*See Note	*See Note		

\* Note. The address + 2 word is reserved for use by the system. All zeros will be returned here.

All parameters are output parameters. It is not necessary to enter values in the parameter block to program this function. Output values for both window are given in milliseconds.

## Example

In the following example, when enabling output %Q0102 is set, the PLC operating system places the current time values of the three windows in the parameter block starting at location %R0100. Additional examples showing the Read Window Values function are included in the next three SYS REQ function descriptions.



## SVCREQ #3: Change Programmer Communications Window Mode and Timer Value

Use SVCREQ function #3 to change the programmer communications window mode and timer value. The change will occur in the CPU sweep following the sweep in which the function is called.

### Note

Of the CPUs discussed in this manual, Service Request 3 is supported only by 90-30 CPUs, beginning with Release 8.0.

The SVCREQ function #3 will pass power flow to the right unless a mode other than 0 (Limited), 1 (Constant), or 2 (Run-to-Completion) is selected.

The parameter block has a length of one word.

To disable the programmer window, enter SVCREQ function #3 with this parameter block:

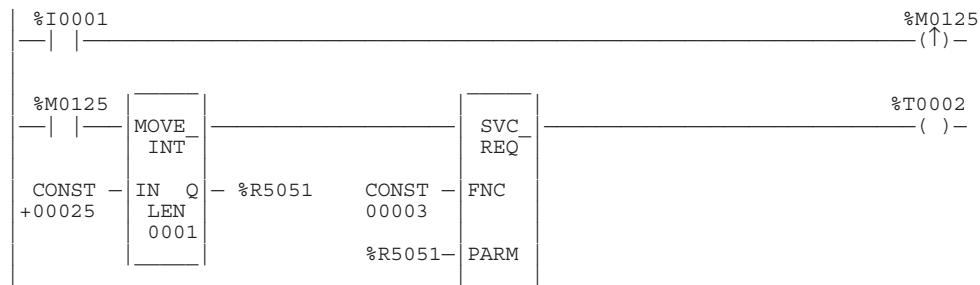
High Byte	Low Byte	
0	0	address

To enable the programmer window, enter SVCREQ function #3 with this parameter block:

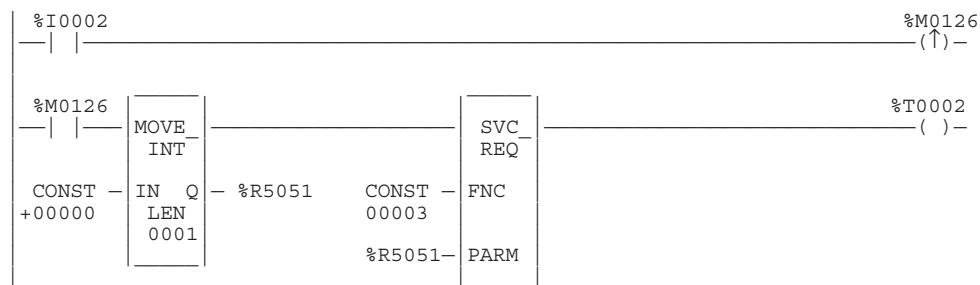
High Byte	Low Byte	
Mode	Value from 1 to 255 ms	address

## Example

In the following example, when %M0125 transitions on, the programmer communications window is enabled and assigned a value of 25 ms. The parameter block is in memory location %R5051.



To disable the programmer communications window, use Service Request 3 to assign a value of zero (0). In this example, when %M0126 transitions on, the programmer communications window is enabled and assigned a value of 0 ms. The parameter block is in memory location %R5051.



## SVCREQ #4: Change System Comm Window Mode and Timer Value

Use SVCREQ function #4 to change the system communications window mode and timer value. The change will occur in the CPU sweep following the sweep in which the function is called.

### Note

Of the CPUs discussed in this manual, Service Request 4 is supported only by 90-30 CPUs, beginning with Release 8.0.

The SVCREQ function #4 will pass power flow to the right unless a mode other than 0 (Limited), 1 (Constant), or 2 (Run-to-Completion) is selected.

The parameter block has a length of one word.

To disable the system communications window, enter SVCREQ function #4 with this parameter block:

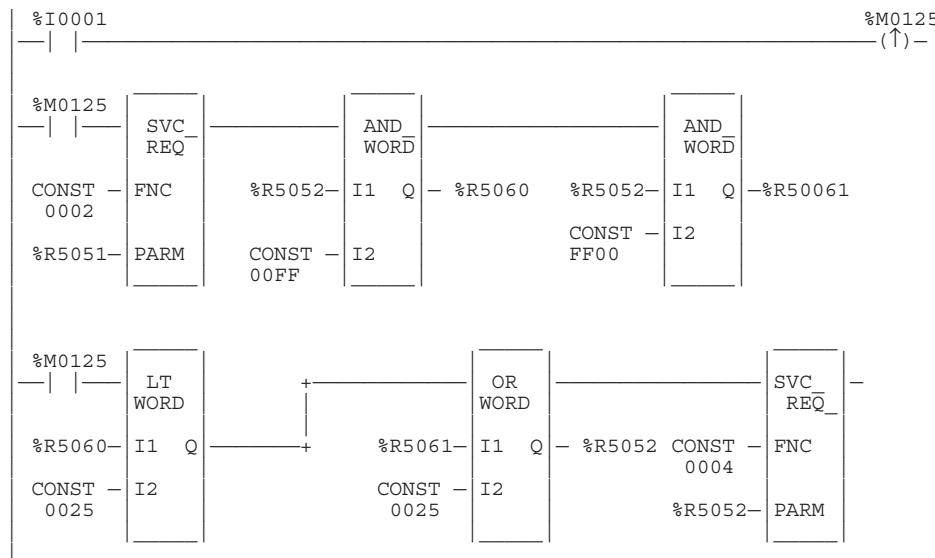
High Byte	Low Byte	
0	0	address

To enable the system communications window, enter SVCREQ function #4 with this parameter block:

High Byte	Low Byte	
Mode	Value from 1 to 255 ms	address

## Example

In the following example, when enabling output %M0125 transitions on, the mode and timer value of the system communications window is read. If the timer value is greater than or equal to 25 ms, the value is not changed. If it is less than 25 ms, the value is changed to 25 ms. In either case, when the rung completes execution the window is enabled. The parameter block for all three windows is at location %R5051. Since the mode and timer for the system communications window is the second value in the parameter block returned from the Read Window Values function (function #2), the location of the existing window time for the system communications window is in the low byte of %R5052.



## SVCREQ #6: Change/Read Number of Words to Checksum

Use the SVCREQ function with function number 6 in order to:

- Read the current word count.
- Set a new word count.

Successful execution will occur, unless some number other than 0 or 1 is entered as the requested operation (see below).

For the Checksum Task functions, the parameter block has a length of 2 words.

### To Read the Current Word Count:

Enter SVCREQ function 6 with this parameter block:

0	address
ignored	address + 1

After the function executes, the function returns the current checksum in the second word of the parameter block. No range is specified for the read function; the value returned is the number of words currently being checksummed.

0	address
current word count	address + 1

### To Set a New Word Count:

Enter SVCREQ function 6 with this parameter block:

1	address
new word count (0 – 32)	address + 1

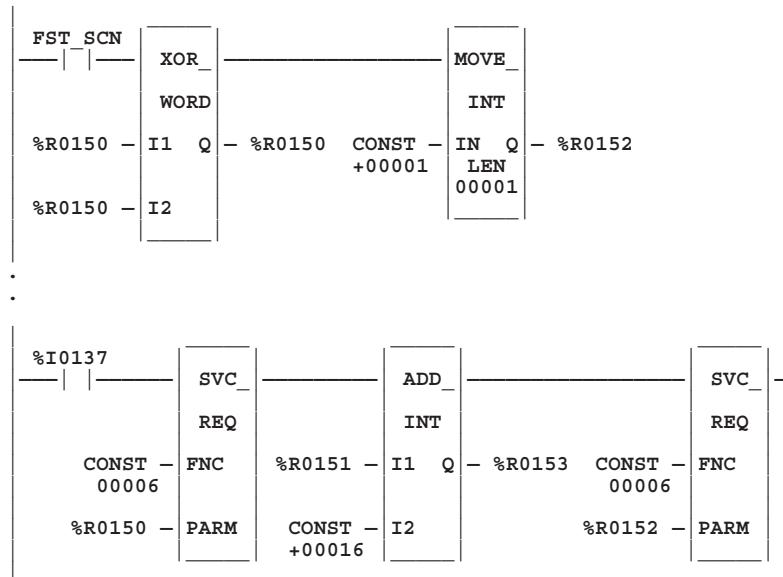
Entering 1 causes the PLC to adjust the number of words to be checksummed to the value given in the second word of the parameter block. For any Series 90-30 CPU, the second word value can be from 0 to 32. If the value is outside this range, an error will be generated. For the Series 90-20 CPU211, the value can be either 0 or 4.

### Note

This Service Request is not available on Micro PLCs.

## Example

In the following example, when enabling contact FST\_SCN is set, the parameter blocks for the checksum task function are built. Later in the program when input %I0137 turns on, the number of words being checksummed is read from the PLC operating system. This number is increased by 16, with the results of the ADD\_INT function being placed in the “hold new count for set” parameter. The second service request block requests the PLC to set the new word count.



The example parameter blocks are located at address %R0150. They have the following content:

0 = read current count	%R0150
Hold current count	%R0151

1 = set current count	%R0152
Hold new count for set	%R0153

## SVCREQ #7: Change/Read Time-of-Day Clock

Use the SVCREQ function with function number 7 to read and set the time-of-day clock in the PLC.

### Note

This function is available only in 331 or higher 90-30 CPUs and on the 28-point Series 90 Micro PLC CPUs (that is, IC693UDR005, IC693UAA007, and IC693UDR010) and the 23-point Series 90 Micro PLC CPUs (IC693UAL006).

Successful execution will occur unless:

1. Some number other than 0 or 1 is entered as the requested operation (see below).
2. An invalid data format is specified.
3. The data provided is not in the expected format.
4. An invalid date is entered, such as 02/29/01, which incorrectly specifies a leap year day in the year 2001 (2001 is not a leap year).

For the date/time functions, the length of the parameter block depends on the data format. BCD format requires 6 words; packed ASCII requires 12 words.

0 = read time and date	address
1 = set time and date	
1 = BCD format	address + 1
3 = packed ASCII format	
	data
	address + 2 to end

In word 1, specify whether the function should read or change the values.

0	=	<b>read</b>
1	=	<b>change</b>

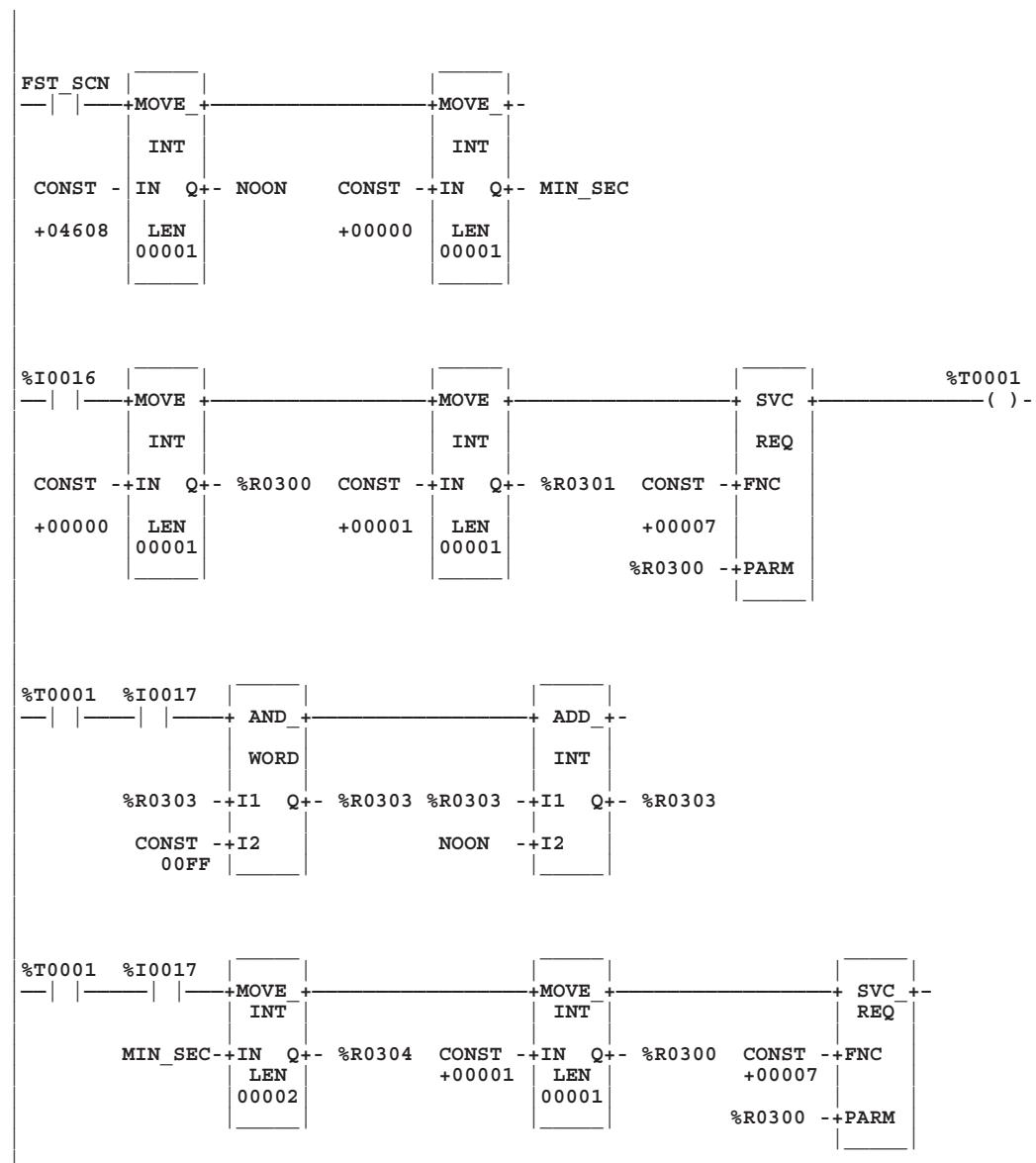
In word 2, specify a data format:

1	=	<b>BCD</b>
3	=	<b>packed ASCII with embedded spaces and colons</b>

Words 3 to the end of the parameter block contain output data returned by a read function, or new data being supplied by a change function. In both cases, format of these data words is the same. When reading the date and time, words (address + 2) through (address + 8) of the parameter block are ignored on input.

## Example

In the following example, when called for by previous logic, a parameter block for the time-of-day clock is built to first request the current date and time, and then set the clock to 12 noon using the BCD format. The parameter block is located at global data location %R0300. Array NOON has been set up elsewhere in the program to contain the values 12, 0, and 0. (Array NOON must also contain the data at %R0300.) The BCD format requires six contiguous memory locations for the parameter block.



## Parameter Block Contents

Parameter block contents for the different data formats are shown on the following pages. For both data formats:

- Hours are stored in 24-hour format.
- Day of the week is a numeric value:

Value	Day of the Week
1	Sunday
2	Monday
3	Tuesday
4	Wednesday
5	Thursday
6	Friday
7	Saturday

## To Change/Read Date and Time Using BCD Format:

In BCD format, each of the time and date items occupies a single byte. This format requires six words. The last byte of the sixth word is not used. When setting the date and time, this byte is ignored; when reading date and time, the function returns a null character (00).

High Byte	Low Byte	
1 = change or 0 = read		
1		address
month	year	address + 1
hours	day of month	address + 2
seconds	minutes	address + 3
(null)	day of week	address + 4

Example output parameter block:  
Read Date and Time in BCD format  
(Sun., July 3, 1988, at 2:45:30 p.m.)

0	
1	
07	88
14	03
30	45
00	01

## To Change/Read Date and Time Using Packed ASCII with Embedded Colons Format

In Packed ASCII format, each digit of the time and date items is an ASCII formatted byte. In addition, spaces and colons are embedded into the data to permit it to be transferred unchanged to a printing or display device. This format requires 12 words.

High Byte	Low Byte
1 = change or 3	0 = read
year	year
month	(space)
(space)	month
day of month	day of month
hours	(space)
:	hours
minutes	minutes
seconds	:
(space)	seconds
day of week	day of week

Example output parameter block:  
Read Date and Time in Packed ASCII Format  
(Mon, Oct. 2, 1989 at 23:13:00)

address	0
address + 1	3
address + 2	39
address + 3	31
address + 4	20
address + 5	30
address + 6	32
address + 7	20
address + 8	33
address + 9	31
address + 10	3A
address + 11	30
	32

## SVCREQ #8: Reset Watchdog Timer

Use SVCREQ function #8 to reset the watchdog timer during the sweep.

### Note

Of the CPUs discussed in this manual, Service Request 8 is supported only by 90-30 CPUs, beginning with Release 8.0.

When the watchdog timer expires, the PLC shuts down without warning. This function allows the timer to keep going during a time-consuming task (for example, while waiting for a response from a communications line).

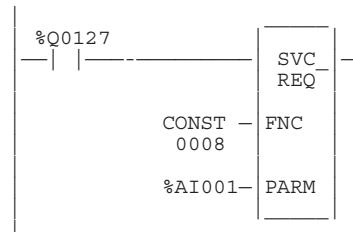
### Caution

**Be sure that restarting the watchdog timer does not adversely affect the controlled process.**

This function has no associated parameter block; however, the programming software requires that an entry be made for PARM. Enter any appropriate reference here; it will not be used.

## Example

In the following example, when %Q0127 turns ON, the watchdog timer is reset.



## SVCREQ #9: Read Sweep Time from Beginning of Sweep

Use SVCREQ function #9 to read the time in milliseconds since the start of the sweep. The data is in 16-bit Word format.

### Note

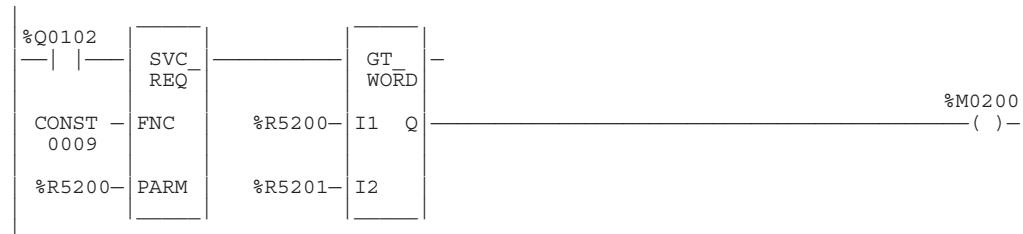
Of the CPUs discussed in this manual, Service Request 9 is supported only by 90-30 CPUs, beginning with Release 8.0.

The parameter block is an output parameter block only; it has a length of one word.

time since start of sweep	address
---------------------------	---------

## Example

In the following example, the elapsed time from the start of the sweep is always read into location %R5200. If it is greater than the value in %R5201, internal coil %M0200 is turned on.



## SVCREQ #10: Read Folder Name

Use SVCREQ function #10 to read the name of the currently-executing folder.

## Note

Of the CPUs discussed in this manual, Service Request 10 is supported *only* by 90-30 CPUs, beginning with Release 8.0.

The output parameter block has a length of four words. It returns eight ASCII characters; the last is a null character (00h). If the program name has fewer than seven characters, null characters are appended to the end.

Low Byte	High Byte	
character 1	character 2	address
character 3	character 4	address + 1
character 5	character 6	address + 2
character 7	00	address + 3

## Example

In the following example, when enabling contact %I0301 transitions ON, register location %R0099 is loaded with the value 10, which is the function code for the Read Folder Name function. In the following rung, when %I0102 is ON, the Service Request reads the folder name and stores it in the four-word block of memory starting at %R0100 (specified at PARM).



## SVCREQ #11: Read PLC ID

Use SVCREQ function #11 to read the name of the Series 90 PLC executing the program.

## Note

Of the CPUs discussed in this manual, Service Request 11 is supported *only* by 90-30 CPUs, beginning with Release 8.0.

The output parameter block has a length of four words. It returns eight ASCII characters; the last is a null character (00h). If the PLC ID has fewer than seven characters, null characters are appended to the end.

Low Byte	High Byte	
character 1	character 2	address
character 3	character 4	address + 1
character 5	character 6	address + 2
character 7	00	address + 3

## Example

In the following example, when enabling contact %I0001 transitions OFF, register location %R0099 is loaded with the value 11, which is the function code for the Read PLC ID function. . In the following rung, when %Q0102 is ON, the Service Request reads the PLC ID and stores it in the four-word block of memory starting at %R0100 (specified at PARM).



## SVCREQ #12: Read PLC Run State

Use SVCREQ function #12 to read the current RUN state of the PLC CPU.

### Note

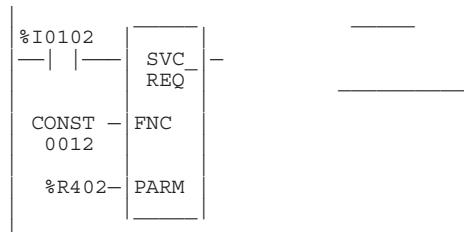
Of the CPUs discussed in this manual, Service Request 12 is supported *only* by 90-30 CPUs, beginning with Release 8.0.

The parameter block is an output parameter block only; it has a length of one word. There are only two valid results obtainable from the execution of this Service Request:

1 = run/disabled	address
2 = run/enabled	

## Example

In the following example, when %I0102 turns ON, the Service Request reads the PLC run state and places the result in memory address %R402. If the PLC is in Run/Disabled mode, %R402 will contain a value of 1. If the PLC is in Run/Enabled mode, %R402 will contain a value of 2.



## SVCREQ #13: Shut Down (Stop) PLC

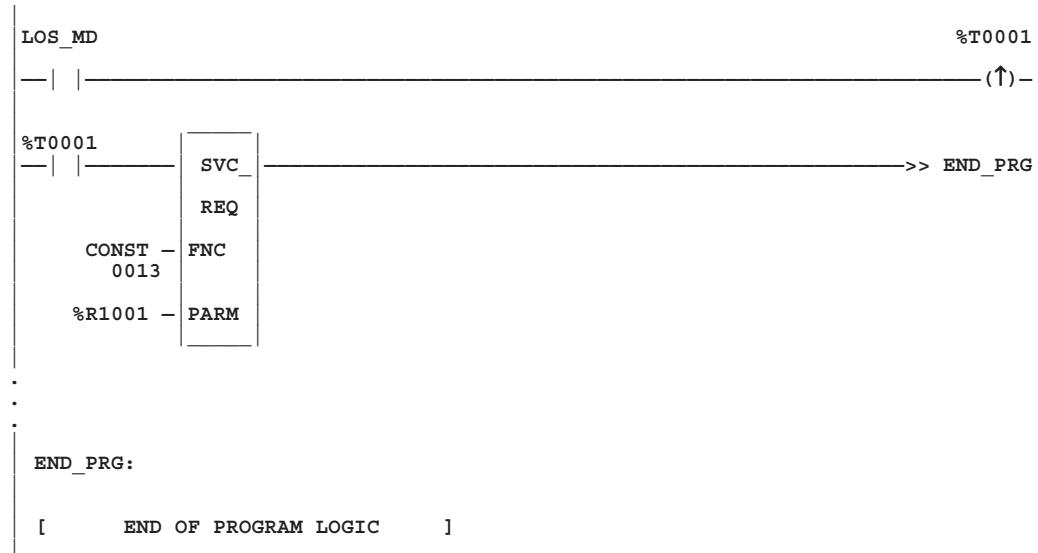
Use SVCREQ function #13 in order to stop the PLC *at the end of the next sweep*. All outputs will go to their designated default states at the beginning of the next PLC sweep. An informational fault is placed in the PLC fault table, noting that a “SHUT DOWN PLC” function block was executed. The I/O scan will continue as configured.

This function has no parameter block.

### Example

In the following example, when a “Loss of I/O Module” fault occurs, SVCREQ function #13 executes. Since no parameter block is needed, the PARM input is not used; however, the programming software requires that an entry be made for PARM.

This example uses a JUMP to the end of the program to force a shutdown if the Shut Down PLC function executes successfully. This JUMP and LABEL are needed because the transition to **STOP** mode does not occur until the end of the sweep in which the function executes. Once the PLC receives this STOP command from the Service Request, it will execute one more sweep and then stop (see NOTE below).



### Note

To ensure that the %S0002 LST\_SCN contact will operate correctly, the PLC will execute one additional sweep after the sweep in which the SVCREQ function #13 was executed.

## SVCREQ #14: Clear Fault Tables

Use SVCREQ function #14 in order to clear either the PLC fault table or the I/O fault table. The SVCREQ output is set ON unless some number other than 0 or 1 is entered as the requested operation (see below).

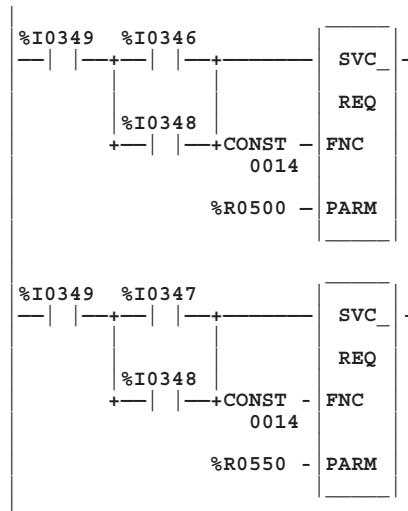
For this function, the parameter block has a length of 1 word. It is an input parameter block only.

0 = clear PLC fault table.	address
1 = clear I/O fault table.	

### Example

In the following example, when contacts %I0346 and %I0349 are both on, the PLC fault table is cleared. When contacts %I0347 and %I0349 are both on, the I/O fault table is cleared. When contacts %I0348 and %I0349 are both on, both fault tables are cleared.

The parameter block for the PLC fault table is located at %R0500, and for the I/O fault table the parameter block is located at %R0550. Both parameter blocks are set up elsewhere in the program (they both must be at logic 1 in order to clear their respective tables).



## SVCREQ #15: Read Last-Logged Fault Table Entry

Use SVCREQ function #15 in order to read the last entry logged in either the PLC fault table or the I/O fault table. The SVCREQ output is set ON unless some number other than 0 or 1 is entered as the requested operation (see below), or the fault table is empty. (For additional information on fault table entries, refer to chapter 3, "Fault Explanations and Correction.")

For this function, the parameter block has a length of 22 words. The input parameter block has this format:

0 = Read PLC fault table. 1 = Read I/O fault table.	address
--	---------

The format for the output parameter block depends on whether the function reads data from the PLC fault table or the I/O fault table.

**PLC Fault Table Output Format**

Low Byte	High Byte	
	0	
long/short		address + 1
spare		address + 2
PLC fault address		address + 3
fault group and action		address + 4
error code		address + 5
		address + 6
		address + 7
		address + 8
		address + 9
		address + 10
		address + 11
fault specific data		address + 12
		address + 13
		address + 14
		address + 15
		address + 16
		address + 17
		address + 18
time stamp		address + 19
		address + 20
		address + 21

**I/O Fault Table Output Format**

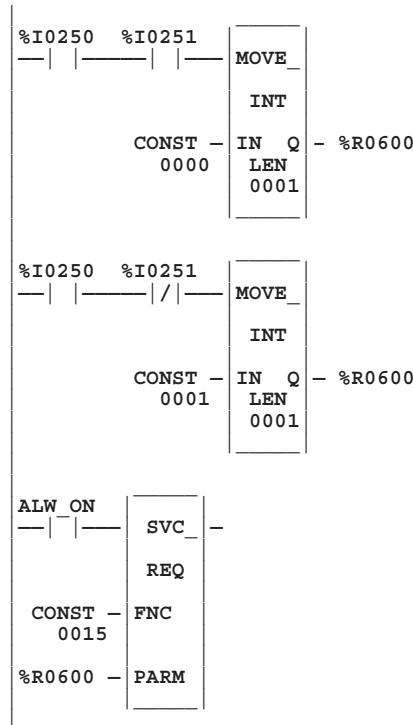
Low Byte	High Byte	
	1	
long/short		reference address
		I/O fault address
		fault group and action
	fault category	fault type
		fault description
		fault specific data
		time stamp

In the first byte of word address + 1, the Long/Short indicator defines the quantity of fault specific data present in the fault entry. It can be:

<b>PLC Fault Table:</b>	00 = -8 bytes (short)
	01 = 24 bytes (long)
<b>I/O Fault Table:</b>	02 = -5 bytes (short)
	03 = 21 bytes (long)

## Example 1

In the following example, when input %I0251 is on and input %I0250 is on, the last entry in the PLC fault table is read into the parameter block. When input %I0251 is off and input %I0250 is on, the last entry in the I/O fault table is read into the parameter block. The parameter block is located at location %R0600.



## Example 2

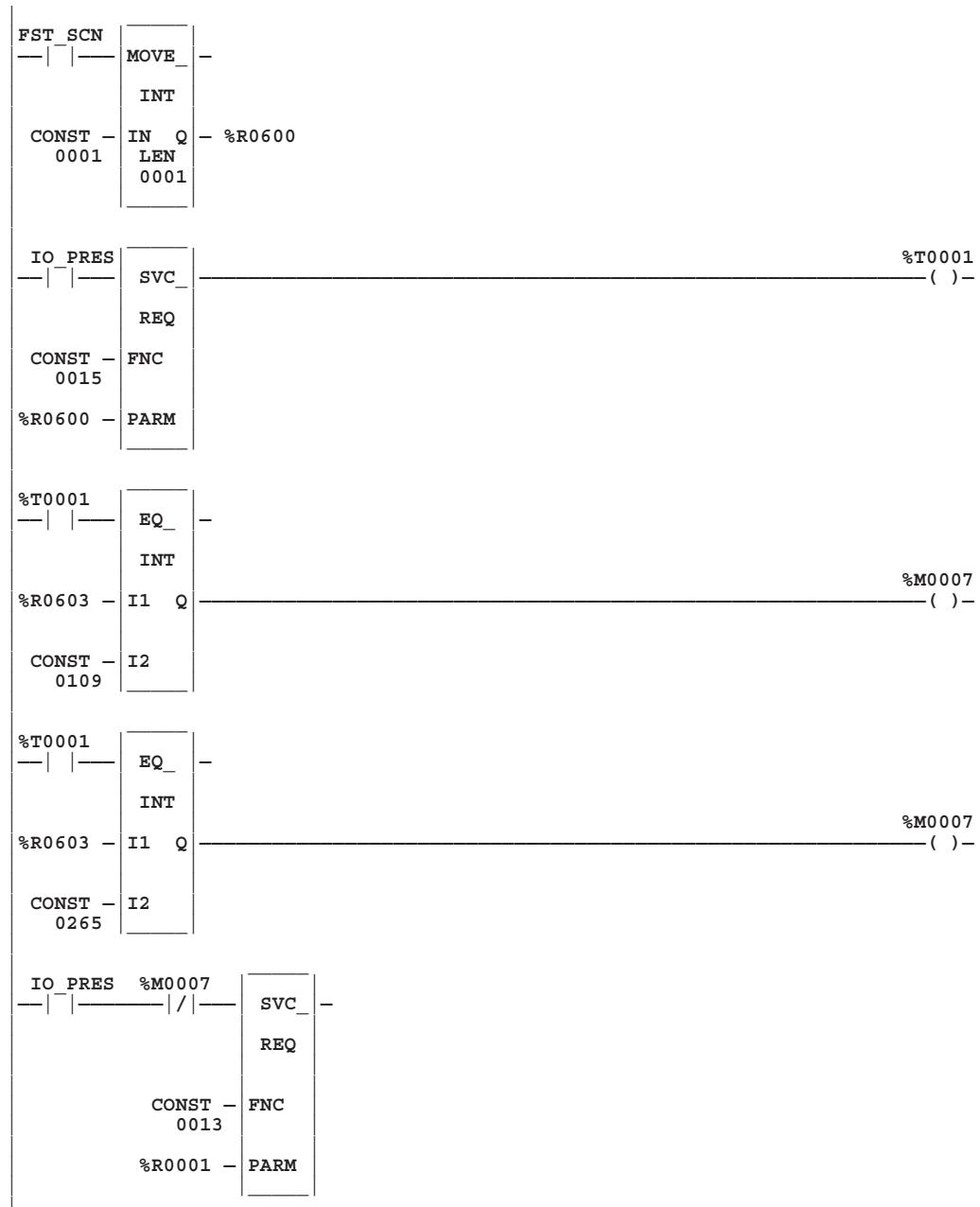
In the next example, the PLC is shut down when any fault occurs on an I/O module except when the fault occurs on modules in rack 0, slot 9 and in rack 1, slot 9. If faults occur on these two modules, the system remains running. The parameter for “table type” is set up on the first sweep. The contact IO\_PRES, when set, indicates that the I/O fault table contains an entry. The PLC CPU sets the normally open contact in the next sweep after the fault logic places a fault in the table. If faults are placed in the table in two consecutive sweeps, the normally open contact is set for two consecutive sweeps.

The example uses a parameter block located at %R0600. After the SVCREQ function executes, the fourth word of the parameter block contains the rack and slot location of the I/O module that faulted:

1		%R0600
long/short		%R0601
	reference address	%R0602
rack number	slot number	%R0603
I/O bus no.	bus address	%R0604
point address		%R0605

### fault data

In the program, the EQ\_INT blocks compare the rack/slot address in the table to hexadecimal constants. The internal coil %M0007 is turned on when the rack/slot where the fault occurred meets the criteria specified above. If coil %M0007 is on, its normally closed contact is off, preventing the shutdown. Conversely, if coil %M0007 is off because the fault occurred on a different module, its normally closed contact is on and the shutdown occurs.



## SVCREQ #16: Read Elapsed Time Clock

Use the SVCREQ function with function number 16 in order to read the value of the system's elapsed time clock. This clock tracks elapsed time in seconds since the PLC powered on. The timer will roll over approximately once every 100 years.

This function has an output parameter block only. The parameter block has a length of 3 words.

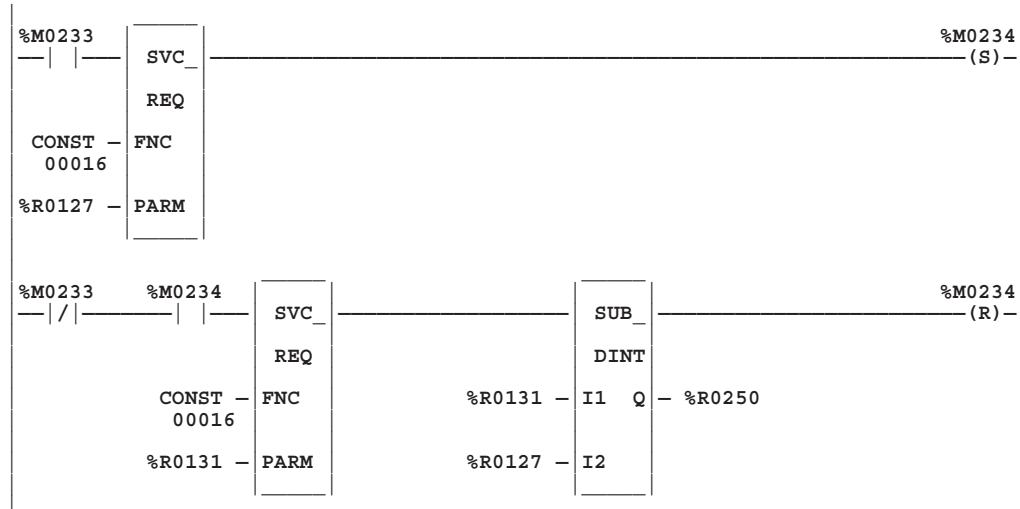
seconds from power on (low order)	address
seconds from power on (high order)	address + 1
100 microsecond ticks	address + 2

The first two words are the elapsed time in seconds. The last word is the number of 100 microsecond ticks in the current second.

## Example

In the following example, when internal coil %M0233 is on, the value of the elapsed time clock is read and coil %M0234 is set. When it is off, the value is read again. The difference between the values is then calculated, and the result is stored in register memory at location %R0250.

The parameter block for the first read is at %R0127; for the second read, at %R0131. The calculation ignores the number of hundred microsecond ticks and the fact that the DINT type is actually a signed value. The calculation is correct until the time since power-on reaches approximately 50 years.



## SVCREQ #18: Read I/O Override Status

Use SVCREQ function #18 in order to read the current status of overrides in the CPU.

### Note

This feature is available **only** for 331 or higher CPUs.

For this function, the parameter block has a length of 1 word. It is an output parameter block only.

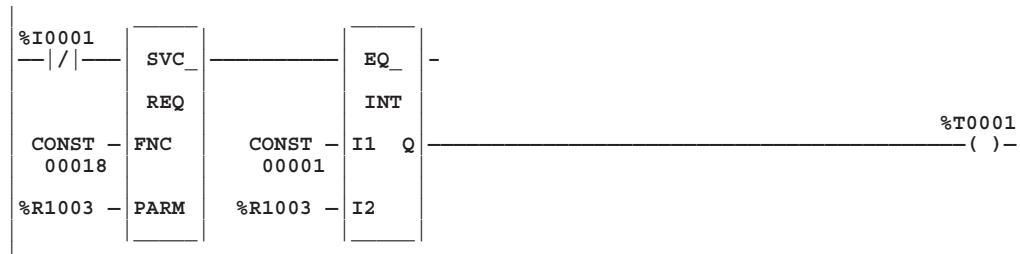
0 = No overrides are set.	address
1 = Overrides are set.	

### Note

SVCREQ #18 reports only overrides of %I and %Q references.

## Example

In the following example, the status of I/O overrides is always read into location %R1003. If any overrides are present, output %T0001 is set on.



## SVCREQ #23: Read Master Checksum

Use SVCREQ function #23 to read the master checksums for the user program and the configuration. The SVCREQ output is always set to ON if the function is enabled, and the output block of information (see below) starts at the address given in parameter 3 (PARM) of the SVCREQ function.

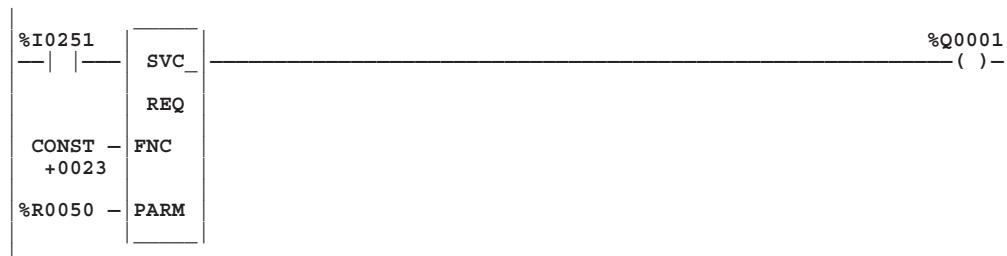
When a **RUN MODE STORE** is active, the program checksums may not be valid until the store is complete. Therefore, two flags are provided at the beginning of the output parameter block to indicate when the program and configuration checksums are valid.

For this function, the output parameter block has a length of 12 words with this format:

Master Program Checksum Valid (0 = not valid, 1 = valid)	address
Master Configuration Checksum Valid (0 = not valid, 1 = valid)	address + 1
Number of Program Blocks (including _MAIN)	address + 2
Size of User Program in Bytes (DWORD data type)	address + 3
Program Additive Checksum	address + 5
Program CRC Checksum (DWORD data type)	address + 6
Size of Configuration Data in Bytes	address + 8
Configuration Additive Checksum	address + 9
Configuration CRC Checksum (DWORD data type)	address + 10

### Example

In the following example, when input %I0251 is ON, the master checksum information is placed into the parameter block, and the output coil (%Q0001) is turned on. The parameter block is located at %R0050.



## SVCREQ #24: Reset Smart Module

Use SVCREQ function #24 to reset a daughterboard or smart module. The SVCREQ output is set ON unless an invalid number for rack and/or slot is entered as shown below.

For this function, the parameter block has a length of 1 word. It is an input parameter block only.

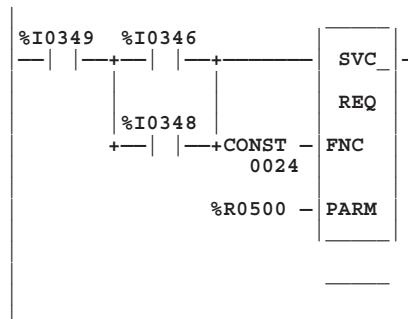
Module Slot (low byte)	address
Module Rack (high byte)	

**Note:** Rack 0, Slot 1 shall indicate a reset is to be sent to the daughterboard.

### Example

In the following example, when input %I0346 is on and input %I0349 is on, the module indicated by the Rack/Slot present in %R0500 is reset.

The parameter block containing the modules rack and slot for the reset module Service Request is located at %R0500. The parameter block is set up elsewhere in the program.



## SVCREQ #26/30: Interrogate I/O

Use SVCREQ function #26 (or #30—they are identical; i.e., you can use either number to accomplish the same thing) to interrogate the actual modules present and compare them with the rack/slot configuration, generating addition, loss, and mismatch alarms, as if a store configuration had been performed. This SVCREQ will generate faults on both the PLC and I/O fault tables, depending on the fault.

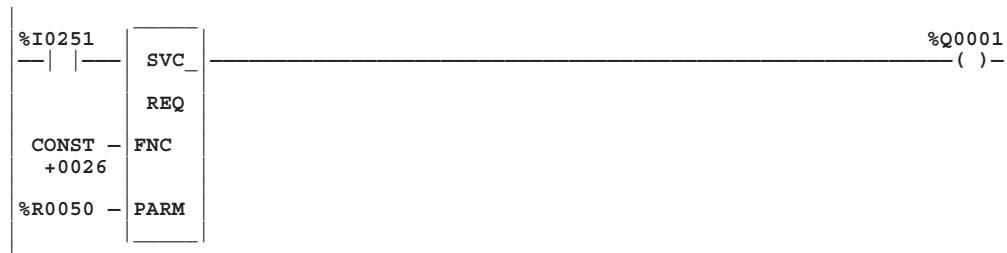
This function has no parameter block and always outputs power flow.

### Note

The time for this SVCREQ to execute depends on how many faults exist. Therefore, execution time of this SVCREQ will be greater for situations where more modules are at fault.

## Example

In the following example, when input %I0251 is ON, the actual modules are interrogated and compared to the rack/slot configuration. Output %Q0001 is turned on after the SVCREQ is complete.



### Note

This Service Request is not available on Micro PLCs.

## SVCREQ #29: Read Elapsed Power Down Time

Use the SVCREQ function #29 to read the amount of time elapsed between the last power-down and the most recent power-up. The SVCREQ output is always set to ON, and the output block of information (see below) starts at the address given in parameter 3 (PARM) of the SVCREQ function.

## Note

This function is available only in the 331 or higher CPUs.

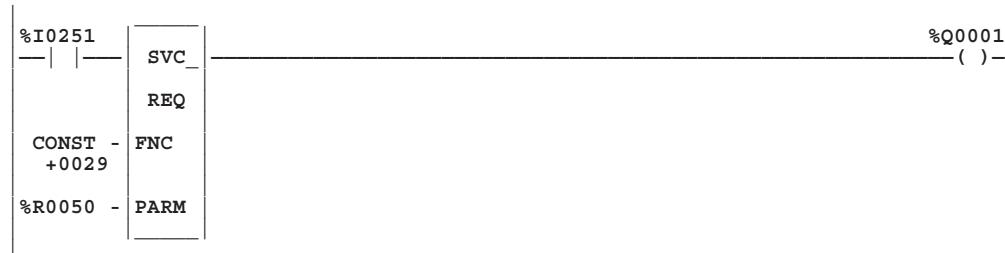
This function has an output parameter block only. The parameter block has a length of 3 words.

Power-Down Elapsed Seconds (low order)	address
Power-Down Elapsed Seconds (high order)	address + 1
100 Microsecond ticks	address + 2

The first two words are the power-down elapsed time in seconds. The last word is the remaining power-down elapsed time in 100 microsecond ticks (which is always 0). Whenever the PLC can not properly calculate the power down elapsed time, the time will be set to 0. This will happen when the PLC is powered up with CLR M/T pressed on the HHP. This will also happen if the watchdog timer times out before power-down.

## Example

In the following example, when input %I0251 is ON, the Elapsed Power-Down Time is placed into the parameter block, and the output coil (%Q0001) is turned on. The parameter block is located at %R0050.



## SVCREQ #45: Skip Next Output & Input Scan

(Suspend I/O) Use the SVCREQ function #45 to skip the next output and input scans. Any changes to the output reference tables during the sweep in which the SVCREQ #45 was executed will not be reflected on the physical outputs of the corresponding modules. Any changes to the physical input data on the modules will not be reflected in the corresponding input references during the sweep after the one in which the SVCREQ #45 was executed.

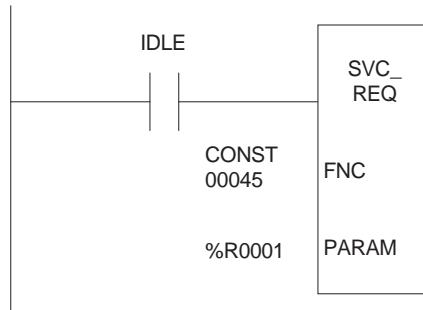
This function has no parameter block.

### Note

The DOIO Function Block is not affected by the use of SVCREQ #45. It will still update the I/O when used in the same logic program as the SVCREQ #45.

### Example

In the following example, when the “Idle” contact passes power flow, the next Output and Input Scan are skipped.



## SVCREQ #46: Fast Backplane Status Access

This function is a method of communicating a few bits to or from one or more smart modules very quickly across the PLC backplane compared with the normal communication method. This increase in communication speed is achieved by limiting the amount of data and the number of replies.

Use SVCREQ function #46 to perform one of the following fast backplane access functions:

- Read a word of extra status data from one or more specified smart modules.
- Write a word of extra status data from one or more specified smart modules.
- Read/Write: Read a word of extra status data from one or more specified modules and write the data value between 0 and 15 to the same module, all in one operation.

### Notes

Currently, the only module designed to support this Service Request is the DSM314 (Digital Servo Module).

A COMM\_REQ or DOIO function block should not be performed with the specified module(s) during the same logic sweep during which either of the data write functions are performed, since they can cause the write data to be lost.

Two functions that write to a module (Write or Read/Write) should not be performed with the same module during the same logic sweep because they can cause the first write data to be lost.

This Service Request is also known as “SNAP.”

This Service Request has a variable length as described below. The first word of the parameter block determines which function will be used and has the following format:

1 = Read extra data	address (word 1)
2 = Write extra data	
3 = Read/write extra data	

## Read Extra Status Data (Function #1)

The Read Extra Data function reads a word of extra status data from each of the modules specified by a list in the parameter block and places the status data values into the parameter block. The parameter block requires  $(N + 4)$  words of reference memory, where N is the number of modules to which the data will be written.

Use the table on the following page to interpret the output values.

Table 12-5. Parameter Block for Read Extra Data Function

Location	Field	Meaning
Address	Function	1 = read extra status data
Address + 1	Error Code	An error code is placed here if the function fails because any of the modules is not present, inappropriate, or not working. For details, see "Error Codes" on page 12-75.
Address + 2	Error rack & slot	The rack & slot number at which the error occurred
Address + 3	First rack & slot	Rack and slot number (in the form RRSS in hexadecimal, where RR is the rack number and SS is the slot number) of the 1st module from which the data will be read
Address + 4	Read data from first module	The data read from the first module will be place here
Address + 5	Second rack & slot	Rack and slot number (in the form RRSS in hexadecimal, where RR is the rack number and SS is the slot number) of the 2nd module from which the data will be read
Address + 6	Read data from second module	The data read from the second module will be place here
Address + $(I * 2) + 1$	Ith rack & slot	Rack and slot number (in the form RRSS in hexadecimal, where RR is the rack number and SS is the slot number) of the Ith module from which the data will be read
Address + $(I * 2) + 2$	Read data from Ith module	The data read from the Ith module will be place here
Address + $(N * 2) + 1$	Last rack & slot	Rack and slot number (in the form RRSS in hexadecimal, where RR is the rack number and SS is the slot number) of the last module from which the data will be read
Address + $(N * 2) + 2$	Read data from last module	The data read from the last module will be place here
Address + $(N * 2) + 3$	End of list indicator	A zero in this word indicates the end of the list of modules

## Write Data (Function #2)

The write data function writes a data value between 0 and 15 from the parameter block to one or more modules specified by a list in the parameter block. The parameter block requires  $(N + 4)$  words of reference memory, where N is the number of modules to which the data will be written.

Table 12-6. Parameter Block for Write Data Function

Location	Field	Meaning
Address	Function	2 = write data
Address + 1	Error Code	An error code is placed here if the function fails because any of the modules is not present, inappropriate, or not working. No error code is set if the function executes but any of the modules does not receive the write data properly. For details, see "Error Codes" on page 12-75.
Address + 2	Error rack & slot	The rack & slot number at which the error occurred
Address + 3	First rack & slot	Rack and slot number (in the form RRSS in hexadecimal, where RR is the rack number and SS is the slot number) of the 1st module to which the data will be sent
Address + 4	Write data for first module	This data value will be written to the first module
Address + 5	Second rack & slot	Rack and slot number (in the form RRSS in hexadecimal, where RR is the rack number and SS is the slot number) of the 2nd module to which the data will be sent
Address + 6	Write data for second module	This data value will be written to the second module
Address + $(I * 2) + 1$	Ith rack & slot	Rack and slot number (in the form RRSS in hexadecimal, where RR is the rack number and SS is the slot number) of the Ith module to which the data will be sent
Address + $(I * 2) + 2$	Write data for Ith module	This data value will be written to the Ith module
Address + $(N * 2) + 1$	Last rack & slot	Rack and slot number (in the form RRSS in hexadecimal, where RR is the rack number and SS is the slot number) of the last module to which the data will be sent
Address + $(N * 2) + 2$	Write data for last module	This data value will be written to the last module
Address + $(N * 2) + 3$	End of list indicator	A zero in this word indicates the end of the list of modules

## Read/Write Data (Function #3)

The read/write function reads a word of extra status data from a module specified in the parameter block, then writes a data value between 0 and 15 from the parameter block to that module. This read write process is repeated for each module in a list in the parameter block. The parameter block ( $N * 3$ ) + 3 words of reference memory, where N is the number of modules with which data will be exchanged.

Table 12-7. Parameter Block for Read/Write Data Function

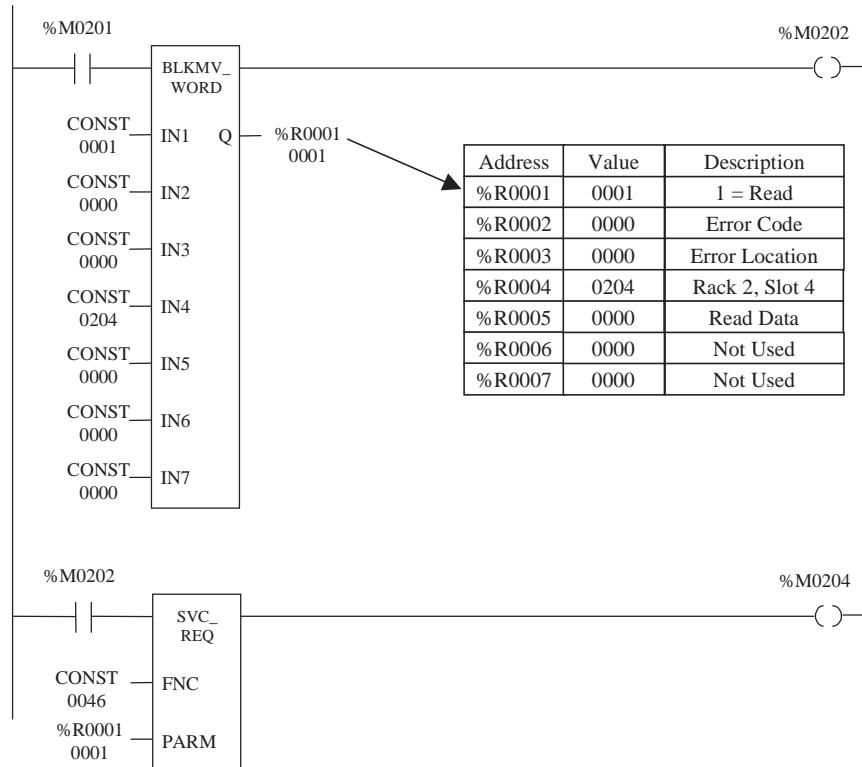
Location	Field	Meaning
Address	Function	3 = read/write
Address + 1	Error Code	An error code is placed here if the function fails because any of the modules is not present, inappropriate, or not working. No error code is set if the function executes but any of the modules does not receive the write data properly. For details, see "Error Codes" on page 12-75.
Address + 2	Error rack & slot	The rack & slot number at which the error occurred
Address + 3	First rack & slot	Rack and slot number (in the form RRSS in hexadecimal, where RR is the rack number and SS is the slot number) of the 1st module with which data will be exchanged
Address + 4	Read data from first module	The data read from the first module will be placed here
Address + 5	Write data for first module	This data value will be written to the first module
Address + 6	Second rack & slot	Rack and slot number (in the form RRSS in hexadecimal, where RR is the rack number and SS is the slot number) of the 2nd module with which data will be exchanged
Address + 7	Read data from second module	The data read from the second module will be placed here
Address + 8	Write data for second module	This data value will be written to the second module
Address + ((I-1) * 3) + 3	Ith rack & slot	Rack and slot number (in the form RRSS in hexadecimal, where RR is the rack number and SS is the slot number) of the Ith module with which data will be exchanged
Address + ((I-1) * 3) + 4	Read data from Ith module	The data read from the Ith module will be placed here
Address + ((I-1) * 3) + 5	Write data for Ith module	This data value will be written to the Ith module
Address + ((N-1) * 3) + 3	Last rack & slot	Rack and slot number (in the form RRSS in hexadecimal, where RR is the rack number and SS is the slot number) of the last module with which data will be exchanged
Address + ((N-1) * 3) + 4	Read data from last module	The data read from the last module will be placed here
Address + ((N-1) * 3) + 5	Write data for last module	This data value will be written to the last module
Address + (N * 3) + 3	End of list indicator	A zero in this word indicates the end of the list of modules

Table 12-8. Error Codes

Value	Description
1	Success — the function has executed normally.
-1	Module not present in the specified slot.
-2	Module inappropriate — module in the specified slot is not a smart module or does not support this functionality.
-3	Module not working — module in the specified slot is not communicating with the CPU properly.
-4	Read data parity error — parity error occurred during a read operation from an expansion or remote rack.
-5	Invalid function specified in the command block.

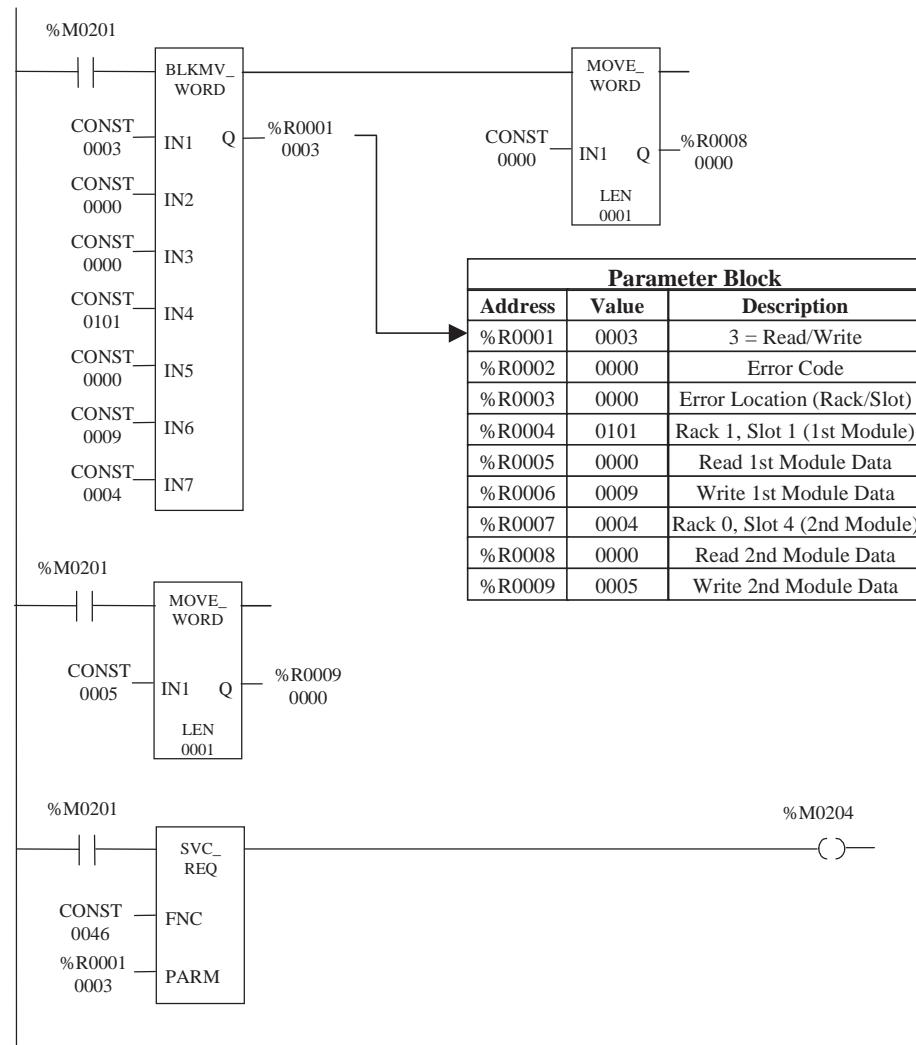
## Example 1

The following example shows a Read (Specified in %R0001) of a single module, located at Rack 2, Slot 4 (specified in %R0004). If the function completes successfully, the data read will be stored in %R0005. If an error occurs, however, an error code will be written to %R0002, and the rack/slot location of the module generating the error will appear in %R0003. Note that since this is a Read function for a single module, Address + 5 and Address + 6 are not used. Therefore, the corresponding memory locations, %R0006 and %R0007, are filled with zeros from the BLKMV instruction's IN6 and IN7 inputs. If an additional module were to be read, %R0006 and %R0007 would be used for the additional module. For more information on the Read function, see Table 12-5 earlier in this chapter.



## Example 2

In this example the BLKMV and two MOVE instructions write the required data to the parameter block, which starts at %R0001 (specified by the SVCREQ PARM input). When enabled, the SVCREQ reads the extra status word data from the module in Rack 0, Slot 4 and from the module in Rack 1, Slot 1. It writes a value of 0005 to the module in Rack 0, Slot 4, and a value of 0009 to the module in Rack 1, Slot 1. (Note that the modules do not need to be listed in the parameter block in order by slot numbers.) Data read from the module in Rack 0, Slot 4 will be placed into %R0008. Data read from the module in Rack 1, Slot 1 will be placed in %R0005.



## SVCREQ #48: Reboot After Fatal Fault Auto Reset

### Compatibility for SVCREQ 48

**CPU** - This Service Request is supported by firmware release 10.00 (or later version) for Series 90-30 CPUs 331, 340, 341, 350, 36x, and 37x.

**Software** - This Service Request is only supported by VersaPro Version 1.1 (or later version) PLC software. Logicmaster does not support this feature.

### Warning

The Reboot After Fatal Fault feature should not be used (Ignore Fatal Faults parameter set to Disabled) in applications where an automatic PLC restart under fault condition could produce an unsafe condition in the controlled equipment. It is the responsibility of the system designer to determine whether this feature can be used safely with their equipment. Failure to follow this warning could result in injury or death to personnel and/or damage to equipment.

### Description

The Reboot After Fatal Fault Service Request lets the PLC automatically resume normal operation after a fatal fault has occurred. Following the fatal fault, the PLC will automatically reset and resume execution. The faults will not be cleared, but will be treated as non-fatal. If fatal faults are present following the power up, the PLC will still be allowed to transition to run mode. This feature is enabled by the Ignore Fatal Faults (or Fatal Fault Override) parameter in the CPU's hardware configuration.

SVCREQ 48 sets the maximum number of retries and the time period during which the retries may occur. If the number of retries allowed within the time period is exceeded, the CPU mode is set to STOP/FAULT. If the period is 0, the CPU mode is set to STOP/FAULT when the number of retries allowed is exceeded.

If the operator cycles power, fatal faults are ignored. The current fault count and time period are initialized. The total number of fatal faults is unchanged, but the total number of retries is incremented. System bit %S0021 is set to 1 whenever retry is successful and remains set until all fatal faults are cleared, or the mode is set to STOP/FAULT.

Table 12-9. Parameter Block for Reboot after Fatal Fault

Location	Field	Meaning
Word 1	Service Request Status	See Return Status Definition, below. User program must initialize this word to zero.
Word 2	Unlimited Retries	0 = Disable (number of retries is set by Word 3) 1 = Enable (Words 3 and 4 ignored)
Word 3	Number of Retries Allowed	Range is 0 to 128 0 = Automatic Reboot is Disabled 1 to 128 = Maximum number of retries that are allowed to occur within the period set in Word 4.
Word 4	Retry Period (in minutes)	Range is 0 to 5940 minutes (99 hours) 0 = No time limit on maximum number of retries set in Word 3. Auto Reboot will be allowed for the number of retries. 1 to 5940 = Auto Reboot is disabled if the number of retries specified is exceeded within the period specified.

Table 12-10. Return Status Definitions for Reboot after Fatal Fault

Status	Description	Notes	Power Flow
-5	Invalid Retry Period	Valid range is 0 to 5940	No
-4	Invalid No. of Retries	Valid range is 0 to 128	No
-3	Invalid Unlimited Retries	Must be 0 or 1	No
-2	Configuration Disabled	Ignore Fatal Faults (Fatal Fault Override) option must be enabled in hardware configuration.	No
0	No Action	Command requires no change	Yes
1	Auto Reset Enabled	Valid command enables reboot after Fatal Fault	Yes
2	Auto Reset Disabled	Valid command disables Reboot after Fatal Fault. Ignore Fatal Faults remains enabled.	

## SVCREQ 49 Auto Reset Statistics

Service Request 49 provides access to two variables which record total number of fatal faults and retries that have occurred. The range of these variables is 0 to 65535. These variables do not roll over if their maximum value is exceeded. (Service Request 48 is used to configure the maximum number of retries allowed and the time limit during which the retries can occur.)

Table 12-11. Parameter Block for Auto Reset Statistics

Word 1	Service Request Status	See Return Status Definitions below. User program must initialize this word to zero.
Word 2	Command	0 = Return total number of Fatal Faults and Number of Retries that have occurred. 1 = Initialize the Total Number of Fatal Faults and Total Number of Retries to Zero.
Word 3	Returned Value = Total number of Fatal Faults that have occurred.	User program should initialize to zero.
Word 4	Returned Value = Total number of Auto Reset Retries	User program should initialize to zero.

Table 12-12. Return Status Definitions for Auto Reset Statistics

Status	Description	Notes	Power Flow
-2	Configuration Disabled	Ignore Fatal Faults (Fatal Fault Override) option must be enabled in hardware configuration.	No
-1	Invalid Command	Command must be 0 or 1.	No
1	Normal Status	Valid Command	Yes

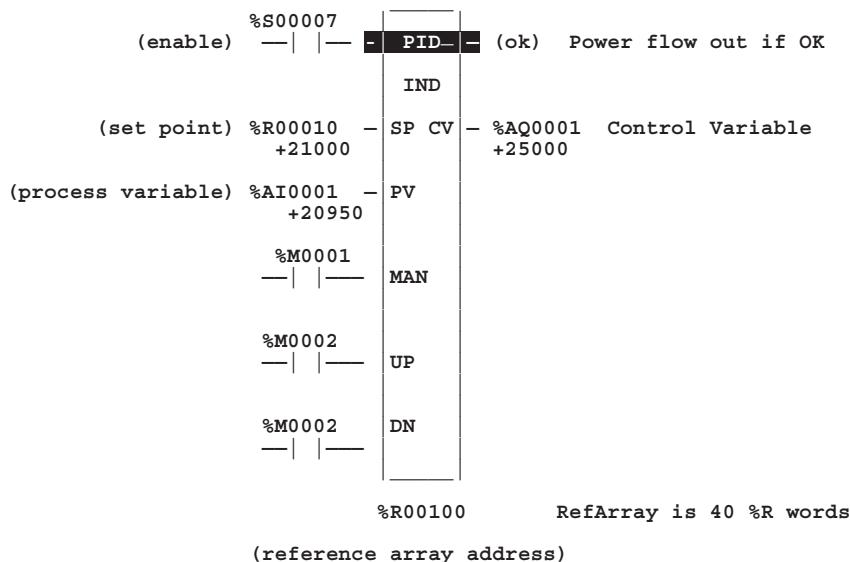
### CPU Compatibility for SVCREQ 49

This Service Request is supported by Firmware Release 10.00 for the Series 90-30 CPUs 331, 340, 341, 350, 36x, and 37x.

## PID

The Proportional plus Integral plus Derivative (PID) control function is the best known general purpose algorithm for closed loop process control. The Series 90 PID function block compares a Process Variable (PV) feedback with a desired process Set Point (SP) and updates a Control Variable (CV) output based on the error.

The block uses PID loop gains and other parameters stored in an array of 40 16 bit words (discussed on page 12-82) to solve the PID algorithm at the desired time interval. All parameters are 16 bit integer words for compatibility with 16 bit analog process variables. This allows %AI memory to be used for input Process Variables and %AQ to be used for output Control Variables. The example shown below includes typical inputs.



As scaled 16 integer numbers, many parameters must be defined in either PV counts or units or CV counts or units. For example, the SP input must be scaled over the same range as PV because the PID block calculates the error from the difference of these two inputs. The PV and CV counts can be -32000 or 0 to 32000, matching analog scaling or from 0 to 10000, to display variables as 0.00% to 100.00%. The PV and CV Counts do not have to have the same scaling, in which case there will be scale factors included in the PID gains.

### Note

The PID will not execute more often than once every 10 milliseconds. This could change your results if you set it up to execute every sweep and the sweep is less than 10 milliseconds. In such a case, the PID function will not run until enough sweeps have occurred to accumulate an elapsed time of 10 milliseconds. For example, if the sweep time is 9 milliseconds, the PID function will execute every other sweep with an elapsed time of 18 milliseconds for every time it executes.

## Parameters

Parameter	Description
enable	When enabled through a contact, the PID function is performed.
SP	SP is the control loop or process set point. Set using PV Counts, the PID adjusts the output CV so that PV matches SP (zero error).
PV	Process Variable input from the process being controlled, often a %AI input.
MAN	When energized to 1 (through a contact), the PID block is in <b>MANUAL</b> mode. If this parameter is not energized (0), the PID block is in automatic mode.
UP	If energized along with MAN, it adjusts the CV up by 1 CV per solution.*
DN	If energized along with MAN, it adjusts the CV down by 1 CV per solution.*
RefArray Address	Address is the location of the PID control block information (user and internal parameters). Uses 40 %R words that cannot be shared.
ok	The ok output is energized when the function is performed without error. It is off if error(s) exist.
CV	CV is the control variable output to the process, often a %AQ analog output.

\*Increments (UP parameter) or decremented (DN parameter) by 1 per access of the PID function.

## Valid Memory Types

Parameter	flow	%I	%Q	%M	%T	%S	%G	%R	%AI	%AQ	const	none
enable	•											
SP		•	•	•	•		•	•	•	•		•
PV		•	•	•	•		•	•	•	•		
MAN	•											
UP	•											
DN	•											
address								•				
ok	•											•
CV		•	•	•	•	•	•	•	•	•		

- Valid reference or place where power can flow through the function.

## PID Parameter Block

Besides the 2 input words and the 3 Manual control contacts, the PID block uses 13 of the parameters in the RefArray. These parameters must be set before calling the block. The other parameters are used by the PLC and are non-configurable. The %Ref shown in the table below is the same RefArray Address at the bottom of the PID block. The number after the plus sign is the offset in the array. For example, if the RefArray starts at %R100, the %R113 will contain the Manual Command used to set the Control Variable and the integrator in Manual mode.

Table 12-13. PID Parameters Overview

Register	Parameter	Low Bit Units	Range of Values
%Ref+0000	Loop Number	Integer	0 to 255 (for user display only)
%Ref+0001	Algorithm	N/A; set and maintained by the PLC	Non-configurable
%Ref+0002	Sample Period	10 milliseconds	0 (every sweep) to 65535 (10.9 Min). Use at least 10 for 90-30 PLCs (see Note on page 12-80).
%Ref+0003	Dead Band +	PV Counts	0 to 32000 (never negative)
%Ref+0004	Dead Band —	PV Counts	-32000 to 0 (never positive)
%Ref+0005	Proportional Gain -Kp	0.01 CV%/PV%	0 to 327.67 %/%
%Ref+0006	Derivative Gain-Kd	0.01 seconds	0 to 327.67 sec
%Ref+0007	Integral Rate-Ki	Repeat/1000 Sec	0 to 32.767 repeat/sec
%Ref+0008	CV Bias/Output Offset	CV Counts	-32000 to 32000 (add to integrator output)
%Ref+0009	Upper Clamp	CV Counts	-32000 to 32000 (>%Ref+10) output limit
%Ref+0010	Lower Clamp	CV Counts	-32000 to 32000 (<%Ref+09) output limit
%Ref+0011	Minimum Slew Time	Second/Full Travel	0 (none) to 32000 sec to move 32000 CV
%Ref+0012	Config Word	Low 5 bits used	Bit 0 to 2 for Error +/-, OutPolarity, Deriv.
%Ref+0013	Manual Command	CV Counts	Tracks CV in Auto or Sets CV in Manual
%Ref+0014	Control Word	Maintained by the PLC, <b>unless</b> Bit 1 is set.	PLC maintained unless set otherwise: low bit sets Override if 1 (see description in the “PID Parameter Details” table on page 12-85)
%Ref+0015	Internal SP	N/A; set and maintained by the PLC	Non-configurable
%Ref+0016	Internal CV	N/A; set and maintained by the PLC	Non-configurable
%Ref+0017	Internal PV	N/A; set and maintained by the PLC	Non-configurable
%Ref+0018	Output	N/A; set and maintained by the PLC	Non-configurable

Table 12-13. PID Parameters Overview - Continued

Register	Parameter	Low Bit Units	Range of Values
%Ref+0019	Diff Term Storage	N/A; set and maintained by the PLC	Non-configurable
%Ref+0020 and %Ref+0021	Int Term Storage	N/A; set and maintained by the PLC	Non-configurable
%Ref+0022	Slew Term Storage	N/A; set and maintained by the PLC	Non-configurable
%Ref+0023	Clock (time last executed)	N/A; set and maintained by the PLC	Non-configurable
%Ref+0024			
%Ref+0025			
%Ref+0026	Y Remainder Storage	N/A; set and maintained by the PLC	Non-configurable
%Ref+0027	Lower Range for SP, PV	PV Counts	-32000 to 32000 (>%Ref+28) for display
%Ref+0028	Upper Range for SP, PV	PV Counts	-32000 to 32000 (<%Ref+27) for display
%Ref+0029 +• %Ref+0034	Reserved for internal use	N/A	Non-configurable
%Ref+0035 • %Ref+0039	Reserved for external use	N/A	Non-configurable

The RefArray array must consist of %R registers on the 90-30 PLC. Note that every PID block call must use a different 40-word array even if all 13 user parameters are the same because other words in the array are used for internal PID data storage. Make sure the array does not extend beyond the end of memory.

To configure operating parameters, select the PID function and press **F10** to zoom in to a screen displaying User Parameters; then use arrow keys to select fields and type in desired values. You can use 0 for most default values, except the CV Upper Clamp, which must be greater than the CV Lower Clamp for the PID block to operate. Note that the PID block does **not** pass power if there is an error in User Parameters, so monitor with a temporary coil while modifying data.

Once suitable PID values have been chosen, they should be defined as constants in the BLKMOV so that they can be used to reload default PID user parameters if needed.

## Operation of the PID Instruction

Normal Automatic operation is to call the PID block every sweep with power flow to Enable and no power flow to Manual input contacts. The block compares the current PLC elapsed time clock with the last PID solution time stored in the internal RefArray. If the time difference is greater than the sample period defined in the third word (%Ref+2) of the RefArray, the PID algorithm is solved using the time difference and both the last solution time and Control Variable output are updated. In Automatic mode, the output Control Variable is placed in the Manual Command parameter %Ref+13.

If power flow is provided to both Enable and Manual input contacts, the PID block is placed in Manual mode and the output Control Variable is set from the Manual Command parameter %Ref+13. If either the UP or DN inputs have power flow, the Manual Command word is incremented or decremented by one CV count every PID solution. For faster manual changes of the output Control Variable, it is also possible to add or subtract any CV count value directly to/from the Manual Command word.

The PID block uses the CV Upper and CV Lower Clamp parameters to limit the CV output. If a positive Minimum Slew Time is defined, it is used to limit the rate of change of the CV output. If either the CV amplitude or rate limit is exceeded, the value stored in the integrator is adjusted so that CV is at the limit. This anti-reset windup feature (defined on page 12-87) means that even if the error tried to drive CV above (or below) the clamps for a long period of time, the CV output will move off the clamp as soon as the error term changes sign.

This operation, with the Manual Command tracking CV in Automatic mode and setting CV in Manual mode, provides a bumpless transfer between Automatic and Manual modes. The CV Upper and Lower Clamps and the Minimum Slew Time still apply to the CV output in Manual mode and the internal value stored in the integrator is updated. This means that if you were to step the Manual Command in Manual mode, the CV output will not change any faster than the Minimum Slew Time (Inverse) rate limit and will not go above or below the CV Upper or CV Lower Clamp limits.

### Note

A specific PID function should not be called more than once per sweep.

The following table provides more details about the parameters discussed briefly in Table 12-3. The number in parentheses after each parameter name is the offset in the RefArray.

Table 12-14. PID Parameter Details

Data Item	Description
Loop Number (00)	This is an optional parameter available to identify a PID block. It is an unsigned integer that provides a common identification in the PLC with the loop number defined by an operator interface device. The loop number is displayed under the block address when logic is monitored from the Logicmaster 90-30/20/Micro software.
Algorithm (01)	An unsigned integer that is set by the PLC to identify what algorithm is being used by the function block. The ISA algorithm is defined as algorithm 1, and the independent algorithm is identified as algorithm 2.
Sample Period (02)	The shortest time, in 10 millisecond increments, between solutions of the PID algorithm. For example, use a 10 for a 100 millisecond sample period. If it is 0, the algorithm is solved every time the block is called (see section below on PID block scheduling).  The PID algorithm is solved only if the current PLC elapsed time clock is at or later than the last PID solution time plus this Sample Period. Remember, that the 90-30 will not use a solution time less than 10 milliseconds (see Note on page 12-80); so sweeps will be skipped for smaller sweep times. This function compensates for the actual time elapsed since the last execution, within 100 microseconds. If this value is set to 0, the function is executed each time it is enabled; however, it is restricted to a minimum of 10 milliseconds as noted above.
Dead Band (+/-) (03/04)	INT values defining the upper (+) and lower (-) Dead Band limits in PV Counts. If no Dead Band is required, these values must be 0. If the PID Error (SP – PV) or (PV – SP) is above the (-) value and below the (+) value, the PID calculations are solved with an Error of 0. If non-zero, the (+) value must be greater than 0 and the (-) value less than 0 or the PID block will not function. <i>You should leave these at 0 until the PID loop gains are setup or tuned.</i> After that, you might want to add Dead Band to avoid small CV output changes due to small variations in error, perhaps to reduce mechanical wear.
Proportional Gain-Kp (05)	This INT number, called the Controller gain, Kc, in the ISA version, determines the change in CV in CV Counts for a 100 PV Count change in the Error term. It is displayed as 0.00 %% with an implied decimal point of 2 . For example, a Kp entered as 450 will be displayed as 4.50 and will result in a $K_p \cdot \text{Error}/100$ or $450 \cdot \text{Error}/100$ contribution to the PID Output. Kp is generally the first gain set when adjusting a PID loop.
Derivative Gain-Kd (06)	This INT number determines the change in CV in CV Counts if the Error or PV changes 1 PV Count every 10 milliseconds. Entered as a time with the low bit indicating 10 milliseconds, it is displayed as 0.00 Seconds with an implied decimal point of 2. For example, a Kd entered as 120 will be displayed as 1.20 Sec and will result in a $K_d \cdot \Delta \text{Error}/\Delta \text{Time}$ or $120 \cdot 4/3$ contribution to the PID Output if Error was changing by 4 PV Counts every 30 milliseconds. Kd can be used to speed up a slow loop response, but is very sensitive to PV input noise.
Integral Rate Gain-Ki (07)	This INT number determines the change in CV in CV Counts if the Error were a constant 1 PV Count. It is displayed as 0.000 Repeats/Sec with an implied decimal point of 3. For example, a Ki entered as 1400 will be displayed as 1.400 Repeats/Sec and will result in a $K_i \cdot \text{Error} \cdot dt$ or $1400 \cdot 20 \cdot 50/1000$ contribution to PID Output for an Error of 20 PV Counts and a 50 millisecond PLC sweep time (Sample Period of 0). Ki is usually the second gain set after Kp.
CV Bias/Output Offset (08)	An INT value in CV Counts added to the PID Output before the rate and amplitude clamps. It can be used to set non-zero CV values if only Kp Proportional gains are used, or for feed forward control of this PID loop output from another control loop.

Table 12-14. PID Parameter Details - Continued

Data Item	Description
CV Upper and Lower Clamps (09/10)	INT values in CV Counts that define the highest and lowest value for CV. These values are required and the Upper Clamp must have a more positive value than the Lower Clamp, or the PID block will not work. These are usually used to define limits based on physical limits for a CV output. They are also used to scale the Bar Graph display for CV for the LM90 or ADS PID display. The block has anti-reset windup to modify the integrator value when a CV clamp is reached.
Minimum Slew Time (11)	A positive value to define the minimum number of seconds for the CV output to move from 0 to full travel of 100% or 32000 CV Counts. It is an inverse rate limit on how fast the CV output can be changed. If positive, CV can not change more than 32000 CV Counts times Delta Time (seconds) divided by Minimum Slew Time. For example, if the Sample Period was 2.5 seconds and the Minimum Slew Time is 500 seconds, CV can not change more than $32000 \times 2.5 / 500$ or 160 CV Counts per PID solution. As with the CV Clamps, there is an anti-windup feature that adjusts the integrator value if the CV rate limit is exceeded. If Minimum Slew Time is 0, there is no CV rate limit. Make sure you set Minimum Slew Time to 0 while you are tuning or adjusting PID loop gains.
Config Word	<p>The low 5 bits of this word are used to modify three standard PID settings. The other bits should be set to 0. Set the low bit to 1 to modify the standard PID Error Term from the normal (SP – PV) to (PV – SP), reversing the sign of the feedback term. This is for Reverse Acting controls where the CV must go down when the PV goes up. Set the second bit to a 1 to invert the Output Polarity so that CV is the negative of the PID output rather than the normal positive value. Set the fourth bit to 1 to modify the Derivative Action from using the normal change in the Error term to the change in the PV feedback term.</p> <p>The low 5 bits in the Config Word are defined in detail below:</p> <ul style="list-style-type: none"> <li><b>Bit 0</b> = Error Term. When this bit is set to 0, the error term is SP — PV. When this bit is set to 1, the error term is PV — SP.</li> <li><b>Bit 1</b> = Output Polarity. When this bit is set to 0, the CV output represents the output of the PID calculation. When it is set to 1, the CV output represents the negative of the output of the PID calculation.</li> <li><b>Bit 2</b> = Derivative action on PV. When this bit is set to 0, the derivative action is applied to the error term. When it is set to 1, the derivative action is applied to PV. All remaining bits should be zero.</li> <li><b>Bit 3</b> = Deadband action. When the Deadband action bit is set to zero, then no deadband action is chosen. If the error is within the deadband limits, then the error is forced to be zero. Otherwise the error is not affected by the deadband limits. If the Deadband action bit is set to one, then deadband action is chosen. If the error is within the deadband limits, then the error is forced to be zero. If, however, the error is outside the deadband limits, then the error is reduced by the deadband limit (error = error – deadband limit).</li> <li><b>Bit 4</b> = Anti-reset windup action. When this bit is set to zero, the anti-reset windup action uses a reset back calculation. When the output is clamped, this replaces the accumulated Y remainder value (defined on page 12-87) with whatever value is necessary to produce the clamped output exactly. When the bit is set to one, this replaces the accumulated Y term with the value of the Y term at the start of the calculation. In this way, the pre-clamp Y value is held as long as the output is clamped.</li> </ul> <p><b>NOTE:</b> The anti-reset windup action bit is only available on release 6.50 or later 90-30 CPUs.</p> <p>Remember that the bits are set in powers of 2. For example, to set Config Word to 0 for default PID configuration, you would add 1 to change the Error Term from SP–PV to PV–SP, or add 2 to change the Output Polarity from CV = PID Output to CV = – PID Output, or add 4 to change Derivative Action from Error rate of change to PV rate of change, etc.</p>

Table 12-14. PID Parameter Details - Continued

Data Item	Description																				
Manual Command (13)	This is an INT value set to the current CV output while the PID block is in Automatic mode. When the block is switched to <b>Manual</b> mode, this value is used to set the CV output and the internal value of the integrator within the Upper and Lower Clamp and Slew Time limits.																				
Control Word (14)	<p>This is an internal parameter that is normally left at 0.</p> <p>If the Override low bit is set to 1, this word and other internal SP, PV and CV parameters must be used for remote operation of this PID block (see below). This allows remote operator interface devices, such as a computer, to take control away from the PLC program. Caution: if you do not want this to happen, make use the Control Word is set to 0. If the low bit is 0, the next 4 bits can be read to track the status of the PID input contacts as long as the PID Enable contact has power. A discrete data structure with the first five bit positions in the following format:</p> <p><b>Bit: Word Value: Function: Status or External Action if Override bit set to 1:</b></p> <table> <tr> <td>0</td> <td>1</td> <td>Override</td> <td>If 0, monitor block contacts below. If 1, set them externally.</td> </tr> <tr> <td>1</td> <td>2</td> <td>Manual/ Auto</td> <td>If 1, block is in <b>Manual</b> mode; other numbers it is in <b>Automatic</b> mode.</td> </tr> <tr> <td>2</td> <td>4</td> <td>Enable</td> <td>Should normally be 1; otherwise block is never called.</td> </tr> <tr> <td>3</td> <td>8</td> <td>UP/Raise</td> <td>If 1 and Manual (Bit 1) is 1, CV is being incremented every solution.</td> </tr> <tr> <td>4</td> <td>16</td> <td>DN/Lower</td> <td>If 1 and Manual (Bit 1) is 1, CV is being incremented every solution.</td> </tr> </table>	0	1	Override	If 0, monitor block contacts below. If 1, set them externally.	1	2	Manual/ Auto	If 1, block is in <b>Manual</b> mode; other numbers it is in <b>Automatic</b> mode.	2	4	Enable	Should normally be 1; otherwise block is never called.	3	8	UP/Raise	If 1 and Manual (Bit 1) is 1, CV is being incremented every solution.	4	16	DN/Lower	If 1 and Manual (Bit 1) is 1, CV is being incremented every solution.
0	1	Override	If 0, monitor block contacts below. If 1, set them externally.																		
1	2	Manual/ Auto	If 1, block is in <b>Manual</b> mode; other numbers it is in <b>Automatic</b> mode.																		
2	4	Enable	Should normally be 1; otherwise block is never called.																		
3	8	UP/Raise	If 1 and Manual (Bit 1) is 1, CV is being incremented every solution.																		
4	16	DN/Lower	If 1 and Manual (Bit 1) is 1, CV is being incremented every solution.																		
SP (15)	(Non-configurable—set and maintained by the PLC) Tracks SP in; must be set externally if Override = 1.																				
CV (16)	(Non-configurable—set and maintained by the PLC) Tracks CV out.																				
PV (17)	(Non-configurable—set and maintained by the PLC) Tracks PV in; must be set externally if Override bit = 1.																				
Output (18)	(Non-configurable—set and maintained by the PLC) This is a signed word value representing the output of the function block before the application of the optional inversion. If no output inversion is configured and the output polarity bit in the control word is set to 0, this value will equal the CV output. If inversion is selected and the output polarity bit is set to 1, this value will equal the negative of the CV output.																				
Diff Term Storage (19)	Used internally for storage of intermediate values. <i>Do not write to this location.</i>																				
Int Term Storage (20/21)	Used internally for storage of intermediate values. <i>Do not write to this location.</i>																				
Slew Term Storage (22)	Used internally for storage of intermediate values. <i>Do not write to this location.</i>																				
Clock (23–25)	Internal elapsed time storage (time last PID executed). <i>Do not write to these locations.</i>																				
Y Remainder (26)	Holds remainder for integrator division scaling for 0 steady state error.																				
Lower and Upper Range (27/28)	Optional INT values in PV Counts that define the highest and lowest display value for the SP and PV Logicmaster <b>Zoom</b> key horizontal bar graph and ADS PID faceplate display.																				
Reserved (29–34 and 35–39)	29–34 are reserved for internal use; 35–39 are reserved for external use. They are reserved for GE Fanuc use, and cannot be used for other purposes.																				

## Internal Parameters in RefArray

As described in Table 12-3 on the previous pages, the PID block reads 13 user parameters and uses the rest of the 40 word RefArray for internal PID storage. Normally you would not need to change any of these values. If you are calling the PID block in Auto mode after a long delay, you might want to use SVC\_REQ #16 to load the current PLC elapsed time clock into %Ref+23 to update the last PID solution time to avoid a step change on the integrator. If you have set the Override low bit of the Control Word (%Ref+14) to 1, the next four bits of the Control Word must be set to control the PID block input contacts (as described in Table 12-3 on the previous pages), and the Internal SP and PV must be set as you have taken control of the PID block away from the ladder logic.

## PID Algorithm Selection (PIDISA or PIDIND) and Gains

The PID block can be programmed selecting either the Independent (PID\_IND) term or standard ISA (PID\_ISA) versions of the PID algorithm. The only difference in the algorithms is how the Integral and Derivative gains are defined. To understand the difference, you need to understand the following:

Both PID types calculate the Error term as SP – PV (Reverse Acting), which can be changed to Direct Acting mode (PV – SP) by setting the Error Term to 1. The Error Term is the low bit (0-bit) in the Config. Word (%Ref+0012). In a Direct Acting proportional (P) loop, an increase in the Process Variable (PV) causes an increase in the output (CV). In a Reverse Acting proportional (P) loop, an increase in the Process Variable (PV) causes a decrease in the output (CV). Introducing the integral term (I) changes the behavior. In a Direct Acting PI loop, the output (CV) will increase when the process variable (PV) is greater than the setpoint (SP). In a Reverse Acting PI loop, the output (CV) will decrease when the Process Variable (PV) is greater than the Setpoint (SP).

**Direct Acting:** Error = measurement – setpoint (PV-SP), Error Term = 1

**Reverse Acting:** Error = setpoint – measurement (SP-PV), Error Term = 0

Note. **Direct Acting** is sometimes referred to as **Forward Acting**.

The Derivative is normally based on the change of the Error term since the last PID solution, which may cause a large change in the output if the SP value is changed. If this is not desired, the third bit of the Config Word can be set to 1 to calculate the Derivative based on the change of the PV. The dt (or Delta Time) is determined by subtracting the last PID solution clock time for this block from the current PLC elapsed time clock.

**dt** = Current PLC Elapsed Time clock – PLC Elapsed Time Clock at Last PID solution

**Derivative** = (Error – previous Error)/dt                  or (PV – previous PV)/dt if 3rd bit of Config Word set to 1

The Independent term PID (PID\_IND) algorithm calculates the output as:

**PID Output** =  $K_p * \text{Error} + K_i * \text{Error} * dt + K_d * \text{Derivative} + \text{CV Bias}$

The standard ISA (PID\_ISA) algorithm has a different form:

**PID Output** =  $K_c * (\text{Error} + \text{Error} * dt/T_i + T_d * \text{Derivative}) + \text{CV Bias}$

where  $K_c$  is the controller gain, and  $T_i$  is the Integral time and  $T_d$  is the Derivative time. The advantage of ISA is that adjusting the  $K_c$  changes the contribution for the integral and derivative terms as well as the proportional one, which may make loop tuning easier. If you have PID gains in terms of  $T_i$  and  $T_d$ , use

$$K_p = K_c \quad K_i = K_c/T_i \quad \text{and} \quad K_d = K_c/T_d$$

to convert them to use as PID User Parameter inputs.

The CV Bias term above is an additive term separate from the PID components. It may be required if you are using only Proportional  $K_p$  gain and you want the CV to be a non-zero value when the PV equals the SP and the Error is 0. In this case, set the CV Bias to the desired CV when the PV is at the SP. CV Bias can also be used for feed forward control where another PID loop or control algorithm is used to adjust the CV output of this PID loop.

If an Integral  $K_i$  gain is used, the CV Bias would normally be 0 as the integrator acts as an automatic bias. Just start up in Manual mode and use the Manual Command word (%Ref+13) to set the integrator to the desired CV, then switch to Automatic mode. This also works if  $K_i$  is 0, except the integrator will not be adjusted based on the Error after going into Automatic mode.

The following diagram shows how the PID algorithms work:

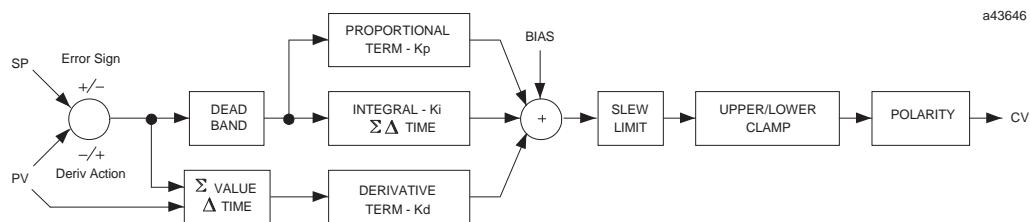


Figure 12-4. Independent Term Algorithm (PIDIND)

The ISA Algorithm (PIDISA) is similar except the  $K_p$  gain is factored out of  $K_i$  and  $K_d$  so that the integral gain is  $K_p * K_i$  and derivative gain is  $K_p * K_d$ . The Error sign, DerivAction and Polarity are set by bits in the Config Word user parameter.

## CV Amplitude and Rate Limits

The block does not send the calculated PID Output directly to CV. Both PID algorithms can impose amplitude and rate of change limits on the output Control Variable. The maximum rate of change is determined by dividing the maximum 100% CV value (32000) by the Minimum Slew Time, if specified as greater than 0. For example, if the Minimum Slew Time is 100 seconds, the rate limit will be 320 CV counts per second. If the dt solution time was 50 milliseconds, the new CV output can not change more than  $320*50/1000$  or 16 CV counts from the previous CV output.

The CV output is then compared to the CV Upper and CV Lower Clamp values. If either limit is exceeded, the CV output is set to the clamped value. If either rate or amplitude limits are exceeded modifying CV, the internal integrator value is adjusted to match the limited value to avoid reset windup.

Finally, the block checks the Output Polarity (2nd bit of the Config Word %Ref+12) and changes the sign of the output if the bit is 1.

$CV = \text{Clamped PID Output}$       or       $- \text{Clamped PID Output if Output Polarity bit set}$

If the block is in Automatic mode, the final CV is placed in the Manual Command %Ref+13. If the block is in Manual mode, the PID equation is skipped as CV is set by the Manual Command, but all the rate and amplitude limits are still checked. That means that the Manual Command can not change the output above the CV Upper Clamp or below the CV Lower Clamps and the output can not change faster than the Minimum Slew Time allowed.

## Sample Period and PID Block Scheduling

The PID block is a digital implementation of an analog control function, so the dt sample time in the PID Output equation is not the infinitesimally small sample time available with analog controls. The majority of processes being controlled can be approximated as a gain with a first or second order lag, possibly with a pure time delay. The PID block sets a CV output to the process and uses the process feedback PV to determine an Error to adjust the next CV output. A key process parameter is the total time constant, which is how fast does the PV respond when the CV is changed. As discussed in the Setting Loop Gains section below, the total time constant,  $T_p + T_c$ , for a first order system is the time required for PV to reach 63% of its final value when CV is stepped. The PID block will not be able to control a process unless its Sample Period is well under half the total time constant. Larger Sample Periods will make it unstable.

The Sample Period should be no bigger than the total time constant divided by 10 (or down to 5 worst case). For example, if PV seems to reach about 2/3 of its final value in 2 seconds, the Sample Period should be less than 0.2 seconds, or 0.4 seconds worst case. On the other hand, the Sample Period should not be too small, such as less than the total time constant divided by 1000, or the  $K_i * \text{Error} * dt$  term for the PID integrator will round down to 0. For example, a very slow process that takes 10 hours or 36000 seconds to reach the 63% level should have a Sample Period of 40 seconds or longer.

Unless the process is very fast, it is not usually necessary to use a Sample Period of 0 to solve the PID algorithm every PID sweep. If many PID loops are used with a Sample Period greater than the sweep time, there may be wide variations in PLC sweep time if many loops end up solving the algorithm at the same time. The simple solution is to sequence a one or more 1 bits through an array of bits set to 0 that is being used to enable power flow to individual PID blocks.

## Determining the Process Characteristics

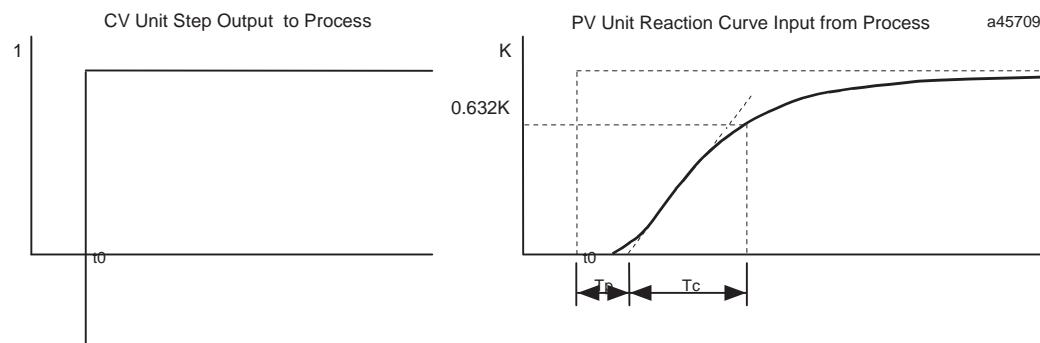
The PID loop gains,  $K_p$ ,  $K_i$  and  $K_d$ , are determined by the characteristics of the process being controlled. Two key questions when setting up a PID loop are:

1. How big is the change in PV when CV changes by a fixed amount, or what is the open loop gain?
2. How fast does the system respond, or how quick does PV change after the CV output is stepped?

Many processes can be approximated by a process gain, first or second order lag and a pure time delay. In the frequency domain, the transfer function for a first order lag system with a pure time delay is:

$$PV(s)/CV(s) = G(s) = K * e^{-(-T_p s)} / (1 + T_c s)$$

Plotting a step response at time  $t_0$  in the time domain provides an open loop unit reaction curve:



The following process model parameters can be determined from the PV unit reaction curve:

K	Process open loop gain = final change in PV/change in CV at time $t_0$ (Note no subscript on K)
$T_p$	Process or pipeline time delay or dead time after $t_0$ before the process output PV starts moving
$T_c$	First order Process time constant, time required after $T_p$ for PV to reach 63.2% of the final PV

Usually the quickest way to measure these parameters is by putting the PID block in Manual mode and making a small step in CV output, by changing the Manual Command %Ref+13, and plotting the PV response over time. For slow processes, this can be done manually, but for faster processes a chart recorder or computer graphic data logging package will help. The CV step size should be large enough to cause an observable change in PV, but not so large that it disrupts the process being measured. A good size may be from 2 to 10% of the difference between the CV Upper and CV Lower Clamp values .

## Setting User Parameters Including Tuning Loop Gains

As all PID parameters are totally dependent on the process being controlled, there are no predetermined values that will work, however, it is usually a simple, iterative procedure to find acceptable loop gain.

1. Set all the functional block parameters to 0, then set the CV Upper and CV Lower Clamps to the highest and lowest CV expected. Set the Sample Period to the estimated process time constant (above)/10 to 100.
2. Put block in Manual mode and set Manual Command (%Ref+13) at different values to check if CV can be moved to Upper and Lower Clamp. Record PV value at some CV point and load it into SP.
3. Set a small gain, such as 100 \* Maximum CV/Maximum PV, into Kp and turn off Manual mode. Step SP by 2 to 10% of the Maximum PV range and observe PV response. Increase Kp if PV step response is too slow or reduce Kp if PV overshoots and oscillates without reaching a steady value.
4. Once a Kp is found, start increasing Ki to get overshooting that dampens out to a steady value in 2 to 3 cycles. This may required reducing Kp. Also try different step sizes and CV operating points.
5. After suitable Kp and Ki gains are found, try adding Kd to get quicker responses to input changes providing it doesn't cause oscillations. Kd is often not needed and will not work with noisy PV.
6. Check gains over different SP operating points and add Dead Band and Minimum Slew Time if needed. Some Reverse Acting processes may need setting Config Word Error Sign or Polarity bits.

## Setting Loop Gains—Ziegler and Nichols Tuning Approach

Once the three process model parameters, K, T<sub>p</sub> and T<sub>c</sub>, are determined, they can be used to estimate initial PID loop gains. The following approach, developed by Ziegler and Nichols in the 1940's, is designed to provide good response to system disturbances with gains producing a amplitude ratio of 1/4. The amplitude ratio is the ratio of the second peak over the first peak in the closed loop response.

1. Calculate the Reaction rate:

$$R = K/T_c$$

2. For Proportional control only, calculate K<sub>p</sub> as

$$K_p = 1/(R * T_p) = T_c/(K * T_p)$$

3. For Proportional and Integral control, use

$$K_p = 0.9/(R * T_p) = 0.9 * T_c/(K * T_p)$$

$$K_i = 0.3 * K_p/T_p$$

4. For Proportional, Integral and Derivative control, use

$$K_p = G/(R * T_p) \quad \text{where } G \text{ is from 1.2 to 2.0}$$

$$K_i = 0.5 * K_p/T_p$$

$$K_d = 0.5 * K_p * T_p$$

5. Check that the Sample Period is in the range (T<sub>p</sub> + T<sub>c</sub>)/10 to (T<sub>p</sub> + T<sub>c</sub>)/1000

Another approach, the “Ideal Tuning” procedure, is designed to provide the best response to SP changes, delayed only by the T<sub>p</sub> process delay or dead time.

$$K_p = 2 * T_c/(3 * K * T_p)$$

$$K_i = T_c$$

$$K_d = K_i/4 \quad \text{if Derivative term is used}$$

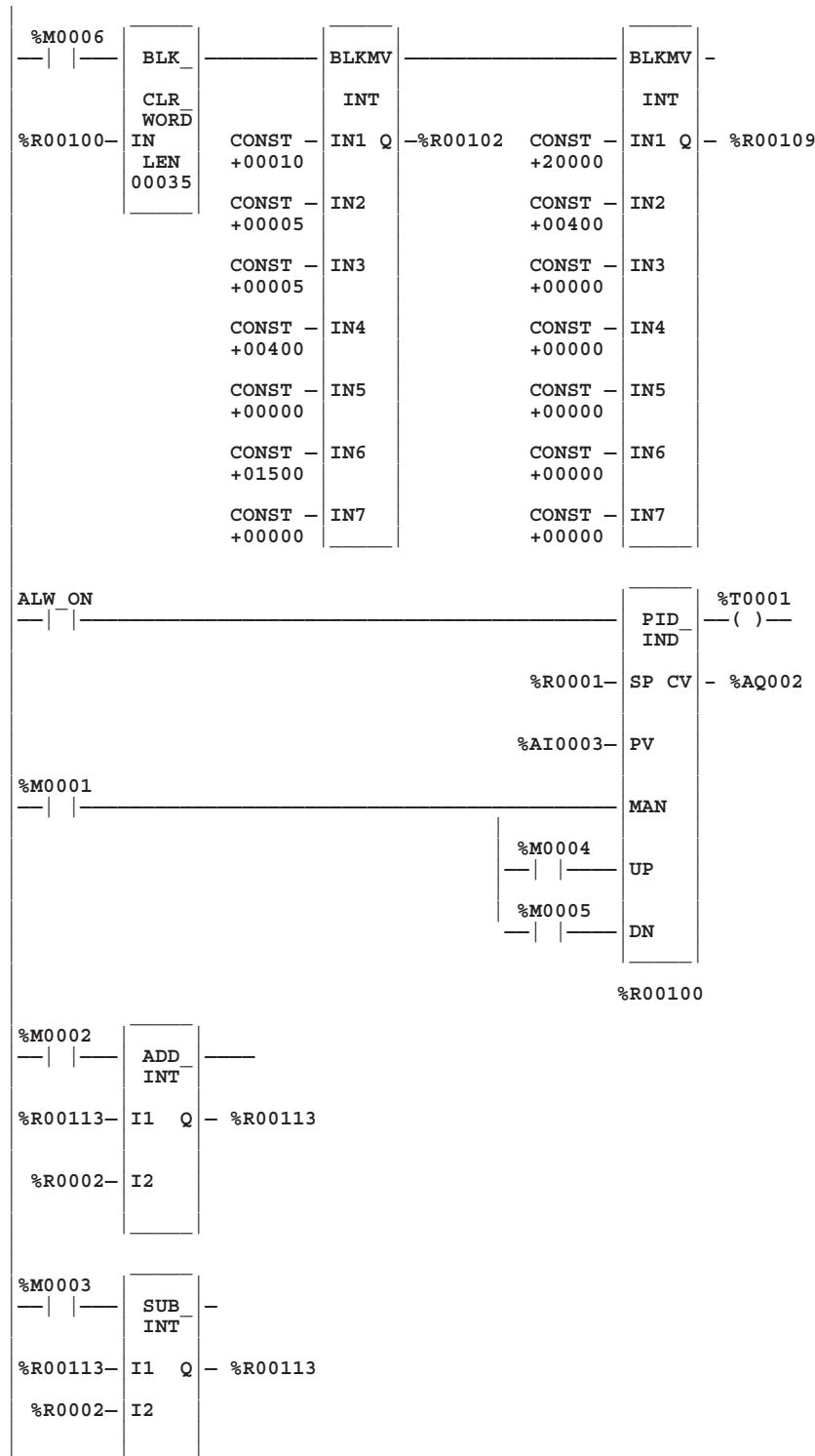
Once initial gains are determined, they must be converted to integer User Parameters. To avoid scaling problems, the Process gain, K, should be calculated as a change in input PV Counts divided by the output step change in CV Counts and not in process PV or CV engineering units. All times should also be specified in seconds. Once K<sub>p</sub>, K<sub>i</sub> and K<sub>d</sub> are determined, K<sub>p</sub> and K<sub>d</sub> can be multiplied by 100 and entered as integer while K<sub>i</sub> can be multiplied by 1000 and entered into the User Parameter %RefArray.

## Sample PID Call

The following example has a Sample Period of 100 milliseconds, a Kp gain of 4.00 and a Ki gain of 1.500. The Set Point is stored in %R1 with the Control Variable output in %AQ2 and the Process Variable returned in %AI3. CV Upper and CV Lower Clamps must be set, in this case to 20000 and 400, and an optional small Dead Band of +5 and -5 has been included. The 40 word RefArray starts in %R100. Closing the %M0006 contact enables a pair of BLKMV instructions, which set the initial parameter values by copying constants into the 14 words starting at %R102 (%Ref+2). (Note: to optimize parameters during the tuning process, access parameters by placing the Logicmaster cursor on the PID instruction and pressing the F10 key, which is the Zoom key.)

The block can be switched to Manual mode with %M0001 so that the Manual Command, %R0113, can be adjusted. Bits %M0004 or %M0005 can be used to increase or decrease %R0113 and the PID CV and integrator by 1 every 100 millisecond solution. For faster manual operation, bits %M0002 and %M0003 can be used to add or subtract the value in %R0002 to/from %R0113 every PLC sweep. The %T0001 output is on when the PID is OK. Note that some of the registers in the 40-register parameter block are not included either because they are not used in this example, or they are not configurable because they are used by the PLC system. For additional parameter information, see Table 12-8.

Address	Value	Description
%R0102	+00010	Sample Period
%R0103	+00005	Dead Band +
%R0104	+00005	Dead Band -
%R0105	+00400	Proportional Gain (Kp)
%R0106	+00000	Derivative Gain (Kd)
%R0107	+01500	Integral Gain (Ki)
%R0108	+00000	CV Bias/Output Offset
%R0109	+20000	Upper Clamp
%R0110	+00400	Lower Clamp
%R0111	+00000	Minimum Slew Time
%R0112	+00000	Config. Word
%R0113	+00000	Manual Command
%R0114	+00000	Control Word
%R0115	+00000	Internal SP (Non-Configurable)



**Appendix****A*****Instruction Timing***

The Series 90-30, 90-20, and Micro PLCs support many different functions and function blocks. This appendix contains tables showing the memory size in bytes and the execution time in microseconds for each function. Memory size is the number of bytes required by the function in a ladder diagram application program.

Two execution times are shown for each function:

Execution Time	Description
Enabled	Time required to execute the function or function block when power flows into and out of the function. Typically, best-case times are when the data used by the block is contained in user RAM (word-oriented memory) and not in the discrete memory.
Disabled	Time required to execute the function when power flows into the function or function block; however, it is in an inactive state, as when a timer is held in the reset state.

**Note**

Timers and counters are updated each time they are encountered in the logic, timers by the amount of time consumed by the last sweep and counters by one count.

**Note**

For the 350, 351, 352, and 360 PLC CPUs, times are identical except for the MOVE instruction, which is different for the 350 CPU—refer to the note at the bottom of the table on page A-6.

Table A-1. Instruction Timing, Standard Models

Function Group	Function	Enabled				Disabled				Increment				Size
		311	313	331	340/41	311	313	331	340/41	311	313	331	340/41	
Timers	On-Delay Timer	146	81	80	42	105	39	38	21	-	-	-	-	15
	Off-Delay Timer	98	47	44	23	116	63	58	32	-	-	-	-	9
	Timer	122	76	75	40	103	54	53	30	-	-	-	-	15
Counters	Up Counter	137	70	69	36	130	63	62	33	-	-	-	-	11
	Down Counter	136	70	69	37	127	61	61	31	-	-	-	-	11
Math	Addition (INT)	76	47	46	24	41	0	1	0	-	-	-	-	13
	Addition (DINT)	90	60	60	34	41	1	0	0	-	-	-	-	13
	Subtraction (INT)	75	46	45	25	41	0	1	0	-	-	-	-	13
	Subtraction (DINT)	92	62	62	34	41	1	0	0	-	-	-	-	13
	Multiplication (INT)	79	49	50	28	41	0	1	0	-	-	-	-	13
	Multiplication (DINT)	108	80	101	43	41	1	0	0	-	-	-	-	13
	Division (INT)	79	51	50	27	41	0	1	0	-	-	-	-	13
	Division (DINT)	375	346	348	175	41	1	0	0	-	-	-	-	13
	Modulo Division (INT)	78	51	49	27	41	0	1	0	-	-	-	-	13
	Modulo Div (DINT)	134	103	107	54	41	1	0	0	-	-	-	-	13
	Square Root (INT)	153	124	123	65	42	0	1	0	-	-	-	-	9
	Square Root (DINT)	268	239	241	120	42	0	0	1	-	-	-	-	9
Relational	Equal (INT)	66	35	36	19	41	1	1	0	-	-	-	-	9
	Equal (DINT)	86	56	54	29	41	1	0	0	-	-	-	-	9
	Not Equal (INT)	67	39	35	22	41	1	1	0	-	-	-	-	9
	Not Equal (DINT)	81	51	51	28	41	1	0	0	-	-	-	-	9
	Greater Than (INT)	64	33	35	20	41	1	1	0	-	-	-	-	9
	Greater Than (DINT)	89	59	58	32	41	1	0	0	-	-	-	-	9
	Greater Than/Eq (INT)	64	36	34	19	41	1	1	0	-	-	-	-	9
	Greater Than/Eq (DINT)	87	58	57	30	41	1	0	0	-	-	-	-	9
	Less Than (INT)	66	35		19	41	1	1	0	-	-	-	-	9
	Less Than (DINT)	87	57		30	41	1	1	0	-	-	-	-	9
	Less Than/Equal (INT)	66	36	34	21	41	1	1	0	-	-	-	-	9
	Less Than/Equal (DINT)	86	57	56	31	41	1	1	0	-	-	-	-	9
	Range (INT)	92	58	54	29	46	1	0	1	-	-	-	-	15
	Range(DINT)	106	75	57	37	45	0	0	0	-	-	-	-	15
	Range(WORD)	93	60	54	29	0	0	0	0	-	-	-	-	15

- Notes:**
1. Time (in microseconds) is based on Release 5.01 of Logicmaster 90-30/20 software for Models 311, 313, 340, and 341 CPUs (Release 7 for the 331).
  2. For table functions, increment is in units of length specified; for bit operation functions, microseconds/bit.; for data move functions, microseconds/number of bits or words.
  3. Enabled time for single length units of type %R, %AI, and %AQ.
  4. COMMREQ time has been measured between CPU and HSC.
  5. DOIO is the time to output values to discrete output module.
  6. Where there is more than one possible case, the time indicated above represents the worst possible case.

Table A-1. Instruction Timing, Standard Models-Continued

Function Group	Function	Enabled				Disabled				Increment				Size
		311	313	331	340/41	311	313	331	340/41	311	313	331	340/41	
Bit Operation	Logical AND	67	37	37	22	42	0	0	1	—	—	—	—	13
	Logical OR	68	38	38	21	42	0	0	1	—	—	—	—	13
	Logical Exclusive OR	66	38	37	20	42	0	1	1	—	—	—	—	13
	Logical Invert, NOT	62	32	31	17	42	0	1	1	—	—	—	—	9
	Shift Bit Left	139	89	90	47	74	26	23	13	11.61	11.61	12.04	6.29	15
	Shift Bit Right	135	87	85	45	75	26	24	13	11.63	11.62	12.02	6.33	15
	Rotate Bit Left	156	127	126	65	42	1	1	0	11.70	11.78	12.17	6.33	15
	Rotate Bit Right	146	116	116	62	42	1	1	0	11.74	11.74	12.13	6.27	15
	Bit Position	102	72	49	38	42	1	0	0	—	—	—	—	13
	Bit Clear	68	38	35	21	42	1	1	1	—	—	—	—	13
	Bit Test	79	49	51	28	41	0	0	1	—	—	—	—	13
	Bit Set	67	37	37	20	42	0	0	0	—	—	—	—	13
	Masked Compare (WORD)	217	154	141	74	107	44	39	21	—	—	—	—	25
	Masked Compare (DWORD)	232	169	156	83	108	44	39	22	—	—	—	—	25
Data Move	Move (INT)	68	37	39	20	43	0	0	0	1.62	1.62	5.25	1.31	13
	Move (BIT)	94	62	64	35	42	0	0	0	12.61	12.64	12.59	6.33	13
	Move (WORD)	67	37	40	20	41	0	0	0	1.62	1.63	5.25	1.31	13
	Block Move (INT)	76	48	50	28	59	30	30	16	—	—	—	—	27
	Block Move (WORD)	76	48	49	29	59	29	28	15	—	—	—	—	27
	Block Clear	56	28	27	14	43	0	0	0	1.35	1.29	1.40	0.78	9
	Shift Register (BIT)	201	153	153	79	85	36	34	18	0.69	0.68	0.71	0.37	15
	Shift Register (WORD)	103	53	52	29	73	25	23	12	1.62	1.62	2.03	1.31	15
	Bit Sequencer	165	101	99	53	96	31	29	16	0.07	0.07	0.08	0.05	15
	COMM_REQ	1317	1272	1489	884	41	2	0	0	—	—	—	—	13
Table	Array Move													
	INT	230	201	177	104	72	41	40	20	1.29	1.15	10.56	2.06	21
	DINT	231	202	181	105	74	44	42	23	3.24	3.24	10.53	2.61	21
	BIT	290	261	229	135	74	43	42	23	-0.03	-0.03	-0.01	0.79	21
	BYTE	228	198	176	104	74	42	42	23	0.81	0.82	8.51	1.25	21
	WORD	230	201	177	104	72	41	40	20	1.29	1.15	10.56	2.06	21
	Search Equal													
	INT	197	158	123	82	78	39	37	20	1.93	1.97	2.55	1.55	19
	DINT	206	166	135	87	79	38	36	21	4.33	4.34	4.55	2.44	19
	BYTE	179	141	117	74	78	38	36	21	1.53	1.49	1.83	1.03	19

- Notes:**
- Time (in microseconds) is based on Release 5.01 of Logicmaster 90-30/20 software for Models 311, 313, 340, and 341 CPUs (Release 7 for the 331).
  - For table functions, increment is in units of length specified.; for bit operation functions, microseconds/bit.; for data move functions, microseconds/number of bits or words.
  - Enabled time for single length units of type %R, %AI, and %AQ.
  - COMMREQ time has been measured between CPU and HSC.
  - DOIO is the time to output values to discrete output module.
  - Where there is more than one possible case, the time indicated above represents the worst possible case.
  - For instructions that have an increment value, multiply the increment by (Length-1) and add that value to the base time.

Table A-1. Instruction Timing, Standard Models-Continued

Function Group	Function	Enabled				Disabled				Increment				Size
		311	313	331	340/41	311	313	331	340/41	311	313	331	340/41	
	Search Not Equal													
	INT	198	159	124	83	79	39	36	21	1.93	1.93	2.48	1.52	19
	DINT	201	163	132	84	79	37	35	21	6.49	6.47	6.88	3.82	19
	BYTE	179	141	117	73	79	38	36	19	1.54	1.51	1.85	1.05	19
	WORD	198	159	124	83	79	39	36	21	1.93	1.93	2.48	1.52	19
	Search Greater Than													
	INT	198	160	125	82	79	37	38	19	3.83	3.83	4.41	2.59	19
	DINT	206	167	135	88	78	38	36	20	8.61	8.61	9.03	4.88	19
	BYTE	181	143	118	73	79	37	36	19	3.44	3.44	3.75	2.03	19
	WORD	198	160	125	82	79	37	38	19	3.83	3.83	4.41	2.59	19
	Search Greater Than/Eq													
	INT	197	160	124	83	77	38	36	20	3.86	3.83	4.45	2.52	19
	DINT	205	167	136	87	80	39	36	21	8.62	8.61	9.02	4.87	19
	BYTE	180	142	118	75	79	37	37	20	3.47	3.44	3.73	2.00	19
	WORD	197	160	124	83	77	38	36	20	3.86	3.83	4.45	2.52	19
	Search Less Than													
	INT	199	159	124	84	78	38	36	20	3.83	3.86	4.48	2.48	19
	DINT	206	168	135	87	79	38	38	19	8.62	8.60	-1.36	4.88	19
	BYTE	181	143	119	75	80	38	37	20	3.44	3.44	3.75	2.00	19
	WORD	199	159	124	84	78	38	36	20	3.83	3.86	4.45	2.48	19
	Search Less Than/Equal													
	INT	200	158	124	82	79	38	37	21	3.79	3.90	4.45	2.55	19
	DINT	207	167	137	88	78	39	37	19	8.60	8.61	9.01	4.86	19
	BYTE	180	143	119	74	78	40	37	19	3.46	3.44	3.73	2.02	19
	WORD	200	158	124	82	79	38	37	21	3.79	3.90	4.45	2.55	19
	Conversion	Convert to INT	74	46	39	25	42	1	1	1	—	—	—	9
	Convert to BCD-4	77	50	34	25	42	1	1	1	—	—	—	—	9

- Notes:**
1. Time (in microseconds) is based on Release 5.01 of Logicmaster 90-30/20 software for Models 311, 313, 340, and 341 CPUs (Release 7 for the 331).
  2. For table functions, increment is in units of length specified.; for bit operation functions, microseconds/bit.; for data move functions, microseconds/number of bits or words.
  3. Enabled time for single length units of type %R, %AI, and %AQ.
  4. COMMREQ time has been measured between CPU and HSC.
  5. DOIO is the time to output values to discrete output module.
  6. Where there is more than one possible case, the time indicated above represents the worst possible case.
  7. For instructions that have an increment value, multiply the increment by (Length -1) and add that value to the base time.

Table A-1. Instruction Timing, Standard Models-Continued

Function Group	Function	Enabled				Disabled				Increment				Size
		311	313	331	340/41	311	313	331	340/41	311	313	331	340/41	
Control	Call a Subroutine	155	93	192	85	41	0	0	0	—	—	—	—	7
	Do I/O	309	278	323	177	38	1	0	0	—	—	—	—	12
	PID – ISA Algorithm	1870	1827	1812	929	91	56	82	30	—	—	—	—	15
	PID – IND Algorithm	2047	2007	2002	1017	91	56	82	30	—	—	—	—	15
	End Instruction	—	—	—	—	—	—	—	—	—	—	—	—	—
	Service Request													
	# 6	93	54	63	45	41	2	0	0	—	—	—	—	9
	# 7 (Read)	—	37	309	161	—	2	0	0	—	—	—	—	9
	# 7 (Set)	—	37	309	161	—	2	0	0	—	—	—	—	9
	#14	447	418	483	244	41	2	0	0	—	—	—	—	9
Service Request	#15	281	243	165	139	41	2	0	0	—	—	—	—	9
	#16	131	104	115	69	41	2	0	0	—	—	—	—	9
	#18	—	56	300	180	—	2	0	0	—	—	—	—	9
	#23	1689	1663	1591	939	43	1	0	0	—	—	—	—	9
	#26/30*	1268	1354	6680	3538	42	0	0	0	—	—	—	—	9
	#29	—	—	55	41	—	—	1	0	—	—	—	—	9
	Nested MCR/ENDMCR Combined	135	73	68	39	75	25	21	12	—	—	—	—	8

\*Service request #26/30 was measured using a high speed counter, 16-point output, in a 5-slot rack.

- Notes:**
1. Time (in microseconds) is based on Release 5.01 of Logicmaster 90-30/20 software for Models 311, 313, 340, and 341 CPUs (Release 7 for the 331).
  2. For table functions, increment is in units of length specified.; for bit operation functions, microseconds/bit.; for data move functions, microseconds/number of bits or words.
  3. Enabled time for single length units of type %R, %AI, and %AQ.
  4. COMMREQ time has been measured between CPU and HSC.
  5. DOIO is the time to output values to discrete output module.
  6. Where there is more than one possible case, the time indicated above represents the worst possible case.
  7. For instructions that have an increment value, multiply the increment by (Length -1) and add that value to the base time.

Table A-2. Instruction Timing, 35x-36x Models

Function Group	Function	Enabled	Disabled	Increment	Enabled	Disabled	Increment	Size
		350/351/36x	350/351/36x	350/351/36x	352	352	352	
Timers	On-Delay Timer	4	6	—	4	5	—	15
	Timer	3	3	—	2	2	—	15
	Off-Delay Timer	3	3	—	3	2	—	15
Counters	Up Counter	1	3	—	2	2	—	13
	Down Counter	3	3	—	1	2	—	13
Math	Addition (INT)	2	0	—	1	0	—	13
	Addition (DINT)	2	0	—	2	0	—	19
	Addition (REAL)	52	0	—	33	0	—	17
	Subtraction (INT)	2	0	—	1	0	—	13
	Subtraction (DINT)	2	0	—	2	0	—	19
	Subtraction (REAL)	53	0	—	34	0	—	17
	Multiplication (INT)	21	0	—	21	0	—	13
	Multiplication (DINT)	24	0	—	24	0	—	19
	Multiplication (REAL)	68	1	—	38	1	—	17
	Division (INT)	22	0	—	22	0	—	13
	Division (DINT),	25	0	—	25	0	—	19
	Division (REAL)	82	2	—	36	2	—	17
	Modulo Division (INT)	21	0	—	21	0	—	13
	Modulo Div (DINT)	25	0	—	25	0	—	19
	Square Root (INT)	42	1	—	41	1	—	10
	Square Root (DINT)	70	0	—	70	0	—	13
	Square Root (REAL)	137	0	—	35	0	—	11
Trigonometric	SIN (REAL)	360	0	—	32	0	—	11
	COS (REAL)	319	0	—	29	0	—	11
	TAN (REAL)	510	1	—	32	1	—	11
	ASIN (REAL)	440	0	—	45	0	—	11
	ACOS (REAL)	683	0	—	63	0	—	11
	ATAN (REAL)	264	1	—	33	1	—	11
Logarithmic	LOG (REAL)	469	0	—	32	0	—	11
	LN (REAL)	437	0	—	32	0	—	11
Exponential	EXP	639	0	—	42	0	—	11
	EXPT	89	1	—	54	1	—	17
Radian Conversion	Convert RAD to DEG	65	1	—	32	1	—	11
	Convert DEG to RAD	59	0	—	32	0	—	11

- Notes:**
1. Time (in microseconds) is based on Release 7 of Logimaster 90-30/20/Micro software for Model 351 and 352 CPUs.
  2. For table functions, increment is in units of length specified.; for bit operation functions, microseconds/bit.; for data move functions, microseconds/number of bits or words.
  3. Enabled time for single length units of type %R, %AI, and %AQ.
  4. COMMREQ time has been measured between CPU and HSC.
  5. DOIO is the time to output values to discrete output module.
  6. Where there is more than one possible case, the time indicated above represents the worst possible case.

Table A-2. Instruction Timing, 35x-36x Models-Continued

Function Group	Function	Enabled	Disabled	Increment	Enabled	Disabled	Increment	Size
		350/351/36x	350/351/36x	350/351/36x	352	352	352	
Relational	Equal (INT)	1	0	—	1	0	—	10
	Equal (DINT)	2	0	—	2	0	—	16
	Equal (REAL)	57	0	—	28	0	—	14
	Not Equal (INT)	1	0	—	1	0	—	10
	Not Equal (DINT)	1	0	—	1	0	—	16
	Not Equal (REAL)	62	0	—	31	0	—	14
	Greater Than (INT)	1	0	—	1	0	—	10
	Greater Than (DINT)	1	0	—	1	0	—	16
	Greater Than (REAL)	57	0	—	32	0	—	14
	Greater Than/Equal (INT)	1	0	—	1	0	—	10
	Greater Than/Equal (DINT)	1	0	—	1	0	—	10
	Greater Than/Equal (REAL)	57	1	—	31	1	—	14
	Less Than (INT)	1	0	—	1	0	—	10
	Less Than (DINT)	1	0	—	1	0	—	16
	Less Than (REAL)	58	1	—	36	1	—	14
	Less Than/Equal (INT)	1	0	—	1	0	—	10
	Less Than/Equal (DINT)	3	0	—	3	0	—	16
	Less Than/Equal (REAL)	37	0	—	37	0	—	14
Bit Operation	Range (INT)	2	1	—	2	1	—	13
	Range (DINT)	2	1	—	2	1	—	22
	Range (WORD)	1	0	—	1	0	—	13
	Logical AND	2	0	—	2	0	—	13
	Logical OR	2	0	—	2	0	—	13
	Logical Exclusive OR	1	0	—	1	0	—	13
	Logical Invert, NOT	1	0	—	1	0	—	10
	Shift Bit Left	31	1	1.37	31	1	1.37	16
	Shift Bit Right	28	0	3.03	28	0	3.03	16
	Rotate Bit Left	25	0	3.12	25	0	3.12	16
	Rotate Bit Right	25	0	4.14	25	0	4.14	16
	Bit Position	20	1	—	20	1	—	13
	Bit Clear	20	0	—	20	0	—	13
	Bit Test	20	0	—	20	0	—	13
	Bit Set	19	1	—	19	1	—	13
Mask Compare (WORD)	52	0	—	52	0	—	25	
	Mask Compare (DWORD)	50	0	—	49	0	—	25

- Notes:**
1. Time (in microseconds) is based on Release 7 of Logimaster 90-30/20/Micro software for Model 351 and 352 CPUs.
  2. For table functions, increment is in units of length specified.; for bit operation functions, microseconds/bit.; for data move functions, microseconds/number of bits or words.
  3. Enabled time for single length units of type %R, %AI, and %AQ.
  4. COMMREQ time has been measured between CPU and HSC.
  5. DOIO is the time to output values to discrete output module.
  6. Where there is more than one possible case, the time indicated above represents the worst possible case.
  7. For instructions that have an increment value, multiply the increment by (Length –1) and add that value to the base time.

Table A-2. Instruction Timing, 35x-36x Models-Continued

Function Group	Function	Enabled	Disabled	Increment	Enabled	Disabled	Increment	Size
		350/351/36X	350/351/36X	350/351/36X	352	352	352	
Data Move	Move (INT)	2	0	0.41	2	0	0.41	10
	Move (BIT)	28	0	4.98	28	0	4.98	13
	Move (WORD)	2	0	0.41	2	0	0.41	10
	Move (REAL)	24	1	0.82	24	1	0.82	13
	Block Move (INT)	2	0	—	2	0	—	28
	Block Move (WORD)	4	4	—	3	0	—	28
	Block Move (REAL)	41	0	—	41	0	—	13
	Block Clear	1	0	0.24	1	0	0.24	11
	Shift Register (BIT)	49	0	0.23	46	0	0.23	16
	Shift Register (WORD)	27	0	0.41	27	0	0.41	16
Table	Bit Sequencer	38	22	0.02	38	22	0.02	16
	COMM_REQ	765	0	—	765	0	—	13
	Array Move							
	INT	54	0	0.97	54	0	0.97	22
	DINT	54	0	0.81	54	0	0.81	22
	BIT	69	0	0.36	69	0	0.36	22
	BYTE	54	1	0.64	54	1	0.64	22
	WORD	54	0	0.97	54	0	0.97	22
	Search Equal							
	INT	37	0	0.62	37	0	0.62	19
Table	DINT	41	1	1.38	41	1	1.38	22
	BYTE	35	0	0.46	35	0	0.46	19
	WORD	37	0	0.62	37	0	0.62	19
	Search Not Equal							
	INT	37	0	0.62	37	0	0.62	19
	DINT	38	0	2.14	38	0	2.14	22
	BYTE	37	0	0.47	37	0	0.47	19
	WORD	37	0	0.62	37	0	0.62	19
	Search Greater Than							
	INT	37	0	1.52	37	0	1.52	19
Table	DINT	39	0	2.26	39	0	2.26	22
	BYTE	36	1	1.24	36	1	1.24	19
	WORD	37	0	1.52	37	0	1.52	19
	Search Greater Than/Equal							
	INT	37	0	1.48	37	0	1.48	19
	DINT	39	0	2.33	39	0	2.33	22
	BYTE	37	1	1.34	37	1	1.34	19
	WORD	37	0	1.48	37	0	1.48	19

- Notes:**
1. Time (in microseconds) is based on Release 7 of Logimaster 90-30/20/Micro software for 350 and 360 Series CPUs.
  2. For table functions, increment is in units of length specified.; for bit operation functions, microseconds/bit.; for data move functions, microseconds/number of bits or words.
  3. Enabled time for single length units of type %R, %AI, and %AQ.
  4. COMMREQ time has been measured between CPU and HSC.
  5. DOIO is the time to output values to discrete output module.
  6. Where there is more than one possible case, the time indicated above represents the worst possible case.
  7. For instructions that have an increment value, multiply the increment by (Length –1) and add that value to the base time.

Table A-2. Instruction Timing, 35x-36x Models-Continued

Function Group	Function	Enabled	Disabled	Increment	Enabled	Disabled	Increment	Size
		350/351/36x	350/351/36x	350/351/36x	352	352	352	
	Search Less Than							
	INT	37	0	1.52	37	0	1.52	19
	DINT	41	1	2.27	41	1	2.27	22
	BYTE	37	0	1.41	37	0	1.41	19
	WORD	37	0	1.52	37	0	1.52	19
	Search Less Than/Equal							
	INT	38	0	1.48	38	0	1.48	19
	DINT	40	1	2.30	40	1	2.30	22
Conversion	BYTE	37	0	1.24	37	0	1.24	19
	WORD	38	0	1.48	38	0	1.48	19
	Convert to INT	19	1	—	19	1	—	10
	Convert to BCD-4	21	1	—	21	1	—	10
	Convert to REAL	27	0	—	21	0	—	8
	Convert to WORD	28	1	—	30	1	—	11
Control	Truncate to INT	32	0	—	32	0	—	11
	Truncate to DINT	63	0	—	31	0	—	11
	Call a Subroutine	72	1	—	73	1	—	7
	Do I/O	114	1	—	115	1	—	13
	PID – ISA Algorithm*	162	34	—	162	34	—	16
	PID – IND Algorithm*	146	34	—	146	34	—	16
	End Instruction	—	—	—	—	—	—	—
	Service Request							
	#6	22	1	—	22	1	—	10
	#7 (Read)	75	1	—	75	1	—	10
	#7 (Set)	75	1	—	75	1	—	10
	#14	121	1	—	121	1	—	10
	#15	46	1	—	46	1	—	10
	#16	36	1	—	36	1	—	10
	#18	261	1	—	261	1	—	10
	#23	426	0	—	426	0	—	10
	#26//30**	2260	1	—	2260	1	—	10
	#29	20	0	—	20	0	—	10
	#43							
	Nested MCR/ENDMCR Combined	1	1	—	1	1	—	4
	Sequential Event Recorder (SER)	See Table A-3	26.50				See Table A-3	

\*The PID times shown above are based on the 6.5 release of the 351 CPU.

\*\*Service request #26/30 was measured using a high speed counter, 16-point output, in a 5-slot rack.

- Notes:**
1. Time (in microseconds) is based on Release 7 of Logimaster 90-30/20/Micro software for 350 and 360 Series CPUs.
  2. For table functions, increment is in units of length specified.; for bit operation functions, microseconds/bit.; for data move functions, microseconds/number of bits or words.
  3. Enabled time for single length units of type %R, %AI, and %AQ.
  4. COMMREQ time has been measured between CPU and HSC.
  5. DOIO is the time to output values to discrete output module.
  6. Where there is more than one possible case, the time indicated above represents the worst possible case.
  7. For instructions that have an increment value, multiply the increment by (Length –1) and add that value to the base time.

Table A-3. SER Function Block Timing

Configuration	Example	Time (μsec)
No power flow (disabled)	—	26.50
<b>Contiguous</b>		
8 channels	%I1—8	79.94
16 channels	%I1—16	80.58
24 channels	%I1—24	81.56
32 channels	%I1—32	81.73
8 + 8 contiguous channels	%I1—8 and %Q1—8	111.03
8 + 8 + 8 contiguous channels	%I1—8, %Q1—8 and %M1—8	143.38
8 + 8 + 8 + 8 contiguous channels	%I1—8, %Q1—8 and %M1—8 and %T1—8	175.79
<b>Noncontiguous</b>		
8 channels	%I1, %M10, %Q3, etc.	299.64
16 channels		552.83
24 channels		806.35
32 channels		1059.85
<b>Reset</b>		
with 8 channels	—	162.63
with 16 channels	—	267.51
with 24 channels	—	372.73
with 32 channels	—	477.95

**Notes:** When a slot with an Input module is specified add an additional 46 μsecs to each of the **Contiguous** and **Noncontiguous** timings.

When the trigger occurs, add an additional 29 usec if using BCD format or 148 usec if using Posix format.

Times shown for reset are for the maximum buffer size of 1024 samples. (Reset clears all samples in the sample buffer.)

Table A-4. Instruction Timing, 37x Models

Function Group	Function	Enabled	Disabled	Increment	Size
		37x	37x	37x	
Timers	On-Delay Timer	4	5	—	15
	Timer	2	2	—	15
	Off-Delay Timer	3	2	—	15
Counters	Up Counter	2	2	—	13
	Down Counter	1	2	—	13
Math	Addition (INT)	1	0	—	13
	Addition (DINT)	2	0	—	19
	Addition (REAL)	5	0	—	17
	Subtraction (INT)	1	0	—	13
	Subtraction (DINT)	2	0	—	19
	Subtraction (REAL)	5	0	—	17
	Multiplication (INT)	5	0	—	13
	Multiplication (DINT)	5	0	—	19
	Multiplication (REAL)	5	0	—	17
	Division (INT)	5	0	—	13
	Division (DINT),	5	0	—	19
	Division (REAL)	5	0	—	17
	Modulo Division (INT)	5	0	—	13
	Modulo Div (DINT)	5	0	—	19
	Square Root (INT)	5	0	—	10
Trigonometric	Square Root (DINT)	10	0	—	13
	Square Root (REAL)	5	0	—	11
	SIN (REAL)	10	0	—	11
	COS (REAL)	10	0	—	11
	TAN (REAL)	10	0	—	11
	ASIN (REAL)	10	0	—	11
	ACOS (REAL)	10	0	—	11
	ATAN (REAL)	5	0	—	11
	LOG (REAL)	5	0	—	11
	LN (REAL)	5	0	—	11
Exponential	EXP	10	0	—	11
	EXPT	10	0	—	17
Radian Conversion	Convert RAD to DEG	5	0	—	11
	Convert DEG to RAD	5	0	—	11

- Notes:**
1. For table functions, increment is in units of length specified; for bit operation functions, microseconds/bit.; for data move functions, microseconds/number of bits or words.
  2. Enabled time for single length units of type %R, %AI, and %AQ.
  3. COMMREQ time has been measured between CPU and HSC.
  4. DOIO is the time to output values to discrete output module.
  5. Where there is more than one possible case, the time indicated above represents the worst possible case.

Table A-4. Instruction Timing, 37x Models- Continued

Function Group	Function	Enabled	Disabled	Increment	Size
		37x	37x	37x	
Relational	Equal (INT)	1	0	—	10
	Equal (DINT)	2	0	—	16
	Equal (REAL)	5	0	—	14
	Not Equal (INT)	1	0	—	10
	Not Equal (DINT)	1	0	—	16
	Not Equal (REAL)	5	0	—	14
	Greater Than (INT)	1	0	—	10
	Greater Than (DINT)	1	0	—	16
	Greater Than (REAL)	5	0	—	14
	Greater Than/Equal (INT)	1	0	—	10
	Greater Than/Equal (DINT)	1	0	—	10
	Greater Than/Equal (REAL)	5	0	—	14
	Less Than (INT)	1	0	—	10
	Less Than (DINT)	1	0	—	16
	Less Than (REAL)	5	0	—	14
	Less Than/Equal (INT)	1	0	—	10
	Less Than/Equal (DINT)	3	0	—	16
	Less Than/Equal (REAL)	5	0	—	14
Bit Operation	Range (INT)	2	0	—	13
	Range (DINT)	2	0	—	22
	Range (WORD)	1	0	—	13
	Logical AND	2	0	—	13
	Logical OR	2	0	—	13
	Logical Exclusive OR	1	0	—	13
	Logical Invert, NOT	1	0	—	10
	Shift Bit Left	5	0	1	16
	Shift Bit Right	5	0	1	16
	Rotate Bit Left	5	0	1	16
	Rotate Bit Right	5	0	1	16
	Bit Position	5	0	—	13
	Bit Clear	5	0	—	13
	Bit Test	5	0	—	13
	Bit Set	5	0	—	13
	Mask Compare (WORD)	9	0	—	25
	Mask Compare (DWORD)	10	0	—	25

- Notes:**
1. For table functions, increment is in units of length specified.; for bit operation functions, microseconds/bit.; for data move functions, microseconds/number of bits or words.
  2. Enabled time for single length units of type %R, %AI, and %AQ.
  3. COMMREQ time has been measured between CPU and HSC.
  4. DOIO is the time to output values to discrete output module.
  5. Where there is more than one possible case, the time indicated above represents the worst possible case.

Table A-4. Instruction Timing, 37x Models- Continued

Function Group	Function	Enabled	Disabled	Increment	Size
		37x	37x	37x	
Data Move	Move (INT)	2	0	1	10
	Move (BIT)	5	0	1	13
	Move (WORD)	2	0	1	10
	Move (REAL)	5	0	1	13
	Block Move (INT)	2	0	—	28
	Block Move (WORD)	3	0	—	28
	Block Move (REAL)	11	1	—	13
	Block Clear	1	0	1	11
	Shift Register (BIT)	10	0	1	16
	Shift Register (WORD)	15	0	1	16
Table	Bit Sequencer	14	10	1	16
	COMM_REQ	200	200	—	13
	Array Move				
	INT	10	0	1	22
	DINT	15	0	1	22
	BIT	10	0	1	22
	BYTE	10	0	1	22
	WORD	10	0	1	22
	Search Equal				
	INT	5	0	1	19
	DINT	5	0	2	22
	BYTE	5	0	1	19
	WORD	5	0	1	19
	Search Not Equal				
	INT	5	0	1	19
	DINT	10	0	2	22
	BYTE	5	0	2	19
	WORD	5	0	2	19
	Search Greater Than				
	INT	5	0	1	19
	DINT	5	0	2	22
	BYTE	10	0	1	19
	WORD	5	0	1	19
	Search Greater Than/Equal				
	INT	5	0	1	19
	DINT	5	0	2	22
	BYTE	5	0	1	19
	WORD	5	0	1	19

- Notes:**
- For table functions, increment is in units of length specified.; for bit operation functions, microseconds/bit.; for data move functions, microseconds/number of bits or words.
  - Enabled time for single length units of type %R, %AI, and %AQ.
  - COMMREQ time has been measured between CPU and HSC.
  - DOIO is the time to output values to discrete output module.
  - Where there is more than one possible case, the time indicated above represents the worst possible case.
  - For instructions that have an increment value, multiply the increment by (Length –1) and add that value to the base time.

Table A-4. Instruction Timing, 37x Models- Continued

Function Group	Function	Enabled	Disabled	Increment	Size
		37x	37x	37x	
	Search Less Than				
	INT	5	0	1	19
	DINT	10	0	2	22
	BYTE	5	0	1	19
	WORD	5	0	1	19
	Search Less Than/Equal				
	INT	5	0	1	19
	DINT	5	0	2	22
Conversion	Convert to INT	5	0	—	10
	Convert to BCD-4	5	0	—	10
	Convert to REAL	5	0	—	8
	Convert to WORD	5	0	—	11
	Truncate to INT	5	0	—	11
	Truncate to DINT	5	0	—	11
Control	Call a Subroutine	15	0	—	7
	Do I/O	5	0	—	13
	PID – ISA Algorithm	14	10	—	16
	PID – IND Algorithm	14	10	—	16
	End Instruction	—	—	—	—
	Service Request				
	#6	5	0	—	10
	#7 (Read)	10	0	—	10
	#7 (Set)	5	0	—	10
	#14	15	0	—	10
	#15	5	0	—	10
	#16	10	0	—	10
	#18	255	0	—	10
	#23	25	0	—	10
	#26//30**	155	0	—	10
	#29	5	0	—	10
	Nested MCR/ENDMCR Combined	1	0	—	4
	Sequential Event Recorder (SER) 8 Channels	60	0	=	
	Sequential Event Recorder (SER) 16 Channels	199	0	=	

\*\*Service request #26/30 was measured using a high speed counter, 16-point output, in a 5-slot rack.

- Notes:**
- For table functions, increment is in units of length specified.; for bit operation functions, microseconds/bit.; for data move functions, microseconds/number of bits or words.
  - Enabled time for single length units of type %R, %AI, and %AQ.
  - COMMREQ time has been measured between CPU and HSC.
  - DOIO is the time to output values to discrete output module.
  - Where there is more than one possible case, the time indicated above represents the worst possible case.
  - For instructions that have an increment value, multiply the increment by (Length –1) and add that value to the base time.

## CPU Boolean Execution Times

This table lists execution times of coils and contacts for the Series 90-30 CPU modules.

Table A-5. Boolean Execution Times

CPU Model	Execution Time per 1,000 Boolean Contacts/Coils
Models 37x	0.15 milliseconds
Models 35x and 36x	0.22 milliseconds
Models 340/341	0.3 milliseconds
Model 331	0.4 milliseconds
Models 313/323	0.6 milliseconds
Model 311	18.0 milliseconds

## Instruction Sizes for CPUs 350 - 374

Memory Size in the following table refers to the number of bytes of user memory required by a given instruction in a ladder diagram application program.

Table A-6. Instruction Sizes for CPUs 350 – 374

Function	Memory Size
Pop stack and AND to top	1
Pop stack and OR to top	1
Duplicate top of stack	1
Pop stack	1
Initial stack	1
Label	5
Jump	5
All other instructions	3
Function blocks – see Table A-2	various

A

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**Appendix****B*****Interpreting Fault Tables***

The Series 90-30, Series 90-20, and Series 90 Micro PLCs maintain two fault tables, the I/O fault table for faults generated by I/O devices (including I/O controllers) and the PLC fault table for internal PLC faults. The information in this appendix will enable you to interpret the message structure format when reading these fault tables. Both tables contain similar information. The fault data in these tables only exists in the PLC, not in the folder. Therefore, if using Logicmaster, you must be connected in either the ONLINE or MONITOR mode to view faults.

- The PLC fault table contains:
  - Fault location.
  - Fault description.
  - Date and time of fault.
- The I/O fault table contains:
  - Fault location.
  - Reference address.
  - Fault category.
  - Fault type.
  - Date and time of fault.

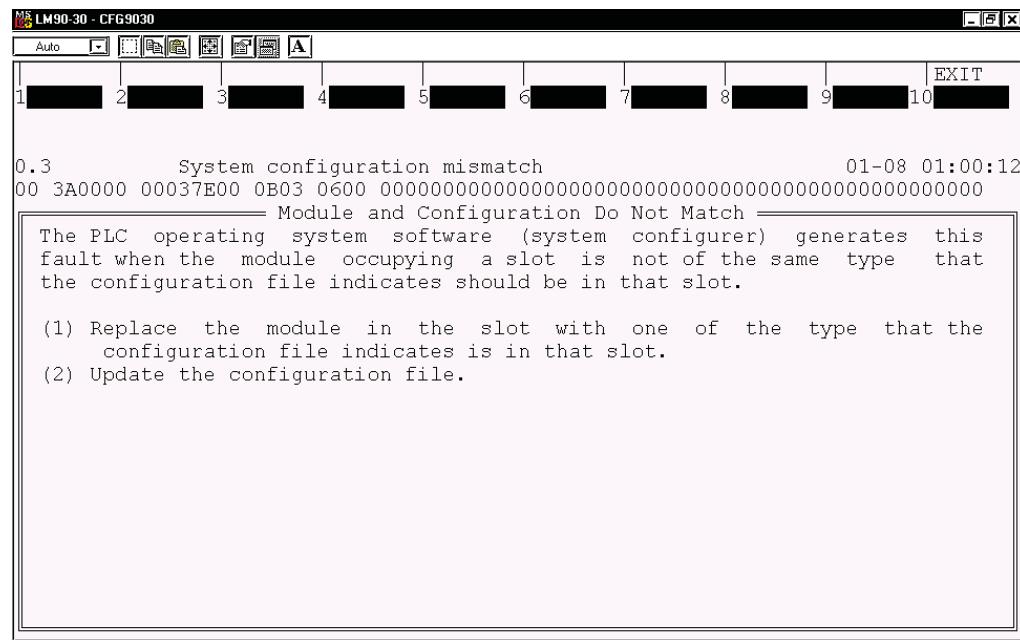
**PLC Fault Table**

Access the PLC fault table through the programming software. For information about accessing fault tables, refer to the online help, *Logicmaster 90 Series 90-30/20/Micro Programming Software User's Manual*, GFK-0466.

B

## Example

The following figure shows the example of a System Configuration Mismatch fault that has been zoomed to its fault detail screen.



The following diagram identifies each field in the fault entry for the System Configuration Mismatch fault displayed above:



This System Configuration Mismatch fault entry is explained below. (All data is in hexadecimal.)

Field	Value	Comment
Long/Short	00	00=Short, which indicates only 8 bytes of the Fault Extra Data field are used
Rack	00	Main rack (rack 0)
Slot	03	Slot 3
Task	F2	
Fault Group	0B	System Configuration Mismatch fault
Fault Action	03	FATAL fault
Error Code	06	
Fault Extra Data	00	No Fault Extra Data reported in the 8 bytes

The following paragraphs describe each field in the fault entry. Included are tables describing the range of values each field may have.

### **Long/Short Indicator**

This byte indicates whether 8 bytes or all 24 bytes of the Fault Extra Data field are used.

Type	Code	Fault Extra Data
Short	00	8 bytes
Long	01	24 bytes

### **Spare**

These six bytes are pad bytes, used to make the PLC fault table entry exactly the same length as the I/O fault table entry.

### **Rack**

The rack number ranges from 0 to 7. Zero is the main rack, containing the PLC. Racks 1 through 7 are expansion racks, connected to the PLC through an expansion cable.

### **Slot**

The slot number ranges from 0 to 9. The PLC CPU always occupies slot 1 in the main rack (rack 0).

### **Task**

The task number ranges from 0 to +65,535. Sometimes the task number gives additional information for PLC engineers; typically, the task can be ignored.

## PLC Fault Group

Fault group is the highest classification of a fault. It identifies the general category of the fault. The fault description text displayed by Logicmaster 90-30/20/Micro software is based on the fault group and the error codes.

Table B-1 lists the possible fault groups in the PLC fault table.

The last non-maskable fault group, ***Additional PLC Fault Codes***, is declared for the handling of new fault conditions in the system without the PLC having to specifically know the alarm codes. All unrecognized PLC-type alarm codes belong to this group.

Table B-1. PLC Fault Groups

Group Number		Group Name	Fault Action
Decimal	Hexadecimal		
1	1	Loss of, or missing, rack	Fatal
4	4	Loss of, or missing, option module	Diagnostic
5	5	Addition of, or extra, rack	Diagnostic
8	8	Addition of, or extra, option module	Diagnostic
11	B	System configuration mismatch	Fatal
12	C	System bus error	Diagnostic
13	D	PLC CPU hardware failure	Fatal
14	E	Non-fatal module hardware failure	Diagnostic
16	10	Option module software failure	Diagnostic
17	11	Program block checksum failure	Fatal
18	12	Low battery signal	Diagnostic
19	13	Constant sweep time exceeded	Diagnostic
20	14	PLC system fault table full	Diagnostic
21	15	I/O fault table full	Diagnostic
22	16	User Application fault	Diagnostic
-	-	Additional PLC fault codes	As specified
128	80	System bus failure	Fatal
129	81	No user's program on power-up	Informational
130	82	Corrupted user RAM detected	Fatal
132	84	Password access failure	Informational
135	87	PLC CPU software failure	Fatal
137	89	PLC sequence-store failure	Fatal

## Fault Action

Each fault may have one of three actions associated with it. These fault actions are fixed on the Series 90-30 PLC and cannot be changed by the user.

Table B-2. PLC Fault Actions

Fault Action	Action Taken by CPU	Code
Informational	Log fault in fault table	1
Diagnostic	Log fault in fault table Set fault references	2
Fatal	Log fault in fault table Set fault references Go to STOP mode	3

## Error Code

The error code further describes the fault. Each fault group has its own set of error codes. Table B-3 shows error codes for the PLC Software Error Group (Group 87H).

Table B-3. Alarm Error Codes for PLC CPU Software Faults

Decimal	Hexadecimal	Name
20	14	Corrupted PLC Program Memory
39	27	Corrupted PLC Program Memory
82	52	Backplane Communications Failed
90	5A	User Shut Down Requested
All others		PLC CPU Internal System Error

Table B-4 shows the error codes for all the other fault groups.

Table B-4. Alarm Error Codes for PLC Faults

<b>Decimal</b>	<b>Hexadecimal</b>	<b>Name</b>
<i>PLC Error Codes for Loss of Option Module Group (4)</i>		
44	2C	Option Module Soft Reset Failed
45	2D	Option Module Soft Reset Failed
255	FF	Option Module Communication Failed
79	4F	Loss of Daughterboard
<i>Error Codes for Reset of, Addition of, or Extra Option Module Group (8)</i>		
2	2	Module Restart Complete
04	4	Addition of Daughterboard
05	5	Reset of Daughterboard
All others		Reset of, Addition of, or Extra Option Module
<i>Error Codes for Option Module Software Failure Group (10 hex)</i>		
1	1	Unsupported Board Type
2	2	COMREQ – mailbox full on outgoing message that starts the COMREQ
3	3	COMREQ – mailbox full on response
5	5	Backplane Communications with PLC; Lost Request
11	B	Resource (alloc, tbl ovrflw, etc.) error
13	D	User program error
401	191	Module Software Corrupted; Requesting Reload
<i>Error Codes for System Configuration Mismatch Group (B hex)</i>		
8	8	Analog Expansion Mismatch
10	A	Unsupported Feature
23	17	Program exceeds memory limits
58	3A	Mismatch of Daughterboard
<i>Error Codes for System Bus Error Group (C hex)</i>		
All others		System Bus Error
<i>Error Codes for Program Block Checksum Group (11 hex)</i>		
3	3	Program or program block checksum failure
<i>Error Codes for Low Battery Signal</i>		
0	0	Failed battery on PLC CPU or other module
1	1	Low battery on PLC CPU or other module
<i>Error Codes for User Application Fault Group (16 hex)</i>		
2	2	PLC Watchdog Timer Timed Out
5	5	COMREQ – WAIT mode not available for this command
6	6	COMREQ – Bad Task ID
7	7	Application Stack Overflow
<i>Error Codes for System Bus Failure Group (80 hex)</i>		
1	1	Operating system
<i>Error Codes for Corrupted User RAM on Powerup Group (82 hex)</i>		
1	1	Corrupted User RAM on Power-up
2	2	Illegal Boolean Opcode Detected
3	3	PLC_ISCP_PC_OVERFLOW
4	4	PRG_SYNTAX_ERR
<i>Error Codes for PLC CPU Hardware Faults (D hex)</i>		
All codes		PLC CPU Hardware Failure

## Fault Extra Data

This field contains details of the fault entry. The following example shows what data may be present:

### Example - Corrupted User RAM Group

Four of the error codes in the System Configuration Mismatch group supply fault extra data:

Table B-5. PLC Fault Data – Illegal Boolean Opcode Detected

Fault Extra Data	Model Number Mismatch
[0]	ISCP Fault Register Contents
[1]	Bad OPCODE
[2,3]	ISCP Program Counter
[4,5]	Function Number

For a RAM failure in the PLC CPU (one of the faults reported as a PLC CPU hardware failure), the address of the failure is stored in the first four bytes of the field.

## PLC Fault Time Stamp

### PLC CPU Hardware Failure (RAM Failure)

The six-byte time stamp is the value of the system clock when the fault was recorded by the PLC CPU. (Values are coded in BCD format.)

Table B-6. PLC Fault Time Stamp

Byte Number	Description
1	Seconds
2	Minutes
3	Hours
4	Day of the month
5	Month
6	Year

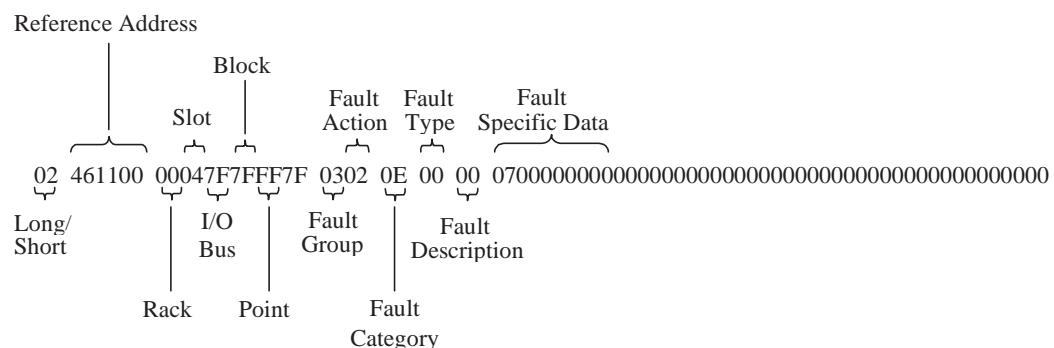
B

## I/O Fault Table

The following figure shows the example of a Loss of I/O Module fault that has been zoomed to its fault detail screen.



The following diagram identifies the hexadecimal information displayed in each field in the example fault entry (System Configuration Mismatch) shown in the figure above.



The following paragraphs describe each field in the I/O fault table. Included are tables describing the range of values each field may have.

### Long/Short Indicator

This byte indicates whether the particular fault uses 5 bytes or ass 21 bytes of the Fault Specific Data field.

Table B-7. I/O Fault Table Format Indicator Byte

Type	Code	Fault Specific Data
Short	02	5 bytes
Long	03	21 bytes

### Reference Address

Reference address is a three-byte address containing the I/O memory type and location (or offset) in that memory which corresponds to the point experiencing the fault. Or, when a Genius block fault or integral analog module fault occurs, the reference address refers to the first point on the block where the fault occurred.

Table B-8. I/O Reference Address

Byte	Description	Range
0	Memory Type	0 – FF
1–2	Offset	0 – 7FF

The memory type byte is one of the following values.

Table B-9. I/O Reference Address Memory Type

Name	Value (Hexadecimal)
Analog input	0A
Analog output	0C
Analog grouped	0D
Discrete input	10 or 46
Discrete output	12 or 48
Discrete grouped	1F

### I/O Fault Address

The I/O fault address is a six-byte address containing rack, slot, bus, block, and point address of the I/O point that generated the fault. The point address is a word; all other addresses are one byte each. All five values may not be present in a fault.

When an I/O fault address does not contain all five addresses, a 7F hex appears in the address to indicate where the significance stops. For example, if 7F appears in the bus byte, the fault is a module fault. Only rack and slot values are significant.

## Rack

The rack number ranges from 0 to 7. Zero is the main rack, i.e., the one containing the CPU. Racks 1 through 7 are expansion racks.

## Slot

The slot number ranges from 0 to 9. The PLC CPU always occupies slot 1 in the main rack (rack 0).

## Point

Point ranges from 1 to 1024 (decimal). It tells which point on the block has the fault when the fault is a point-type fault.

## I/O Fault Group

Fault group is the highest classification of a fault. It identifies the general category of the fault. The fault description text displayed by Logicmaster 90-30/20/Micro software is based on the fault group and the error codes.

Table B-10 lists the possible fault groups in the I/O fault table. Group numbers less than 80 (Hex) are maskable faults.

The last non-maskable fault group, ***Additional I/O Fault Codes***, is declared for the handling of new fault conditions in the system without the PLC having to specifically know the alarm codes. All unrecognized I/O-type alarm codes belong to this group.

Table B-10. I/O Fault Groups

Group Number	Group Name	Fault Action
3	Loss of, or missing, I/O module	Diagnostic
7	Addition of, or extra, I/O module	Diagnostic
9	IOC or I/O bus fault	Diagnostic
A	I/O module fault	Diagnostic
-	Additional I/O fault codes	As specified

## I/O Fault Action

The fault action specifies what action the PLC CPU should take when a fault occurs. Table B-11 lists possible fault actions.

Table B-11. I/O Fault Actions

Fault Action	Action Taken by CPU	Code
Informational	Log fault in fault table	1
Diagnostic	Log fault in fault table Set fault references	2
Fatal	Log fault in fault table Set fault references Go to STOP mode	3

## I/O Fault Specific Data

An I/O fault table entry may contain up to 5 bytes of I/O fault specific data.

### Symbolic Fault Specific Data

Table B-12 lists data that is required for block circuit configuration.

Table B-12. I/O Fault Specific Data

Decimal Number	Hex Code	Description
<i>Circuit Configuration</i>		
	1	Circuit is an input – tristate
	2	Circuit is an input
	3	Circuit is an output

## Fault Actions for Specific Faults

Forced/unforced circuit faults are reported as informational faults. All others are diagnostic or fatal.

The model number mismatch, I/O type mismatch and non-existent I/O module faults are reported in the PLC fault table under the System Configuration Mismatch group. They are not reported in the I/O fault table.

## I/O Fault Time Stamp

The six-byte time stamp is the value of the system clock when the fault was recorded by the PLC CPU. Values are coded in BCD format.

Table B-13. I/O Fault Time Stamp

Byte Number	Description
1	Seconds
2	Minutes
3	Hours
4	Day of the month
5	Month
6	Year

# Appendix C

## Instruction Mnemonics

In Program Display/Edit mode, you can quickly enter or search for a programming instruction by typing the ampersand (&) character followed by the instruction's mnemonic. For some instructions, you can also specify a reference address or nickname, a label, or a location reference address.

This appendix lists the mnemonics of the programming instructions for Logicmaster 90-30/20/Micro programming software. The complete mnemonic is shown in column 3 of this table, and the shortest entry you can make for each instruction is listed in column 4.

At any time during programming in Logicmaster, you can display a help screen that lists these mnemonics by pressing the ALT and I keys.

Function Group	Instruction	Mnemonic						
		All	INT	DINT	BIT	BYTE	WORD	REAL
Contacts	Any Contact	&CON	&CON					
	Normally Open Contact	&NOCON	&NOCON					
	Normally Closed Contact	&NCCON	&NCCON					
	Continuation Contact	&CONC	&CONC					
Coils	Any Coil	&COI	&COI					
	Normally Open Coil	&NOCOI	&NOCOI					
	Negated Coil	&NCCOI	&NCCOI					
	Positive Transition Coil	&PCOI	&PCOI					
	Negative Transition Coil	&NCOI	&NCOI					
	SET Coil	&SL	&SL					
	RESET Coil	&RL	&RL					
	Retentive SET Coil	&SM	&SM					
	Retentive RESET Coil	&RM	&RM					
	Retentive Coil	&NOM	&NOM					
	Negated Retentive Coil	&NCM	&NCM					
	Continuation Coil	&COILC	&COILC					
Links	Horizontal Link	&HO	&HO					
	Vertical Link	&VE	&VE					
Timers	On Delay Timer	&ON	&ON					
	Elapsed Timer	&TM	&TM					
	Off Delay Timer	&OF	&OF					
Counters	Up Counter	&UP	&UP					
	Down Counter	&DN	&DN					

Function Group	Instruction	Mnemonic								
		All	BCD-4	INT	DINT	BIT	BYTE	WORD	REAL	
Math	Addition	&AD		&AD_I	&AD_DI				&AD_R &SUB_R &MUL_R &DIV_R &MOD_R&SQ_R	
	Subtraction	&SUB		&SUB_I	&SUB_DI					
	Multiplication	&MUL		&MUL_I	&MUL_DI					
	Division	&DIV		&DIV_I	&DIV_DI					
	Modulo	&MOD		&MOD_I	&MOD_DI					
	Square Root	&SQ		&SQ_I	&SQ_DI					
	Sine	&SIN								
	Cosine	&COS								
	Tangent	&TAN								
	Inverse Sine	&ASIN								
	Inverse Cosine	&ACOS								
	Inverse Tangent	&ATAN								
	Base 10 Logarithm	&LOG								
	Natural Logarithm	&LN								
	Power of e	&EXP								
	Power of x	&EXPT								
Relational	Equal	&EQ		&EQ_I	&EQ_DI				&EQ_R &NE_R &GT_R &GE_R &LT_R &LE_R	
	Not Equal	&NE		&NE_I	&NE_DI					
	Greater Than	&GT		&GT_I	&GT_DI					
	Greater or Equal	&GE		&GE_I	&GE_DI					
	Less Than	&LT		&LT_I	&LT_DI					
	Less Than or Equal	&LE		&LE_I	&LE_DI					
Bit Operation	AND	&AN							&AN_W &OR_W &XO_W &NOT_W &SHL_W &SHR_W &ROL_W &ROR_W &BT_W &BS_W &BCL_W &BP_W &MCM_W	
	OR	&OR								
	Exclusive OR	&XO								
	NOT	&NOT								
	Bit Shift Left	&SHL								
	Bit Shift Right	&SHR								
	Bit Rotate Left	&ROL								
	Bit Rotate Right	&ROR								
	Bit Test	&BT								
	Bit Set	&BS								
	Bit Clear	&BCL								
	Bit Position	&BP								
	Masked Compare	&MCM								
Conversion	Convert to Integer	&TO_INT		&TO_INT_BCD4					&BCD4_R	
	Convert to Double Integer	&TO_DINT								
	Convert to BCD-4	&BCD4								
	Convert to REAL	&TO_REAL								
	Convert to WORD	&TO_W								
	Truncate to Integer	&TRINT								
	Truncate to Double Integer	&TRDINT								

Function Group	Instruction	Mnemonic						
		All	INT	DINT	BIT	BYTE	WORD	REAL
Data Move	Move	&MOV	&MOV_I		&MOV_BI		&MOV_W	&MOV_R
	Block Move	&BLKM	&BLKM_I				&BLKM_W	&BLKM_R
	Block Clear	&BLKC					&AR_W	
	Shift Register	&SHF						
	Bit Sequencer	&BI						
	Communications Request	&COMMR						
Table	Array Move	&AR	&AR_I	&AR_DI	&AR_BI	&AR_BY	&AR_W	
	Search Equal	&SRCHE	&SRCHE_I	&SRCHE_DI		&SRCHE_BY	&SRCHE_W	
	Search Not Equal	&SRCHN	&SRCHN_I	&SRCHN_DI		&SRCHN_BY	&SRCHN_W	
	Search Greater Than	&SRCHGT	&SRCHGT_I	&SRCHGT_DI		&SRCHGT_BY	&SRCHGT_W	
	Search Greater Than or Equal	&SRCHGE	&SRCHGE_I	&SRCHGE_DI		&SRCHGE_BY	&SRCHGE_W	
	Search Less Than	&SRCHLT	&SRCHLT_I	&SRCHLT_DI		&SRCHLT_BY	&SRCHLT_W	
	Search Less Than or Equal	&SRCHLE	&SRCHLE_I	&SRCHLE_DI		&SRCHLE_BY	&SRCHLE_W	
Control	Call a Subroutine	&CA						
	Do I/O	&DO						
	SER	&SER						
	PID – ISA Algorithm	&PIDIS						
	PID – IND Algorithm	&PIDIN						
	SFC Reset	&SFCR						
	End	&END						
	Rung Explanation (Comment)	&COMME						
	System Services Request	&SV						
	Master Control Relay	&MCR						
	End Master Control Relay	&ENDMCR						
	Nested Master Control Relay	&MCRN						
	Nested End Master Cntl Relay	&ENDMCRN						
	Jump	&JUMP						
	Nested Jump	&JUMPN						
	Label	&LABEL						
	Nested Label	&LABELN						

**Appendix****D****Key Functions**

This appendix lists the keyboard functions that are active in the software environment. To display this information on the Logicmaster screen, press ALT-K to access key help.

<b>Key Sequence</b>	<b>Description</b>	<b>Key Sequence</b>	<b>Description</b>
<i>Keys Available Throughout the Software Package</i>			
ALT-A	Abort.	CTRL-Break	Exit package.
ALT-C	Clear field.	Esc	Zoom out.
ALT-M	Change Programmer mode.	CTRL-Home	Previous command-line contents.
ALT-R	Change PLC Run/Stop state.	CTRL-End	Next command-line contents.
ALT-E	Toggle status area.	CTRL-←	Cursor left within the field.
ALT-J	Toggle command line.	CTRL→	Cursor right within the field.
ALT-L	List directory files.	CTRL-D	Decrement reference address.
ALT-P	Print screen.	CTRL-U	Increment reference address.
ALT-H	Help.	Tab	Change/increment field contents.
ALT-K	Key help.	Shift-Tab	Change/decrement field contents.
ALT-I	Instruction mnemonic help.	Enter	Accept field contents.
ALT-N	Toggle display options.	CTRL-E	Display last system error.
ALT-T	Start Teach mode.	F12 or Keypad -	Toggle discrete reference.
ALT-Q	Stop Teach mode.	F11 or Keypad *	Override discrete reference.
ALT-n	Playback file n (n = 0 thru 9).		
<i>Keys Available in the Program Editor Only</i>			
ALT-B	Toggle text editor bell.	Keypad +	Accept rung.
ALT-D	Delete rung element/Delete rung.	Enter	Accept rung.
ALT-S	Store block to PLC and disk.	CTRL-PgUp	Previous rung.
ALT-X	Display zoom level.	CTRL-PgDn	Next rung.
ALT-U	Update disk.	~	Horizontal shunt.
ALT-V	Variable table window.		Vertical shunt.
ALT-F2	Go to operand reference table.	Tab	Go to the next operand field.
<i>Special Keys</i>			
ALT-O	Password override. Available only on the Password screen in the configuration software.		

**D**

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The Help card on the next page contains a listing of the key help and also the instruction mnemonics help text for Logicmaster 90-30/20/Micro software. This card is printed in triplicate and is perforated for easier removal from the manual.

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D

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# Appendix

# *E*

## *Using Floating-Point Numbers*

There are a few considerations you need to understand when using floating-point numbers. The first section discusses these general considerations. Refer to page E-5 and following for instructions on entering and displaying floating-point numbers.

### Note

Floating-point capabilities are **only** supported on the 35x and 36x series CPUs Release 9.00 or later, and on all releases of CPU352 and 37x series.

## Floating-Point Numbers

The programming software provides the ability to edit, display, store, and retrieve numbers with real values. Some functions operate on floating-point numbers. However, to use floating-point numbers with the programming software, you must have a 35x, 36x or 37x series CPU (see Note above). Floating-point numbers are represented in decimal scientific notation, with a display of six significant digits.

### Note

In this manual, the terms “floating-point” and “real” are used interchangeably to describe the floating-point number display/entry feature of the programming software.

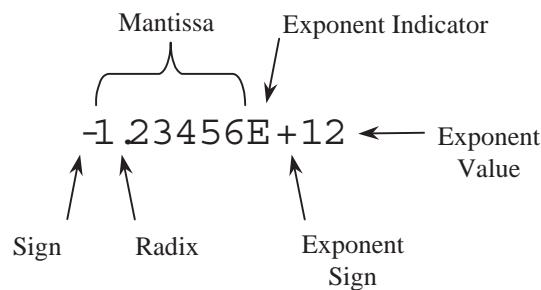
The following format is used. For numbers in the range 9999999 to .0001, the display has no exponent and up to six or seven significant digits. For example:

Entered	Displayed	Description
.000123456789	+.0001234567	Ten digits, six or seven significant.
-12.345e-2	-.1234500	Seven digits, six or seven significant.
1234	+1234.000	Seven digits, six or seven significant.

Outside the range listed above, only six significant digits are displayed and the display has the following form: +1.23456E+12

## Real Number Terminology

A real number is stored in a 32-bit double word register. The following discusses the terms used for the parts of a real number.



**Sign** – Either plus or minus. Stored in the most significant bit (bit 32) of the double word. A one in bit 32 indicates a negative sign. A zero in bit 32 indicates a positive sign.

**Radix** – A period (dot) symbol that separates the whole number portion from the fractional number portion of the mantissa. For decimal numbers, the radix is commonly called the decimal point.

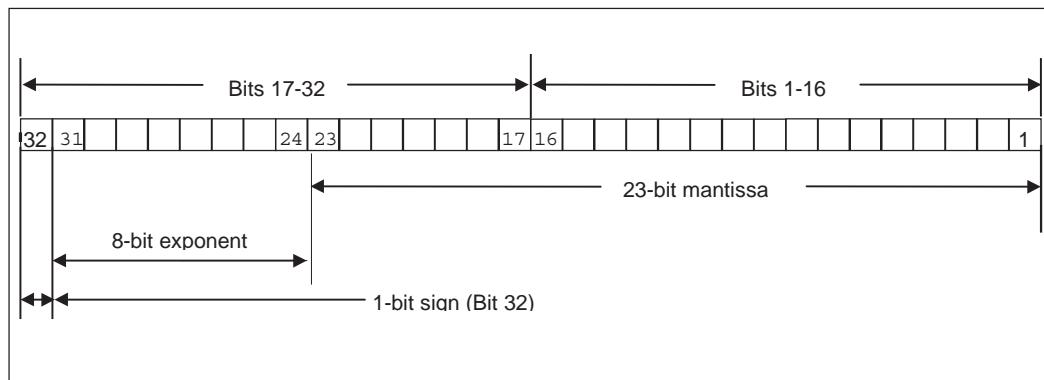
**Exponent** – (Also called a “Characteristic”). It is stored in 8 bits, in bit positions 31 through 24 of the 32-bit double word. The exponent may have values in the range of +127 to -126; however, the exponent is always stored as a positive number because the CPU automatically adds 127 to its value before storing it.

**Mantissa** – (Also called a Significand”). The basic number without the sign and exponent. It is stored in 23 bits, in bit positions 23 through 1 of the 32-bit word.

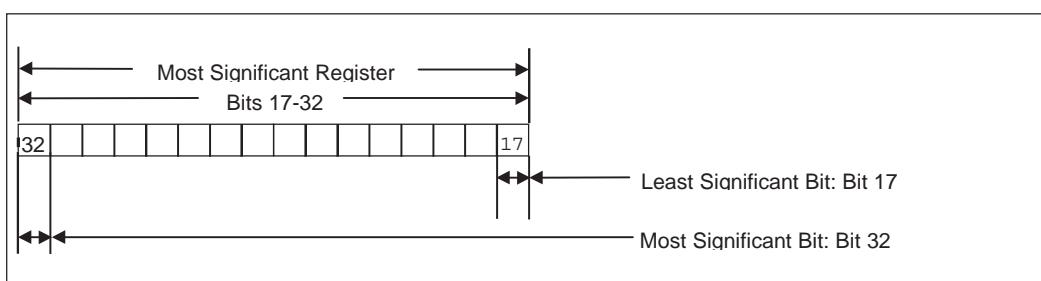
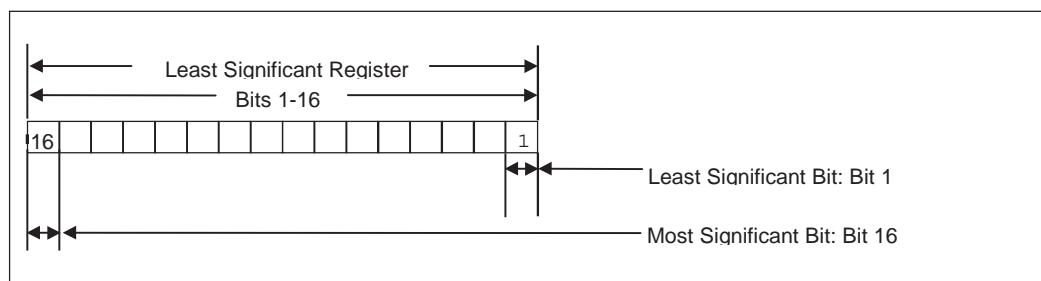
**Precision** – Related to the number of significant digits that can be stored. Since a double integer register uses 31 bits to store a number (bit 32 is used for the sign), it can potentially store numbers with greater precision than a real (floating-point) register, which only uses 23 bits to store a number’s mantissa.

## Internal Format of Floating-Point Numbers

Floating-point numbers are stored in single precision IEEE-standard format. This format requires 32 bits, which translates to two adjacent 16-bit PLC registers. The encoding of the bits is diagrammed below.



Register use by a single floating-point number is diagrammed below. In this diagram, if the floating-point number occupies registers %R0005 and %R0006, for example, %R0005 is the least significant register and %R0006 is the most significant register.



## Values of Floating-Point Numbers

Use the following table to calculate the value of a floating-point number from the binary number stored in two registers.

Exponent (e)	Mantissa (f)	Value of Floating Point Number
255	Non-zero	Not a valid number (NaN).
255	0	$-1^s * \infty$
$0 < e < 255$	Any value	$-1^s * 2^{e-127} * 1.f$
0	Non-zero	$-1^s * 2^{-126} * 0.f$
0	0	0

f = the mantissa. The mantissa is a binary fraction.

e = the exponent. The exponent is an integer E such that E+127 is the power of 2 by which the mantissa must be multiplied to yield the floating-point value.

s = the sign bit.

\* = the multiplication operator.

For example, consider the floating-point number 12.5. The IEEE floating-point binary representation of the number is:

01000001 01001000 00000000 00000000

or 41480000 hex. The most significant bit (the sign bit) is zero (s=0). The next eight most significant bits are 10000010, or 130 decimal (e=130).

The mantissa is stored as a decimal binary number with the decimal point preceding the most significant of the 23 bits. Thus, the most significant bit in the mantissa is a multiple of  $2^{-1}$ , the next most significant bit is a multiple of  $2^{-2}$ , and so on to the least significant bit, which is a multiple of  $2^{-23}$ . The final 23 bits (the mantissa) are:

1001000 00000000 00000000

The value of the mantissa, then, is .5625 (that is,  $2^{-1} + 2^{-4}$ ).

Since e > 0 and e < 255, we use the third formula in the table above:

$$\begin{aligned}
 \text{number} &= -1^s * 2^{e-127} * 1.f \\
 &= -1^0 * 2^{130-127} * 1.5625 \\
 &= 1 * 2^3 * 1.5625 \\
 &= 8 * 1.5625 \\
 &= 12.5
 \end{aligned}$$

Thus, you can see that the above binary representation is correct.

The range of numbers that can be stored in this format is from  $\pm 1.401298E-45$  to  $\pm 3.402823E+38$  and the number zero.

## Entering and Displaying Floating-Point Numbers

In the mantissa, up to six or seven significant digits of precision may be entered and stored; however, the programming software will display only the first six of these digits. The mantissa may be preceded by a positive or negative sign. If no sign is entered, the floating-point number is assumed to be positive.

If an exponent is entered, it must be preceded by the letter **E** or **e**, and the mantissa must contain a decimal point to avoid mistaking it for a hexadecimal number. The exponent may be preceded by a sign; but, if none is provided, it is assumed to be positive. If no exponent is entered, it is assumed to be zero. No spaces are allowed in a floating-point number.

To provide ease-of-use, several formats are accepted in both command-line and field data entry. These formats include an integer, a decimal number, or a decimal number followed by an exponent. These numbers are converted to a standard form for display once the user has entered the data and pressed the **Enter** key.

Examples of valid floating-point number entries and their normalized display are shown below.

Entered	Displayed in Logicmaster
250	+250.0000
+4	+4.000000
-2383019	-2383019.
34.	+34.00000
-.0036209	-.003620900
12.E+9	+1.20000E+10
-.0004E-11	-4.00000E-15
731.0388	+731.0388
99.20003e-29	+9.92000E-28

Examples of invalid or incorrect floating-point number entries are shown below.

Incorrect Entry	Explanation/Result
-433E23	Missing decimal point. LM90 displays message “Bad numeric value.”
10e-19	Missing decimal point. LM90 displays message “Bad numeric value.”
1 0.e19	There is a space between the 1 and the 0 in the mantissa. Real numbers must be entered without spaces between digits or characters. Logicmaster recognizes this entry as the incorrect value +1.000000.
4.1e 19	There is a space between the e and the 19 in the exponent. Real numbers must be entered without spaces between digits or characters. Logicmaster recognizes this entry as the incorrect value +4.100000.

## Errors in Floating-Point Numbers and Operations

### Positive and Negative Infinity

On a 352 or 374 CPU, overflow occurs when a number greater than 3.402823E+38 or less than -3.402823E+38 is generated by a REAL function. On all other 90-30 models that support floating point operations, the range is greater than  $2^{16}$  or less than  $-2^{16}$ . When your number exceeds the range, the ok output of the function is set OFF, and the result is set to positive infinity (for a number greater than 3.402823E+38 on a 352 or 374 CPU or  $2^{16}$  on all other models) or negative infinity (for a number less than -3.402823E+38 or  $-2^{16}$  on all other models). You can determine where this occurs by testing the sense of the ok output.

Mnemonic	Ladder Screen Value	Reference Table Value (Hex)	Description
POS_INF	+OVERFLOW	7F80 0000	IEEE positive infinity representation in hex.
NEG_INF	-OVERFLOW	FF80 0000	IEEE negative infinity representation in hex.

### Note

If you are using software floating point (all models capable of floating point operations except the 352 or 374 CPU), numbers are rounded to zero (0) at  $\pm 1.175494E-38$ .

If the infinities produced by overflow are used as operands to other REAL functions, they may cause an undefined result. This undefined result is referred to as an NaN (Not a Number). For example, the result of adding positive infinity to negative infinity is undefined. When the ADD\_REAL function is invoked with positive infinity and negative infinity as its operands, it produces an NaN for its result.

### Not a Number (NaN)

A Not a Number is an undefined number such as the result of dividing zero by zero. Positive and Negative Infinities are not considered to be NaNs. The following sections will help you identify when an NaN result has been obtained.

## NaN Codes for 352 or 374 CPU

On a 352 or 374 CPU, each REAL function capable of producing an NaN produces a specialized NaN code that identifies the function and can be read in the applicable Reference Table. The indication on the Logicmaster ladder logic screen will be the unsigned term “OVERFLOW.” (If the term “OVERFLOW” is preceded by a plus or minus sign, it indicates a positive or negative infinity.)

Not a Number (NaN) Codes for the 352 and 374 CPU		
Mnemonic	Reference Table Value (Hex)	Description
NaN_ADD.	7F81 FFFF	Real addition error value in hex.
NaN_SUB	7F81 FFFF	Real subtraction error value in hex.
NaN_MUL	7F82 FFFF	Real multiplication error value in hex.
NaN_DIV	7F83 FFFF	Real division error value in hex.
NaN_SQRT	7F84 FFFF	Real square root error value in hex.
NaN_LOG	7F85 FFFF	Real logarithm error value in hex.
NaN_POW0	7F86 FFFF	Real exponent error value in hex.
NaN_SIN	7F87 FFFF	Real sine error value in hex.
NaN_COS	7F88 FFFF	Real cosine error value in hex.
NaN_TAN	7F89 FFFF	Real tangent error value in hex.
NaN_ASIN	7F8A FFFF	Real inverse sine error value in hex.
NaN_ACOS	7F8B FFFF	Real inverse cosine error value in hex.
NaN_BCD	7F8C FFFF	BCD-4 to real error.
REAL_INDEF	FFC0 0000	Real indefinite, divide 0 by 0 error.

## NaN Code for 35x, 36x, and 37x CPUs (excluding 352 CPU)

All Series 90-30 CPUs that support firmware-based floating point operations (which excludes the 352 CPU, which is hardware-based) produce only one NaN output: FFFF FFFF. The indication on the Logicmaster ladder logic screen will be the unsigned term “OVERFLOW.”

Not a Number (NaN) Type for 35x, 36x, and 37xCPUs (Excluding 352 CPU)		
Mnemonic	Reference Table Value (Hex)	Description
NaN_SW	FFFF FFFF	Software Floating Point code for all NaNs

## Propagation and Power Flow for NaN and Infinity Numbers

When an NaN result is fed into another function, it passes through to the result. For example, if an NaN\_ADD is the first operand to the SUB\_REAL function, the result of the SUB\_REAL is NaN\_ADD. If both operands to a function are NaNs, the first operand will pass through. Because of this feature of propagating NaNs through functions, you can identify the function where the NaN originated.

### Note

For NaN, the ok output is OFF (not energized).

The following table explains when power is or is not passed when dealing with numbers viewed as or equal to infinity for binary operations such as Add, Multiply, etc. As shown previously, outputs that exceed the positive or negative limits are viewed as POS\_INF or NEG\_INF respectively.

**Table E-1. General Case of Power Flow for Floating-Point Math Operations**

Operation	Input 1	Input 2	Output	Power Flow
All	Number	Number	Positive or Negative Infinity	No
All Except Division	Infinity	Number	Infinity	Yes
All	Number	Infinity	Infinity	Yes
Division	Infinity	Number	Infinity	No
All	Number	Number	NaN	No

**Appendix****F**

# *Programming Software Comparison*

This manual was written for users of Logicmaster (a DOS-based PLC programming software). The Windows-based PLC software products, such as CIMPPLICITY® Machine Edition Logic Developer and VersaPro®, provide PLC instruction set information in the software's built-in on-line help system rather than in a manual. Users of the Windows-based programming software should be aware that instructions appear differently than the way they appear on a Logicmaster screen (they still work the same in the PLC). The online help system has the most accurate information about using the instruction set in the Windows-based programming software.

In addition to the on-line help system, you can refer to the following manuals for information on using the software:

*VersaPro™ Programming Software User's Guide*, GFK-1670

*CIMPPLICITY® Machine Edition Getting Started Guide*, GFK-1868

## Notes

### Support for DRUM Sequencer Instruction

This instruction, supported by CPUs 350-364 release 10.00 and later, and all versions of CPU37x , is not supported in any version of Logicmaster; therefore, not discussed in this manual. This instruction is supported in VersaPro, starting with release 1.1, and in all versions of Logic Developer. Information for this instruction can be found in the on-line help built into these two software packages.

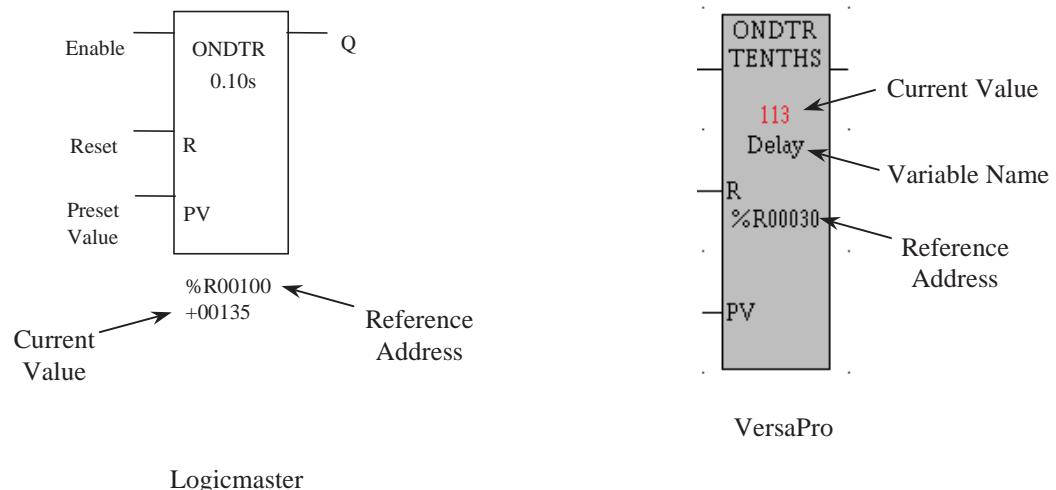
### Start and End of Program Markers

These are used in Logicmaster ladder logic screens, but are not visible on the Windows-based programmers' ladder logic screens.

### Instruction Control Word Address Location

Certain instructions, such as timers, counters, and the bit sequencer require a group of consecutive words to store certain internal calculations. This group of words is usually called a control block. In Logicmaster, the address of the first word of the control block (as well as any value stored in that address) appears below the instruction on the ladder logic screen (as %R00100 in the figure below). For the Windows-based programmers, this reference address of the first word appears inside the instruction on the ladder logic screen (as %R00030 in the figure below). VersaPro also displays

the Variable Name of the reference address (Delay in the figure below) inside the instruction. If no one has assigned a Variable Name to the reference address, the address itself will be the default Variable Name (so the reference address would appear inside the instruction in both places). Right above the word Delay in the VersaPro view is the value 113, which represents the current value stored in that variable.



### Real Number Display Differences

There are differences between the way the programs display undefined results such as when a divide by zero calculation is attempted. Appendix E of this manual discusses how Logicmaster displays these results in both the ladder screen and reference tables.

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### **X**

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# TECHNICAL DATA SHEET

**Equipment Type:** Batteries

**Location:** Battery Compartment

**Model Numbers:** NP 7 12

**Manufacturer:** Yuasa

**Supplier:** Battery Specialties

6/10 Argon St  
Sumner Park  
(07) 3279 4375

# NP SERIES - NP7-12

## Reliability is your Security

Utilizing the latest advance design Oxygen Recombination Technology, Yuasa have applied their 80 years of experience in the lead acid battery field to produce the optimum design of Sealed Lead Acid batteries.

## FEATURES

- Superb recovery from deep discharge.
- Electrolyte suspension system.
- Gas Recombination.
- Multipurpose: Float or Cyclic use.
- Usable in any orientation
- Superior energy density.
- Lead calcium grids for extended life.
- Manufactured World wide.
- Application specific designs.

## Technical Features

### Sealed Construction

Yuasa's unique construction and sealing technique ensures no electrolyte leakage from case or terminals.

### Electrolyte Suspension System

All NP batteries utilize Yuasa's unique electrolyte suspension system incorporating a microfine glass mat to retain the maximum amount of electrolyte in the cells. The electrolyte is retained in the separator material and there is no free electrolyte to escape from the cells. No gels or other contaminants are added.

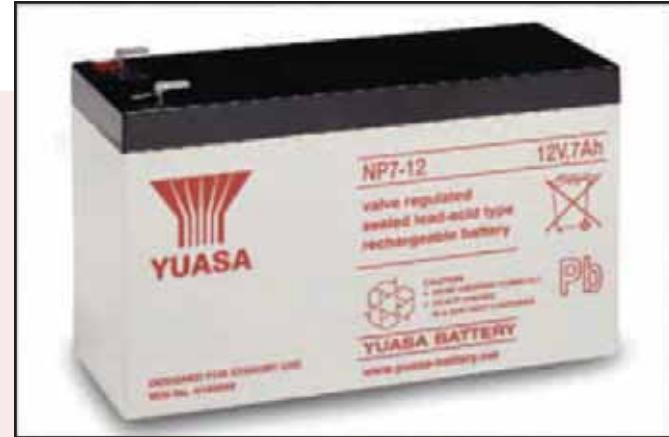
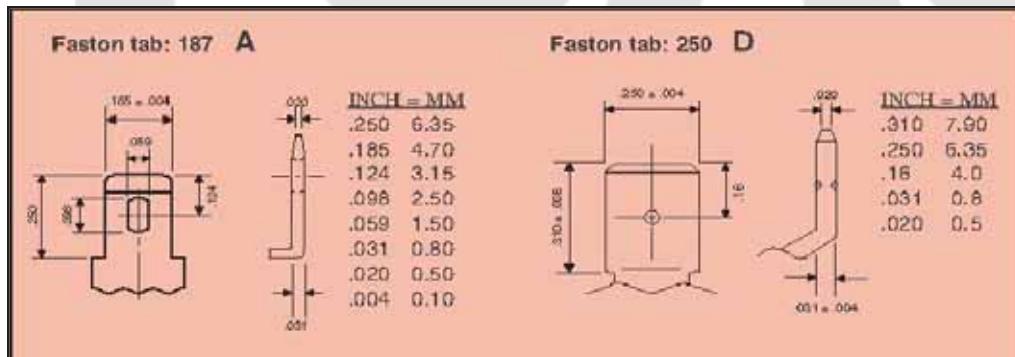
### Control of Gas Generation

The design of Yuasa's NP batteries incorporates the very latest oxygen recombination technology to effectively control the generation of gas during normal use.

### Low Maintenance Operation

Due to the perfectly sealed construction and the recombination of gasses within the cell, the battery is almost maintenance free.

## Terminals



## Terminals

NP batteries are manufactured using a range of terminals which vary in size and type. Please refer to details as shown.

## Operation in any Orientation

The combination of sealed construction and Yuasa's unique electrolyte suspension system allows operation in any orientation, with no loss of performance or fear of electrolyte leakage.

## Valve Regulated Design

The batteries are equipped with a simple, safe low pressure venting system which releases excess gas and automatically reseals should there be a build up of gas within the battery due to severe overcharge. Note. On no account should the battery be charged in a sealed container.

## General Specifications

Nominal Capacity (Ah)	NP7-12
20hr to 1.75vpc 30°C	7
1 0hr to 1.75vpc 20°C	6.4
5hr to 1.70vpc 20°C	5.9
1 hr to 1 .60vpc 20°C	4.2
Voltage	12
Energy Density (Wh.L.20hr)	91
Specific Energy (Wh.kg.20hr)	32
Int. Resistance (m.Ohms)	25
Maximum discharge (A)	40/75
Short Circuit current (A)	210
Dimensions (mm)	
Length	151
Width	65
Height overall	97.5
Weight (Kg)	2.65
Terminal	A/D
Layout	4
Terminal Torque Nm	-

# NP SERIES - NP7-12

## Lead Calcium Grids

The heavy duty lead calcium alloy grids provide an extra margin of performance and life in both cyclic and float applications and give unparalleled recovery from deep discharge.

## Long Cycle Service Life

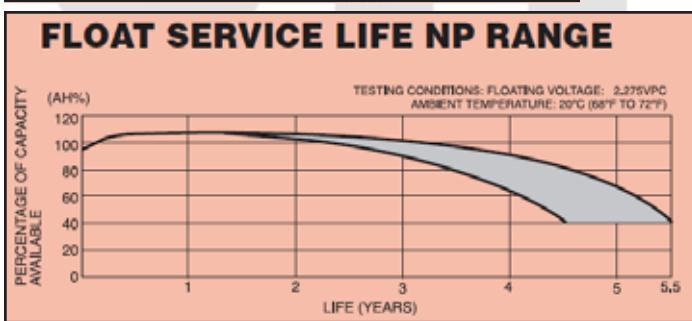
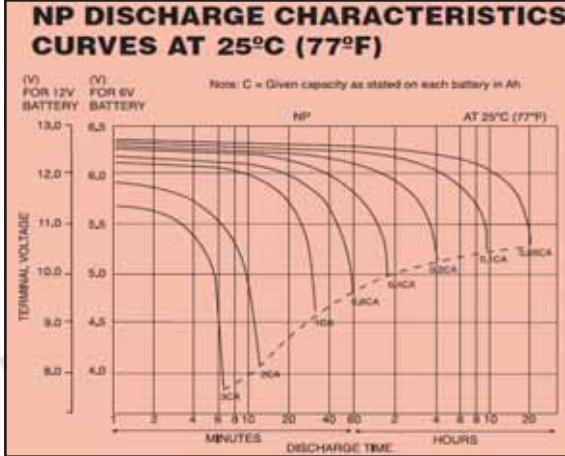
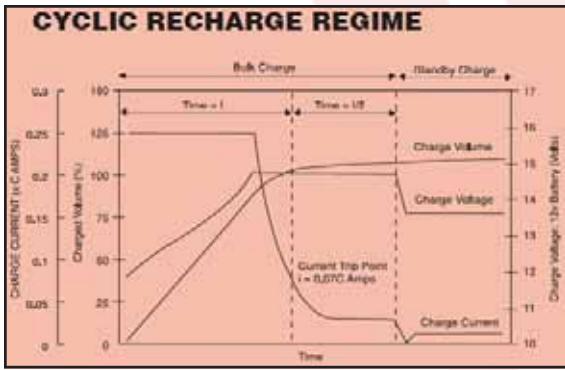
Depending upon the average depth of discharge, over a thousand discharge/charge cycles can be expected.

## Float Service Life

The expected service life is five years in float standby applications.

## Separators

The use of the special separator material provides a very efficient insulation between plates preventing inter-plate short circuits and prohibiting the shedding of active materials.



## Long shelf Life

The extremely low self discharge rate allows the battery to be stored for extended periods up to one year at normal ambient temperatures with no permanent loss of capacity.

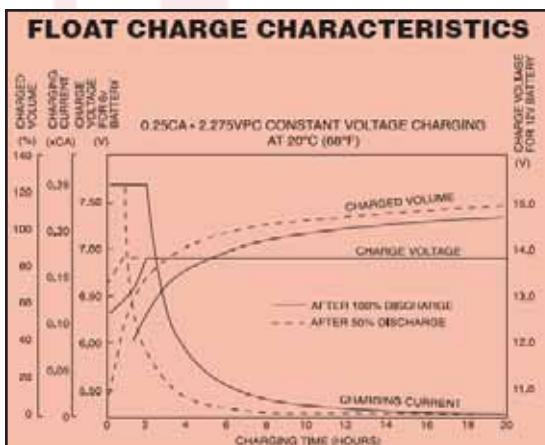
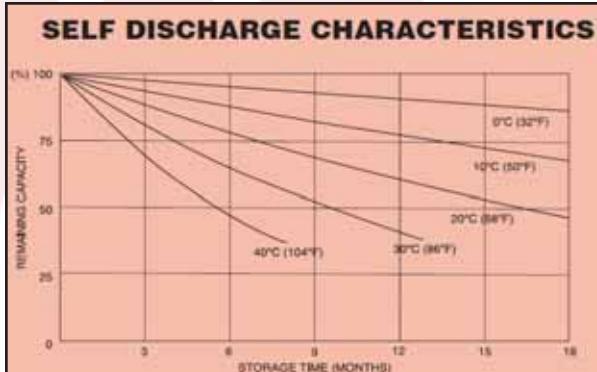
## Operating Temperature Range

The batteries can be used over a broad temperature range permitting considerable flexibility in system design and location.

Charge – 15°C to 50°C

Discharge – 20°C to 60°C

Storage – 20°C to 50°C (fully charged battery)



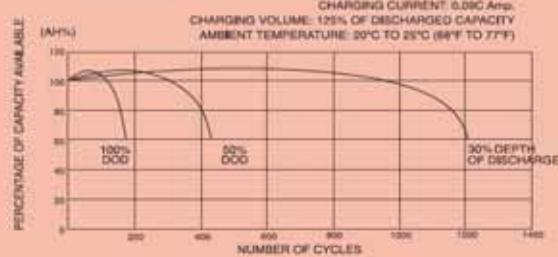
## TYPICAL DISCHARGE CHARACTERISTICS NP RANGE

### CYCLE SERVICE LIFE IN RELATION TO DEPTH OF DISCHARGE

TESTING CONDITIONS: DISCHARGE CURRENT: 0.17C Amp; (FV 1.7V/CELL CHARGING CURRENT: 0.09C Amp;

CHARGING VOLUME: 125% OF DISCHARGED CAPACITY

AMBIENT TEMPERATURE: 20°C TO 25°C (68°F TO 77°F)



Distributed by



Yuasa Battery Inc.

2901 Montrose Ave  
Laureldale, PA 19605  
[www.yuasabatteries.com](http://www.yuasabatteries.com)

Registered number 1548820

Cat. No.

NP7-12 January 08

Document: TMS1407

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2.21

## TECHNICAL DATA SHEET

**Equipment Type:** LED Lights

**Location:**

**Model Numbers:** Lumifa LF1B-N Series

**Manufacturer:** IDEC

**Supplier:** IPD Australia Pty Ltd  
Unit 17  
104 Ferntree Gully Road  
Oakleigh, Victoria 3166,

Ph: 03 8523 5900  
Fax: 03 8523 5999  
Web: [www.idec.com](http://www.idec.com)

# LF1B Series

## LED Illumination Units



Low heat generation.  
Four lengths & four illumination colors available.

Slim, space-saving design  
(only 16mm thick)

Heat generation reduced by 70%\*

Less power consumption &  
71% less CO<sub>2</sub> emission\*

5 times longer life\*

\*Compared to 20W fluorescent lamps.



Illumination Colors & Application Examples				
Illumination Color	Cool White	Warm White	Yellow	Red
Power Voltage	24V DC			
Appearance	Clear Cover			
	White Cover			
Spectrum				
Features	Suppressing glare, the bright, clear cool white illumination color lights up a target object clearly. This illumination color gives off a color temperature of 5500K.	Warm color similar to that of incandescent lamps. This illumination color gives off a color temperature of 2800K.	Yellow illumination color gives off an emission spectrum with a dominant wavelength of 590 nm.	Red illumination color gives off an emission spectrum with a dominant wavelength of 625 nm.
Applications	<ul style="list-style-type: none"> <li>Control panel</li> <li>Plant equipment</li> <li>Refrigerator/freezer</li> <li>Inspection/test equipment</li> <li>Advertising display/board</li> <li>Machine tool</li> </ul>	<ul style="list-style-type: none"> <li>Food processing machines</li> <li>Cosmetic plants</li> <li>Chemical plants</li> <li>Showcases</li> <li>Food display cases</li> </ul>	<ul style="list-style-type: none"> <li>Manufacturing equipment</li> <li>IC foundries</li> </ul>	<ul style="list-style-type: none"> <li>Photosensitive materials</li> <li>Semiconductor manufacturing equipment</li> </ul>

## Features

- Brightness: 62.5 Lumens/Watt
- Low heat generation.
- Less energy usage, longer operation life, smaller mounting space, and no electrical noise.
- 71% reduction of power and CO<sub>2</sub> emission when compared to 20W fluorescent lamps (LF1B-C/D)
- Thin and slim style fits into compact spaces.
- Two cover colors: clear and white (diffused light)
- Cool white, warm white, yellow and red illumination colors available.
- UL Listed & IP54 protection against dust and water splash (IEC 60529)



## Part No. Development

LF1B- C 3 S - 2 THWW4

LED Module Arrangement

- A: 3 LEDs x 1 row
- B: 6 LEDs x 1 row
- C: 12 LEDs x 1 row
- D: 24 LEDs x 1 row

Rated Voltage  
2: 24V DC

LED Illumination Color

- THWW4: Cool white
- TLWW4: Warm white
- SHY6: Yellow
- SHR6: Red

Degree of Protection

- S: IP54
- Cover
- 3: Clear plastic
- 4: White plastic

## LED Optics Specifications

Illumination Color	Cool White	Warm White	Yellow	Red																																
Luminous Intensity (typ.) (Single LED module)	5000 mcd	4500 mcd	2300 mcd	1800 mcd																																
Color Temperature (typ.)/Dominant Wavelength (typ.)	5500K	2800K	590 nm	625 nm																																
Reference Illuminance (typ.) at 500 mm (clear cover)	<table border="1"> <tr> <td>3 LEDs x 1 row</td><td>90 lx</td></tr> <tr> <td>6 LEDs x 1 row</td><td>170 lx</td></tr> <tr> <td>12 LEDs x 1 row</td><td>330 lx</td></tr> <tr> <td>24 LEDs x 1 row</td><td>560 lx</td></tr> </table>	3 LEDs x 1 row	90 lx	6 LEDs x 1 row	170 lx	12 LEDs x 1 row	330 lx	24 LEDs x 1 row	560 lx	<table border="1"> <tr> <td>3 LEDs x 1 row</td><td>60 lx</td></tr> <tr> <td>6 LEDs x 1 row</td><td>110 lx</td></tr> <tr> <td>12 LEDs x 1 row</td><td>200 lx</td></tr> <tr> <td>24 LEDs x 1 row</td><td>350 lx</td></tr> </table>	3 LEDs x 1 row	60 lx	6 LEDs x 1 row	110 lx	12 LEDs x 1 row	200 lx	24 LEDs x 1 row	350 lx	<table border="1"> <tr> <td>3 LEDs x 1 row</td><td>20 lx</td></tr> <tr> <td>6 LEDs x 1 row</td><td>40 lx</td></tr> <tr> <td>12 LEDs x 1 row</td><td>75 lx</td></tr> <tr> <td>24 LEDs x 1 row</td><td>125 lx</td></tr> </table>	3 LEDs x 1 row	20 lx	6 LEDs x 1 row	40 lx	12 LEDs x 1 row	75 lx	24 LEDs x 1 row	125 lx	<table border="1"> <tr> <td>3 LEDs x 1 row</td><td>20 lx</td></tr> <tr> <td>6 LEDs x 1 row</td><td>40 lx</td></tr> <tr> <td>12 LEDs x 1 row</td><td>75 lx</td></tr> <tr> <td>24 LEDs x 1 row</td><td>125 lx</td></tr> </table>	3 LEDs x 1 row	20 lx	6 LEDs x 1 row	40 lx	12 LEDs x 1 row	75 lx	24 LEDs x 1 row	125 lx
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Note: Illumination colors and illuminance may vary. Specifications shown in the above table are typical values and may vary depending upon actual environment.

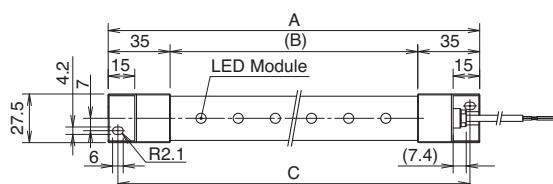
## LF1B Series Illumination Units

### Performance Specifications

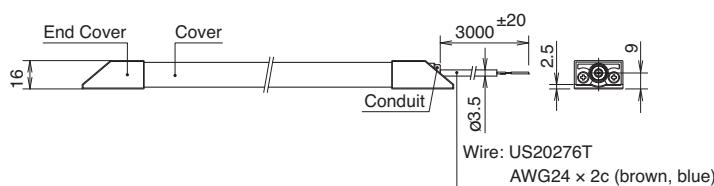
Rated Voltage	24V DC (non-polarized)
Input Current (typ.) (at the rated voltage)	LF1B-A 30mA
	LF1B-B 60mA
	LF1B-C 120mA
	LF1B-D 240mA
Power Consumption (typ.) (at the rated voltage)	LF1B-A 0.8W
	LF1B-B 1.5W
	LF1B-C 2.9W
	LF1B-D 5.8W
Insulation Resistance	100MΩ minimum (500V DC megger)
Dielectric Strength	1000V AC, 1 minute (between live and dead parts)
Vibration Resistance (damage limits)	Frequency: 5 to 55 Hz Amplitude: 0.5 mm
Shock Resistance (damage limits)	1000m/s <sup>2</sup>
Operating Temperature	-30 to +55°C (no freezing)
Operating Humidity	45 to 85% RH (no condensation)
Storage Temperature	-35 to +70°C (no freezing)
Operating Atmosphere	No corrosive gas
Life	40000 hours (The total illumination duration in which the luminance maintains a minimum of 70% of the initial value.)
Degree of Protection	IP54
Material	End cover, conduit: polyamide Cover: polycarbonate Wire: US20276T AWG24 x 2C
Weight (approx.)	LF1B-A 95g
	LF1B-B 125g
	LF1B-C 165g
	LF1B-D 255g

- Do not use the LF1B illumination units in environments subject to corrosive gases, otherwise illuminance may deteriorate.

### Dimensions

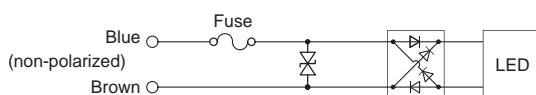


Type No.	A	B	C
LF1B-A	134	64	123
LF1B-B	210	140	199
LF1B-C	330	260	319
LF1B-D	580	510	569



All dimensions in mm.

### Internal Circuit



## **TECHNICAL DATA SHEET**

**Equipment Type:** Radio Power Supply

**Location:** RTU Section

**Model Numbers:** PBIH

**Manufacturer:** Powerbox

**Supplier:** Powerbox Australia Pty Ltd  
433 Logan Road  
Stones Corner, QLD 4120

Ph: 07 3394 8372  
Fax: 07 3394 8373  
Web: [www.powerbox.com.au](http://www.powerbox.com.au)

# PBIH Series

15 - 150 WATTS DC/DC SINGLE OUTPUT

## FEATURES

- Wide selection of models
- 4 input voltage ranges
- High efficiency
- Low output ripple
- Proven reliability
- Good thermal margins



## SPECIFICATIONS

INPUT		OPERATING
Input voltage	12VDC (9.2–16) 24VDC (19–32) 48VDC (38–63) 110VDC (85–140)	Efficiency 70%–89%
Inrush current	20A max. for 110V only	Safety isolation (1 minute) Type – 12, 24, 48V input Input – Output: 1500VAC Input– Case: 1500VAC Output– Case: 500VAC Type– 110V input Input– Output: 2000VAC Input– Case: 2000VAC Output– Case: 500VAC
OUTPUT		Insulation resistance 50MΩ (500VDC) Input – Case
Output voltage	See table	Parallel operation Consult sales office for details
Voltage adjustment	±10%, ±5% for PBIH-F	Remote control PBIH-R Series: Open link: output normal Short link: output off
ENVIRONMENTAL		
Output current	See table	Operating temperature 0°C to 70°C.
Ripple & noise	Output Volts x 1% + 50mV to -100mV pk-pk	Temperature derating Derate 100% load from 50°C - 70°C at 1.5% per °C to 30% load.
Line regulation	0.8% over input range	Cooling Convection cooled
Load regulation	0.9%, 0%–100% load	Storage temperature -20°C to +85°C
Temperature coefficient	0°C to 50°C, 0.03% per °C	Humidity 85%
Overvoltage protection	O.V. clamp, PBIH-F Output shutdown, PBIH-G, J, M, R – input must be switched off for at least 30S to reactivate	Shock 30G, PBIH-F, G and J
Overcurrent protection	Fold back – PBIH-F Current limiting, PBIH-G, J, M, R (PBIH-R series is adjustable); PBIH110xxR models are not adjustable	Vibration (5Hz–10Hz, 10mm), (10Hz–50Hz) 2G, PBIH-F, G and J
Drift	Output V x 0.5% + 15(mV) per 8 hrs after 1 hr warm-up	
Rise Time	200ms max. – PBIH-F, M, R 100ms max. – PBIH-G, J (at 25°C)	
Holdup time	10ms (only 110V input)	
Remote sense	PBIH-R Series only	
STANDARDS AND APPROVALS		
Safety	Designed to UL1950	
C-Tick	AS/NZS CISPR11 Group 1, Class A	
MECHANICAL		
Weight	PBIH-F : 250g PBIH-G : 380g PBIH-J : 410g PBIH-M : 800g PBIH-R : 1.4kg	

# PBIH Series

## 15 - 150 WATTS DC/DC SINGLE OUTPUT

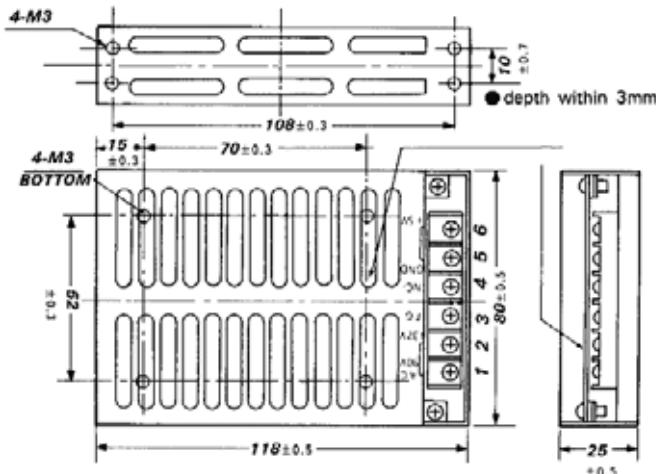
### SELECTION TABLE

MODEL NUMBER	INPUT	OUTPUT	OUTPUT POWER
PBIH-1205F	9.2-16V	5V	3A
PBIH-1212F	9.2-16V	12V	1.2A
PBIH-1215F	9.2-16V	15V	1A
PBIH-1224F	9.2-16V	24V	0.62A
PBIH-2405F	19-32V	5V	3A
PBIH-2412F	19-32V	12V	1.2A
PBIH-2415F	19-32V	15V	1A
PBIH-2424F	19-32V	24V	0.62A
PBIH-4805F	38-63V	5V	3A
PBIH-4812F	38-63V	12V	1.2A
PBIH-4815F	38-63V	15V	1A
PBIH-4824F	38-63V	24V	0.62A
PBIH-11005F	85-140V	5V	3A
PBIH-11012F	85-140V	12V	1.2A
PBIH-11015F	85-140V	15V	1A
PBIH-11024F	85-140V	24V	0.62A
PBIH-1205G	9.2-16V	5V	5A
PBIH-1212G	9.2-16V	12V	2.1A
PBIH-1215G	9.2-16V	15V	1.7A
PBIH-1224G	9.2-16V	24V	1.1A
PBIH-1248G	9.2-16V	48V	0.5A
PBIH-2405G	19-32V	5V	5A
PBIH-2412G	19-32V	12V	2.1A
PBIH-2415G	19-32V	15V	1.7A
PBIH-2424G	19-32V	24V	1.1A
PBIH-2448G	19-32V	48V	0.5A
PBIH-4805G	38-63V	5V	5A
PBIH-4812G	38-63V	12V	2.1A
PBIH-4815G	38-63V	15V	1.7A
PBIH-4824G	38-63V	24V	1.1A
PBIH-4848G	38-63V	48V	0.5A
PBIH-11005G	85-140V	5V	5A

MODEL NUMBER	INPUT	OUTPUT	OUTPUT POWER
PBIH-11012G	85-140V	12V	2.1A
PBIH-11015G	85-140V	15V	1.7A
PBIH-11024G	85-140V	24V	1.1A
PBIH-11048G	85-140V	48V	0.5A
PBIH-1205J	9.2-16V	5V	8A
PBIH-1212J	9.2-16V	12V	3.3A
PBIH-1215J	9.2-16V	15V	2.7A
PBIH-1224J	9.2-16V	24V	1.7A
PBIH-1248J	9.2-16V	48V	0.8A
PBIH-2405J	19-32V	5V	10A
PBIH-2412J	19-32V	12V	4.3A
PBIH-2415J	19-32V	15V	3.4A
PBIH-2424J	19-32V	24V	2.5A
PBIH-2448J	19-32V	48V	1A
PBIH-4805J	38-63V	5V	10A
PBIH-4812J	38-63V	12V	4.3A
PBIH-4815J	38-63V	15V	3.4A
PBIH-4824J	38-63V	24V	2.5A
PBIH-4848J	38-63V	48V	1A
PBIH-11005J	85-140V	5V	10A
PBIH-11012J	85-140V	12V	4.3A
PBIH-11015J	85-140V	15V	3.4A
PBIH-11024J	85-140V	24V	2.5A
PBIH-11048J	85-140V	48V	1A
PBIH-1205M	9.2-16V	5V	18A
PBIH-1212M	9.2-16V	12V	9A
PBIH-1215M	9.2-16V	15V	7A
PBIH-1224M	9.2-16V	24V	4.5A
PBIH-1248M	9.2-16V	48V	2A
PBIH-2405M	19-32V	5V	20A
PBIH-2412M	19-32V	12V	9A
PBIH-2415M	19-32V	15V	7A

MODEL NUMBER	INPUT	OUTPUT	OUTPUT POWER
PBIH-2424M	19-32V	24V	5A
PBIH-2448M	19-32V	48V	2A
PBIH-4805M	38-63V	5V	20A
PBIH-4812M	38-63V	12V	9A
PBIH-4815M	38-63V	15V	7A
PBIH-4824M	38-63V	24V	5A
PBIH-4848M	38-63V	48V	2A
PBIH-11005M	85-140V	5V	20A
PBIH-11012M	85-140V	12V	9A
PBIH-11015M	85-140V	15V	7A
PBIH-11024M	85-140V	24V	5A
PBIH-11048M	85-140V	48V	2A
PBIH-1205R	9.2-16V	5V	27A
PBIH-1212R	9.2-16V	12V	13A
PBIH-1215R	9.2-16V	15V	10A
PBIH-1224R	9.2-16V	24V	6.5A
PBIH-1248R	9.2-16V	48V	3.3A
PBIH-2405R	19-32V	5V	30A
PBIH-2412R	19-32V	12V	14A
PBIH-2415R	19-32V	15V	11A
PBIH-2424R	19-32V	24V	7A
PBIH-2448R	19-32V	48V	3.5A
PBIH-4805R	38-63V	5V	30A
PBIH-4812R	38-63V	12V	14A
PBIH-4815R	38-63V	15V	11A
PBIH-4824R	38-63V	24V	7A
PBIH-4848R	38-63V	48V	3.5A
PBIH-11005R	85-140V	5V	30A
PBIH-11012R	85-140V	12V	14A
PBIH-11015R	85-140V	15V	11A
PBIH-11024R	85-140V	24V	7A
PBIH-11048R	85-140V	48V	3.5A

### PBIH-F



• Dimensions in mm

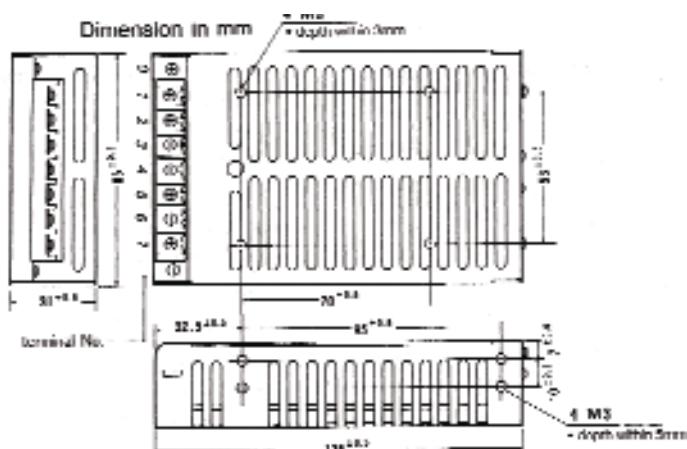
terminal No.	
1	0 V (DC in)
2	+V (DC in)
3	FG
4	NO Connection
5	-V out
6	+V out

## DC-DC CONVERTERS

## PBIH Series

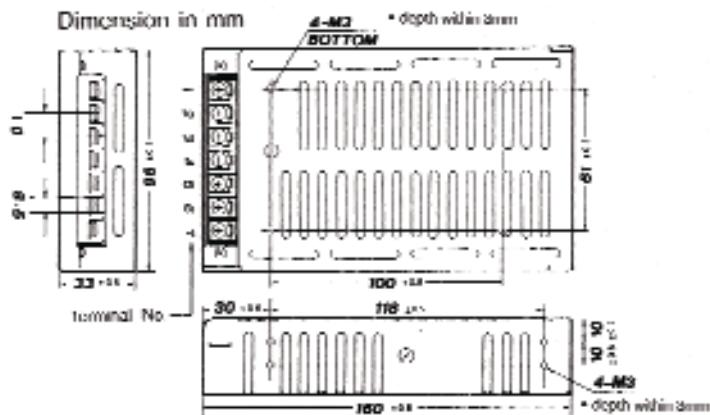
## 15-150 WATTS SINGLE OUTPUT

## PBIH-G



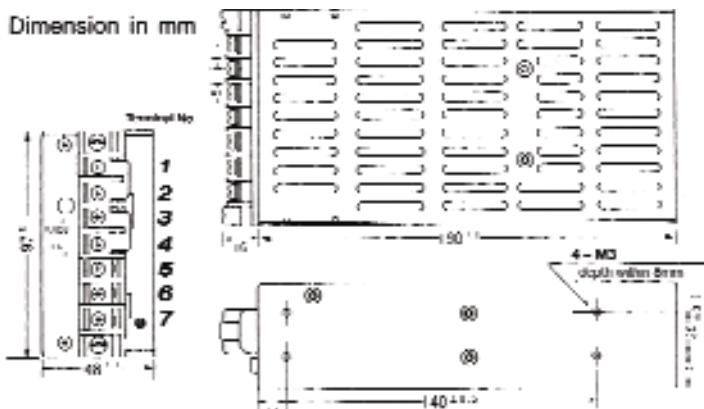
Terminal	Connection
0	FG
1	DC +V in
2	0V in
3	LFC
4	NO
5	NO
6	-V out
7	+V out

## PBIH-J



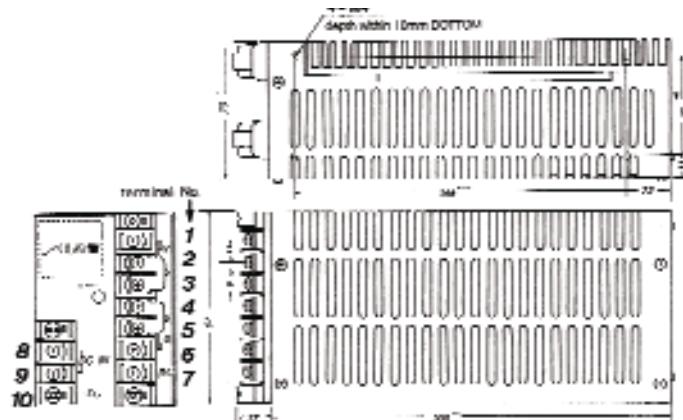
Terminal	Connection
1	FG
2	DC +V in
3	0V in
4	LFC
5	-V out
6	+V out
7	NC

## PBIH-M



Terminal	Connection
1	+V out
2	+V out
3	-V out
4	-V out
5	FG
6	-V in
7	+V in

## PBIH-R



Terminal	Connection
1, 2	+V out
3	+S
4	-S
5, 6	V out
7	Remote Control
8	DC +V in
9	DC 0V in
10	FG

# **TECHNICAL DATA SHEET**

**Equipment Type:** VSD

**Location:** Motor Starter Section

**Model Numbers:** FC202

**Manufacturer:** Danfoss

**Supplier:** **Queensland**  
Unit 26/67 Depot Street  
Banyo, QLD 4014  
Tel: +61 7 3292 3600  
Fax: +61 7 3266 4571



# Operating Instructions

## VLT® AQUA Drive FC 202 Low Harmonic Drive





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ContentsOperating Instructions

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# 1 Introduction

## 1.1 Purpose of the Manual

The purpose of this manual is to provide information for the installation and operation of a VLT® Low Harmonic Drive. The manual includes relevant safety information for installation and operation. *Chapter 1 Introduction* and *chapter 2 Safety* introduce the unit function and cover proper mechanical and electrical installation procedures. There are chapters on start-up and commissioning, applications and basic troubleshooting. *Chapter 8 Specifications* provides a quick reference for ratings and dimensions, as well as other operating specifications. This manual provides a basic knowledge of the unit and explains setup and basic operation.

VLT® is a registered trademark.

## 1.2 Additional Resources

Other resources are available to understand advanced functions and programming.

- The *VLT® AQUA Drive FC 202 Operating Instructions* provide details on installation and operation of the frequency converter.
- The *VLT® AQUA Drive FC 202 Programming Guide* provides greater detail on working with parameters and many application examples.
- The *VLT® AQUA Drive FC 202 Design Guide* provides detailed capabilities and functionality to design motor control systems.
- Supplemental publications and manuals are available from Danfoss.  
See [www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm](http://www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm) for listings.
- Optional equipment may change some of the procedures described. Reference the instructions supplied with those options for specific requirements. Contact the local Danfoss supplier or visit the Danfoss website: [www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm](http://www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm), for downloads or additional information.
- The *VLT® Active Filter AAF00x Operating Instructions* provide additional information about the filter portion of the Low Harmonic Drive.

## 1.3 Product Overview

### 1.3.1 Intended Use

A frequency converter (also called a drive) is an electronic motor controller that converts DC into a variable AC waveform output. The frequency and voltage of the output are regulated to control the motor speed or torque. The frequency converter can vary the speed of the motor in response to system feedback, such as with position sensors on a conveyor belt. The frequency converter can also regulate the motor by responding to remote commands from external controllers.

The frequency converter

- monitors the system and motor status
- issues warnings or alarms for fault conditions
- starts and stops the motor
- optimises energy efficiency

Operation and monitoring functions are available as status indications to an outside control system or serial communication network.

A Low Harmonic Drive (LHD) is a single unit that combines the frequency converter with an advanced active filter (AAF) for harmonic mitigation. The frequency converter and filter are 2 separate pieces packaged together in an integrated system, but each functions independently. In this manual, there are separate specifications for the frequency converter and the filter. Since the frequency converter and filter are together in the same enclosure, the unit is transported, installed, and operated as a single entity.

### 1.3.2 Working Principle

The VLT Low Harmonic Drive is a high-power frequency converter with an integrated active filter. An active filter is a device that actively monitors harmonic distortion levels and injects compensative harmonic current onto the line to cancel the harmonics.

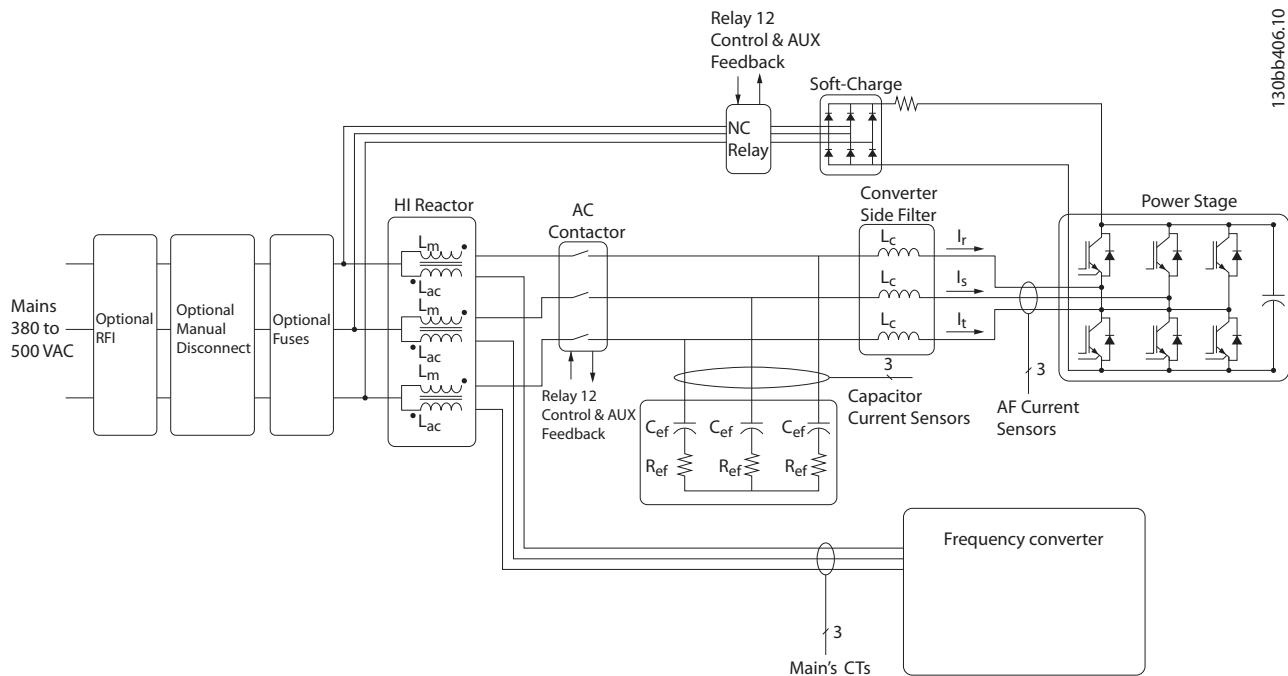


Illustration 1.1 Basic Layout for the Low Harmonic Drive

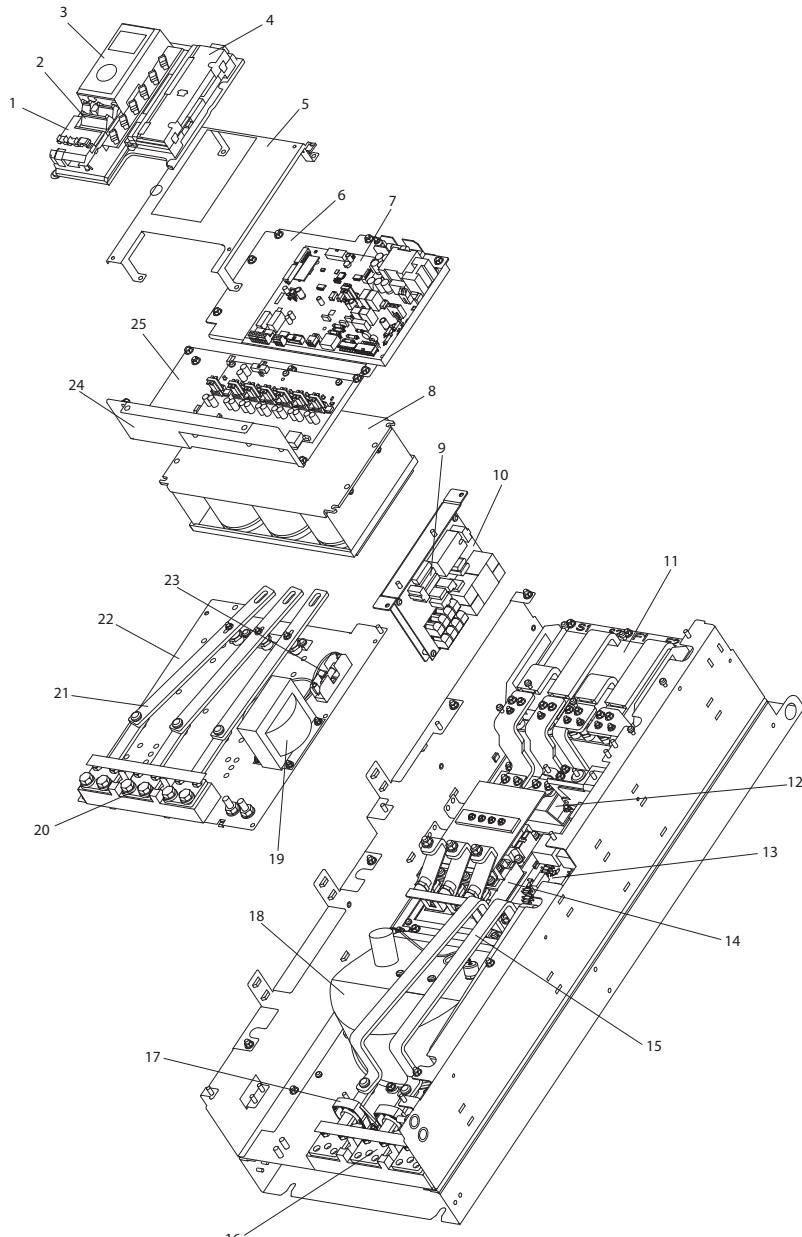
Low Harmonic Drives are designed to draw an ideal sinusoidal current waveform from the supply grid with a power factor of 1. Where traditional non-linear load draws pulse-shaped currents, the Low Harmonic Drive compensates that via the parallel filter path, lowering the stress on the supply grid. The Low Harmonic Drive meets the highest harmonic standards with a THID less than 5% at full load for <3% pre-distortion on a 3% unbalanced 3-phase grid.

## Introduction

## Operating Instructions

## 1

## 1.3.3 Exploded View Drawings



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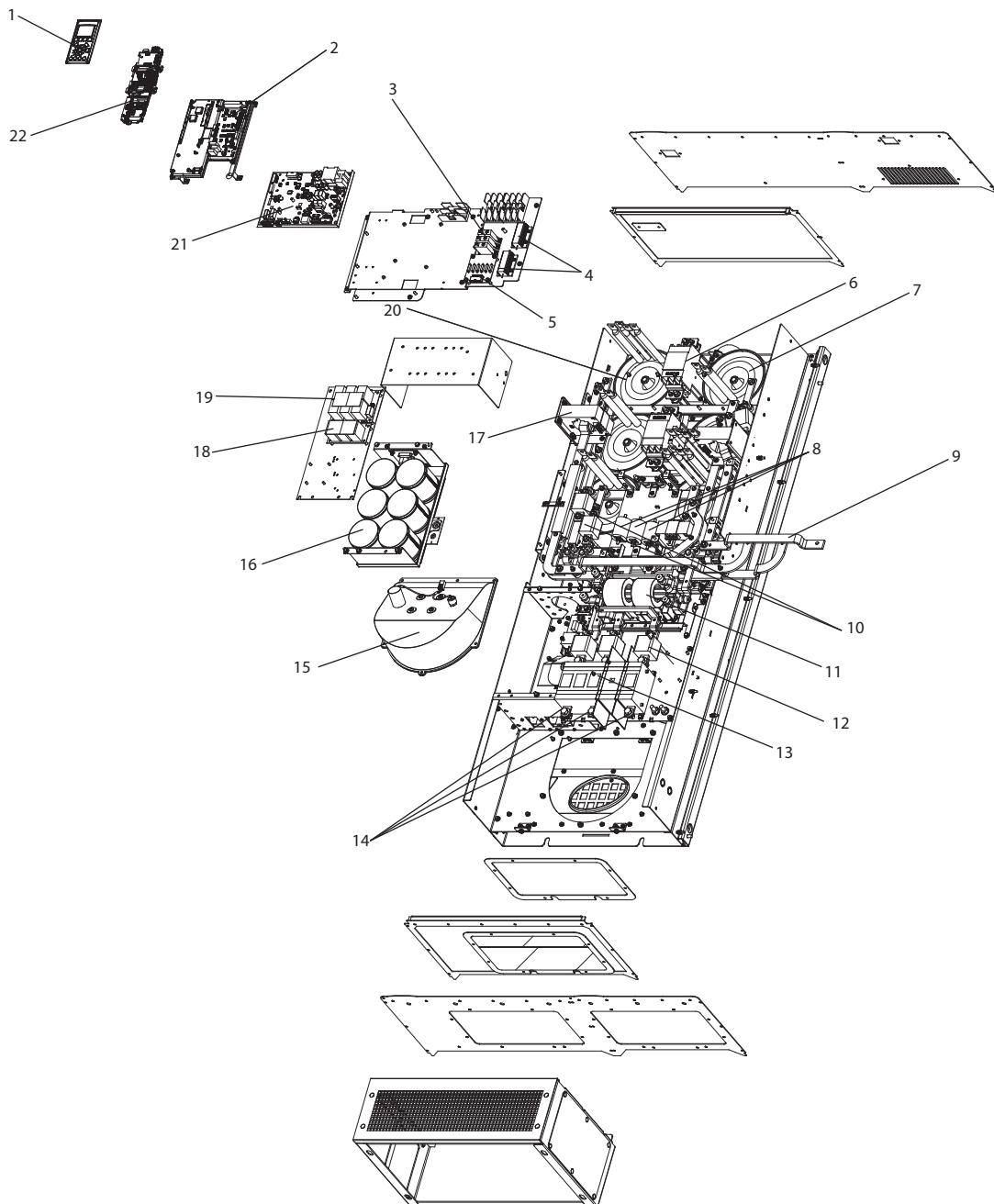
1	Control card	14	SCR/diode module
2	Control input terminals	15	IGBT output bus bar
3	Local control panel (LCP)	16	Output motor terminals
4	Control card C option	17	Current sensor
5	Mounting bracket	18	Fan assembly
6	Power card mounting plate	19	Fan transformer
7	Power card	20	AC input terminals
8	Capacitor bank assembly	21	AC input bus bar
9	Soft charge fuses	22	Input terminal mounting plate assembly
10	Soft charge card	23	Fan fuse
11	DC inductor	24	Capacitor bank cover plate
12	Soft charge module	25	IGBT gate drive card
13	IGBT module		

Illustration 1.2 Frame Size D13 Drive Enclosure

## Introduction

## Operating Instructions

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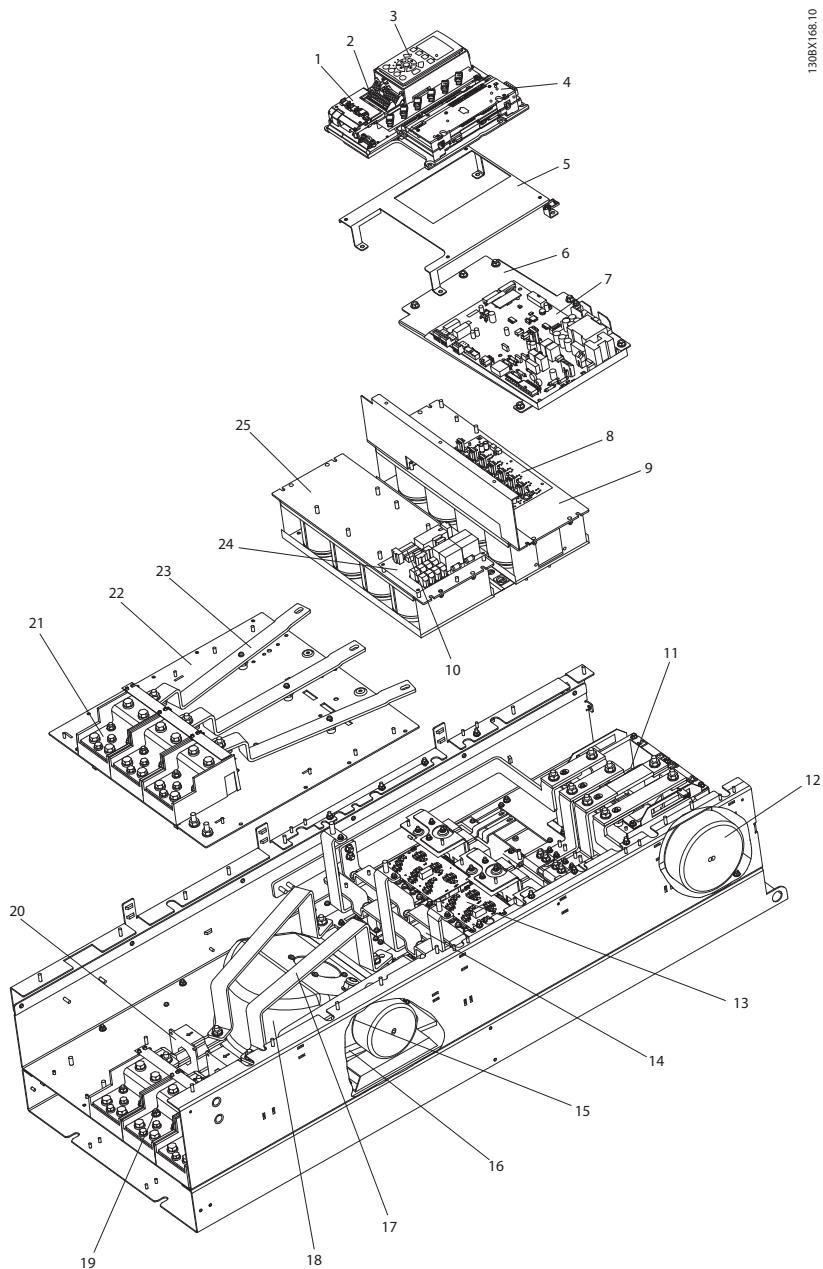
1	Local control panel (LCP)	13	Mains fuses
2	Active filter card (AFC)	14	Mains disconnect
3	Metal oxide varistor (MOV)	15	Mains terminals
4	Soft charge resistors	16	Heat sink fan
5	AC capacitors discharge board	17	DC capacitor bank
6	Mains contactor	18	Current transformer
7	LC inductor	19	RFI differential mode filter
8	AC capacitors	20	RFI common mode filter
9	Mains bus bars to drive input	21	HI inductor
10	IGBT fuses	22	Power card
11	RFI		
12			

Illustration 1.3 Frame Size D13 Filter Enclosure

## Introduction

## Operating Instructions

1



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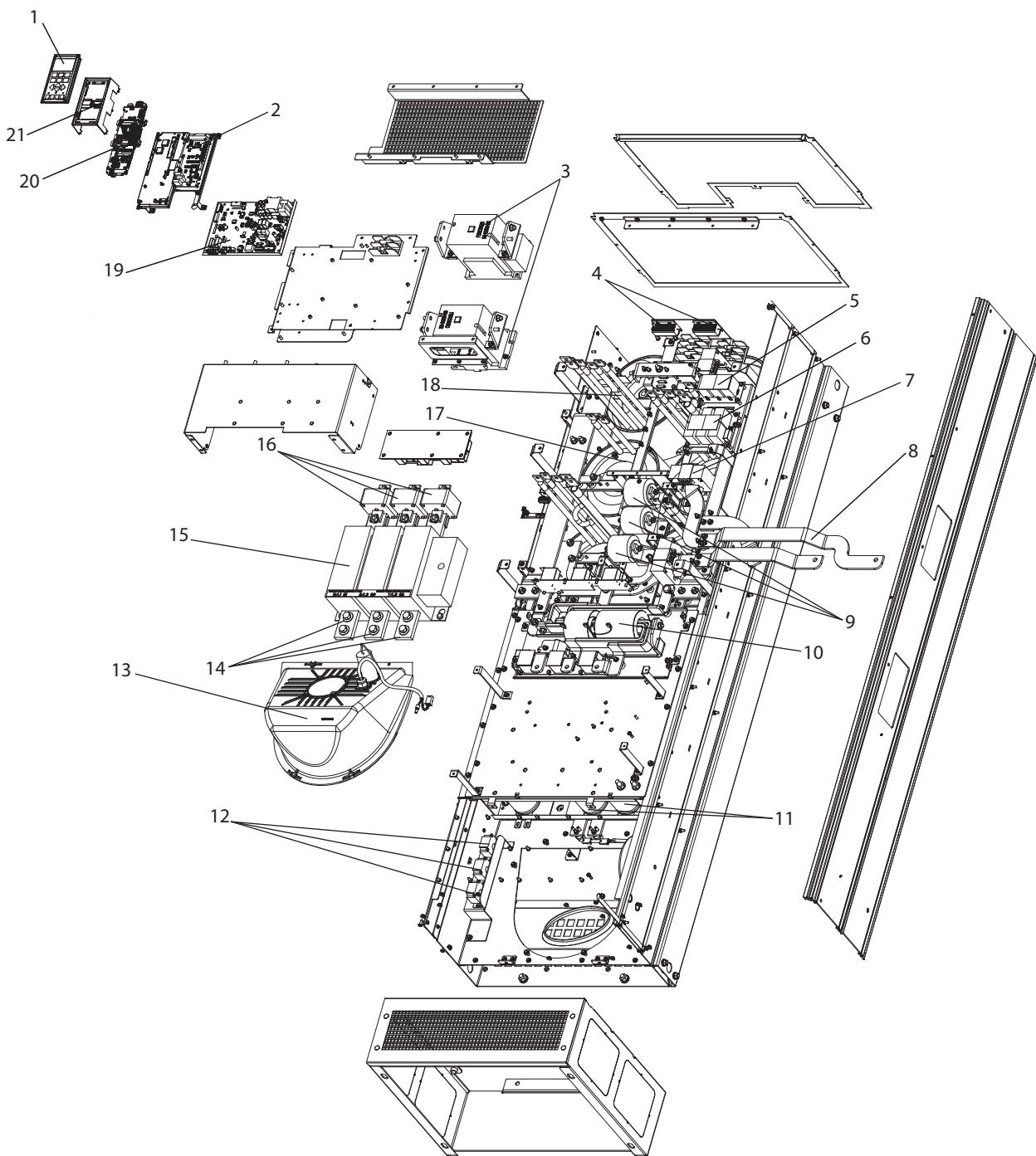
1	Control card	14	SCR and diode
2	Control input terminals	15	Fan inductor (not on all units)
3	Local control panel (LCP)	16	Soft charge resistor assembly
4	Control card C option	17	IGBT output bus bar
5	Mounting bracket	18	Fan assembly
6	Power card mounting plate	19	Output motor terminals
7	Power card	20	Current sensor
8	IGBT gate drive card	21	Main AC power input terminals
9	Upper capacitor bank assembly	22	Input terminal mounting plate
10	Soft charge fuses	23	AC input bus bar
11	DC inductor	24	Soft charge card
12	Fan transformer	25	Lower capacitor bank assembly
13	IGBT module		

Illustration 1.4 Frame Size E9 Drive Enclosure

## Introduction

## Operating Instructions

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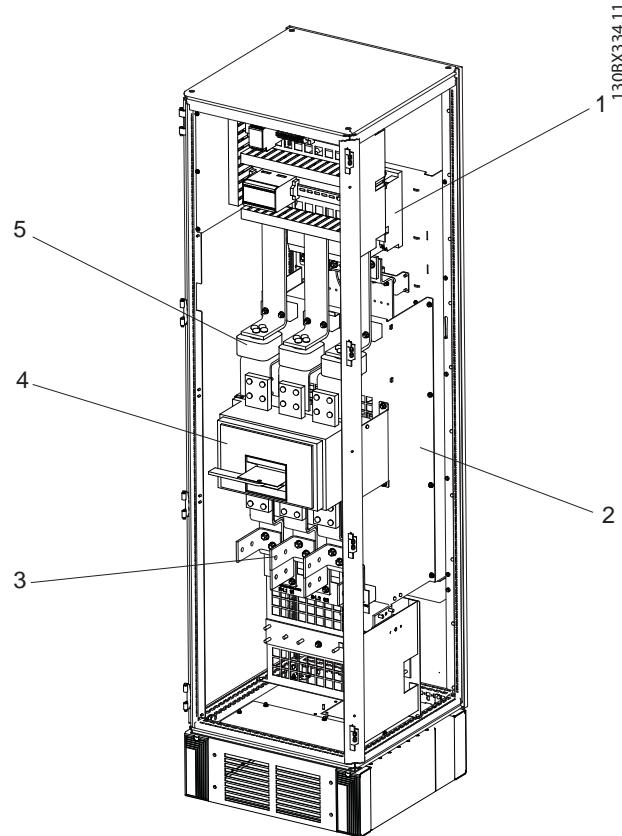
1	Local control panel (LCP)	12	AC capacitor current transducers
2	Active filter card (AFC)	13	Heat sink fan
3	Mains contactors	14	Mains terminals
4	Soft charge resistors	15	Mains disconnect
5	RFI differential mode filter	16	Mains fuses
6	RFI common mode filter	17	LC inductor
7	Current transformer (CT)	18	HI inductor
8	Mains bus bars to drive output	19	Power card
9	AC capacitors	20	Control card
10	RFI	21	LCP cradle
11	Lower DC capacitor bank		

Illustration 1.5 Frame Size E9 Filter Enclosure

## Introduction

## Operating Instructions

1



1	Contactor	4	Circuit breaker or disconnect (if purchased)
2	RFI filter	5	AC mains/line fuses (if purchased)
3	Mains AC power input terminals		

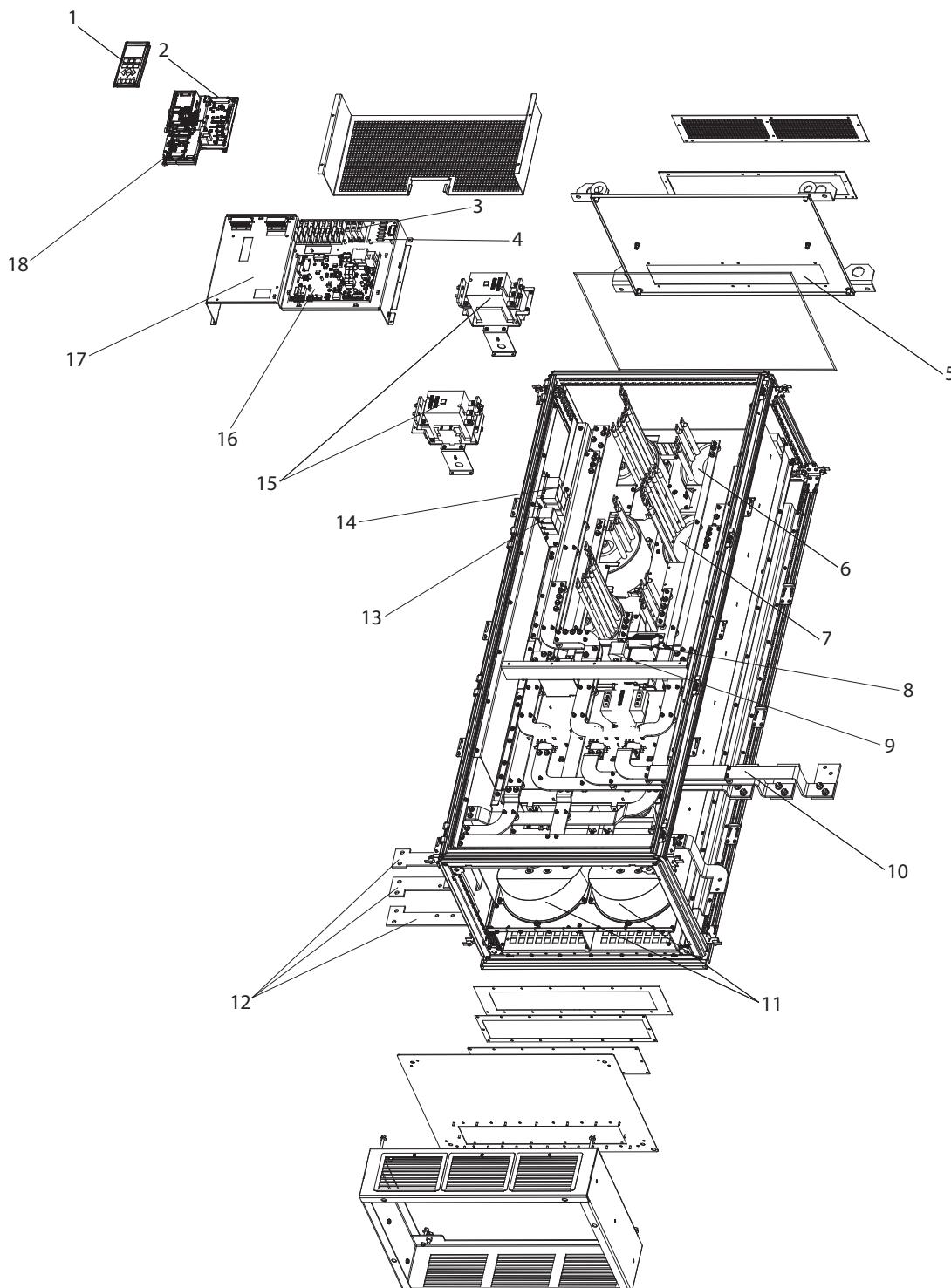
Illustration 1.6 Frame Size F18 Options Cabinet\*

\*The options cabinet is not optional for the LHD. The ancillary equipment is stored in the cabinet.

## Introduction

## Operating Instructions

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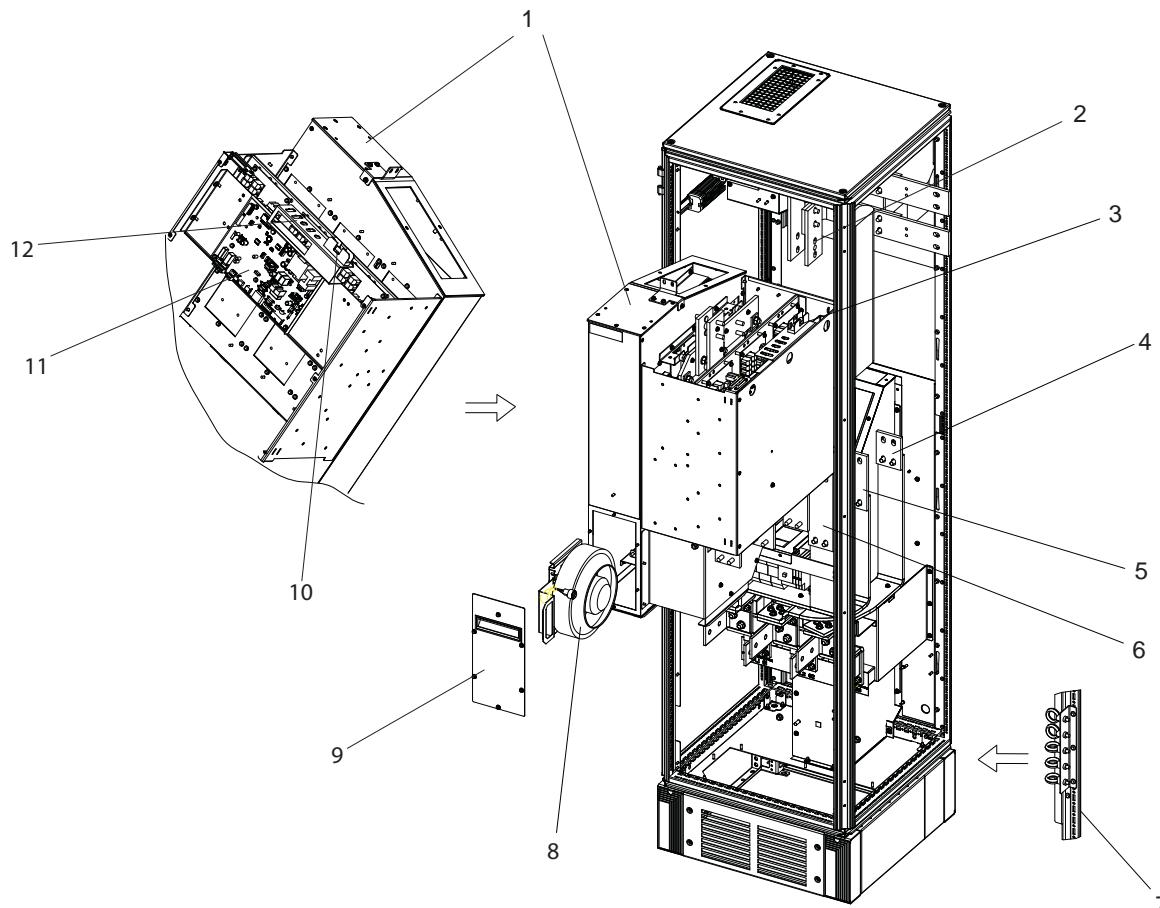
1	Local control panel (LCP)	10	Mains bus bars to drive input
2	Active filter card (AFC)	11	Heat sink fans
3	Soft charge resistors	12	Mains terminals (R/L1, S/L2, T/L3) from options cabinet
4	Metal oxide varistor (MOV)	13	RFI differential mode filter
5	AC capacitors discharge board	14	RFI common mode filter
6	LC inductor	15	Mains contactor
7	HI inductor	16	Power card
8	Mixing fan	17	Control card
9	IGBT fuses	18	LCP cradle

Illustration 1.7 Frame Size F18 Filter Cabinet

## Introduction

## Operating Instructions

1



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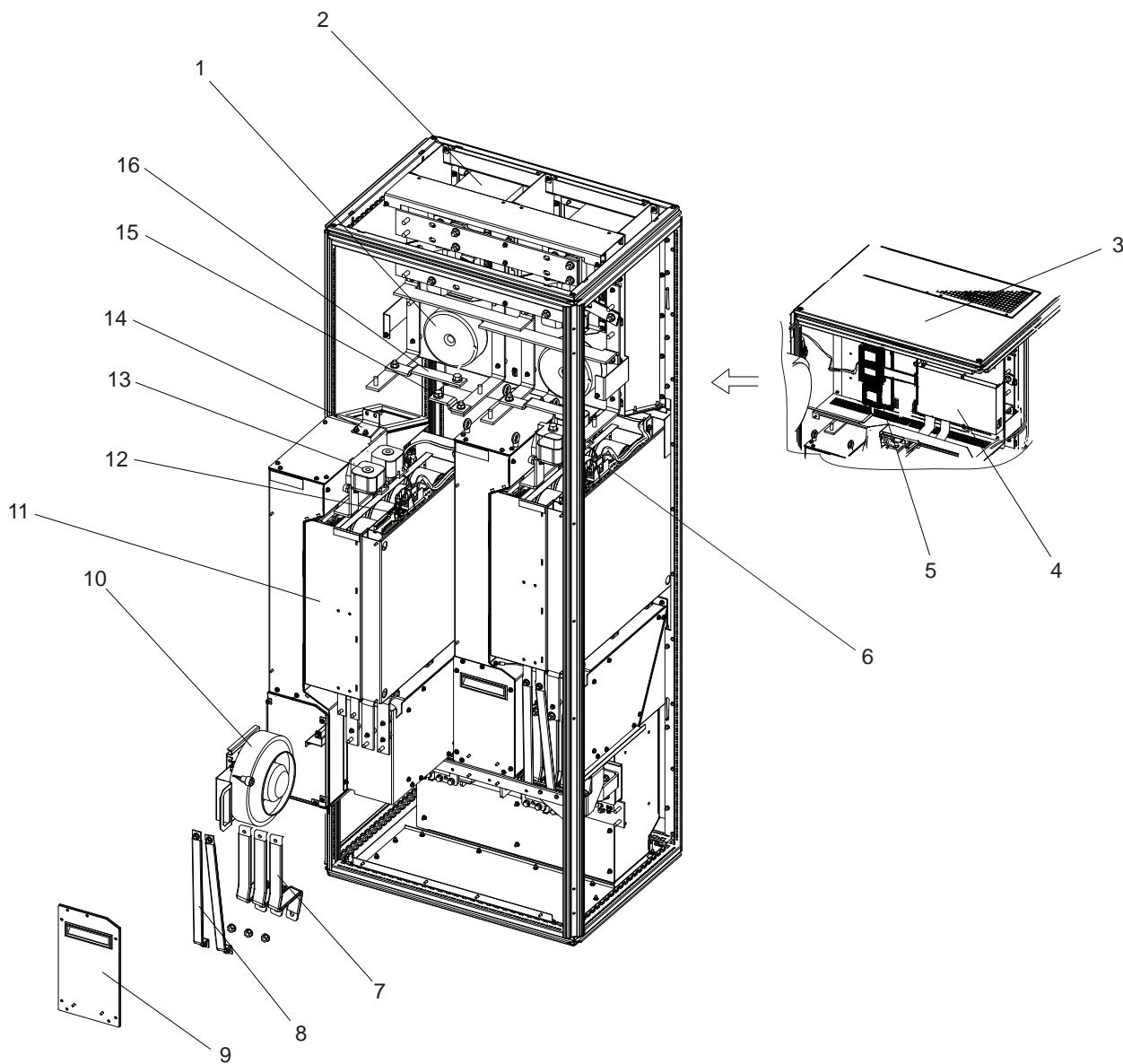
1	Rectifier module	7	Module lifting eye bolts (mounted on a vertical strut)
2	DC bus bar	8	Module heat sink fan
3	SMPS fuse	9	Fan door cover
4	(Optional) back AC fuse mounting bracket	10	SMPS fuse
5	(Optional) middle AC fuse mounting bracket	11	Power card
6	(Optional) front AC fuse mounting bracket	12	Panel connectors

Illustration 1.8 Frame Size F18 Rectifier Cabinet

## Introduction

## Operating Instructions

130BX330.10



1	Fan transformer	9	Fan door cover
2	DC link inductor	10	Module heat sink fan
3	Top cover plate	11	Inverter module
4	MDCIC board	12	Panel connectors
5	Control card	13	DC fuse
6	SMPS fuse and fan fuse	14	Mounting bracket
7	Motor output bus bar	15	(+) DC bus bar
8	Brake output bus bar	16	(-) DC bus bar

Illustration 1.9 Frame Size F18 Inverter Cabinet

## 1.4 Enclosure Types and Power Ratings

Frame size		D13	E9	F18
Enclosure protection	IP	21/54	21/54*	21/54
	NEMA	Type 1/Type 12	Type 1/Type 12	Type 1/Type 12
High overload rated power - 160% overload torque		160-250 kW at 400 V (380-480 V)	315-450 kW at 400 V (380-480 V)	500-710 kW at 400 V (380-480 V)
Drive dimensions [mm/inch]	Height	1780.570.1	2000.7/78.77	2278.4/89.70
	Width	1021.9 mm/40.23	1200/47.24	2792/109.92
	Depth	377.8/14.87	493.5/19.43	605.8/23.85
Drive dimensions [kg/lbs]	Max Weight	390/860	676/1490	1900/4189
	Shipping Weight	454/1001	840/1851	2345/5171

Table 1.1 Mechanical Dimensions and Rated Power, D, E and F Frames

## 1.5 Approvals and Certifications

### 1.5.1 Approvals



Table 1.2 Compliance Marks: CE, UL, and C-Tick

### 1.5.2 Compliance with ADN

For compliance with the European Agreement concerning International Carriage of Dangerous Goods by Inland Waterways (ADN), refer to *ADN-compliant Installation* in the *Design Guide*.

## 2 Safety

### 2.1 Safety Symbols

The following symbols are used in this document:

#### **WARNING**

Indicates a potentially hazardous situation which could result in death or serious injury.

#### **CAUTION**

Indicates a potentially hazardous situation which could result in minor or moderate injury. It may also be used to alert against unsafe practices.

#### **NOTICE**

Indicates important information, including situations that may result in damage to equipment or property.

### 2.2 Qualified Personnel

Correct and reliable transport, storage, installation, operation and maintenance are required for the safe operation of the frequency converter. Only qualified personnel are allowed to install or operate this equipment.

Qualified personnel is defined as trained staff, who are authorised to install, commission, and maintain equipment, systems and circuits in accordance with pertinent laws and regulations. Additionally, qualified personnel are familiar with the instructions and safety measures described in this document.

### 2.3 Safety Precautions

#### **WARNING**

##### HIGH VOLTAGE

Frequency converters contain high voltage when connected to AC mains input power. Qualified personnel only should perform installation, start up, and maintenance. Failure to perform installation, start up, and maintenance by qualified personnel could result in death or serious injury.

#### **WARNING**

##### UNINTENDED START

When the frequency converter is connected to AC mains, the motor may start at any time. The frequency converter, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the frequency converter is connected to AC mains could result in death, serious injury, equipment, or property damage.

#### **WARNING**

##### DISCHARGE TIME

Frequency converters contain DC-link capacitors that can remain charged even when the frequency converter is not powered. To avoid electrical hazards, disconnect AC mains, any permanent magnet type motors, and any remote DC-link power supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters. Wait for the capacitors to fully discharge before performing any service or repair work. The amount of wait time is listed in the *Discharge Time* table. Failure to wait the specified time after power has been removed before doing service or repair could result in death or serious injury.

Voltage [V]	Power range [kW]	Minimum waiting time (minutes)
380-500	132-250 kW*	20
	315-630 kW	40

Table 2.1 Discharge Times

\*Power ranges are for normal overload operation.

## 3 Mechanical Installation

### 3.1 Equipment Pre-Installation Checklist

- Before unpacking the frequency converter, examine the packaging for signs of damage. If the unit is damaged, refuse delivery and immediately contact the shipping company to claim the damage.
- Before unpacking the frequency converter, locate it as close as possible to the final installation site
- Compare the model number on the nameplate to what was ordered to verify the proper equipment
- Ensure each of the following are rated for the same voltage:
  - Mains (power)
  - Frequency converter
  - Motor
- Ensure the output current rating is equal to or greater than the motor full load current for peak motor performance.
  - Motor size and frequency converter power must match for proper overload protection.
  - If frequency converter rating is less than that of the motor, full motor output is impossible.

### 3.2 Unpacking

#### 3.2.1 Items Supplied

Items supplied may vary according to product configuration.

- Make sure the items supplied and the information on the nameplate correspond to the order confirmation.
- Check the packaging and the frequency converter visually for damage caused by inappropriate handling during shipment. File any claim for damage with the carrier. Retain damaged parts for clarification.

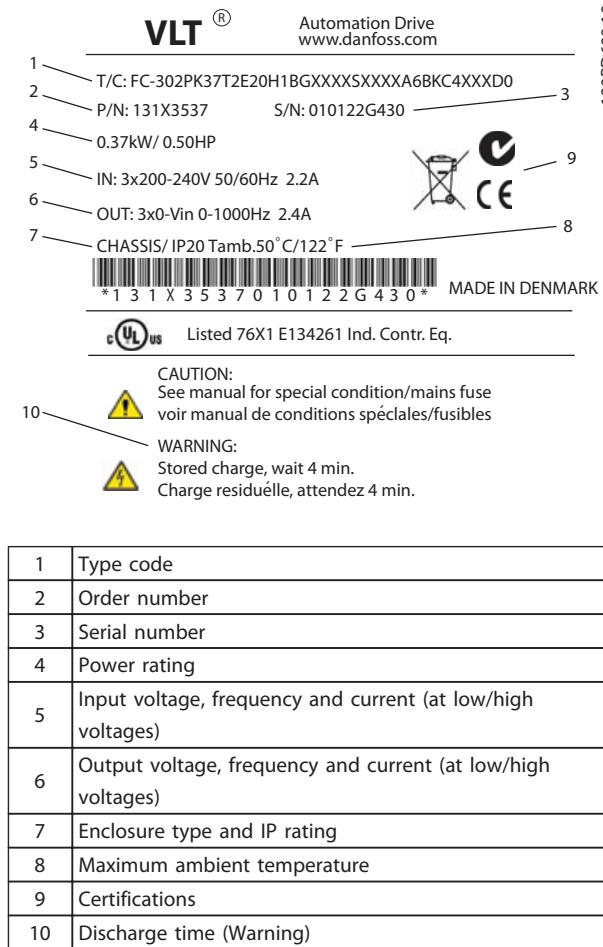


Illustration 3.1 Product Nameplate (Example)

#### **NOTICE**

**Do not remove the nameplate from the frequency converter (loss of warranty).**

### 3.3 Installation Environment

#### 3.3.1 Planning the Installation Site

Select the best possible operation site by considering the following (see details on the following pages, and in the *Design Guide*):

- Ambient operating temperature
- Installation method
- Cooling
- Position of the unit
- Cable routing
- Voltage and current supply from power source
- Current rating within range
- Fuse ratings if not using built-in fuses

### 3.4 Mounting

#### 3.4.1 Cooling and Airflow

##### Cooling

Cooling can be obtained in different ways, by using the cooling ducts in the bottom and the top of the unit, by taking air in and out the back of the unit or by combining the cooling possibilities.

##### Back cooling

The backchannel air can also be ventilated in and out the back of a Rittal TS8 enclosure for frame size F18 LHD. This offers a solution where the backchannel could take air from outside the facility and return the heat losses outside the facility thus reducing air-conditioning requirements.

##### **NOTICE**

A door fan(s) is required on the enclosure to remove the heat losses not contained in the backchannel of the drive and any additional losses generated from other components installed inside the enclosure. The total required air flow must be calculated so that the appropriate fans can be selected. Some enclosure manufacturers offer software for performing the calculations (i.e. Rittal Therm software).

##### Airflow

The necessary airflow over the heat sink must be secured. The flow rate is shown in *Table 3.1*.

Enclosure protection	Frame size	Door fan/top fan airflow Total airflow of multiple fans	Heat sink fan Total airflow for multiple fans
IP21/NEMA 1 IP54/NEMA 12	D13 (LHD120)	3 door fans, 510 m <sup>3</sup> /h (300 cfm) (2+1, 3x170=510)	2 heat sink fans, 1530 m <sup>3</sup> /h (900 cfm) (1+1, 2x765=1530)
	E9 P315-P400 (LHD210)	4 door fans, 680 m <sup>3</sup> /h (400 cfm) (2+2, 4x170=680)	2 heat sink fans, 2675 m <sup>3</sup> /h (1574 cfm) (1+1, 1230+1445=2675)
	F18 (LHD330)	6 door fans, 3150 m <sup>3</sup> /h (1854 cfm) (6x525=3150)	5 heat sink fans, 4485 m <sup>3</sup> /h (2639 cfm) 2+1+2, ((2x765)+(3x985)=4485)

Table 3.1 Heat Sink Air Flow

**Mechanical Installation****Operating Instructions****3*****NOTICE***

For the drive section, the fan runs for the following reasons:

- AMA
- DC Hold
- Pre-Mag
- DC Brake
- 60% of nominal current is exceeded
- Specific heat sink temperature exceeded (power size dependent)
- Specific power card ambient temperature exceeded (power size dependent)
- Specific control card ambient temperature exceeded

Once the fan is started, it runs for minimum 10 minutes.

***NOTICE***

For the active filter, the fan runs for the following reasons:

- Active filter running
- Active filter not running, but mains current exceeding limit (power size dependent)
- Specific heat sink temperature exceeded (power size dependent)
- Specific power card ambient temperature exceeded (power size dependent)
- Specific control card ambient temperature exceeded

Once the fan is started, it runs for minimum 10 minutes.

**External ducts**

If additional duct work is added externally to the Rittal cabinet, the pressure drop in the ducting must be calculated. Use the charts below to derate the frequency converter according to the pressure drop.

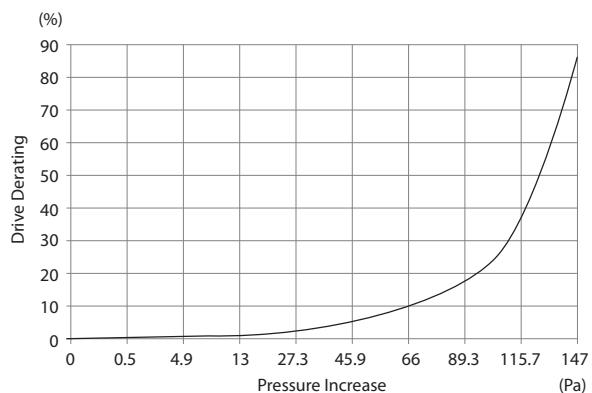


Illustration 3.2 D-Frame Derating vs. Pressure Change

Drive Air Flow: 450 cfm (765 m<sup>3</sup>/h)

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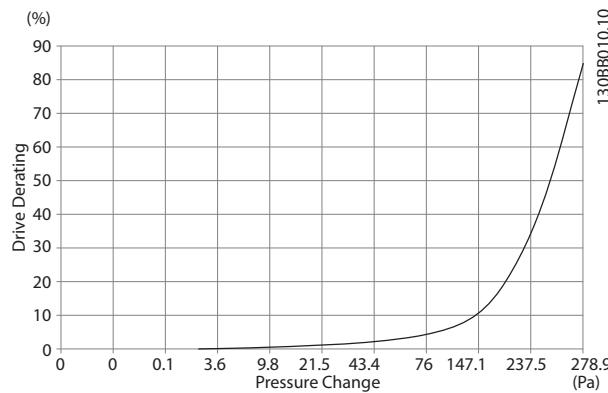


Illustration 3.3 E-Frame Derating vs. Pressure Change (Small Fan), P315

Drive Air Flow: 650 cfm (1105 m<sup>3</sup>/h)

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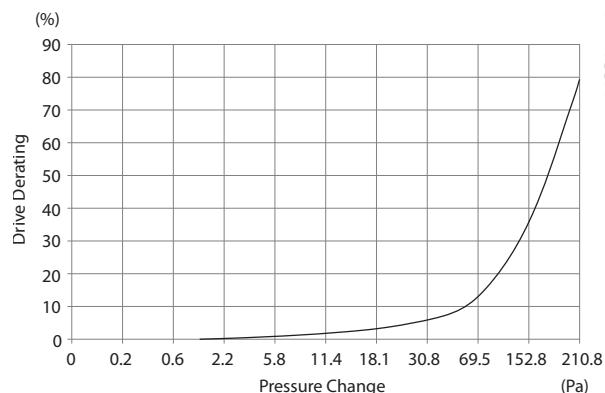
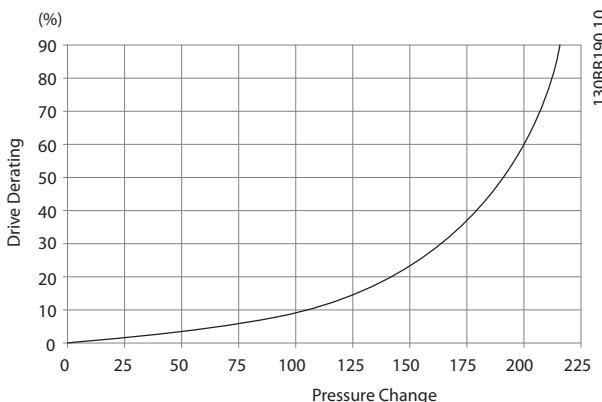


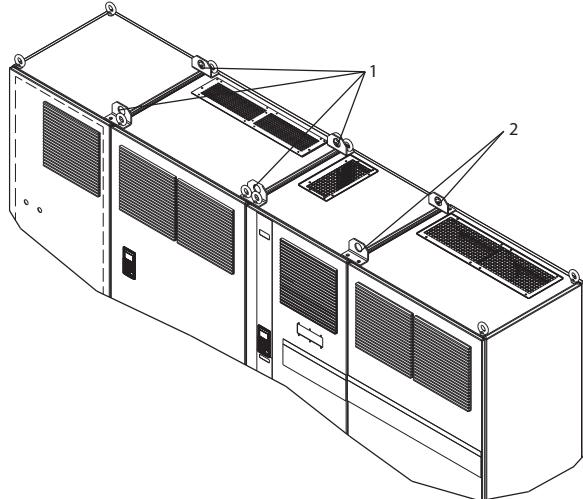
Illustration 3.4 E-Frame Derating vs. Pressure Change (Large Fan) P355-P450

Drive Air Flow: 850 cfm (1445 m<sup>3</sup>/h)

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**Mechanical Installation****Operating Instructions****Illustration 3.5 F-Frame Derating vs. Pressure Change**

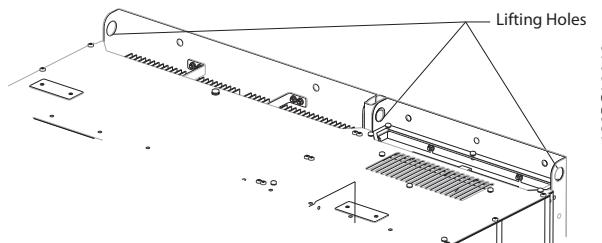
Drive Air Flow: 580 cfm (985 m³/h)



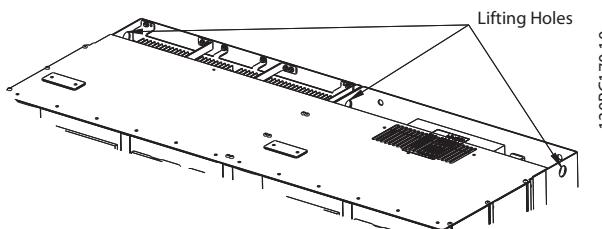
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**3****3.4.2 Lifting**

Lift the frequency converter using the dedicated lifting eyes. For all D-frames, use a bar to avoid bending the lifting holes of the frequency converter.



130BC166.10

**Illustration 3.6 Recommended Lifting Method, Frame Size D13**

130BC170.10

**Illustration 3.7 Recommended Lifting Method, Frame Size E9**

1 Lifting holes for the filter

2 Lifting holes for the frequency converter

**Illustration 3.8 Recommended Lifting Method, Frame Size F18****NOTICE**

A spreader bar is also an acceptable way to lift the F-frame.

**NOTICE**

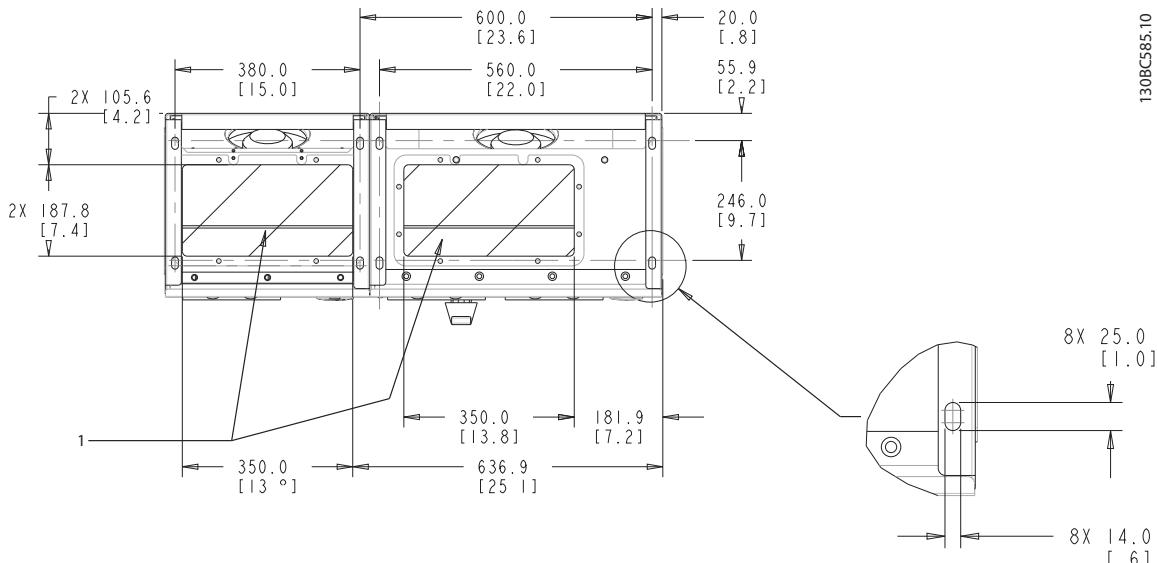
The F18 pedestal is packaged separately and included in the shipment. Mount the frequency converter on the pedestal in its final location. The pedestal allows proper airflow and cooling.

**WARNING**

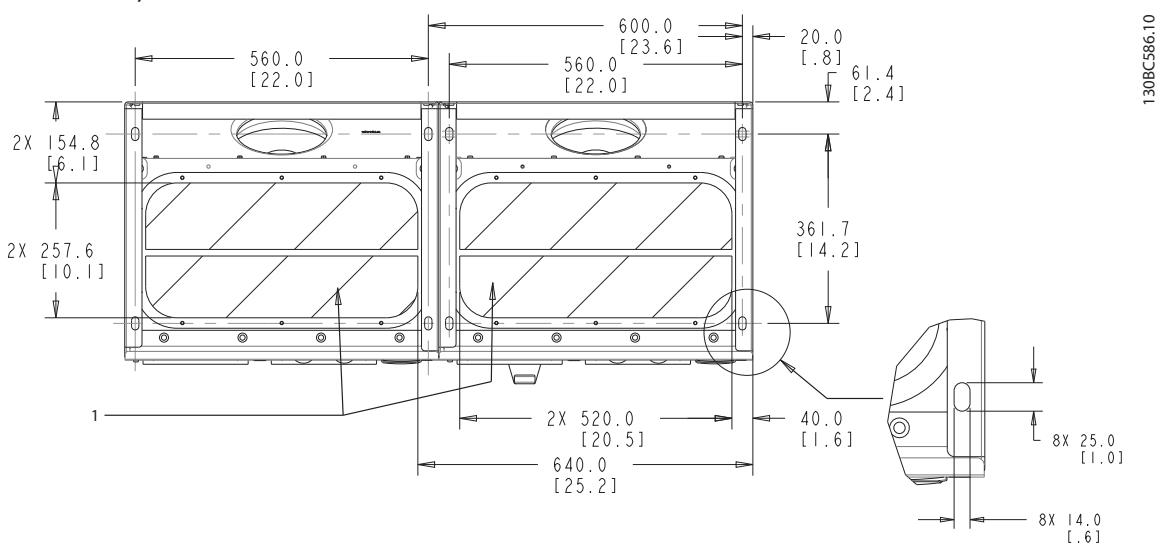
The lifting bar must be able to handle the weight of the frequency converter. See *chapter 8.2 Mechanical Dimensions* for the weight of the different frame sizes. Maximum diameter for bar is 2.5 cm (1 inch). The angle from the top of the frequency converter to the lifting cable should be 60° or greater.

**Mechanical Installation****Operating Instructions****3****3.4.3 Cable Entry and Anchoring**

Cables enter the unit through gland plate openings in the bottom. The illustrations in this section show gland entry locations and detailed views of anchoring hole dimensions.

**Bottom View, D13**

1	Cable entry locations
---	-----------------------

**Illustration 3.9 Cable Entry Diagram, D13****Bottom View, E9**

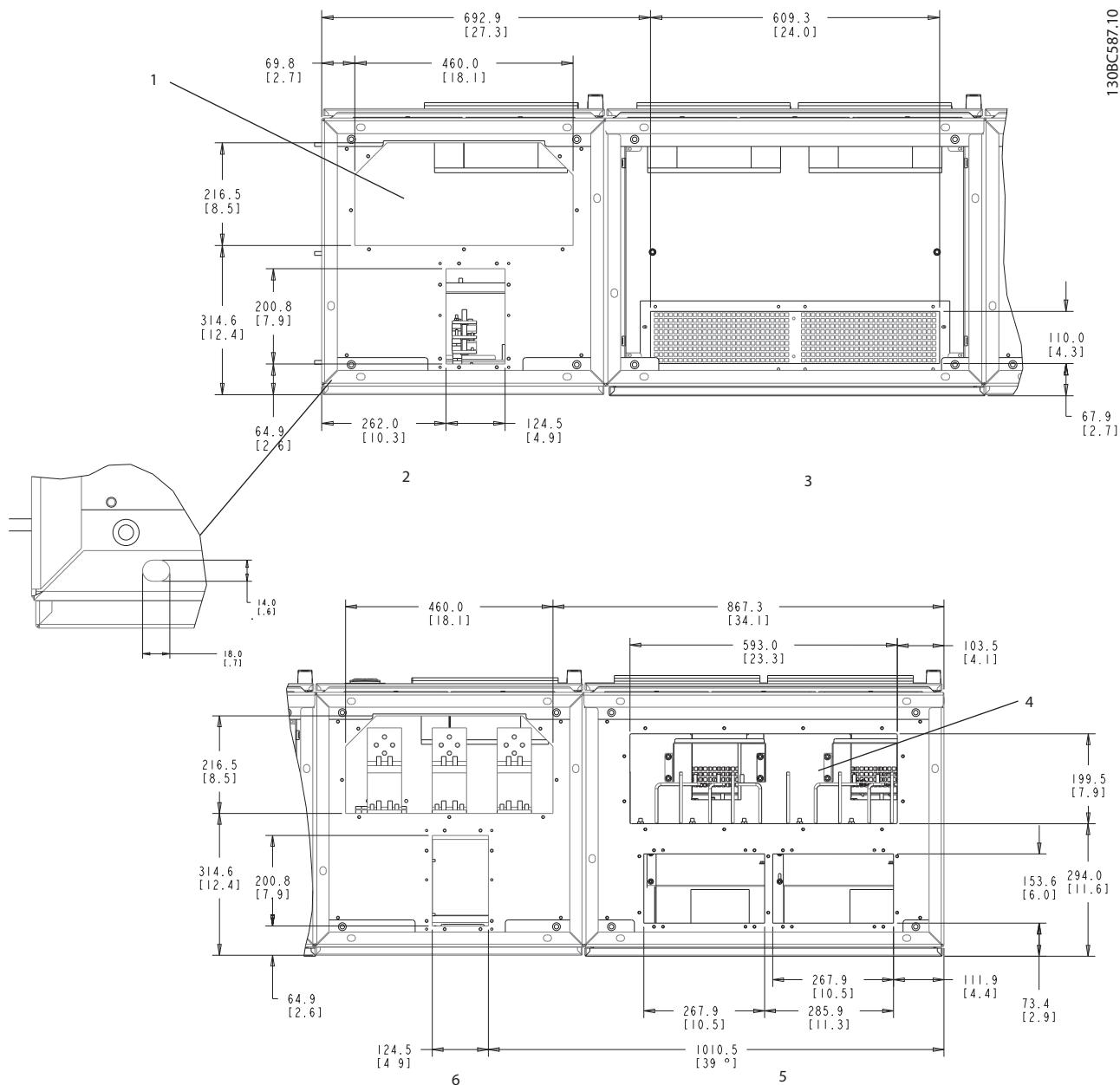
1	Cable entry locations
---	-----------------------

**Illustration 3.10 Cable Entry Diagram, E9**

## Mechanical Installation

## Operating Instructions

## Bottom View, F18



3

1	Mains cable entry	4	Motor cable entry
2	Option enclosure	5	Inverter enclosure
3	Filter enclosure	6	Rectifier enclosure

Illustration 3.11 Cable Entry Diagram, F18

## Mechanical Installation

## Operating Instructions

## 3.4.4 Terminal Locations for Frame Size D13

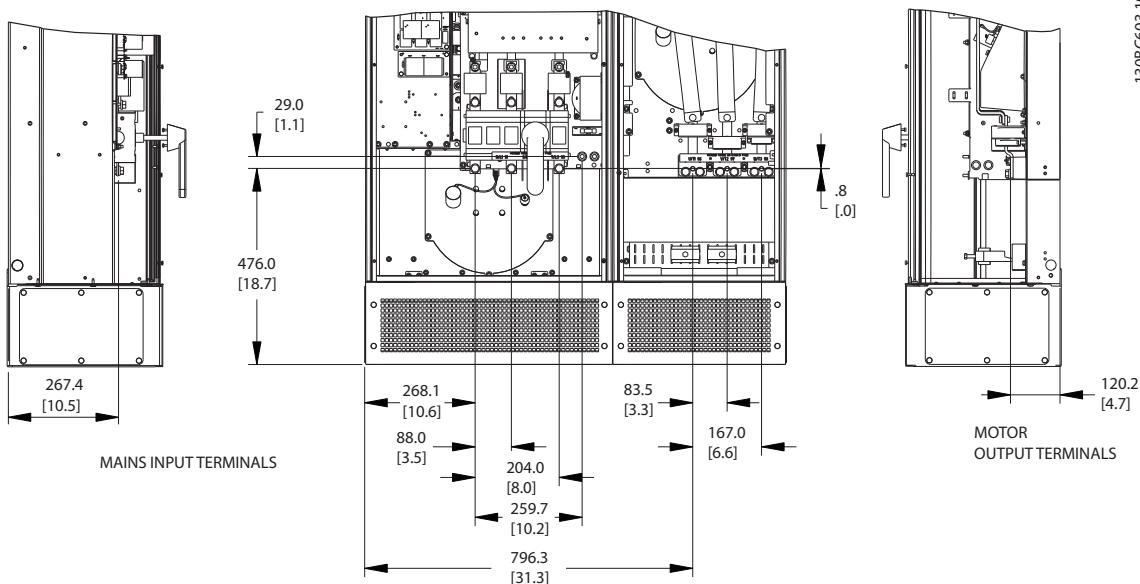


Illustration 3.12 Frame Size D13 Terminal Locations

Allow for bend radius of heavy power cables.

**NOTICE**

All D-frames are available with standard input terminals, fuse, or disconnect switch.

## 3.4.5 Terminal Locations for Frame Size E9

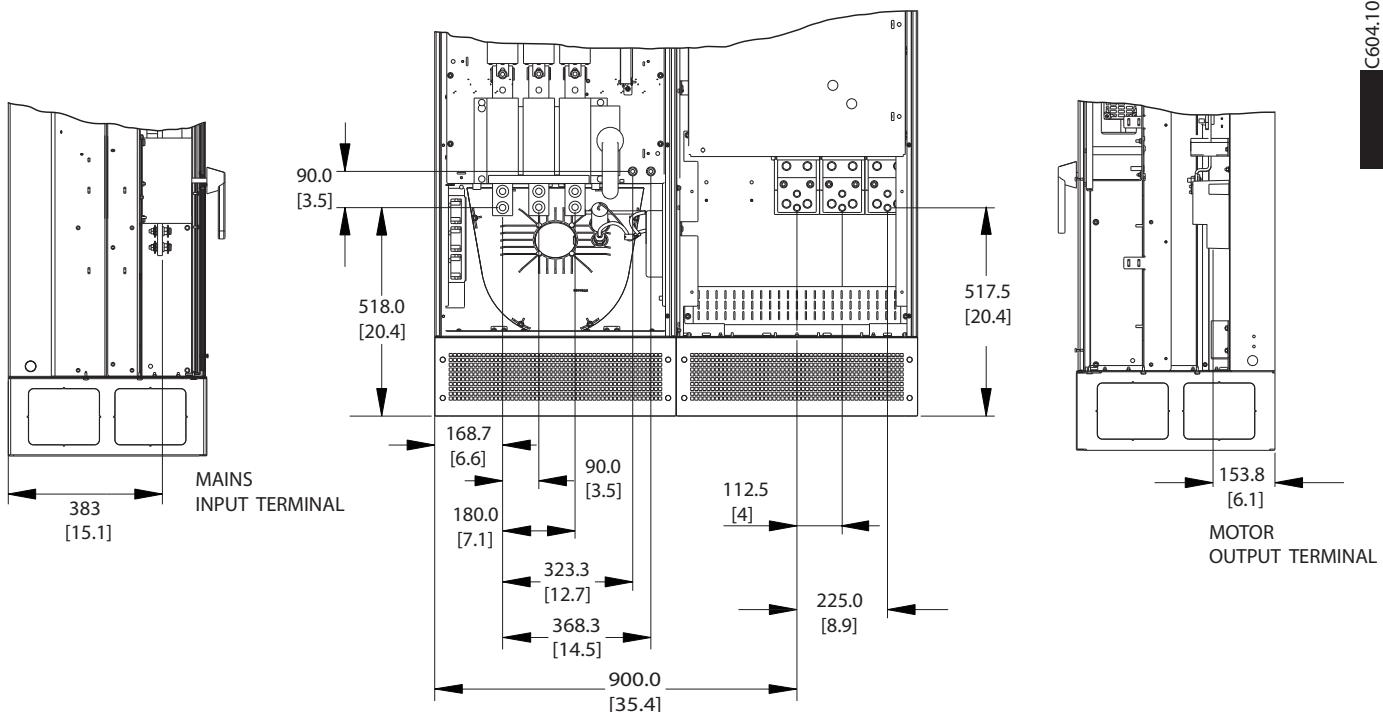


Illustration 3.13 Frame Size E9 Terminal Locations

Allow for bend radius of heavy power cables.

**NOTICE**

All E-frames are available with standard input terminals, fuse, or disconnect switch.

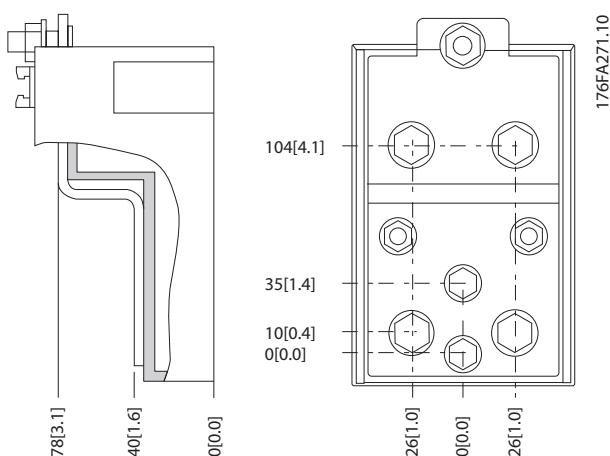


Illustration 3.14 Close-up Terminal Diagrams

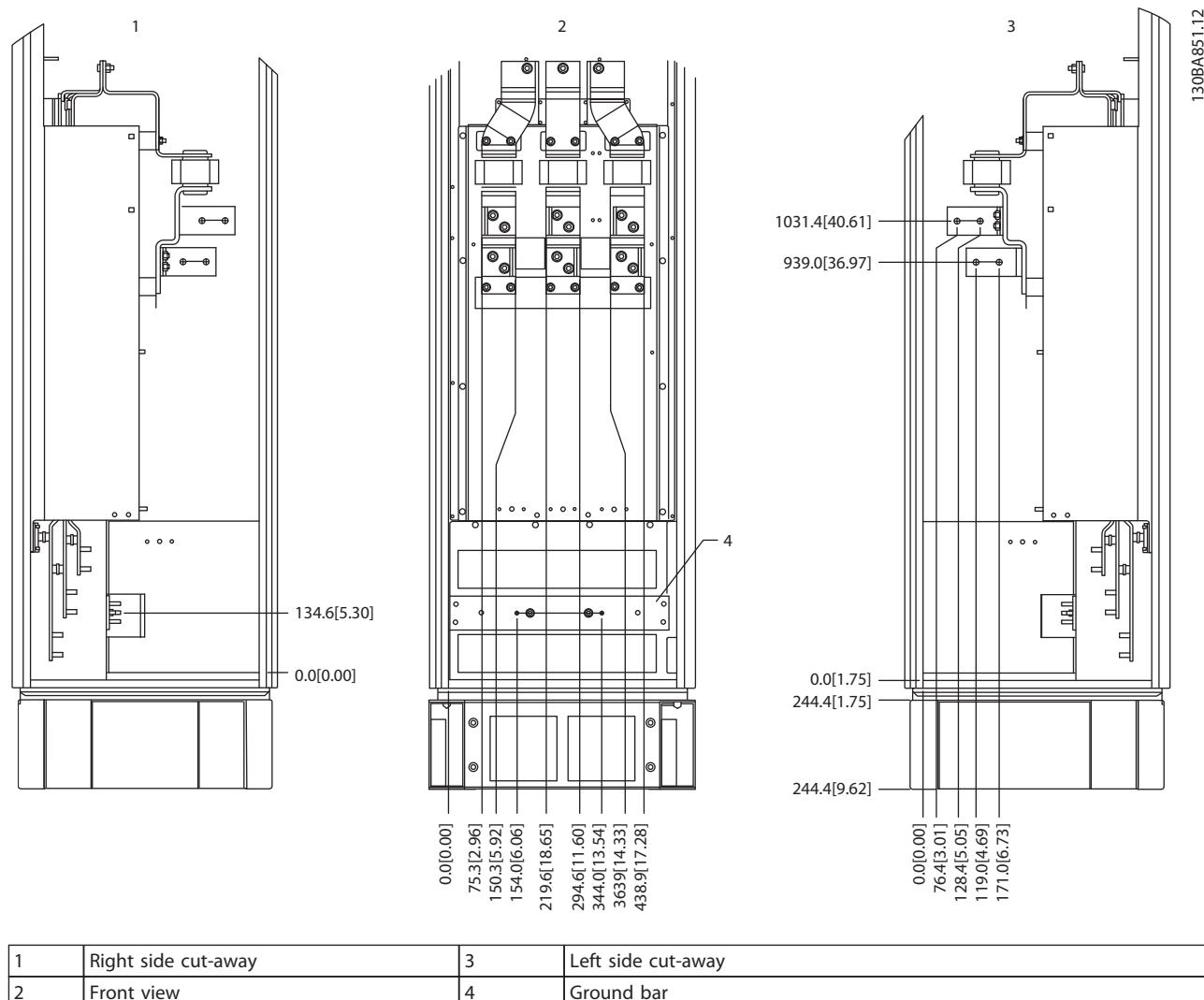
### 3.4.6 Terminal Locations for Frame Size F18

Consider the position of the terminals when designing the cable access.

F-frame units have 4 interlocked cabinets:

- Input options cabinet (not optional for LHD)
- Filter cabinet
- Rectifier cabinet
- Inverter cabinet

See chapter 1.3.3 *Exploded View Drawings* for exploded views of each cabinet. Mains inputs are located in the input option cabinet, which conducts power to the rectifier via interconnecting bus bars. Output from the unit is from the inverter cabinet. No connection terminals are located in the rectifier cabinet. Interconnecting bus bars are not shown.

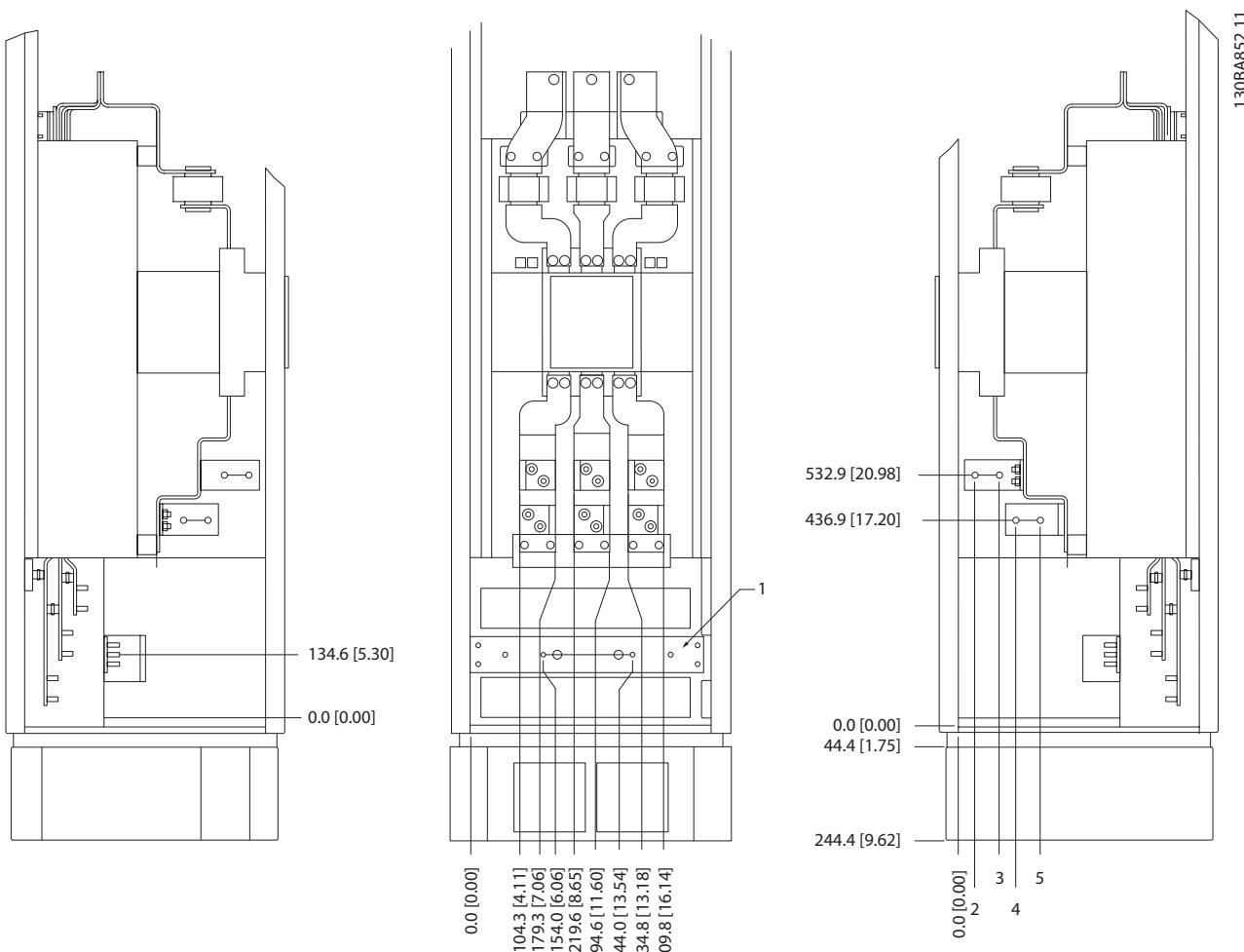


**Illustration 3.15 Frame Size F18 Input Option Cabinet - Fuses Only**

The gland plate is 42 mm below the 0 level. Shown are the left side view, front, and right.

## Mechanical Installation

## Operating Instructions



	500 kW (mm [in.])	560-710 kW (mm [in.])
1	Ground Bar	
2	34.9 [1.4]	46.3 [1.8]
3	86.9 [3.4]	98.3 [3.9]
4	122.2 [4.8]	119 [4.7]
5	174.2 [6.9]	171 [6.7]

\*Disconnect location and related dimensions vary with kilowatt rating

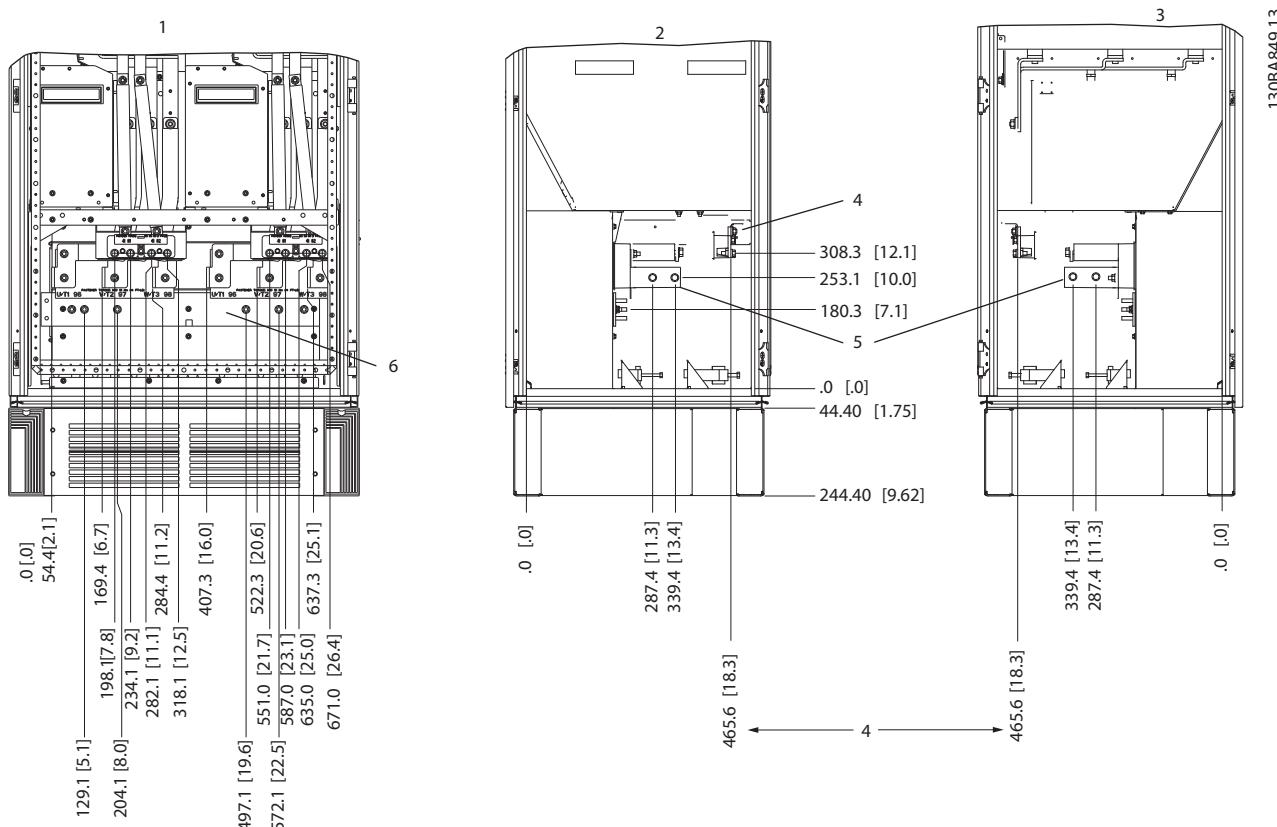
Illustration 3.16 Frame Size F18 Input Option Cabinet with Circuit Breaker

The gland plate is 42 mm below the 0 level. Shown are the left side view, front, and right.

## Mechanical Installation

## Operating Instructions

3



1	Front View	5	Motor output bus bar
2	Left Side View	6	Ground bar
3	Right Side View	7	Screen clamp
4	Brake Terminals		

Illustration 3.17 Frame Size F18 Inverter Cabinet

The gland plate is 42 mm below the 0 level. Shown are the left side view, front, and right.

### 3.4.7 Torque

Correct torque is imperative for all electrical connections.  
Incorrect torque results in a bad electrical connection. Use a torque wrench to ensure correct torque.

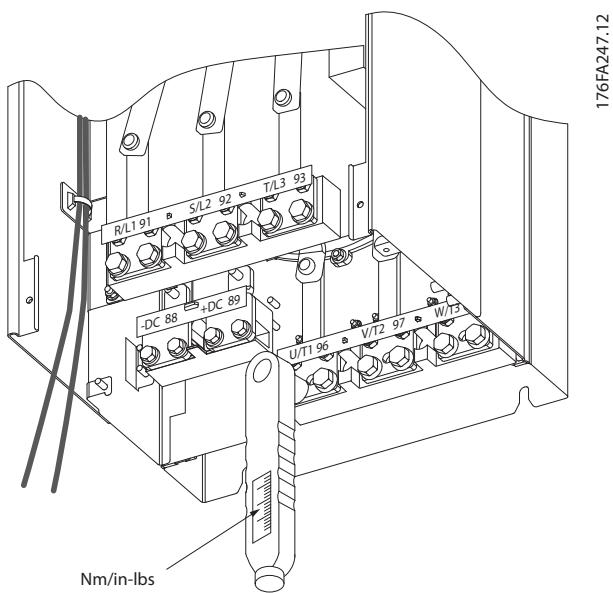


Illustration 3.18 Use a Torque Wrench to Tighten the Bolts

Frame size	Terminal	Torque [Nm] (in-lbs)	Bolt size
D	Mains Motor	19–40 (168–354)	M10
	Load sharing Brake	8.5–20.5 (75–181)	M8
E	Mains Motor Load sharing	19–40 (168–354)	M10
	Brake	8.5–20.5 (75–181)	M8
F	Mains Motor	19–40 (168–354)	M10
	Load sharing	19–40 (168–354)	M10
	Brake	8.5–20.5 (75–181)	M8
	Regen	8.5–20.5 (75–181)	M8

Table 3.2 Torque for Terminals

## 4 Electrical Installation

### 4.1 Safety Instructions

See *chapter 2 Safety* for general safety instructions.

#### **WARNING**

##### INDUCED VOLTAGE

Induced voltage from output motor cables that run together can charge equipment capacitors even with the equipment turned off and locked out. Failure to run output motor cables separately or use screened cables could result in death or serious injury.

- Run output motor cables separately, or
- use screened cables

#### **CAUTION**

##### SHOCK HAZARD

The frequency converter can cause a DC current in the PE conductor. Failure to follow the recommendation below means the RCD may not provide the intended protection.

- When a residual current-operated protective device (RCD) is used for protection against electrical shock, only an RCD of Type B is permitted on the supply side.

#### Overcurrent Protection

- Additional protective equipment such as short circuit protection or motor thermal protection between frequency converter and motor is required for applications with multiple motors.
- Input fusing is required to provide short circuit and overcurrent protection. If not factory-supplied, fuses must be provided by the installer. See maximum fuse ratings in *chapter 8.5 Fuses*.

#### Wire Type and Ratings

- All wiring must comply with local and national regulations regarding cross-section and ambient temperature requirements.
- Power connection wire recommendation:  
Minimum 75 °C rated copper wire.

See *chapter 8.1 Power-Dependent Specifications* and *chapter 8.3 General Technical Data - Frequency Converter* for recommended wire sizes and types.

### 4.2 EMC Compliant Installation

To obtain an EMC-compliant installation, follow the instructions provided in *chapter 4.4 Grounding*, *chapter 4.5 Input Options*, *chapter 4.6 Motor Connection*, and *chapter 4.8 Control Wiring*.

### 4.3 Power Connections

#### **NOTICE**

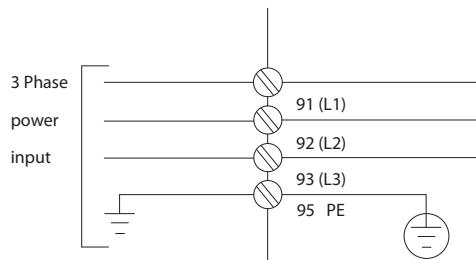
##### Cables-General Information

All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. UL applications require 75 °C copper conductors. For non-UL applications, 75 and 90 °C copper conductors are thermally acceptable.

The power cable connections are situated as shown in *Illustration 4.1*. Dimension cable cross-section in accordance with the current ratings and local legislation. See *chapter 8.3.1 Cable lengths and cross-sections* for details.

For protection of the frequency converter, use the recommended fuses if there are no built-in fuses. Fuse recommendations are provided in *chapter 8.5 Fuses*. Ensure that proper fusing is made according to local regulation.

The mains connection is fitted to the mains switch, if included.



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Illustration 4.1 Power Cable Connections

#### **NOTICE**

To comply with EMC emission specifications, screened/armoured cables are recommended. If an unscreened/unarmoured cable is used, see *chapter 4.7.3 Power and Control Wiring for Unscreened Cables*.

See *chapter 8 Specifications* for correct dimensioning of motor cable cross-section and length.

### Screening of cables

Avoid installation with twisted screen ends (pigtails). They spoil the screening effect at higher frequencies. If breaking the screen is necessary to install a motor isolator or contactor, continue the screen at the lowest possible HF impedance.

Connect the motor cable screen to both the de-coupling plate of the frequency converter and to the metal housing of the motor.

Make the screen connections with the largest possible surface area (cable clamp). Use the installation devices within the frequency converter.

### Cable-length and cross-section

The frequency converter has been EMC tested with a given length of cable. Keep the motor cable as short as possible to reduce the noise level and leakage currents.

### Switching frequency

When frequency converters are used together with sine-wave filters to reduce the acoustic noise from a motor, the switching frequency must be set according to

#### 14-01 Switching Frequency.

Term. no.	96	97	98	99	
	U	V	W	PE <sup>1)</sup>	Motor voltage 0–100% of mains voltage. 3 wires out of motor
	U1	V1	W1	PE <sup>1)</sup>	Delta-connected 6 wires out of motor
	U1	V1	W1	PE <sup>1)</sup>	Star-connected U2, V2, W2 U2, V2, and W2 to be interconnected separately.

Table 4.1 Terminal Connections

#### 1) Protective Earth Connection

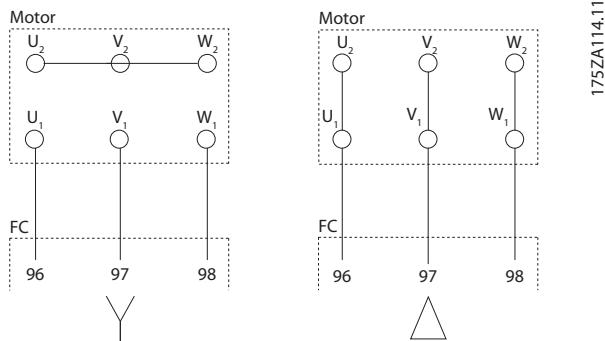


Illustration 4.2 Y and Delta Terminal Configurations

### 4.4 Grounding

Consider the following basic issues for electromagnetic compatibility (EMC) during installation:

- Safety grounding: The frequency converter has a high leakage current and must be grounded appropriately for safety reasons. Apply local safety regulations.
- High-frequency grounding: Keep the ground wire connections as short as possible.

Connect the different ground systems at the lowest possible conductor impedance. Keep the conductor as short as possible and use the greatest possible surface area for the lowest possible conductor impedance.

The metal cabinets of the different devices are mounted on the cabinet rear plate using the lowest possible HF impedance. Doing so avoids different HF voltages for individual devices and the risk of radio interference currents running in connection cables between the devices. The radio interference is reduced.

To obtain a low HF impedance, use the fastening bolts of the devices as HF connection to the rear plate. Remove insulating paint or similar from the fastening points.

### 4.5 Input Options

#### 4.5.1 Extra Protection (RCD)

ELCB relays, multiple protective grounding, or standard grounding provide extra protection, if local safety regulations are followed.

In the case of a ground fault, a DC component develops in the fault current.

If using ELCB relays, observe local regulations. Relays must be suitable for protection of 3-phase equipment with a bridge rectifier and for a brief discharge on power-up.

#### 4.5.2 RFI Switch

##### Mains supply isolated from ground

If the frequency converter is supplied from an isolated mains source or TT/TN-S mains with grounded leg, turn off the RFI switch via 14-50 RFI Filter on both frequency converter and the filter. For further reference, see IEC 364-3. When optimum EMC performance is needed, parallel motors are connected, or the motor cable length is above 25 m, set 14-50 RFI Filter to [ON].

In OFF, the internal RFI capacitors (filter capacitors) between the chassis and the intermediate circuit are cut off to avoid damage to the intermediate circuit and reduce ground capacity currents (IEC 61800-3).

Refer to the application note *VLT on IT mains*. It is important to use isolation monitors that work together with power electronics (IEC 61557-8).

### 4.5.3 Shielded Cables

It is important to connect shielded cables properly to ensure high EMC immunity and low emissions.

**Connection can be made using either cable glands or clamps:**

- EMC cable glands: Generally available cable glands can be used to ensure an optimum EMC connection.
- EMC cable clamp: Clamps allowing easy connection are supplied with the unit.

### 4.6 Motor Connection

#### 4.6.1 Motor Cable

Connect the motor to terminals U/T1/96, V/T2/97, W/T3/98, on the far right of the unit. Ground to terminal 99. All types of 3-phase asynchronous standard motors can be used with a frequency converter. The factory setting is for clockwise rotation with the frequency converter output connected as follows:

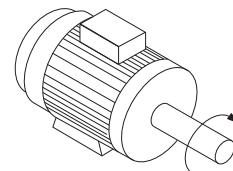
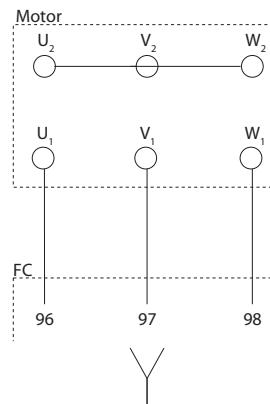
Terminal No.	Function
96, 97, 98	Mains U/T1, V/T2, W/T3
99	Ground

Table 4.2 Terminal Functions

- Terminal U/T1/96 connected to U-phase
- Terminal V/T2/97 connected to V-phase
- Terminal W/T3/98 connected to W-phase

The direction of rotation can be changed by switching 2 phases in the motor cable or by changing the setting of 4-10 *Motor Speed Direction*.

Motor rotation check can be performed via 1-28 *Motor Rotation Check* and following the steps shown in the display.



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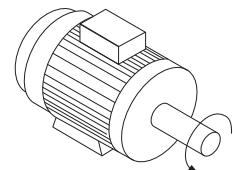
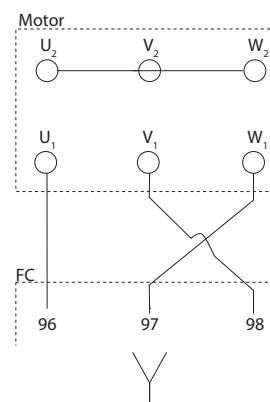


Illustration 4.3 Motor Rotation Check

#### F-frame requirements

Use motor phase cables in quantities of 2, resulting in 2, 4, 6, or 8 to obtain an equal number of wires on both inverter module terminals. The cables are required to be equal length within 10% between the inverter module terminals and the first common point of a phase. The recommended common point is the motor terminals.

#### Output junction box requirements

The length, minimum 2.5 m, and quantity of cables must be equal from each inverter module to the common terminal in the junction box.

#### NOTICE

If a retrofit application requires an unequal number of wires per phase, consult the factory or use the top/bottom entry side cabinet option, instruction 177R0097.

#### 4.6.2 Brake Cable

Frequency converters with factory installed brake chopper option

(Only standard with letter B in position 18 of type code).

**Electrical Installation****Operating Instructions**

The connection cable to the brake resistor must be screened and the max. length from frequency converter to the DC bar is limited to 25 m.

Terminal No.	Function
81, 82	Brake resistor terminals

Table 4.3 Terminal Functions

The connection cable to the brake resistor must be screened. Connect the screen with cable clamps to the conductive back plate of the frequency converter and the metal cabinet of the brake resistor.

Size the brake cable cross-section to match the brake torque. See also *Brake Instructions* for further information regarding safe installation.

**WARNING**

Note that voltages up to 790 V DC, depending on the supply voltage, are possible on the terminals.

**F-frame requirements**

The brake resistors must be connected to the brake terminals in each inverter module.

**4.6.3 Brake Resistor Temperature Switch**

The input for the brake resistor temperature switch can be used to monitor the temperature of an externally connected brake resistor. If the connection between 104 and 106 is removed, the frequency converter trips on warning/alarm 27, Brake IGBT.

Install a Klixon switch that is 'normally closed' in series with the existing connection on either 106 or 104. Any connection to this terminal must be double insulated against high voltage to maintain PELV.

Normally closed: 104–106 (factory installed jumper).

Terminal No.	Function
106, 104, 105	Brake resistor temperature switch.

Table 4.4 Terminal Functions

**CAUTION**

If the temperature of the brake resistor is too high and the thermal switch drops out, the frequency converter stops braking. The motor coasts.

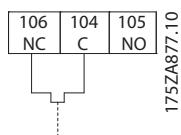


Illustration 4.4 Factory-installed Jumper

**4.6.4 Motor Insulation**

For motor cable lengths  $\leq$  the maximum cable length, the motor insulation ratings listed in *Table 4.5* are recommended. The peak voltage can be twice the DC-link voltage or 2.8 times mains voltage, due to transmission line effects in the motor cable. If a motor has lower insulation rating, use a dU/dt or sine wave filter.

Nominal Mains Voltage	Motor Insulation
$U_N \leq 420$ V	Standard $U_{LL} = 1,300$ V
$420 < U_N \leq 500$ V	Reinforced $U_{LL} = 1,600$ V

Table 4.5 Recommended Motor Insulation Ratings

**4.6.5 Motor Bearing Currents**

Motors with a rating 110 kW or higher combined with frequency converters are best with NDE (Non-Drive End) insulated bearings to eliminate circulating bearing currents caused by motor size. To minimise DE (Drive End) bearing and shaft currents, proper grounding is required for:

- Frequency converter
- Motor
- Motor-driven machine
- Motor to the driven machine

Although failure due to bearing currents is infrequent, use the following strategies to reduce the likelihood:

- Use an insulated bearing
- Apply rigorous installation procedures
- Ensure that the motor and load motor are aligned
- Strictly follow the EMC Installation guideline
- Reinforce the PE so the high frequency impedance is lower in the PE than the input power leads
- Provide a good high frequency connection between the motor and the frequency converter
- Ensure that the impedance from frequency converter to building ground is lower than the grounding impedance of the machine. Make a direct ground connection between the motor and load motor.
- Apply conductive lubrication
- Try to ensure that the line voltage is balanced to ground.
- Use an insulated bearing as recommended by the motor manufacturer (note: Motors from reputable manufacturers typically have insulated bearings as standard in motors of this size)

**Electrical Installation****Operating Instructions****4**

If found to be necessary and after consultation with Danfoss:

- Lower the IGBT switching frequency
- Modify the inverter waveform, 60° AVM vs. SFAVM
- Install a shaft grounding system or use an isolating coupling between motor and load
- Use minimum speed settings if possible
- Use a dU/dt or sinus filter

#### 4.6.6 Motor Thermal Protection

The electronic thermal relay in the frequency converter has received UL-approval for single motor protection, when 1-90 *Motor Thermal Protection* is set for *ETR Trip* and 1-24 *Motor Current* is set to the rated motor current (see the motor name plate).

For thermal motor protection, it is also possible to use the MCB 112 PTC Thermistor Card option. This card provides ATEX certificate to protect motors in explosion hazardous areas, Zone 1/21 and Zone 2/22. When 1-90 *Motor Thermal Protection*, set to [20] *ATEX ETR*, is combined with the use of MCB 112, it is possible to control an Ex-e motor in explosion hazardous areas. Consult the *Programming Guide* for details on how to set up the frequency converter for safe operation of Ex-e motors.

#### 4.7 AC Mains Connection

##### 4.7.1 Mains Connection

Mains must be connected to terminals 91, 92 and 93 on the far left of the unit. Ground is connected to the terminal on the right of terminal 93.

Terminal No.	Function
91, 92, 93	Mains R/L1, S/L2, T/L3
94	Ground

Table 4.6 Terminal Functions

Ensure that the power supply can supply the necessary current to the frequency converter.

If the unit is without built-in fuses, ensure that the appropriate fuses have the correct current rating.

#### 4.7.2 External Fan Supply

If the frequency converter is supplied by DC or the fan must run independently of the power supply, use an external power supply. Make the connection on the power card.

Terminal No.	Function
100, 101	Auxiliary supply S, T
102, 103	Internal supply S, T

Table 4.7 Terminal Functions

The connector on the power card provides the connection of line voltage for the cooling fans. The fans are connected from the factory to be supplied from a common AC line (jumpers between 100–102 and 101–103). If external power supply is needed, remove the jumpers and connect the supply to terminals 100 and 101. Protect with a 5 A. In UL applications, use a Littelfuse KLK-5 or equivalent.

#### 4.7.3 Power and Control Wiring for Unscreened Cables

##### **WARNING**

###### INDUCED VOLTAGE

Induced voltage from coupled output motor cables charges equipment capacitors even with the equipment turned off and locked out. Run motor cables from multiple frequency converters separately. Failure to run output cables separately could result in death or serious injury.

##### **CAUTION**

###### COMPROMISED PERFORMANCE

The frequency converter runs less efficiently if wiring is not isolated properly. To isolate high frequency noise, the following in separate metallic conduits:

- power wiring
- motor wiring
- control wiring

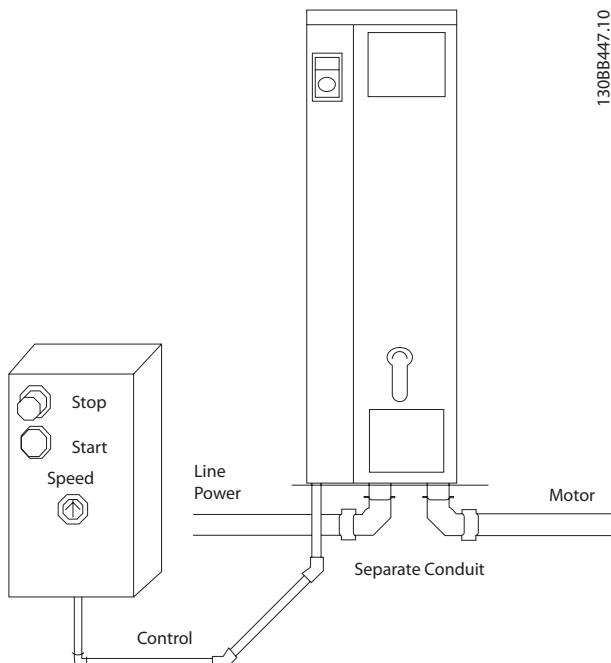
Failure to isolate these connections could result in less than optimum controller and associated equipment performance.

Because the power wiring carries high frequency electrical pulses, it is important to run input power and motor power in separate conduit. If incoming power wiring is in the same conduit as motor wiring, these pulses can couple electrical noise back onto the power grid. Isolate control wiring from high-voltage power wiring.

## Electrical Installation

## Operating Instructions

When screened/armoured cable is not used, at least 3 separate conduits are connected to the panel option (see *Illustration 4.5*).



**Illustration 4.5 Proper Electrical Installation Using Conduit**

**Electrical Installation****Operating Instructions****4.7.4 Mains Disconnects**

Frame size	Power & Voltage	Type
D	P132-P200 380-500 V	OT400U12-9 or ABB OETL-NF400A
E	P250 380-500 V	ABB OETL-NF600A
E	P315-P400 380-500 V	ABB OETL-NF800A
F	P450 380-500 V	Merlin Gerin NPJF36000S12AAYP
F	P500-P630 380-500 V	Merlin Gerin NRK36000S20AAYP

**4**

Table 4.8 Recommended Mains Disconnects

**4.7.5 F-Frame Circuit Breakers**

Frame size	Power & Voltage	Type
F	P450 380-500 V	Merlin Gerin NPJF36120U31AABSCYP
F	P500-P630 380-500 V	Merlin Gerin NRJF36200U31AABSCYP

Table 4.9 Recommended Circuit Breakers

**4.7.6 F-Frame Mains Contactors**

Frame size	Power & Voltage	Type
F	P450-P500 380-500 V	Eaton XTCE650N22A
F	P560-P630 380-500 V	Eaton XTCEC14P22B

Table 4.10 Recommended Contactors

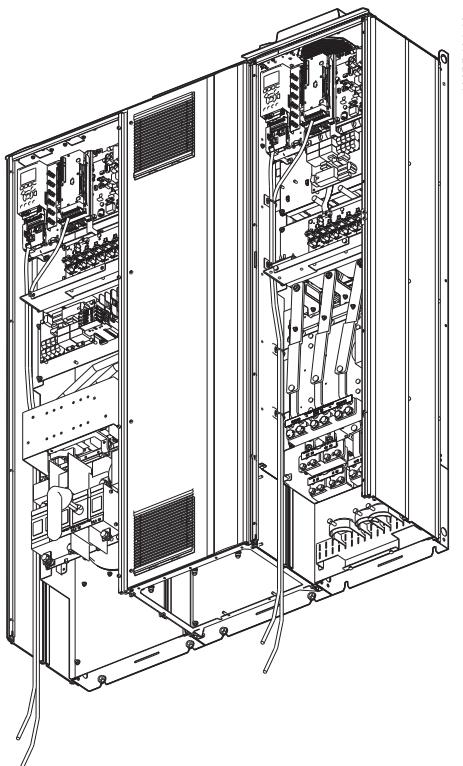
## 4.8 Control Wiring

### 4.8.1 Control Cable Routing

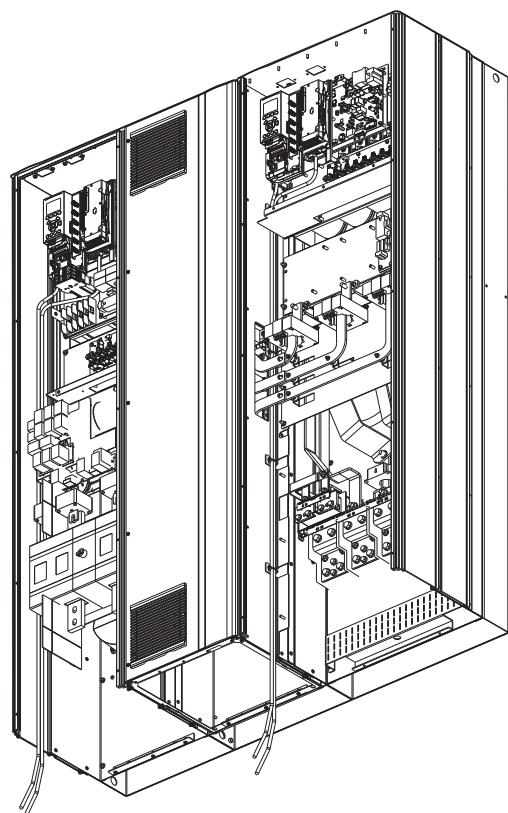
Tie down all control wires to the designated control cable routing as shown in *Illustration 4.6*, *Illustration 4.7*, and *Illustration 4.8*. Remember to connect the shields in a proper way to ensure optimum electrical immunity.

#### Fieldbus connection

Connections are made to the relevant options on the control card. For details, see the relevant fieldbus instruction. The cable must be placed in the provided path inside the frequency converter and tied down together with other control wires (see *Illustration 4.6* and *Illustration 4.7*).



**Illustration 4.6 Control Card Wiring Path for Frame Size D13**

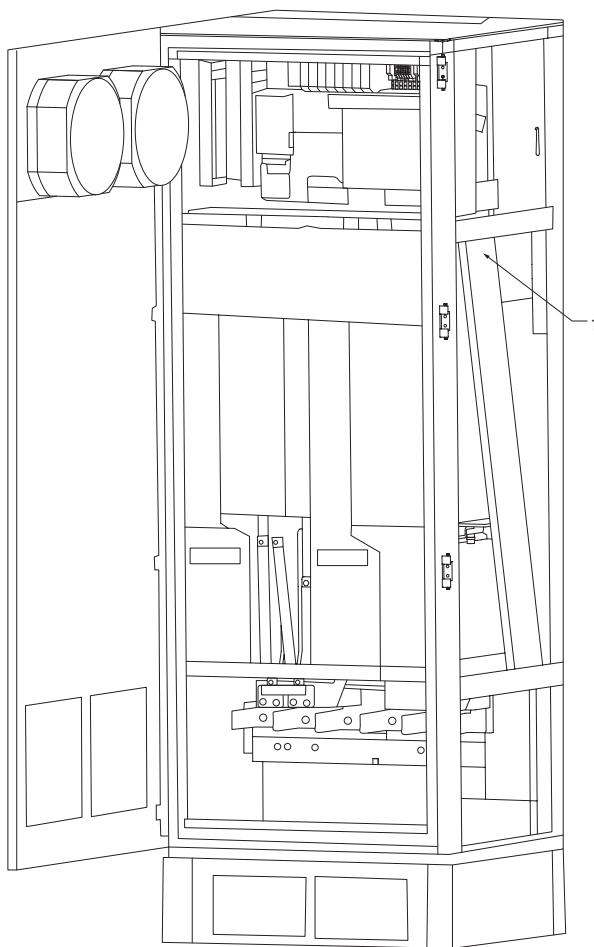


**Illustration 4.7 Control Card Wiring Path for Frame Size E9**

## Electrical Installation

## Operating Instructions

4



1 Routing path for the control card wiring, inside the frequency converter enclosure.

Illustration 4.8 Control Card Wiring Path for Frame Size F18

#### 4.8.2 Access to Control Terminals

All terminals to the control cables are located beneath the LCP (both filter and frequency converter LCPs). They are accessed by opening the door of the unit.

#### 4.8.3 Electrical Installation, Control Terminals

To connect the cable to the terminal:

1. Strip insulation by about 9–10 mm

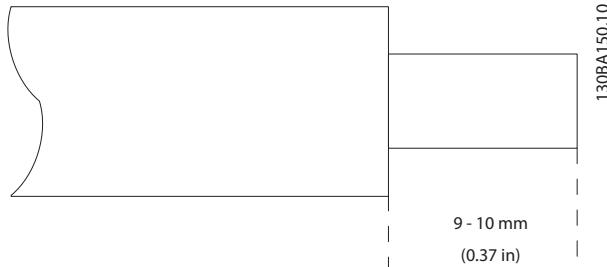


Illustration 4.9 Length to Strip the Insulation

2. Insert a screwdriver (max. 0.4x2.5 mm) in the square hole.
3. Insert the cable in the adjacent circular hole.

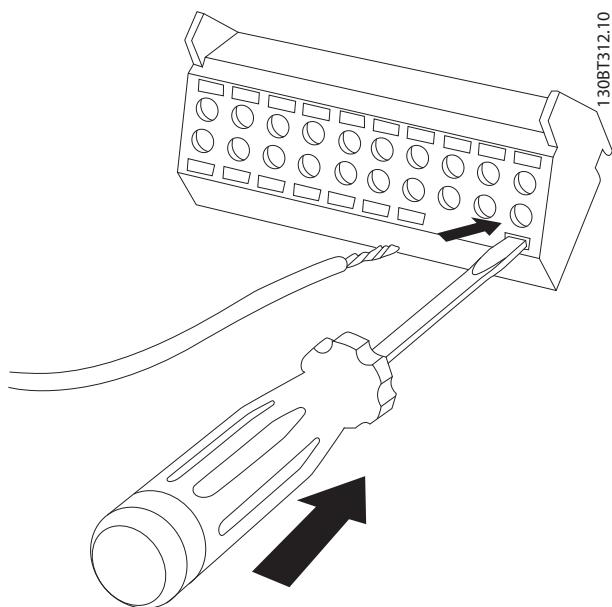


Illustration 4.10 Inserting the Cable in the Terminal Block

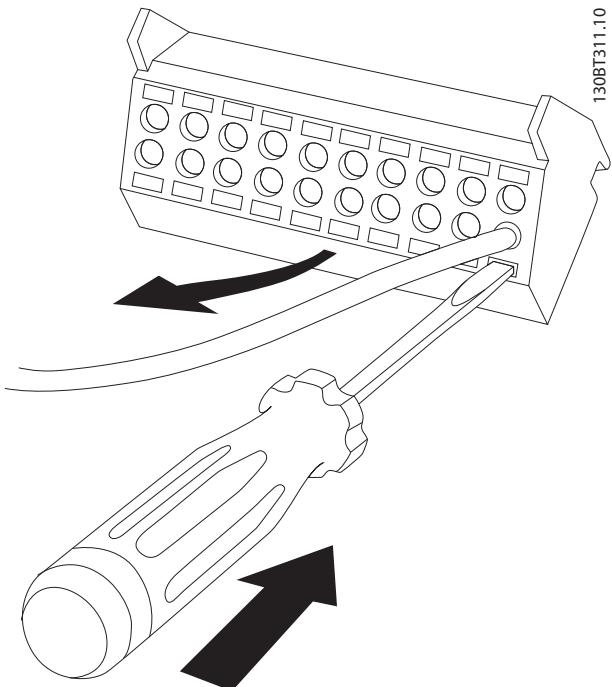
4. Remove the screwdriver. The cable is now mounted in the terminal.

## Electrical Installation

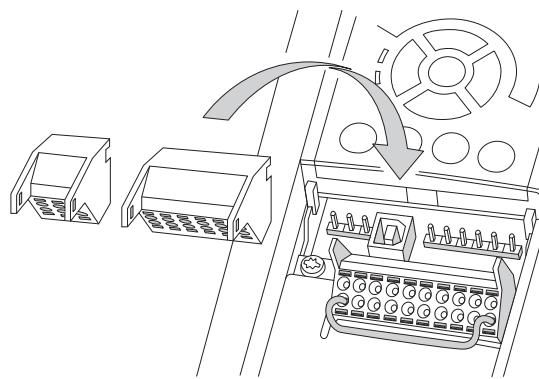
## Operating Instructions

**To remove the cable from the terminal:**

1. Insert a screwdriver (max. 0.4 x 2.5 mm) in the square hole.
2. Pull out the cable.



**Illustration 4.11 Removing the Screwdriver after Cable Insertion**



**Illustration 4.12 Control Terminal Locations**

## Electrical Installation

## Operating Instructions

4

## 4.8.4 Electrical Installation, Control Cables

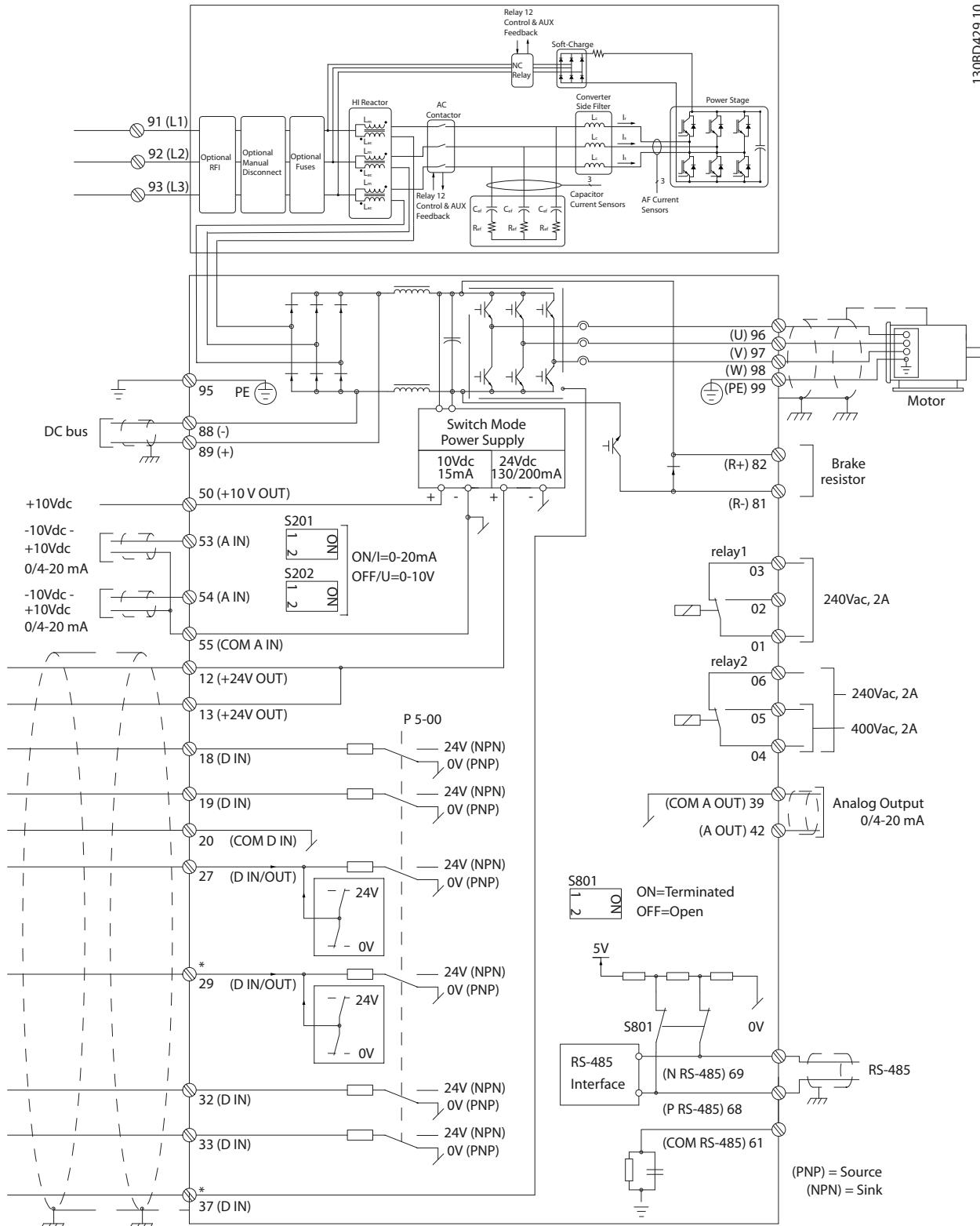
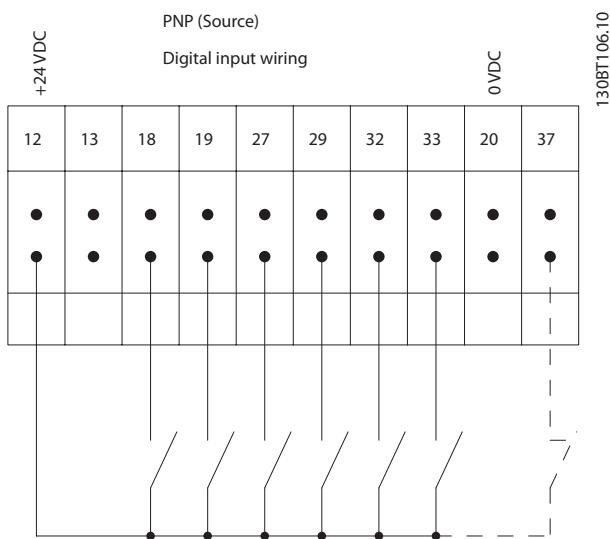


Illustration 4.13 Terminal Diagram

Long control cables and analog signals may result in 50/60 Hz ground loops due to noise from mains supply cables.

If ground loops occur, break the screen or insert a 100 nF capacitor between screen and chassis, if needed.

Connect the digital and analog inputs and outputs to the control cards of the units separately to avoid ground currents. These connections are on terminals 20, 55, and 39 for both the filter and frequency converter sections.



**Illustration 4.14 Input Polarity of Control Terminals, PNP**

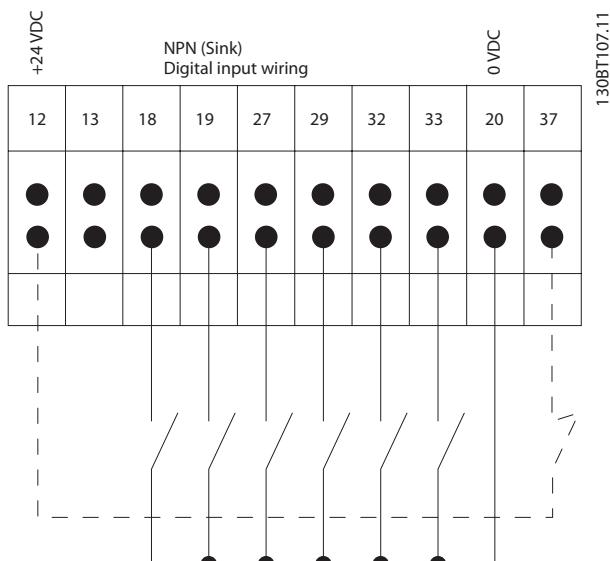
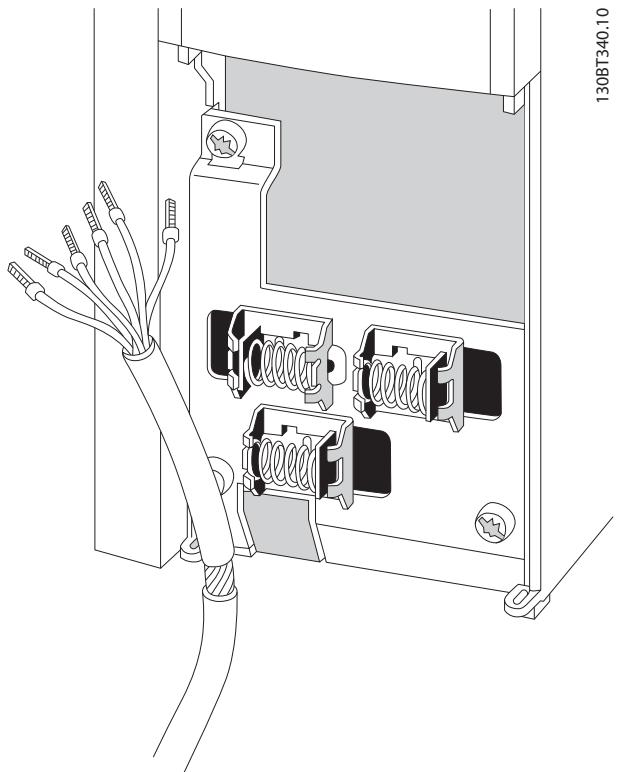


Illustration 4.15 Input Polarity of Control Terminals, NPN

**NOTICE**

To comply with EMC emission specifications, screened/armoured cables are recommended. If using unscreened/unarmoured cable, see *chapter 4.7.3 Power and Control Wiring for Unscreened Cables*. If using unscreened control cables, use ferrite cores to improve EMC performance.



#### Illustration 4.16 Connecting Shielded Cables

Connect the shields in a proper way to ensure optimum electrical immunity.

## 4.9 Additional Connections

#### 4.9.1 Mechanical Brake Control

In hoisting/lowering applications, it is necessary to be able to control an electro-mechanical brake:

- Control the brake using any relay output or digital output (terminal 27 or 29).
  - Keep the output closed (voltage-free) as long as the frequency converter is unable to 'support' the motor, due to the load being too heavy, for example.
  - Select [32] *Mechanical brake control* in parameter group 5-4\* *Relays* for applications with an electro-mechanical brake.
  - The brake is released when the motor current exceeds the preset value in 2-20 *Release Brake Current*.

## Electrical Installation

## Operating Instructions

- The brake engages when the output frequency is less than the frequency set in 2-21 *Activate Brake Speed [RPM]* or 2-22 *Activate Brake Speed [Hz]*, only if the frequency converter completes a stop command.

If the frequency converter is in alarm mode or in an overvoltage situation, the mechanical brake immediately cuts in.

## 4

## 4.9.2 Parallel Connection of Motors

The frequency converter can control several parallel-connected motors. The total current consumption of the motors must not exceed the rated output current  $I_{M,N}$  for the frequency converter.

**NOTICE**

**Installations with cables connected in a common joint as in Illustration 4.17, is only recommended for short cable lengths.**

**NOTICE**

**When motors are connected in parallel, 1-29 *Automatic Motor Adaptation (AMA)* cannot be used.**

**NOTICE**

**The electronic thermal relay (ETR) of the frequency converter cannot be used as motor protection for the individual motor in systems with parallel-connected motors. Provide further motor protection with thermistors in each motor or individual thermal relays. Circuit breakers are not suitable as protection.**

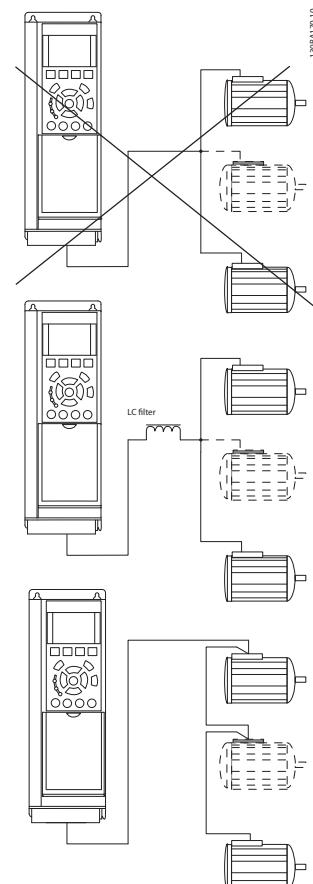


Illustration 4.17 Installations with Cables Connected in a Common Joint

Problems are possible at start and at low RPM values if motor sizes vary widely. The relatively high ohmic resistance in the stator of small motors calls for a higher voltage at start and at low RPM values.

## 4.9.3 Motor Thermal Protection

The electronic thermal relay in the frequency converter has received UL-approval for single motor protection, when 1-90 *Motor Thermal Protection* is set for [4] *ETR Trip 1* and 1-24 *Motor Current* is set to the rated motor current (see motor name plate).

For thermal motor protection, it is also possible to use the VLT® PTC Thermistor Card MCB 112. This card provides ATEX certification to protect motors in explosion hazardous areas, Zone 1/21 and Zone 2/22. When 1-90 *Motor Thermal Protection* is set to [20] *ATEX ETR* and MCB 112 are combined, it is possible to control an Ex-e motor in explosion hazardous areas. Consult the *Programming Guide* for details on how to set up the frequency converter for safe operation of Ex-e motors.

#### 4.9.4 Safe Torque Off (STO)

To run Safe Torque Off, additional wiring for the frequency converter is required. Refer to *VLT® Frequency Converters Safe Torque Off Operating Instructions* for further information.

#### 4.9.5 Switches S201, S202, and S801

Use switches S201 (A53) and S202 (A54) to select a current (0-20 mA) or a voltage (-10 V to 10 V) configuration of the analog input terminals 53 and 54.

Switch S801 (BUS TER.) can be used to enable termination on the RS-485 port (terminals 68 and 69).

See *Illustration 4.13*.

**Default setting:**

S201 (A53) = OFF (voltage input)

S202 (A54) = OFF (voltage input)

S801 (Bus termination) = OFF

**NOTICE**

**When changing the function of S201, S202 or S801 do not use force for the switch-over. Remove the LCP cradle when operating the switches. The switches must not be operated with power on the frequency converter.**

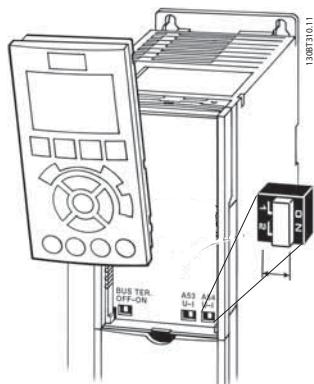


Illustration 4.18 Remove the LCP Cradle to Access Switches

#### 4.9.6 Serial Communication

RS-485 is a 2-wire bus interface compatible with multi-drop network topology, i.e. nodes can be connected as a bus, or via drop cables from a common trunk line. A total of 32 nodes can be connected to one network segment. Repeaters divide networks.

**NOTICE**

**Each repeater functions as a node within the segment in which it is installed. Each node connected within a given network must have a unique node address, across all segments.**

Terminate each segment at both ends, using either the termination switch (S801) of the frequency converters or a biased termination resistor network. Always use screened twisted pair (STP) cable for bus cabling, and always follow good common installation practice.

Low-impedance ground connection of the screen at every node is important, including at high frequencies. Thus, connect a large surface of the screen to ground, for example with a cable clamp or a conductive cable gland. It may be necessary to apply potential-equalizing cables to maintain the same ground potential throughout the network - particularly in installations with long cables. To prevent impedance mismatch, always use the same type of cable throughout the entire network. When connecting a motor to the frequency converters, always use screened motor cable.

Cable	Screened twisted pair (STP)
Impedance	120 Ω
Cable length [m]	Max. 1200 (including drop lines) Max. 500 station-to-station

Table 4.11 Cable Recommendations

#### 4.9.7 F-frame Options

**Space heaters and thermostat**

There are space heaters mounted on the cabinet interior of F-frame frequency converters. These heaters are controlled by an automatic thermostat and help control humidity inside the enclosure. The thermostat default settings turn on the heaters at 10 °C (50 °F) and turn them off at 15.6 °C (60 °F).

**Cabinet light with power outlet**

A light mounted on the cabinet interior of F-frame frequency converters increases visibility during servicing and maintenance. The housing includes a power outlet for temporarily powering tools or other devices, available in 2 voltages:

- 230 V, 50 Hz, 2.5 A, CE/ENEC
- 120 V, 60 Hz, 5 A, UL/cUL

**Transformer tap set-up**

If the cabinet light and outlet and/or the space heaters and thermostat are installed, transformer T1 requires its taps to be set to the proper input voltage. A 380-480/500 V frequency converter is initially set to the 525 V tap and a 525-690 V frequency converters is set to the 690 V tap to ensure no overvoltage of secondary equipment occurs if the tap is not changed before applying power. See *Table 4.12* to set the proper tap at terminal T1 located in the rectifier cabinet.

Input voltage range [V]	Tap to select [V]
380 V-440	400
441 V-490	460
491 V-550	525
551 V-625	575
626 V-660	660
661 V-690	690

**Table 4.12 Transformer Tap Set-up****NAMUR terminals**

NAMUR is an international association of automation technology users in the process industries, primarily chemical and pharmaceutical industries in Germany. Selecting this option provides terminals organised and labeled to the specifications of the NAMUR standard for frequency converters input and output terminals. This requires VLT® PTC Thermistor Card MCB 112 VLT® Extended Relay Card MCB 113.

**RCD (Residual Current Device)**

Uses the core balance method to monitor ground fault currents in grounded and high-resistance grounded systems (TN and TT systems in IEC terminology). There is a pre-warning (50% of main alarm set-point) and a main alarm set-point. Associated with each set-point is an SPDT alarm relay for external use. Requires an external "window-type" current transformer (supplied and installed by the customer).

- Integrated into the frequency converter safe torque off circuit
- IEC 60755 Type B device monitors AC, pulsed DC, and pure DC ground fault currents
- LED bar graph indicator of the ground fault current level from 10–100% of the set-point
- Fault memory
- TEST/RESET button

**Insulation Resistance Monitor (IRM)**

Monitors the insulation resistance in ungrounded systems (IT systems in IEC terminology) between the system phase conductors and ground. There is an ohmic pre-warning and a main alarm set-point for the insulation level. An SPDT alarm relay for external use is associate with each setpoint.

**NOTICE**

Only one insulation resistance monitor can be connected to each ungrounded (IT) system.

- Integrated into the frequency converter safe torque off circuit
- LCD display of the ohmic value of the insulation resistance
- Fault memory
- INFO, TEST, and RESET buttons

**IEC emergency stop with Pilz safety relay**

Includes a redundant 4-wire emergency-stop push button mounted on the front of the enclosure and a Pilz relay that monitors it in conjunction with the frequency converter STO circuit and the mains contactor located in the options cabinet.

**Manual motor starters**

Provide 3-phase power for electric blowers often required for larger motors. Power for the starters is provided from the load side of any supplied contactor, circuit breaker, or disconnect switch. Power is fused before each motor starter, and is off when the incoming power to the frequency converters is off. Up to 2 starters are allowed (one if a 30 A, fuse-protected circuit is ordered), and are integrated into the frequency converter STO circuit. Unit features include:

- Operation switch (on/off)
- Short-circuit and overload protection with test function
- Manual reset function

**30 A, fuse-protected terminals**

- 3-phase power matching incoming mains voltage for powering auxiliary customer equipment
- Not available if 2 manual motor starters are selected
- Terminals are off when the incoming power to the frequency converter is off
- Power for the fused protected terminals is provided from the load side of any supplied contactor, circuit breaker, or disconnect switch

In applications where the motor is used as a brake, energy is generated in the motor and sent back into the frequency converter. If the energy cannot be transported back to the motor, it increases the voltage in the frequency converter DC line. In applications with frequent braking and/or high inertia loads, this increase may lead to an overvoltage trip in the frequency converter and finally a shut down. Brake resistors are used to dissipate the excess energy resulting from the regenerative braking. The resistor is selected based on its ohmic value, its power dissipation rate and its physical size. Danfoss offers a wide

variety of different resistors that are specifically designed for Danfoss frequency converters.

#### Load sharing

Load sharing is a feature on standard frequency converters, but is not available on the LHD unit.

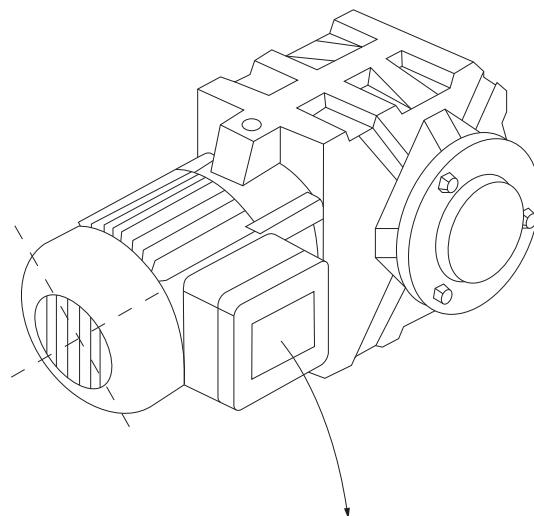
#### 4.10 Final Set-up and Test

Before operating the frequency converter, perform a final test of the installation:

1. Locate the motor name plate to find out whether the motor is star- (Y) or delta- connected ( $\Delta$ ).
2. Enter the motor name plate data in the parameter list. Access the list by pressing the [Quick Menu] key and selecting Q2 Quick Set-up. See *Table 4.13*.

1.	Motor Power [kW] or Motor Power [HP]	1-20 Motor Power [kW] 1-21 Motor Power [HP]
2.	Motor Voltage	1-22 Motor Voltage
3.	Motor Frequency	1-23 Motor Frequency
4.	Motor Current	1-24 Motor Current
5.	Motor Nominal Speed	1-25 Motor Nominal Speed

**Table 4.13 Quick Set-up Parameters**



BAUER D-7 3734 ESLINGEN					
3~ MOTOR NR. 1827421 2003					
S/E005A9					
	1,5	KW			
n <sub>2</sub> 31,5	/min.	400	Y	V	
n <sub>1</sub> 1400	/min.		50	Hz	
COS θ 0,80			3,6	A	
1,7L					
B	IP 65	H1/1A			

**Illustration 4.19 Motor Name Plate**

3. Perform an Automatic Motor Adaptation (AMA) to ensure optimum performance.
  - 3a Connect terminal 27 to terminal 12 or set 5-12 Terminal 27 Digital Input to [0] *No operation*.
  - 3b Activate the AMA 1-29 Automatic Motor Adaptation (AMA).
  - 3c Select either complete or reduced AMA. If an LC filter is mounted, run only the reduced AMA, or remove the LC filter during the AMA procedure.
  - 3d Press [OK]. The display shows "Press [Hand On] to start."
  - 3e Press [Hand On]. A progress bar indicates whether the AMA is in progress.
  - 3f Press [Off] - the frequency converter enters into alarm mode and the display shows that the user terminated AMA.

**Electrical Installation****Operating Instructions****Stop the AMA during operation****Successful AMA**

- The display shows "Press [OK] to finish AMA".
- Press [OK] to exit the AMA state.

**Unsuccessful AMA**

- The frequency converter enters into alarm mode. A description of the alarm can be found in *chapter 7.5 Troubleshooting*.
- "Report Value" in the alarm log shows the last measuring sequence carried out by the AMA, before the frequency converter entered alarm mode. This number, along with the description of the alarm, helps with troubleshooting. Mention the number and alarm description when contacting Danfoss service personnel.

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Unsuccessful AMA is the result of incorrectly registered motor name plate data or too large a difference between the motor power size and the frequency converter power size.

**Set up the desired limits for speed and ramp time**

Minimum Reference	3-02 Minimum Reference
Maximum Reference	3-03 Maximum Reference

**Table 4.14 Reference Parameters**

Motor Speed Low Limit	4-11 Motor Speed Low Limit [RPM] or 4-12 Motor Speed Low Limit [Hz]
Motor Speed High Limit	4-13 Motor Speed High Limit [RPM] or 4-14 Motor Speed High Limit [Hz]

**Table 4.15 Speed Limits**

Ramp-up Time 1 [s]	3-41 Ramp 1 Ramp Up Time
Ramp-down Time 1 [s]	3-42 Ramp 1 Ramp Down Time

**Table 4.16 Ramp Times**

**Commissioning****Operating Instructions**

## 5 Commissioning

### 5.1 Safety Instructions

See chapter 2 Safety for general safety instructions.

#### **WARNING**

##### **HIGH VOLTAGE**

Frequency converters contain high voltage when connected to AC mains input power. Failure to perform installation, start-up, and maintenance by qualified personnel could result in death or serious injury.

- Installation, start-up, and maintenance must be performed by qualified personnel only.

##### **Before applying power:**

1. Close cover properly.
2. Check that all cable glands are firmly tightened.
3. Ensure that input power to the unit is OFF and locked out. Do not rely on the frequency

converter disconnect switches for input power isolation.

4. Verify that there is no voltage on input terminals L1 (91), L2 (92), and L3 (93), phase-to-phase and phase-to-ground.
5. Verify that there is no voltage on output terminals 96 (U), 97 (V), and 98 (W), phase-to-phase and phase-to-ground.
6. Confirm continuity of the motor by measuring ohm values on U-V (96-97), V-W (97-98), and W-U (98-96).
7. Check for proper grounding of the frequency converter as well as the motor.
8. Inspect the frequency converter for loose connections on terminals.
9. Confirm that the supply voltage matches voltage of frequency converter and motor.

**5**

## **CAUTION**

Before applying power to the unit, inspect the entire installation as detailed in *Table 5.1*. Check mark those items when completed.

Inspect for	Description	<input checked="" type="checkbox"/>
Auxiliary equipment	<ul style="list-style-type: none"> <li>• Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers on the input power side of the frequency converter or output side to the motor. Ensure that they are ready for full speed operation.</li> <li>• Check function and installation of any sensors used for feedback to the frequency converter</li> <li>• Remove power factor correction caps on motors, if present</li> </ul>	
Cable routing	<ul style="list-style-type: none"> <li>• Use separate metallic conduits for each of the following:           <ul style="list-style-type: none"> <li>• input power</li> <li>• motor wiring</li> <li>• control wiring</li> </ul> </li> </ul>	
Control wiring	<ul style="list-style-type: none"> <li>• Check for broken or damaged wires and loose connections</li> <li>• Check that control wiring is isolated from power and motor wiring for noise immunity</li> <li>• Check the voltage source of the signals, if necessary</li> <li>• The use of shielded cable or twisted pair is recommended. Ensure that the shield is terminated correctly</li> </ul>	
Cooling clearance	<ul style="list-style-type: none"> <li>• Measure that top and bottom clearance is adequate to ensure proper air flow for cooling</li> </ul>	
EMC considerations	<ul style="list-style-type: none"> <li>• Check for proper installation regarding electromagnetic compatibility</li> </ul>	
Environmental considerations	<ul style="list-style-type: none"> <li>• See equipment label for the maximum ambient operating temperature limits</li> <li>• Humidity levels must be 5–95% non-condensing</li> </ul>	

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Inspect for	Description	<input checked="" type="checkbox"/>
Fusing and circuit breakers	<ul style="list-style-type: none"> <li>Check for proper fusing or circuit breakers</li> <li>Check that all fuses are inserted firmly and in operational condition and that all circuit breakers are in the open position</li> </ul>	
Grounding	<ul style="list-style-type: none"> <li>The unit requires a ground wire from its chassis to the building ground</li> <li>Check for good ground connections that are tight and free of oxidation</li> <li>Grounding to conduit or mounting the back panel to a metal surface is not a suitable ground</li> </ul>	
Input and output power wiring	<ul style="list-style-type: none"> <li>Check for loose connections</li> <li>Check that motor and mains are in separate conduit or separated screened cables</li> </ul>	
Panel interior	<ul style="list-style-type: none"> <li>Inspect that the unit interior is free of debris and corrosion</li> </ul>	
Switches	<ul style="list-style-type: none"> <li>Ensure that all switch and disconnect settings are in the proper positions</li> </ul>	
Vibration	<ul style="list-style-type: none"> <li>Check that the unit is mounted solidly or that shock mounts are used, as necessary</li> <li>Check for an unusual amount of vibration</li> </ul>	

Table 5.1 Start-up Checklist

## 5.2 Applying Power

### **WARNING**

#### HIGH VOLTAGE!

Frequency converters contain high voltage when connected to AC mains. Installation, start-up and maintenance should be performed by qualified personnel only. Failure to comply could result in death or serious injury.

### **WARNING**

#### UNINTENDED START!

When the frequency converter is connected to AC mains, the motor may start at any time. The frequency converter, motor, and any driven equipment must be in operational readiness. Failure to comply could result in death, serious injury, equipment, or property damage.

1. Confirm that the input voltage is balanced within 3%. If not, correct input voltage imbalance before proceeding.
2. Ensure that optional equipment wiring, if present, matches the installation application.
3. Ensure that all operator devices are off. Panel doors should be closed or cover mounted.
4. Apply power to the unit. Do not start the frequency converter at this time. For units with a disconnect switch, turn the switch on to apply power.

### **NOTICE**

If the status line at the bottom of the LCP reads AUTO REMOTE COASTING or Alarm 60 External Interlock is displayed, this indicates that the unit is ready to operate but is missing an input signal on terminal 27.

## 5.3 Local Control Panel Operation

### 5.3.1 Local Control Panel

The local control panel (LCP) is the combined display and keypad on the front of the unit.

The LCP has several user functions:

- Start, stop, and control speed when in local control
- Display operational data, status, warnings and cautions
- Programming frequency converter functions
- Manually reset the frequency converter after a fault when auto-reset is inactive

An optional numeric LCP (NLCP) is also available. The NLCP operates in a manner similar to the LCP. See the *Programming Guide* for details on use of the NLCP.

### **NOTICE**

For commissioning via PC, install MCT 10 Set-up Software. The software is available for download (basic version) or for ordering (advanced version, order number 130B1000). For more information and downloads, see [www.danfoss.com/BusinessAreas/DrivesSolutions/Software+MCT10/MCT10+Downloads.htm](http://www.danfoss.com/BusinessAreas/DrivesSolutions/Software+MCT10/MCT10+Downloads.htm).

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### 5.3.2 LCP Layout

The LCP is divided into 4 functional groups (see *Illustration 5.1*).

- A. Display area
- B. Display menu keys
- C. Navigation keys and indicator lights (LEDs)
- D. Operation keys and reset

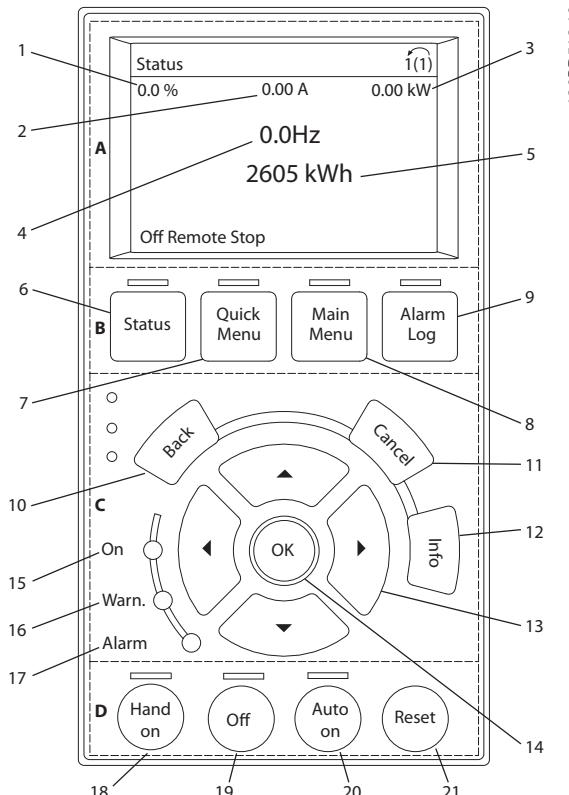


Illustration 5.1 Local Control Panel (LCP)

#### A. Display Area

The display area is activated when the frequency converter receives power from mains voltage, a DC bus terminal, or an external 24 V DC supply.

**Commissioning****Operating Instructions**

The information displayed on the LCP can be customised for user application. Select options in the Quick Menu Q3-13 *Display Settings*.

Callout	Display	Parameter number	Default setting
1	1.1	0-20	Reference %
2	1.2	0-21	Motor current
3	1.3	0-22	Power [kW]
4	2	0-23	Frequency
5	3	0-24	kWh counter

**5****Table 5.2 Legend to Illustration 5.1, Display Area****B. Display Menu Keys**

Menu keys are used for menu access for parameter set-up, toggling through status display modes during normal operation, and viewing fault log data.

Callout	Key	Function
6	Status	Shows operational information.
7	Quick Menu	Allows access to programming parameters for initial set-up instructions and many detailed application instructions.
8	Main Menu	Allows access to all programming parameters.
9	Alarm Log	Displays a list of current warnings, the last 10 alarms, and the maintenance log.

**Table 5.3 Legend to Illustration 5.1, Display Menu Keys****C. Navigation Keys and Indicator Lights (LEDs)**

Navigation keys are used for programming functions and moving the display cursor. The navigation keys also provide speed control in local (hand) operation. There are also 3 frequency converter status indicator lights in this area.

Callout	Key	Function
10	Back	Reverts to the previous step or list in the menu structure.
11	Cancel	Cancels the last change or command as long as the display mode has not changed.
12	Indo	Press for a definition of the function being displayed.
13	Navigation keys	Press to move between items in the menu.
14	OK	Press to access parameter groups or to enable a choice.

**Table 5.4 Legend to Illustration 5.1, Navigation Keys**

Callout	Indicator	Light	Function
15	ON	Green	The ON light activates when the frequency converter receives power from mains voltage, a DC bus terminal, or an external 24 V supply.
16	WARN	Yellow	When warning conditions are met, the yellow WARN light comes on and text appears in the display area identifying the problem.
17	ALARM	Red	A fault condition causes the red alarm light to flash and an alarm text is displayed.

**Table 5.5 Legend to Illustration 5.1, Indicator Lights (LEDs)****D. Operation Keys and Reset**

Operation keys are located at the bottom of the LCP.

Callout	Key	Function
18	Hand On	Starts the frequency converter in local control. <ul style="list-style-type: none"> <li>An external stop signal by control input or serial communication overrides the local hand on</li> </ul>
19	Off	Stops the motor but does not remove power to the frequency converter.
20	Auto On	Puts the system in remote operational mode. <ul style="list-style-type: none"> <li>Responds to an external start command by control terminals or serial communication</li> </ul>
21	Reset	Resets the frequency converter manually after a fault has been cleared.

**Table 5.6 Legend to Illustration 5.1, Operation Keys and Reset****NOTICE**

The display contrast can be adjusted by pressing [Status] and [ $\Delta$ ]/[ $\nabla$ ] keys.

**5.3.3 Parameter Settings**

Establishing the correct programming for applications often requires setting functions in several related parameters.

Programming data are stored internally in the frequency converter.

- For back-up, upload data into the LCP memory
- To download data to another frequency converter, connect the LCP to that unit and download the stored settings
- Restoring factory default settings does not change data stored in the LCP memory

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### 5.3.4 Uploading/Downloading Data to/from the LCP

1. Press [Off] to stop the motor before uploading or downloading data.
2. Go to [Main Menu] 0-50 LCP Copy and press [OK].
3. Select [1] All to LCP to upload data to LCP or select [2] All from LCP to download data from the LCP.
4. Press [OK]. A progress bar shows the uploading or downloading process.
5. Press [Hand On] or [Auto On] to return to normal operation.

### 5.3.5 Changing Parameter Settings

Parameter settings can be accessed and changed from the [Quick Menu] or from the [Main Menu]. The [Quick Menu] only gives access to a limited number of parameters.

1. Press [Quick Menu] or [Main Menu] on the LCP.
2. Press [ $\Delta$ ] [ $\nabla$ ] to browse through the parameter groups, press [OK] to select a parameter group.
3. Press [ $\Delta$ ] [ $\nabla$ ] to browse through the parameters, press [OK] to select a parameter.
4. Press [ $\Delta$ ] [ $\nabla$ ] to change the value of a parameter setting.
5. Press [ $\leftarrow$ ] [ $\rightarrow$ ] to shift digit when a decimal parameter is in the editing state.
6. Press [OK] to accept the change.
7. Press either [Back] twice to enter Status, or press [Main Menu] once to enter Main Menu.

#### View changes

*Quick Menu Q5 - Changes Made* lists all parameters changed from default settings.

- The list shows only parameters which have been changed in the current edit-setup.
- Parameters which have been reset to default values are not listed.
- The message *Empty* indicates that no parameters have been changed.

### 5.3.6 Restoring Default Settings

#### **NOTICE**

**Risk of loosing programming, motor data, localisation, and monitoring records by restoration of default settings. To provide a back-up, upload data to the LCP before initialisation.**

Restoring the default parameter settings is done by initialisation of the frequency converter. Initialisation is carried out through 14-22 *Operation Mode* (recommended) or manually.

- Initialisation using 14-22 *Operation Mode* does not reset frequency converter settings such as operating hours, serial communication selections, personal menu settings, fault log, alarm log, and other monitoring functions.
- Manual initialisation erases all motor, programming, localisation, and monitoring data and restores factory default settings.

#### Recommended initialisation procedure, via 14-22 *Operation Mode*

1. Press [Main Menu] twice to access parameters.
2. Scroll to 14-22 *Operation Mode* and press [OK].
3. Scroll to *Initialisation* and press [OK].
4. Remove power to the unit and wait for the display to turn off.
5. Apply power to the unit.
6. Alarm 80 is displayed.
7. Press [Reset] to return to operation mode.

#### Manual initialisation procedure

1. Remove power to the unit and wait for the display to turn off.
2. Press and hold [Status], [Main Menu], and [OK] at the same time while applying power to the unit (approximately 5 s or until audible click and fan starts).

Factory default parameter settings are restored during start-up. This may take slightly longer than normal.

Manual initialisation does not reset the following frequency converter information:

- 15-00 *Operating hours*
- 15-03 *Power Up's*
- 15-04 *Over Temp's*
- 15-05 *Over Volt's*

**Commissioning****Operating Instructions**

## 5.4 Basic Programming

### 5.4.1 Commissioning with SmartStart

The SmartStart wizard enables fast configuration of basic motor and application parameters.

- At first power up or after initialisation of the frequency converter, SmartStart starts automatically.
- Follow on-screen instructions to complete commissioning of the frequency converter. Always reactivate SmartStart by selecting *Quick Menu Q4 - SmartStart*.
- For commissioning without use of the SmartStart wizard, refer to *chapter 5.4.2 Commissioning via [Main Menu]* or the *Programming Guide*.

**5**

#### **NOTICE**

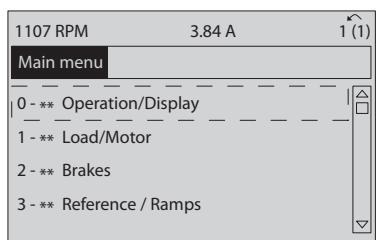
Motor data are required for the SmartStart set-up. The required data are normally available on the motor nameplate.

### 5.4.2 Commissioning via [Main Menu]

Recommended parameter settings are intended for start-up and checkout purposes. Application settings may vary.

Enter data with power ON, but before operating the frequency converter.

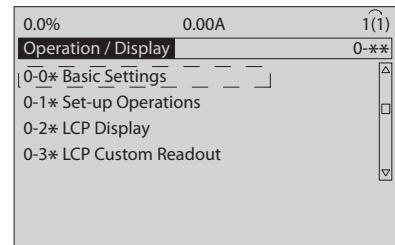
1. Press [Main Menu] on the LCP.
2. Press the navigation keys to scroll to parameter group *0-\*\* Operation/Display* and press [OK].



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Illustration 5.2 Main Menu

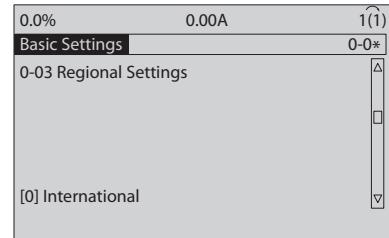
3. Press navigation keys to scroll to parameter group *0-0\* Basic Settings* and press [OK].



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Illustration 5.3 Operation/Display

4. Press navigation keys to scroll to *0-03 Regional Settings* and press [OK].



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Illustration 5.4 Basic Settings

5. Press navigation keys to select *[0] International* or *[1] North America* as appropriate and press [OK]. (This changes the default settings for a number of basic parameters).
6. Press [Main Menu] on the LCP.
7. Press the navigation keys to scroll to *0-01 Language*.
8. Select language and press [OK].
9. If a jumper wire is in place between control terminals 12 and 27, leave *5-12 Terminal 27 Digital Input* at factory default. Otherwise, select *No Operation* in *5-12 Terminal 27 Digital Input*.
10. *3-02 Minimum Reference*
11. *3-03 Maximum Reference*
12. *3-41 Ramp 1 Ramp Up Time*
13. *3-42 Ramp 1 Ramp Down Time*
14. *3-13 Reference Site*. Linked to Hand/Auto Local Remote.

**Commissioning****Operating Instructions**

### 5.4.3 Asynchronous Motor Set-up

Enter the motor data in parameter 1-20 *Motor Power [kW]* or 1-21 *Motor Power [HP]* to 1-25 *Motor Nominal Speed*. The information can be found on the motor nameplate.

1. 1-20 *Motor Power [kW]* or 1-21 *Motor Power [HP]*
2. 1-22 *Motor Voltage*
3. 1-23 *Motor Frequency*
4. 1-24 *Motor Current*
5. 1-25 *Motor Nominal Speed*

### 5.4.4 Permanent Magnet Motor Set-up

#### **NOTICE**

**Only use permanent magnet (PM) motor with fans and pumps.**

#### Initial Programming Steps

1. Activate PM motor operation 1-10 *Motor Construction*, select (1) *PM, non salient SPM*
2. Set 0-02 *Motor Speed Unit* to [0] *RPM*

#### Programming motor data

After selecting PM motor in 1-10 *Motor Construction*, the PM motor-related parameters in parameter groups 1-2\* *Motor Data*, 1-3\* *Adv. Motor Data* and 1-4\* are active. The necessary data can be found on the motor nameplate and in the motor data sheet.

Program the following parameters in the listed order

1. 1-24 *Motor Current*
2. 1-26 *Motor Cont. Rated Torque*
3. 1-25 *Motor Nominal Speed*
4. 1-39 *Motor Poles*
5. 1-30 *Stator Resistance (Rs)*  
Enter line to common stator winding resistance ( $R_s$ ). If only line-line data are available, divide the line-line value with 2 to achieve the line to common (starpoint) value.  
It is also possible to measure the value with an ohmmeter, which takes the resistance of the cable into account. Divide the measured value by 2 and enter the result.
6. 1-37 *d-axis Inductance (Ld)*  
Enter line to common direct axis inductance of the PM motor.  
If only line-line data are available, divide the line-line value with 2 to achieve the line-common (starpoint) value.  
It is also possible to measure the value with an inductancemeter, which takes the inductance of

the cable into account. Divide the measured value by 2 and enter the result.

7. 1-40 *Back EMF at 1000 RPM*  
Enter line to line back EMF of PM Motor at 1000 RPM mechanical speed (RMS value). Back EMF is the voltage generated by a PM motor when no drive is connected and the shaft is turned externally. Back EMF is normally specified for nominal motor speed or for 1000 RPM measured between 2 lines. If the value is not available for a motor speed of 1000 RPM, calculate the correct value as follows: If back EMF is e.g. 320 V at 1800 RPM, it can be calculated at 1000 RPM as follows:  
$$\text{Back EMF} = (\text{Voltage} / \text{RPM}) * 1000 = (320 / 1800) * 1000 = 178$$
. This is the value that must be programmed for 1-40 *Back EMF at 1000 RPM*.

#### Test motor operation

1. Start the motor at low speed (100 to 200 RPM). If the motor does not turn, check installation, general programming and motor data.
2. Check if start function in 1-70 *PM Start Mode* fits the application requirements.

#### Rotor detection

This function is the recommended choice for applications where the motor starts from standstill, e.g. pumps or conveyors. On some motors, an acoustic sound is heard when the impulse is sent out. This does not harm the motor.

#### Parking

This function is the recommended choice for applications where the motor is rotating at slow speed eg. windmilling in fan applications. 2-06 *Parking Current* and 2-07 *Parking Time* can be adjusted. Increase the factory setting of these parameters for applications with high inertia.

Start the motor at nominal speed. If the application does not run well, check the VVC+ PM settings. Recommendations in different applications can be seen in *Table 5.7*.

**Commissioning****Operating Instructions**

Application	Settings
Low inertia applications $I_{Load}/I_{Motor} < 5$	1-17 <i>Voltage filter time const.</i> to be increased by factor 5 to 10 1-14 <i>Damping Gain</i> should be reduced 1-66 <i>Min. Current at Low Speed</i> should be reduced (<100%)
Low inertia applications $50 > I_{Load}/I_{Motor} > 5$	Keep calculated values
High inertia applications $I_{Load}/I_{Motor} > 50$	1-14 <i>Damping Gain</i> , 1-15 <i>Low Speed Filter Time Const.</i> and 1-16 <i>High Speed Filter Time Const.</i> should be increased
High load at low speed <30% (rated speed)	1-17 <i>Voltage filter time const.</i> should be increased 1-66 <i>Min. Current at Low Speed</i> should be increased (>100% for a prolonged time can overheat the motor)

**Table 5.7 Recommendations in Different Applications**

If the motor starts oscillating at a certain speed, increase 1-14 *Damping Gain*. Increase the value in small steps. Depending on the motor, a good value for this parameter can be 10% or 100% higher than the default value.

Starting torque can be adjusted in 1-66 *Min. Current at Low Speed*. 100% provides nominal torque as starting torque.

#### 5.4.5 Automatic Energy Optimisation (AEO)

**NOTICE**

AEO is not relevant for permanent magnet motors.

Automatic Energy Optimisation (AEO) is a procedure that minimises voltage to the motor, reducing energy consumption, heat, and noise.

To activate AEO, set parameter 1-03 *Torque Characteristics* to [2] *Auto Energy Optim. CT* or [3] *Auto Energy Optim. VT*.

#### 5.4.6 Automatic Motor Adaptation (AMA)

**NOTICE**

AMA is not relevant for PM motors.

Automatic motor adaptation (AMA) is a procedure that optimises compatibility between the frequency converter and the motor.

- The frequency converter builds a mathematical model of the motor for regulating output motor current. The procedure also tests the input phase balance of electrical power. It compares the

motor characteristics with the data entered in parameters 1-20 to 1-25.

- The motor shaft does not turn and no harm is done to the motor while running the AMA.
- Some motors may be unable to run the complete version of the test. In that case, select [2] *Enable reduced AMA*.
- If an output filter is connected to the motor, select *Enable reduced AMA*.
- If warnings or alarms occur, see *chapter 7 Diagnostics and Troubleshooting*.
- Run this procedure on a cold motor for best results.

**To run AMA**

- Press [Main Menu] to access parameters.
- Scroll to parameter group 1-\*\* *Load and Motor* and press [OK].
- Scroll to parameter group 1-2\* *Motor Data* and press [OK].
- Scroll to 1-29 *Automatic Motor Adaptation (AMA)* and press [OK].
- Select [1] *Enable complete AMA* and press [OK].
- Follow on-screen instructions.
- The test runs automatically and indicate when it is complete.

#### 5.5 Checking Motor Rotation

**NOTICE**

Risk of damage to pumps/compressors caused by motor running in wrong direction. Before running the frequency converter, check the motor rotation.

The motor runs briefly at 5 Hz or the minimum frequency set in 4-12 *Motor Speed Low Limit [Hz]*.

- Press [Main Menu].
- Scroll to 1-28 *Motor Rotation Check* and press [OK].
- Scroll to [1] *Enable*.

The following text appears: *Note! Motor may run in wrong direction.*

- Press [OK].
- Follow the on-screen instructions.

**NOTICE**

To change the direction of rotation, remove power to the frequency converter and wait for power to discharge. Reverse the connection of any 2 of the 3 motor wires on the motor or frequency converter side of the connection.

## 5.6 Local-control Test

1. Press [Hand On] to provide a local start command to the frequency converter.
2. Accelerate the frequency converter by pressing [▲] to full speed. Moving the cursor left of the decimal point provides quicker input changes.
3. Note any acceleration problems.
4. Press [Off]. Note any deceleration problems.

In the event of acceleration or deceleration problems, see *chapter 7.5 Troubleshooting*. See *chapter 7.3 Warnings and Alarm Definitions - Frequency Converter* and *chapter 7.4 Warning and Alarm Definitions - Filter (Left LCP)* for resetting the frequency converter after a trip.

## 5.7 System Start-up

The procedure in this section requires user-wiring and application programming to be completed. The following procedure is recommended after application set-up is completed.

1. Press [Auto On].
2. Apply an external run command.
3. Adjust the speed reference throughout the speed range.
4. Remove the external run command.
5. Check sound and vibration level of the motor to ensure that the system is working as intended.

If warnings or alarms occur, see *chapter 7.3 Warnings and Alarm Definitions - Frequency Converter*.

## Application Examples

## Operating Instructions

## 6 Application Examples

### 6.1 Introduction

The examples in this section are intended as a quick reference for common applications.

- Parameter settings are the regional default values unless otherwise indicated (selected in *0-03 Regional Settings*).
- Parameters associated with the terminals and their settings are shown next to the drawings.
- Where switch settings for analog terminals A53 or A54 are required, these are also shown.

### 6

#### **NOTICE**

When the optional Safe Torque Off feature is used, a jumper wire may be required between terminal 12 (or 13) and terminal 37 for the frequency converter to operate when using factory default programming values.

### 6.2 Application Examples

#### 6.2.1 Speed

		Parameters	
FC		Function	Setting
+24 V	12○	6-10 Terminal 53	0.07 V*
+24 V	13○	Low Voltage	
D IN	18○	6-11 Terminal 53	10 V*
D IN	19○	High Voltage	
COM	20○	6-14 Terminal 53	0 Hz
D IN	27○	Low Ref./Feedb.	
D IN	29○	Value	
D IN	32○	6-15 Terminal 53	50 Hz
D IN	33○	High Ref./Feedb.	
D IN	37○	Value	
* = Default Value			
Notes/comments:			
D IN 37 is an option.			

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Table 6.1 Analog Speed Reference (Voltage)

		Parameters	
FC		Function	Setting
+24 V	12○	6-12 Terminal 53	4 mA*
+24 V	13○	Low Current	
D IN	18○	6-13 Terminal 53	20 mA*
D IN	19○	High Current	
COM	20○	6-14 Terminal 53	0 Hz
D IN	27○	Low Ref./Feedb.	
D IN	29○	Value	
D IN	32○	6-15 Terminal 53	50 Hz
D IN	33○	High Ref./Feedb.	
D IN	37○	Value	
+10 V	50○	* = Default Value	
A IN	53○	+	
A IN	54○		
COM	55○	-	
A OUT	42○		4 - 20mA
COM	39○		
U-I			
A53			
Notes/comments:			
D IN 37 is an option.			

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Table 6.2 Analog Speed Reference (Current)

		Parameters	
FC		Function	Setting
+24 V	12○	6-10 Terminal 53	0.07 V*
+24 V	13○	Low Voltage	
D IN	18○	6-11 Terminal 53	10 V*
D IN	19○	High Voltage	
COM	20○	6-14 Terminal 53	0 Hz
D IN	27○	Low Ref./Feedb.	
D IN	29○	Value	
D IN	32○	6-15 Terminal 53	1500 Hz
D IN	33○	High Ref./Feedb.	
D IN	37○	Value	
+10 V	50○	* = Default Value	
A IN	53○	+ →	
A IN	54○		
COM	55○	-	
A OUT	42○		
COM	39○		
U-I			
A53			
Notes/comments:			
D IN 37 is an option.			

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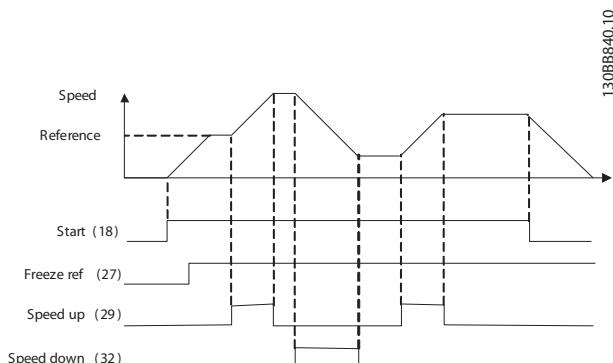
Table 6.3 Speed Reference (Using a Manual Potentiometer)

## Application Examples

## Operating Instructions

FC		Parameters	
		Function	Setting
+24 V	12○	5-10 Terminal 18	[8] Start*
+24 V	13○	Digital Input	
D IN	18○	5-12 Terminal 27	[19] Freeze
D IN	19○	Digital Input	Reference
COM	20○	5-13 Terminal 29	[21] Speed
D IN	27○	Digital Input	Up
D IN	29○	5-14 Terminal 32	[22] Speed
D IN	32○	Digital Input	Down
D IN	33○	* = Default Value	
D IN	37○		
+10 V	50○	<b>Notes/comments:</b>	
A IN	53○	D IN 37 is an option.	
A IN	54○		
COM	55○		
A OUT	42○		
COM	39○		

Table 6.4 Speed Up/Down

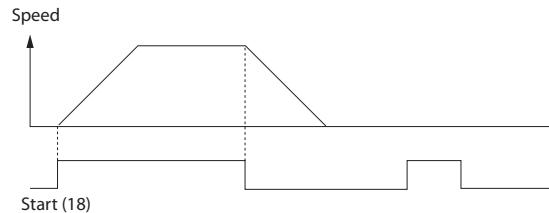


### Illustration 6.1 Speed Up/Down

## 6.2.2 Start/Stop

FC		Parameters	
		Function	Setting
+24 V	120	5-10 Terminal 18	[8] Start*
+24 V	130	Digital Input	
D IN	180	5-12 Terminal 27	[0] No operation
D IN	190	Digital Input	
COM	200	5-19 Terminal 37	[1] Safe Stop
D IN	270	Safe Stop	Alarm
D IN	290	* = Default Value	
D IN	320	<b>Notes/comments:</b>	
D IN	330	If 5-12 Terminal 27 Digital Input	
D IN	370	is set to [0] No operation, a	
+10	500	jumper wire to terminal 27 is	
A IN	530	not needed.	
A IN	540	D IN 37 is an option.	
COM	550		
A OUT	420		
COM	390		

**Table 6.5 Start/Stop Command with Safe Stop Option**



#### **Illustration 6.2 Start/Stop Command with Safe Stop**

## Application Examples

## Operating Instructions

		Parameters	
Function	Setting		
5-10 Terminal 18 Digital Input	[9] Latched Start		
5-12 Terminal 27 Digital Input	[6] Stop Inverse		
* = Default Value			
<b>Notes/comments:</b> If 5-12 Terminal 27 Digital Input is set to [0] No operation, a jumper wire to terminal 27 is not needed. D IN 37 is an option.			

FC

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Table 6.6 Pulse Start/Stop

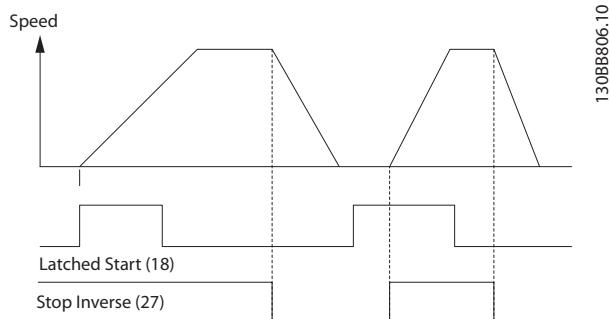


Illustration 6.3 Latched Start/Stop Inverse

		Parameters	
Function	Setting		
5-10 Terminal 18 Digital Input	[8] Start		
5-11 Terminal 19 Digital Input	[10] Reversing*		
5-12 Terminal 27 Digital Input	[0] No operation		
5-14 Terminal 32 Digital Input	[16] Preset ref bit 0		
5-15 Terminal 33 Digital Input	[17] Preset ref bit 1		
3-10 Preset Reference			
Preset ref. 0	25%		
Preset ref. 1	50%		
Preset ref. 2	75%		
Preset ref. 3	100%		
* = Default Value			
<b>Notes/comments:</b> D IN 37 is an option.			

Table 6.7 Start/Stop with Reversing and 4 Preset Speeds

## 6.2.3 External Alarm Reset

		Parameters	
Function	Setting		
5-11 Terminal 19 Digital Input	[1] Reset		
* = Default Value			
<b>Notes/comments:</b> D IN 37 is an option.			

FC

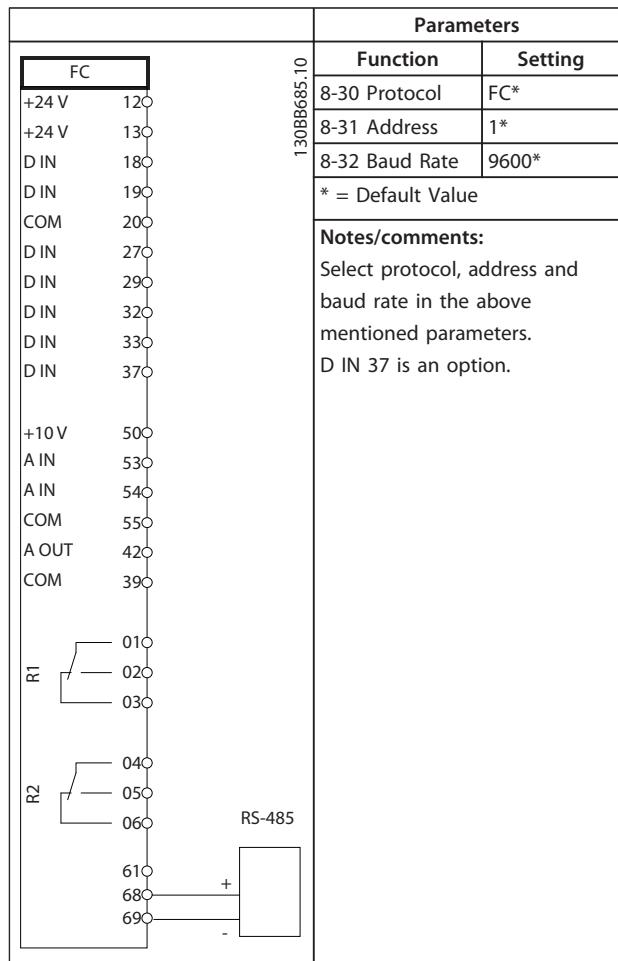
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Table 6.8 External Alarm Reset

## Application Examples

## Operating Instructions

#### 6.2.4 RS-485



**Table 6.9 RS-485 Network Connection**

### 6.2.5 Motor Thermistor

**CAUTION**

## **THERMISTOR INSULATION**

- Use only thermistors with reinforced or double insulation to meet PELV insulation requirements.

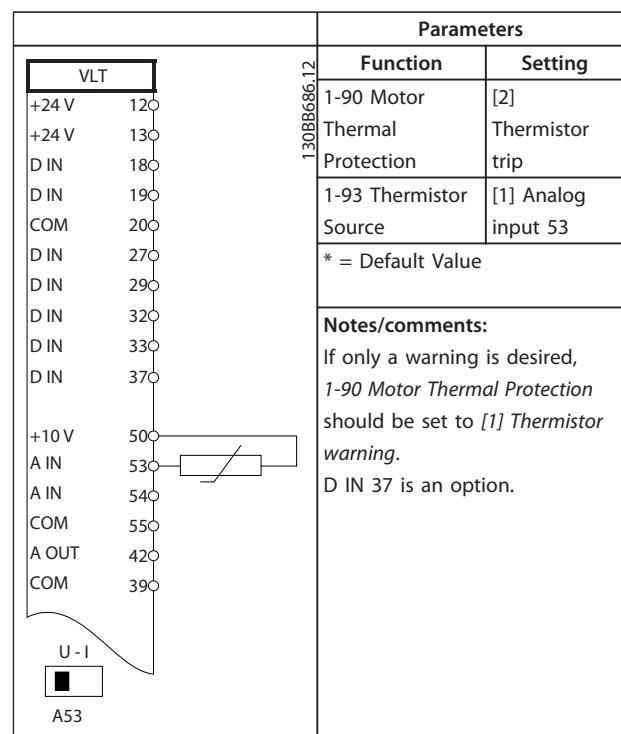
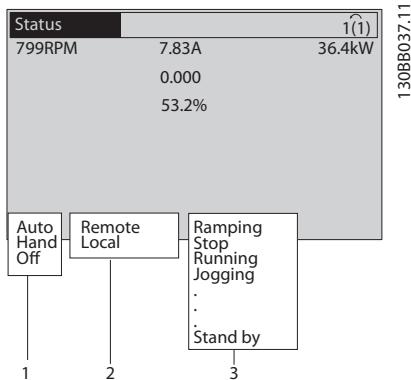


Table 6.10 Motor Thermistor

## 7 Diagnostics and Troubleshooting

### 7.1 Status Messages

When the frequency converter is in status mode, status messages are generated automatically and appear in the bottom line of the display (see *Illustration 7.1*).



1	Operation mode (see <i>Table 7.1</i> )
2	Reference site (see <i>Table 7.2</i> )
3	Operation status (see <i>Table 7.3</i> )

**Illustration 7.1 Status Display**

*Table 7.1* to *Table 7.3* describe the displayed status messages.

Off	The frequency converter does not react to any control signal until [Auto On] or [Hand On] is pressed.
Auto On	The frequency converter is controlled from the control terminals and/or the serial communication.
Hand On	Control the unit via the navigation keys on the LCP. Stop commands, reset, reversing, DC brake, and other signals applied to the control terminals can override local control.

**Table 7.1 Operation Mode**

Remote	The speed reference is given from external signals, serial communication, or internal preset references.
Local	The frequency converter uses [Hand On] control or reference values from the LCP.

**Table 7.2 Reference Site**

AC Brake	AC Brake was selected in 2-10 <i>Brake Function</i> . The AC brake over-magnetises the motor to achieve a controlled slow down.
AMA finish OK	Automatic motor adaptation (AMA) was carried out successfully.
AMA ready	AMA is ready to start. Press [Hand On] to start.
AMA running	AMA process is in progress.
Braking	The brake chopper is in operation. The brake resistor absorbs generative energy.
Braking max.	The brake chopper is in operation. The power limit for the brake resistor has been reached.
Coast	<ul style="list-style-type: none"> <li>• Coast inverse was selected as a function for a digital input (parameter group 5-1* <i>Digital Inputs</i>). The corresponding terminal is not connected.</li> <li>• Coast activated by serial communication</li> </ul>
Ctrl. Ramp-down	<p>Control Ramp-down was selected in 14-10 <i>Mains Failure</i>.</p> <ul style="list-style-type: none"> <li>• The mains voltage is below the value set in 14-11 <i>Mains Voltage at Mains Fault</i> at mains fault</li> <li>• The frequency converter ramps down the motor using a controlled ramp down</li> </ul>
Current High	The frequency converter output current is above the limit set in 4-51 <i>Warning Current High</i> .
Current Low	The frequency converter output current is below the limit set in 4-52 <i>Warning Speed Low</i> .
DC Hold	DC hold is selected in 1-80 <i>Function at Stop</i> and a stop command is active. The motor is held by a DC current set in 2-00 <i>DC Hold/Preheat Current</i> .
DC Stop	<p>The motor is held with a DC current (2-01 <i>DC Brake Current</i>) for a specified time (2-02 <i>DC Braking Time</i>).</p> <ul style="list-style-type: none"> <li>• DC brake is activated in 2-03 <i>DC Brake Cut In Speed [RPM]</i> and a stop command is active.</li> <li>• DC brake (inverse) is selected as a function for a digital input (parameter group 5-1* <i>Digital Inputs</i>). The corresponding terminal is not active.</li> <li>• The DC brake is activated via serial communication.</li> </ul>
Feedback high	The sum of all active feedbacks is above the feedback limit set in 4-57 <i>Warning Feedback High</i> .
Feedback low	The sum of all active feedbacks is below the feedback limit set in 4-56 <i>Warning Feedback Low</i> .

## Diagnostics and Troubleshoo...

## Operating Instructions

Freeze output	The remote reference is active, which holds the present speed. <ul style="list-style-type: none"> <li>• Freeze output was selected as a function for a digital input (parameter group 5-1* <i>Digital Inputs</i>). The corresponding terminal is active. Speed control is only possible via the terminal functions Speed Up and Speed Down.</li> <li>• Hold ramp is activated via serial communication.</li> </ul>	Protection md	Protection mode is active. The unit has detected a critical status (an overcurrent or overvoltage). <ul style="list-style-type: none"> <li>• To avoid tripping, the switching frequency is reduced to 4 kHz.</li> <li>• If possible, protection mode ends after approximately 10 s.</li> <li>• Protection mode can be restricted in 14-26 <i>Trip Delay at Inverter Fault</i>.</li> </ul>
Freeze output request	A freeze output command has been given, but the motor remains stopped until a run permissive signal is received.	QStop	The motor is decelerating using 3-81 <i>Quick Stop Ramp Time</i> . <ul style="list-style-type: none"> <li>• Quick stop inverse was selected as a function for a digital input (parameter group 5-1* <i>Digital Inputs</i>). The corresponding terminal is not active.</li> <li>• The quick stop function was activated via serial communication.</li> </ul>
Freeze ref.	<i>Freeze Reference</i> was selected as a function for a digital input (parameter group 5-1* <i>Digital Inputs</i> ). The corresponding terminal is active. The frequency converter saves the actual reference. Changing the reference is now only possible via terminal functions speed up and speed down.	Ramping	The motor is accelerating/decelerating using the active ramp up/down. The reference, a limit value, or a standstill is not yet reached.
Jog request	A jog command has been given, but the motor remains stopped until a run permissive signal is received via a digital input.	Ref. high	The sum of all active references is above the reference limit set in 4-55 <i>Warning Reference High</i> .
Jogging	The motor is running as programmed in 3-19 <i>Jog Speed [RPM]</i> . <ul style="list-style-type: none"> <li>• Jog was selected as function for a digital input (parameter group 5-1* <i>Digital Inputs</i>). The corresponding terminal is active.</li> <li>• The jog function is activated via the serial communication.</li> <li>• The jog function was selected as a reaction for a monitoring function. The monitoring function is active.</li> </ul>	Ref. low	The sum of all active references is below the reference limit set in 4-54 <i>Warning Reference Low</i> .
Motor check	In 1-80 <i>Function at Stop, Motor Check</i> was selected. A stop command is active. To ensure that a motor is connected to the frequency converter, a permanent test current is applied to the motor.	Run on ref.	The frequency converter is running in the reference range. The feedback value matches the setpoint value.
OVC control	<i>Ovvoltage control</i> was activated in 2-17 <i>Overvoltage Control, [2] Enabled</i> . The connected motor supplies the frequency converter with generative energy. The overvoltage control adjusts the V/Hz ratio to run the motor in controlled mode and to prevent the frequency converter from tripping.	Run request	A start command has been given, but the motor is stopped until a run permissive signal is received via digital input.
PowerUnit Off	(Only frequency converters with an external 24 V power supply installed). Mains supply to the frequency converter is removed, but the control card is supplied by the external 24 V.	Running	The frequency converter drives the motor.
		Sleep Mode	The energy saving function is enabled. The motor has stopped, but restarts automatically when required.
		Speed high	Motor speed is above the value set in 4-53 <i>Warning Speed High</i> .
		Speed low	Motor speed is below the value set in 4-52 <i>Warning Speed Low</i> .
		Standby	In Auto On mode, the frequency converter starts the motor with a start signal from a digital input or serial communication.
		Start delay	In 1-71 <i>Start Delay</i> , a delay starting time was set. A start command is activated and the motor starts after the start delay time expires.
		Start fwd/rev	Start forward and start reverse were selected as functions for 2 different digital inputs (parameter group 5-1* <i>Digital Inputs</i> ). The motor starts in forward or reverse depending on which corresponding terminal is activated.
		Stop	The frequency converter has received a stop command from the LCP, digital input, or serial communication.

Trip	An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, the frequency converter can be reset manually by pressing [Reset] or remotely by control terminals or serial communication.
Trip lock	An alarm occurred and the motor is stopped. Once the cause of the alarm is cleared, power must be cycled to the frequency converter. The frequency converter can then be reset manually by pressing [Reset] or remotely by control terminals or serial communication.

Table 7.3 Operation Status

**NOTICE**

In auto/remote mode, the frequency converter requires external commands to execute functions.

**7**

## 7.2 Warning and Alarm Types

The frequency converter monitors the condition of its input power, output, and motor factors as well as other system performance indicators. A warning or alarm does not necessarily indicate a problem internal to the frequency converter itself. In many cases, it indicates failure conditions from:

- input voltage
- motor load
- motor temperature
- external signals
- other areas monitored by internal logic

Investigate as indicated in the alarm or warning.

### 7.2.1 Warnings

A warning is issued when an alarm condition is impending or when an abnormal operating condition is present and may result in the frequency converter issuing an alarm. A warning clears by itself when the abnormal condition is removed.

### 7.2.2 Alarm Trip

An alarm is issued when the frequency converter is tripped, that is, the frequency converter suspends operation to prevent frequency converter or system damage. The motor coasts to a stop. The frequency converter logic continues to operate and monitors the frequency converter status. After the fault condition is remedied, reset the frequency converter. It is then ready to start operation again.

A trip can be reset in any of 4 ways:

- Press [Reset] on the LCP
- Digital reset input command
- Serial communication reset input command
- Auto reset

### 7.2.3 Alarm Trip-lock

An alarm that causes the frequency converter to trip-lock requires that input power is cycled. The motor coasts to a stop. The frequency converter logic continues to operate and monitors the frequency converter status. Remove input power to the frequency converter and correct the cause of the fault, then restore power. This action puts the frequency converter into a trip condition as described in chapter 7.2.2 Alarm Trip and may be reset in any of the 4 ways.

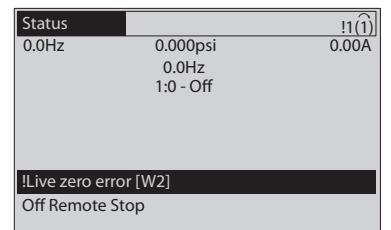


Illustration 7.2 Warning Display

An alarm or trip-lock alarm flashes in the display along with the alarm number.

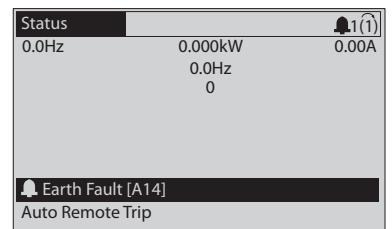
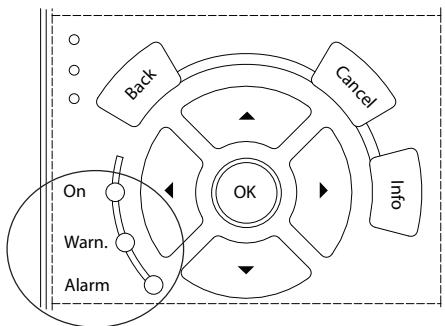


Illustration 7.3 Alarm Display

In addition to the text and alarm code in the display, there are 3 status indicator lights.

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130BB467.11

Illustration 7.4 Status Indicator Lights

	Warning LED	Alarm LED
Warning	On	Off
Alarm	Off	On (Flashing)
Trip-Lock	On	On (Flashing)

Table 7.4 Status Indicator Lights Explanations

### 7.3 Warnings and Alarm Definitions - Frequency Converter

The warning/alarm information below defines each warning/alarm condition, provides the probable cause for the condition, and details a remedy or troubleshooting procedure.

#### WARNING 1, 10 Volts low

The control card voltage is below 10 V from terminal 50. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Max. 15 mA or minimum 590 Ω.

A short circuit in a connected potentiometer or improper wiring of the potentiometer can cause this condition.

#### Troubleshooting

- Remove the wiring from terminal 50. If the warning clears, the problem is with the wiring. If the warning does not clear, replace the control card.

#### WARNING/ALARM 2, Live zero error

This warning or alarm only appears if programmed in 6-01 Live Zero Timeout Function. The signal on one of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or faulty device sending the signal can cause this condition.

#### Troubleshooting

- Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. MCB 101 terminals 11 and 12 for signals, terminal 10 common. MCB

109 terminals 1, 3, 5 for signals, terminals 2, 4, 6 common).

- Check that the frequency converter programming and switch settings match the analog signal type.
- Perform input terminal signal test.

#### WARNING/ALARM 3, No motor

No motor has been connected to the output of the frequency converter.

#### WARNING/ALARM 4, Mains phase loss

A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier on the frequency converter. Options are programmed at 14-12 *Function at Mains Imbalance*.

#### Troubleshooting

- Check the supply voltage and supply currents to the frequency converter.

#### WARNING 5, DC link voltage high

The intermediate circuit voltage (DC) is higher than the high-voltage warning limit. The limit is dependent on the frequency converter voltage rating. The unit is still active.

#### WARNING 6, DC link voltage low

The intermediate circuit voltage (DC) is lower than the low-voltage warning limit. The limit is dependent on the frequency converter voltage rating. The unit is still active.

#### WARNING/ALARM 7, DC overvoltage

If the intermediate circuit voltage exceeds the limit, the frequency converter trips after a time.

#### Troubleshooting

- Connect a brake resistor
- Extend the ramp time
- Change the ramp type
- Activate the functions in 2-10 *Brake Function*
- Increase 14-26 *Trip Delay at Inverter Fault*
- If the alarm/warning occurs during a power sag, use kinetic back-up (14-10 *Mains Failure*)

#### WARNING/ALARM 8, DC under voltage

If the DC-link voltage drops below the undervoltage limit, the frequency converter checks if a 24 V DC backup supply is connected. If no 24 V DC backup supply is connected, the frequency converter trips after a fixed time delay. The time delay varies with unit size.

#### Troubleshooting

- Check that the supply voltage matches the frequency converter voltage.
- Perform input voltage test.
- Perform soft charge circuit test.

**WARNING/ALARM 9, Inverter overload**

The frequency converter is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection issues a warning at 98% and trips at 100%, while giving an alarm. The frequency converter cannot be reset until the counter is below 90%.

The fault is that the frequency converter has run with more than 100% overload for too long.

**Troubleshooting**

- Compare the output current shown on the LCP with the frequency converter rated current.
- Compare the output current shown on the LCP with measured motor current.
- Display the thermal drive load on the LCP and monitor the value. When running above the frequency converter continuous current rating, the counter increases. When running below the frequency converter continuous current rating, the counter decreases.

**WARNING/ALARM 10, Motor overload temperature**

According to the electronic thermal protection (ETR), the motor is too hot. Select whether the frequency converter issues a warning or an alarm when the counter reaches 100% in *1-90 Motor Thermal Protection*. The fault occurs when the motor runs with more than 100% overload for too long.

**Troubleshooting**

- Check for motor overheating.
- Check if the motor is mechanically overloaded
- Check that the motor current set in *1-24 Motor Current* is correct.
- Ensure that Motor data in parameters 1-20 to 1-25 are set correctly.
- If an external fan is in use, check in *1-91 Motor External Fan* that it is selected.
- Running AMA in *1-29 Automatic Motor Adaptation* (AMA) tunes the frequency converter to the motor more accurately and reduces thermal loading.

**WARNING/ALARM 11, Motor thermistor over temp**

The thermistor might be disconnected. Select whether the frequency converter issues a warning or an alarm in *1-90 Motor Thermal Protection*.

**Troubleshooting**

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 or 54 is set for

voltage. Check that *1-93 Thermistor Resource* selects terminal 53 or 54.

- When using digital inputs 18 or 19, check that the thermistor is connected correctly between either terminal 18 or 19 (digital input PNP only) and terminal 50.
- If a KTY sensor is used, check for correct connection between terminals 54 and 55
- If using a thermal switch or thermistor, check that the programming of *1-93 Thermistor Resource* matches sensor wiring.
- If using a KTY Sensor, check the programming of *1-95 KTY Sensor Type*, *1-96 KTY Thermistor Resource* and *1-97 KTY Threshold level* match sensor wiring.

**WARNING/ALARM 12, Torque limit**

The torque has exceeded the value in *4-16 Torque Limit Motor Mode* or the value in *4-17 Torque Limit Generator Mode*. *14-25 Trip Delay at Torque Limit* can change this warning from a warning-only condition to a warning followed by an alarm.

**Troubleshooting**

- If the motor torque limit is exceeded during ramp up, extend the ramp up time.
- If the generator torque limit is exceeded during ramp down, extend the ramp down time.
- If torque limit occurs while running, possibly increase the torque limit. Make sure that the system can operate safely at a higher torque.
- Check the application for excessive current draw on the motor.

**WARNING/ALARM 13, Over current**

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 1.5 s, then the frequency converter trips and issues an alarm. Shock loading or quick acceleration with high inertia loads can cause this fault. If the acceleration during ramp up is quick, the fault can also appear after kinetic back-up. If extended mechanical brake control is selected, trip can be reset externally.

**Troubleshooting**

- Remove power and check if the motor shaft can be turned.
- Check that the motor size matches the frequency converter.
- Check parameters 1-20 to 1-25 for correct motor data.

**ALARM 14, Earth (ground) fault**

There is current from the output phases to ground, either in the cable between the frequency converter and the motor or in the motor itself.

**Troubleshooting**

- Remove power to the frequency converter and repair the ground fault.
- Check for ground faults in the motor by measuring the resistance to the ground of the motor cables and the motor with a megohmmeter.
- Perform current sensor test.

**ALARM 15, Hardware mismatch**

A fitted option is not operational with the present control board hardware or software.

Record the value of the following parameters and contact Danfoss:

- 15-40 FC Type
- 15-41 Power Section
- 15-42 Voltage
- 15-43 Software Version
- 15-45 Actual Typecode String
- 15-49 SW ID Control Card
- 15-50 SW ID Power Card
- 15-60 Option Mounted
- 15-61 Option SW Version (for each option slot)

**ALARM 16, Short circuit**

There is short-circuiting in the motor or motor wiring.

Remove power to the frequency converter and repair the short circuit.

**WARNING/ALARM 17, Control word timeout**

There is no communication to the frequency converter.

The warning is only active when 8-04 Control Word Timeout Function is not set to [0] Off.

If 8-04 Control Word Timeout Function is set to [2] Stop and [26] Trip, a warning appears and the frequency converter ramps down until it trips and then displays an alarm.

**Troubleshooting:**

- Check connections on the serial communication cable.
- Increase 8-03 Control Word Timeout Time
- Check the operation of the communication equipment.
- Verify a proper installation based on EMC requirements.

**WARNING/ALARM 22, Hoist mechanical brake**

Report value shows what kind it is.

0 = The torque ref. was not reached before time out (2-27 Torque Ramp Time).

1 = Expected brake feedback not received before time out (2-23 Activate Brake Delay, 2-25 Brake Release Time).

**WARNING 23, Internal fan fault**

The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in 14-53 Fan Monitor ([0] Disabled).

**Troubleshooting**

- Check fan resistance.
- Check soft charge fuses.

**WARNING 24, External fan fault**

The fan warning function is an extra protective function that checks if the fan is running/mounted. The fan warning can be disabled in 14-53 Fan Monitor ([0] Disabled).

**Troubleshooting**

- Check fan resistance.
- Check soft charge fuses.

**WARNING 25, Brake resistor short circuit**

The brake resistor is monitored during operation. If a short circuit occurs, the brake function is disabled and the warning appears. The frequency converter is still operational, but without the brake function.

**Troubleshooting**

- Remove power to the frequency converter and replace the brake resistor (see 2-15 Brake Check).

**WARNING/ALARM 26, Brake resistor power limit**

The power transmitted to the brake resistor is calculated as a mean value over the last 120 s of run time. The calculation is based on the intermediate circuit voltage and the brake resistance value set in 2-16 AC brake Max.

*Current.* The warning is active when the dissipated braking is higher than 90% of the brake resistance power. If [2] Trip is selected in 2-13 Brake Power Monitoring, the frequency converter trips when the dissipated braking power reaches 100%.

**WARNING**

If the brake transistor is short-circuited, there is a risk of substantial power being transmitted to the brake resistor.

**WARNING/ALARM 27, Brake chopper fault**

The brake transistor is monitored during operation and if a short circuit occurs, the brake function is disabled and a warning is issued. The frequency converter is still operational, but since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.

Remove power to the frequency converter and remove the brake resistor.

This alarm/warning could also occur if the brake resistor overheats. Terminals 104 and 106 are available as brake resistors Klixon inputs.

**WARNING/ALARM 28, Brake check failed**

The brake resistor is not connected or not working. Check 2-15 Brake Check.

**ALARM 29, Heat Sink temp**

The maximum temperature of the heat sink has been exceeded. The temperature fault resets when the temperature falls below a defined heat sink temperature. The trip and reset points are different based on the frequency converter power size.

**Troubleshooting**

Check for the following conditions.

- Ambient temperature too high.
- Motor cables too long.
- Incorrect airflow clearance above and below the frequency converter
- Blocked airflow around the frequency converter.
- Damaged heat sink fan.
- Dirty heat sink.

For the D, E, and F enclosures, this alarm is based on the temperature measured by the heat sink sensor mounted inside the IGBT modules. For the F enclosures, the thermal sensor in the rectifier module can also cause this alarm.

**Troubleshooting**

- Check fan resistance.
- Check soft charge fuses.
- IGBT thermal sensor.

**ALARM 30, Motor phase U missing**

Motor phase U between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase U.

**ALARM 31, Motor phase V missing**

Motor phase V between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase V.

**ALARM 32, Motor phase W missing**

Motor phase W between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase W.

**ALARM 33, Inrush fault**

Too many power-ups have occurred within a short time period. Let the unit cool to operating temperature.

**WARNING/ALARM 34, Fieldbus communication fault**

The fieldbus on the communication option card is not working.

**WARNING/ALARM 36, Mains failure**

This warning/alarm is only active if the supply voltage to the frequency converter is lost and *14-10 Mains Failure* is not set to *[0] No Function*. Check the fuses to the frequency converter and mains supply to the unit.

**ALARM 38, Internal fault**

When an internal fault occurs, a code number defined in *Table 7.5* is displayed.

**Troubleshooting**

- Cycle power
- Check that the option is properly installed
- Check for loose or missing wiring

It may be necessary to contact Danfoss service or the supplier. Note the code number for further troubleshooting directions.

No.	Text
0	Serial port cannot be initialised. Contact your Danfoss supplier or Danfoss Service Department.
256–258	Power EEPROM data is defective or too old
512	Control board EEPROM data is defective or too old.
513	Communication time-out reading EEPROM data
514	Communication time-out reading EEPROM data
515	Application-oriented control cannot recognise the EEPROM data.
516	Cannot write to the EEPROM because a write command is on progress.
517	Write command is under time-out
518	Failure in the EEPROM
519	Missing or invalid barcode data in EEPROM
783	Parameter value outside of min/max limits
1024–1279	A CAN telegram that has to be sent could not be sent.
1281	Digital signal processor flash time-out
1282	Power micro software version mismatch
1283	Power EEPROM data version mismatch
1284	Cannot read digital signal processor software version
1299	Option SW in slot A is too old
1300	Option SW in slot B is too old
1301	Option SW in slot C0 is too old
1302	Option SW in slot C1 is too old
1315	Option SW in slot A is not supported (not allowed)
1316	Option SW in slot B is not supported (not allowed)
1317	Option SW in slot C0 is not supported (not allowed)
1318	Option SW in slot C1 is not supported (not allowed)
1379	Option A did not respond when calculating platform version
1380	Option B did not respond when calculating platform version
1381	Option C0 did not respond when calculating platform version.
1382	Option C1 did not respond when calculating platform version.
1536	An exception in the application-oriented control is registered. Debug information written in LCP.

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No.	Text
1792	DSP Watch Dog is active. Debugging of power part data, motor-oriented control data not transferred correctly.
2049	Power data restarted
2064-2072	H081x: Option in slot x has restarted
2080-2088	H082x: Option in slot x has issued a powerup-wait
2096-2104	H983x: Option in slot x has issued a legal powerup-wait
2304	Could not read any data from power EEPROM
2305	Missing SW version from power unit
2314	Missing power unit data from power unit
2315	Missing SW version from power unit
2316	Missing lo_statepage from power unit
2324	Power card configuration is determined to be incorrect at power-up
2325	A power card has stopped communicating while main power is applied
2326	Power card configuration is determined to be incorrect after the delay for power cards to register.
2327	Too many power card locations have been registered as present.
2330	Power size information between the power cards does not match.
2561	No communication from DSP to ATACD
2562	No communication from ATACD to DSP (state running)
2816	Stack overflow control board module
2817	Scheduler slow tasks
2818	Fast tasks
2819	Parameter thread
2820	LCP stack overflow
2821	Serial port overflow
2822	USB port overflow
2836	cflistMempool too small
3072-5122	Parameter value is outside its limits
5123	Option in slot A: Hardware incompatible with control board hardware
5124	Option in slot B: Hardware incompatible with control board hardware.
5125	Option in slot C0: Hardware incompatible with control board hardware.
5126	Option in slot C1: Hardware incompatible with control board hardware.
5376-6231	Out of memory

Table 7.5 Internal Fault, Code Numbers

**ALARM 39, Heat Sink sensor**

No feedback from the heat sink temperature sensor.

The signal from the IGBT thermal sensor is not available on the power card. The problem could be on the power card, on the gate drive card, or the ribbon cable between the power card and gate drive card.

**WARNING 40, Overload of digital output terminal 27**

Check the load connected to terminal 27 or remove short-circuit connection. Check 5-00 Digital I/O Mode and 5-01 Terminal 27 Mode.

**WARNING 41, Overload of digital output terminal 29**

Check the load connected to terminal 29 or remove short-circuit connection. Check 5-00 Digital I/O Mode and 5-02 Terminal 29 Mode.

**WARNING 42, Overload of digital output on X30/6 or overload of digital output on X30/7**

For X30/6, check the load connected to X30/6 or remove the short-circuit connection. Check 5-32 Term X30/6 Digi Out (MCB 101).

For X30/7, check the load connected to X30/7 or remove the short-circuit connection. Check 5-33 Term X30/7 Digi Out (MCB 101).

**ALARM 45, Earth fault 2**

Ground fault.

**Troubleshooting**

- Check for proper grounding and loose connections.
- Check for proper wire size.
- Check motor cables for short-circuits or leakage currents.

**ALARM 46, Power card supply**

The supply on the power card is out of range.

There are 3 power supplies generated by the switch mode power supply (SMPS) on the power card: 24 V, 5 V, ±18 V. When powered with 24 V DC with the MCB 107 option, only the 24 V and 5 V supplies are monitored. When powered with 3 phase mains voltage, all 3 supplies are monitored.

**WARNING 47, 24 V supply low**

The 24 V DC is measured on the control card. This alarm arises when the detected voltage of terminal 12 is lower than 18 V.

**Troubleshooting**

- Check for a defective control card.

**WARNING 48, 1.8 V supply low**

The 1.8 V DC supply used on the control card is outside of allowable limits. The power supply is measured on the control card. Check for a defective control card. If an option card is present, check for an overvoltage condition.

**WARNING 49, Speed limit**

When the speed is not within the specified range in 4-11 Motor Speed Low Limit [RPM] and 4-13 Motor Speed High Limit [RPM], the frequency converter shows a warning. When the speed is below the specified limit in 1-86 Trip Speed Low [RPM] (except when starting or stopping), the frequency converter trips.

**ALARM 50, AMA calibration failed**

Contact Danfoss supplier or Danfoss service department.

**ALARM 51, AMA check  $U_{\text{nom}}$  and  $I_{\text{nom}}$** 

The settings for motor voltage, motor current and motor power are wrong. Check the settings in parameters 1-20 to 1-25.

**ALARM 52, AMA low  $I_{\text{nom}}$** 

The motor current is too low. Check the settings.

**ALARM 53, AMA motor too big**

The motor is too big for the AMA to operate.

**ALARM 54, AMA motor too small**

The motor is too small for the AMA to operate.

**ALARM 55, AMA parameter out of range**

The parameter values of the motor are outside of the acceptable range. AMA cannot run.

**ALARM 56, AMA interrupted by user**

The user has interrupted the AMA.

**ALARM 57, AMA internal fault**

Try to restart AMA again a number of times, until the AMA is carried out.

**NOTICE**

**Repeated runs may heat the motor to a level where the resistance  $R_s$  and  $R_r$  are increased. In most cases, however, this behaviour is not critical.**

**ALARM 58, AMA Internal fault**

Contact the Danfoss supplier.

**WARNING 59, Current limit**

The current is higher than the value in 4-18 *Current Limit*. Ensure that motor data in parameters 1-20 to 1-25 are set correctly. Possibly increase the current limit. Be sure that the system can operate safely at a higher limit.

**WARNING 60, External interlock**

External interlock has been activated. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock and reset the frequency converter (via serial communication, digital I/O, or by pressing [Reset]).

**WARNING/ALARM 61, Tracking error**

An error between calculated motor speed and speed measurement from feedback device. The function warning/alarm/disable is set in 4-30 *Motor Feedback Loss Function*. Accepted error setting in 4-31 *Motor Feedback Speed Error* and the allowed time the error occur setting in 4-32 *Motor Feedback Loss Timeout*. During a commissioning procedure, the function could be effective.

**WARNING 62, Output frequency at maximum limit**

The output frequency is higher than the value set in 4-19 *Max Output Frequency*.

**ALARM 63, Mechanical brake low**

The actual motor current has not exceeded the release brake current within the start delay time window.

**ALARM 64, Voltage Limit**

The load and speed combination demands a motor voltage higher than the actual DC-link voltage.

**WARNING/ALARM 65, Control card over temperature**

The cut-out temperature of the control card is 80 °C.

**Troubleshooting**

- Check that the ambient operating temperature is within limits
- Check for clogged filters
- Check fan operation
- Check the control card

**WARNING 66, Heat sink temperature low**

The frequency converter is too cold to operate. This warning is based on the temperature sensor in the IGBT module.

Increase the ambient temperature of the unit. Also, a trickle amount of current can be supplied to the frequency converter whenever the motor is stopped by setting 2-00 *DC Hold/Preheat Current at 5%* and 1-80 *Function at Stop*

**Troubleshooting**

The heat sink temperature measured as 0 °C could indicate that the temperature sensor is defective, causing the fan speed to increase to the maximum. If the sensor wire between the IGBT and the gate drive card is disconnected, this warning would result. Also, check the IGBT thermal sensor.

**ALARM 67, Option module configuration has changed**

One or more options have either been added or removed since the last power-down. Check that the configuration change is intentional and reset the unit.

**ALARM 68, Safe Stop activated**

Safe Torque Off has been activated. To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal (via bus, digital I/O, or by pressing [Reset]).

**ALARM 69, Power card temperature**

The temperature sensor on the power card is either too hot or too cold.

**Troubleshooting**

- Check the operation of the door fans.
- Check that the filters for the door fans are not blocked.
- Check that the gland plate is properly installed on IP21/IP 54 (NEMA 1/12) frequency converters.

**ALARM 70, Illegal FC configuration**

The control card and power card are incompatible. To check compatibility, contact the Danfoss supplier with the type code of the unit from the nameplate and the part numbers of the cards.

**ALARM 71, PTC 1 Safe Torque Off**

Safe Torque Off has been activated from the VLT® PTC Thermistor Card MCB 112 (motor too warm). Normal operation can resume when the VLT® PTC Thermistor Card MCB 112 applies 24 V DC to T-37 (when the motor temperature is acceptable) and when the digital input

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from the VLT® PTC Thermistor Card MCB 112 is deactivated. When that happens, a reset signal must be sent (via Bus, Digital I/O, or by pressing [Reset]). Note that if automatic restart is enabled, the motor could start when the fault is cleared.

#### **ALARM 72, Dangerous failure**

Safe Torque Off with trip lock. Unexpected signal levels on safe stop and digital input from the VLT® PTC Thermistor Card MCB 112.

#### **WARNING 73, Safe Stop auto restart**

Safe stopped. With automatic restart enabled, the motor could start when the fault is cleared.

#### **WARNING 76, Power unit setup**

The required number of power units does not match the detected number of active power units.

#### **WARNING 77, Reduced power mode**

The frequency converter is operating in reduced power mode (less than the allowed number of inverter sections). This warning is generated on power cycle when the frequency converter is set to run with fewer inverters, and remains on.

#### **ALARM 79, Illegal power section configuration**

The scaling card has an incorrect part number or is not installed. The MK102 connector on the power card could not be installed.

#### **ALARM 80, Drive initialised to default value**

Parameter settings are initialised to default settings after a manual reset. To clear the alarm, reset the unit.

#### **ALARM 81, CSIV corrupt**

CSIV file has syntax errors.

#### **ALARM 82, CSIV parameter error**

CSIV failed to init a parameter.

#### **ALARM 85, Dang fail PB**

Profibus/Profisafe error.

#### **WARNING/ALARM 104, Mixing fan fault**

The fan is not operating. The fan monitor checks that the fan is spinning at power-up or whenever the mixing fan is turned on. The mixing-fan fault can be configured as a warning or an alarm trip by 14-53 Fan Monitor.

#### **Troubleshooting**

- Cycle power to the frequency converter to determine if the warning/alarm returns.

#### **ALARM 243, Brake IGBT**

This alarm is only for F-frame frequency converters. It is equivalent to Alarm 27. The report value in the alarm log indicates which power module generated the alarm:

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F3 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.

2 = second frequency converter from the left inverter module in F14 frame size.

3 = right inverter module in F12 or F13 frame sizes.

3 = third from the left inverter module in F14 frame size.

4 = far right inverter module in F14 frame size.

5 = rectifier module.

6 = right rectifier module in F14 frame size.

#### **ALARM 244, Heat Sink temperature**

This alarm is only for F-frame frequency converters. It is equivalent to Alarm 29. The report value in the alarm log indicates which power module generated the alarm.

1 = left most inverter module.

2 = middle inverter module in F12 or F3 frame sizes.

2 = right inverter module in F10 or F11 frame sizes.

2 = second frequency converter from the left inverter module in F14 frame size.

3 = right inverter module in F12 or F13 frame sizes.

3 = third from the left inverter module in F14 frame size.

4 = far right inverter module in F14 frame size.

5 = rectifier module.

6 = right rectifier module in F14 frame size.

#### **ALARM 245, Heat Sink sensor**

This alarm is only for F-frame frequency converters. It is equivalent to Alarm 39. The report value in the alarm log indicates which power module generated the alarm

1 = left most inverter module.

2 = middle inverter module in F12 or F13 frame sizes.

2 = right inverter module in F10 or F11 frame sizes.

2 = second frequency converter from the left inverter module in F14 frame size.

3 = right inverter module in F12 or F13 frame sizes.

3 = third from the left inverter module in F14 frame size.

4 = far right inverter module in F14 frame size.

5 = rectifier module.

6 = right rectifier module in F14 frame size.

**ALARM 246, Power card supply**

This alarm is only for F-frame frequency converter. It is equivalent to Alarm 46. The report value in the alarm log indicates which power module generated the alarm

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F13 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second frequency converter from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame sizes.
- 3 = third from the left inverter module in F14 frame size.
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

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**ALARM 247, Power card temperature**

This alarm is only for F-frame frequency converters. It is equivalent to Alarm 69. The report value in the alarm log indicates which power module generated the alarm

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F13 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second frequency converter from the left inverter module in F14 frame size.
- 3 = right inverter module in F12 or F13 frame sizes.
- 3 = third from the left inverter module in F14 frame size.
- 4 = far right inverter module in F14 frame size.
- 5 = rectifier module.
- 6 = right rectifier module in F14 frame size.

**ALARM 248, Illegal power section configuration**

This alarm is only for F-frame frequency converters. It is equivalent to Alarm 79. The report value in the alarm log indicates which power module generated the alarm:

- 1 = left most inverter module.
- 2 = middle inverter module in F12 or F13 frame sizes.
- 2 = right inverter module in F10 or F11 frame sizes.
- 2 = second frequency converter from the left inverter module in F14 frame size.

3 = right inverter module in F12 or F13 frame sizes.

3 = third from the left inverter module in F14 frame size.

4 = far right inverter module in F14 frame size.

5 = rectifier module.

6 = right rectifier module in F14 frame size.

**WARNING 250, New spare part**

A component in the frequency converter has been replaced. Reset the frequency converter for normal operation.

**WARNING 251, New typecode**

The power card or other components have been replaced and the typecode changed. Reset to remove the warning and resume normal operation.

## 7.4 Warning and Alarm Definitions - Filter (Left LCP)

### **NOTICE**

This section covers warnings and alarms on the filter side LCP. For warning and alarms for the frequency converter, see chapter 7.3 *Warnings and Alarm Definitions - Frequency Converter*

A warning or an alarm is signalled by the relevant LED on the front of the filter and indicated by a code on the display.

A warning remains active until its cause is no longer present. Under certain circumstances operation of the unit may still be continued. Warning messages may be critical, but are not necessarily so.

In the event of an alarm, the unit has tripped. To restart operation, reset the rectified alarms.

**This may be done in 4 ways:**

1. By pressing [Reset].
2. Via a digital input with the Reset function.
3. Via serial communication/optional fieldbus.
4. By resetting automatically using the [Auto Reset] function.

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### **NOTICE**

After a manual reset pressing [Reset], press [Auto On] or [Hand On] to restart the unit.

If an alarm cannot be reset, the reason may be that its cause has not been rectified, or the alarm is trip-locked (see also Table 7.6).

Alarms that are trip-locked offer additional protection, meaning that the mains supply must be switched off before the alarm can be reset. After being switched back on, the unit is no longer blocked and may be reset as described above once the cause has been rectified.

Alarms that are not trip-locked can also be reset using the automatic reset function in 14-20 *Reset Mode* (Warning: automatic wake-up is possible)

If a warning and alarm is marked against a code in Table 7.6, either a warning occurs before an alarm, or it can be specified whether it is a warning or an alarm that is to be displayed for a given fault.

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts low	X			
2	Live zero error	(X)	(X)		6-01
4	Mains phase loss	X			
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC over voltage	X	X		
8	DC under voltage	X	X		
13	Over current	X	X	X	
14	Earth fault	X	X	X	
15	Hardware mismatch		X	X	
16	Short circuit		X	X	
17	Control word timeout	(X)	(X)		8-04
23	Internal fan fault	X			
24	External fan fault	X			14-53
29	Heatsink temp	X	X	X	
33	Inrush fault		X	X	
34	Fieldbus fault	X	X		

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No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
35	Option fault	X	X		
38	Internal fault				
39	Heatsink sensor		X	X	
40	Overload of digital output terminal 27	(X)			5-00, 5-01
41	Overload of digital output terminal 29	(X)			5-00, 5-02
46	Pwr. card supply		X	X	
47	24 V supply low	X	X	X	
48	1.8 V supply low		X	X	
65	Control board over-temperature	X	X	X	
66	Heat sink temperature low	X			
67	Option configuration has changed		X		
68	Safe torque off activated		X <sup>1)</sup>		
69	Pwr. card temp		X	X	
70	Illegal FC configuration			X	
72	Dangerous Failure			X <sup>1)</sup>	
73	Safe torque off auto restart				
76	Power unit setup	X			
79	Illegal PS config		X	X	
80	Unit initialised to default value		X		
244	Heatsink temp	X	X	X	
245	Heatsink sensor		X	X	
246	Pwr.card supply		X	X	
247	Pwr.card temp		X	X	
248	Illegal PS config		X	X	
250	New spare part			X	
251	New type code		X	X	
300	Mains cont. fault	X			
301	SC cont. fault	X			
302	Cap. over current	X	X		
303	Cap. earth fault	X	X		
304	DC over current	X	X		
305	Mains freq. limit		X		
308	Resistor temp	X		X	
309	Mains earth fault	X	X		
311	Switch. freq. limit		X		
312	CT range		X		
314	Auto CT interrupt		X		
315	Auto CT error		X		
316	CT location error	X			
317	CT polarity error	X			
318	CT ratio error	X			

7

Table 7.6 Alarm/Warning Code List

A trip is the action when an alarm has appeared. The trip coasts the motor and can be reset by pressing [Reset] or make a reset by a digital input (parameter group 5-1\* *Digital Inputs [1] Reset*). The origin event that caused an alarm cannot damage the frequency converter or cause dangerous conditions. A trip lock is an action when an alarm occurs, which may cause damage to frequency converter or connected parts. A Trip Lock situation can only be reset by a power cycling.

Warning	yellow
Alarm	flashing red
Trip locked	yellow and red

Table 7.7 LED Indicator Lights

Alarm Word and Extended Status Word					
Bit	Hex	Dec	Alarm Word	Warning Word	Extended Status Word
0	00000001	1	Mains cont. fault	Reserved	Reserved
1	00000002	2	Heatsink temp	Heatsink temp	Auto CT running
2	00000004	4	Ground fault	Ground fault	Reserved
3	00000008	8	Ctrl.card temp	Ctrl.card temp	Reserved
4	00000010	16	Ctrl. word TO	Ctrl. word TO	Reserved
5	00000020	32	Over current	Over current	Reserved
6	00000040	64	SC cont. fault	Reserved	Reserved
7	00000080	128	Cap. over current	Cap. over current	Reserved
8	00000100	256	Cap. earth fault	Cap. earth fault	Reserved
9	00000200	512	Inverter overl.	Inverter overl.	Reserved
10	00000400	1024	DC under volt	DC under volt	Reserved
11	00000800	2048	DC over volt	DC over volt	Reserved
12	00001000	4096	Short circuit	DC voltage low	Reserved
13	00002000	8192	Inrush fault	DC voltage high	Reserved
14	00004000	16384	Mains ph. loss	Mains ph. loss	Reserved
15	00008000	32768	Auto CT error	Reserved	Reserved
16	00010000	65536	Reserved	Reserved	Reserved
17	00020000	131072	Internal fault	10V low	Password Time Lock
18	00040000	262144	DC over current	DC over current	Password Protection
19	00080000	524288	Resistor temp	Resistor temp	Reserved
20	00100000	1048576	Mains earth fault	Mains earth fault	Reserved
21	00200000	2097152	Switch. freq. limit	Reserved	Reserved
22	00400000	4194304	Fieldbus fault	Fieldbus fault	Reserved
23	00800000	8388608	24 V supply low	24V supply low	Reserved
24	01000000	16777216	CT range	Reserved	Reserved
25	02000000	33554432	1.8V supply low	Reserved	Reserved
26	04000000	67108864	Reserved	Low temp	Reserved
27	08000000	134217728	Auto CT interrupt	Reserved	Reserved
28	10000000	268435456	Option change	Reserved	Reserved
29	20000000	536870912	Unit initialized	Unit initialized	Reserved
30	40000000	1073741824	Safe torque off	Safe torque off	Reserved
31	80000000	2147483648	Mains freq. limit	Extended status word	Reserved

Table 7.8 Description of Alarm Word, Warning Word and Extended Status Word

The alarm words, warning words and extended status words can be read out via serial bus or optional fieldbus for diagnosis. See also 16-90 *Alarm Word*, 16-92 *Warning Word* and 16-94 *Ext. Status Word*. Reserved means that the bit is not guaranteed to be any particular value. Reserved bits should not be used for any purpose.

### 7.4.1 Fault Messages for Active Filter

#### **WARNING 1, 10 volts low**

The control card voltage is below 10 V from terminal 50. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Max. 15 mA or minimum 590 Ω. Fault messages - active filter

#### **WARNING/ALARM 2, Live zero error**

The signal on terminal 53 or 54 is less than 50% of the value set in parameters 6-10, 6-12, 6-20 or 6-22.

#### **WARNING 4, Mains phase loss**

A phase is missing on the supply side, or the mains voltage imbalance is too high.

#### **WARNING 5, DC link voltage high**

The intermediate circuit voltage (DC) is higher than the high-voltage warning limit. The unit is still active.

#### **WARNING 6, DC link voltage low**

The intermediate circuit voltage (DC) is below the undervoltage limit of the control system. The unit is still active.

#### **WARNING/ALARM 7, DC overvoltage**

If the intermediate circuit voltage exceeds the limit, the unit trips.

#### **WARNING/ALARM 8, DC under voltage**

If the intermediate circuit voltage (DC) drops below the under voltage limit, the filter checks if a 24 V back-up supply is connected. If not, the unit trips. Check that the mains voltage matches the nameplate specification.

#### **WARNING/ALARM 13, Over Current**

the unit current limit has been exceeded.

#### **ALARM 14, Earth (ground) fault**

The sum current of the IGBT CTs does not equal zero. Check if the resistance of any phase to ground has a low value. Check both before and after mains contactor. Ensure IGBT current transducers, connection cables, and connectors are ok.

#### **ALARM 15, Incomp. Hardware**

A mounted option is incompatible with the present control card SW/HW.

#### **ALARM 16, Short circuit**

There is a short-circuit in the output. Turn off the unit and correct the error.

#### **WARNING/ALARM 17, Control word timeout**

There is no communication to the unit.

The warning is only active when 8-04 *Control Word Timeout Function* is not set to off.

Possible correction: Increase 8-03 *Control Word Timeout Time*. Change 8-04 *Control Word Timeout Function*

#### **WARNING 23, Internal fan fault**

Internal fans have failed due to defect hardware or fans not mounted.

#### **WARNING 24, External fan fault**

External fans have failed due to defect hardware or fans not mounted.

#### **ALARM 29, Heat sink temp**

The maximum temperature of the heat sink has been exceeded. The temperature fault is not reset until the temperature falls below a defined heat sink temperature.

#### **ALARM 33, Inrush fault**

Check whether a 24 V external DC supply has been connected.

#### **WARNING/ALARM 34, Fieldbus communication fault**

The fieldbus on the communication option card is not working.

#### **WARNING/ALARM 35, Option Fault:**

Contact Danfoss or supplier.

#### **ALARM 38, Internal fault**

Contact Danfoss or supplier.

#### **ALARM 39, Heat sink sensor**

No feedback from the heat sink temperature sensor.

#### **WARNING 40, Overload of Digital Output Terminal 27**

Check the load connected to terminal 27 or remove short-circuit connection.

#### **WARNING 41, Overload of Digital Output Terminal 29**

Check the load connected to terminal 29 or remove short-circuit connection.

#### **WARNING 43, Ext. Supply (option)**

The external 24 V DC supply voltage on the option is not valid.

#### **ALARM 46, Power card supply**

The supply on the power card is out of range.

#### **WARNING 47, 24 V supply low**

Contact Danfoss or supplier.

#### **WARNING 48, 1.8 V supply low**

Contact Danfoss or supplier.

#### **WARNING/ALARM/TRIP 65, Control card over temperature**

Control card over temperature: The cut-out temperature of the control card is 80 °C.

#### **WARNING 66, Heat sink temperature low**

This warning is based on the temperature sensor in the IGBT module.

#### **Troubleshooting**

The heat sink temperature measured as 0 °C could indicate that the temperature sensor is defective, causing the fan speed to increase to the maximum. If the sensor wire between the IGBT and the gate drive card is disconnected, this warning would result. Also, check the IGBT thermal sensor.

#### **ALARM 67, Option module configuration has changed**

One or more options have either been added or removed since the last power-down.

**ALARM 68, Safe Torque Off activated**

Safe Torque Off has been activated. To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal (via bus, digital I/O, or by pressing [Reset]. See 5-19 Terminal 37 Safe Stop.

**ALARM 69, Power card temperature**

The temperature sensor on the power card is either too hot or too cold.

**ALARM 70, Illegal FC Configuration**

Actual combination of control board and power board is illegal.

**WARNING 73, Safe Torque Off auto restart**

Safe stopped. Note that with automatic restart enabled, the motor can start when the fault is cleared.

**ALARM 79, Illegal power section configuration**

The scaling card is the incorrect part number or not installed. Also MK102 connector on the power card could not be installed.

**ALARM 80, Unit initialised to default value**

Parameter settings are initialised to default settings after a manual reset.

**ALARM 244, Heat sink temperature**

Report value indicates source of alarm (from left):

1-4 inverter  
5-8 rectifier

**ALARM 245, Heat sink sensor**

No feedback from the heat sink sensor. Report value indicates source of alarm (from left):

1-4 inverter  
5-8 rectifier

**ALARM 246, Power card supply**

The supply on the power card is out of range. Report value indicates source of alarm (from left):

1-4 inverter  
5-8 rectifier

**ALARM 247, Power card temperature**

Power card over temperature. Report value indicates source of alarm (from left):

1-4 inverter  
5-8 rectifier

**ALARM 248, Illegal power section configuration**

Power size configuration fault on the power card. Report value indicates source of alarm (from left):

1-4 inverter  
5-8 rectifier

**ALARM 250, New spare part**

The power or switch mode power supply has been exchanged. The filter type code must be restored in the EEPROM. Select the correct type code in 14-23 Typecode Setting according to the label on the unit. Remember to select 'Save to EEPROM' to complete.

**ALARM 251, New type code**

The filter has a new type code.

**ALARM 300, Mains Cont. Fault**

The feedback from the mains contactor did not match the expected value within the allowed time frame. Contact Danfoss or supplier.

**ALARM 301, SC Cont. Fault**

The feedback from the soft charge contactor did not match the expected value within the allowed time frame. Contact Danfoss or supplier.

**ALARM 302, Cap. Over Current**

Excessive current was detected through the AC capacitors. Contact Danfoss or supplier.

**ALARM 303, Cap. Earth Fault**

An earth fault was detected through the AC capacitor currents. Contact Danfoss or supplier.

**ALARM 304, DC Over Current**

Excessive current through the DC-link capacitor bank was detected. Contact Danfoss or supplier.

**ALARM 305, Mains Freq. Limit**

The mains frequency was outside the limits. Verify that the mains frequency is within product specification.

**ALARM 306, Compensation Limit**

The needed compensation current exceeds unit capability. Unit is running at full compensation.

**ALARM 308, Resistor temp**

Excessive resistor heat sink temperature detected.

**ALARM 309, Mains Earth Fault**

An earth fault was detected in the mains currents. Check the mains for shorts and leakage current.

**ALARM 310, RTDC Buffer Full**

Contact Danfoss or supplier.

**ALARM 311, Switch. Freq. Limit**

The average switching frequency of the unit exceeded the limit. Verify that 300-10 Active Filter Nominal Voltage and 300-22 CT Nominal Voltage are set correctly. If so, contact Danfoss or supplier.

**ALARM 312, CT Range**

Current transformer measurement limitation was detected. Verify that the CTs used are an appropriate ratio.

**ALARM 314, Auto CT Interrupt**

Auto CT detection has been interrupted.

**ALARM 315, Auto CT Error**

An error was detected while performing auto CT detection. Contact Danfoss or supplier.

**WARNING 316, CT Location Error**

The auto CT function could not determine the correct locations of the CTs.

**WARNING 317, CT Polarity Error**

The auto CT function could not determine the correct polarity of the CTs.

**WARNING 318, CT Ratio Error**

The auto CT function could not determine the correct primary rating of the CTs.

## 7.5 Troubleshooting

Symptom	Possible cause	Test	Solution
Display dark/No function	Missing input power	See <i>Table 5.1</i>	Check the input power source
	Missing or open fuses or circuit breaker tripped	See <i>Open fuses and Tripped circuit breaker</i> in this table for possible causes	Follow the recommendations provided
	No power to the LCP	Check the LCP cable for proper connection or damage	Replace the faulty LCP or connection cable
	Shortcut on control voltage (terminal 12 or 50) or at control terminals	Check the 24 V control voltage supply for terminals 12/13 to 20-39 or 10 V supply for terminals 50 to 55	Wire the terminals properly
	Wrong LCP (LCP from VLT® 2800 or 5000/6000/8000/ FCD or FCM)		Use only LCP 101 (P/N 130B1124) or LCP 102 (P/N 130B1107)
	Wrong contrast setting		Press [Status] + [▲]/[▼] to adjust the contrast
	Display (LCP) is defective	Test using a different LCP	Replace the faulty LCP or connection cable
Intermittent display	Internal voltage supply fault or SMPS is defective		Contact supplier
	Overloaded power supply (SMPS) due to improper control wiring or a fault within the frequency converter	To rule out a problem in the control wiring, disconnect all control wiring by removing the terminal blocks.	If the display stays lit, then the problem is in the control wiring. Check the wiring for shorts or incorrect connections. If the display continues to cut out, follow the procedure for display dark.
Motor not running	Service switch open or missing motor connection	Check if the motor is connected and the connection is not interrupted (by a service switch or other device).	Connect the motor and check the service switch
	No mains power with 24 V DC option card	If the display is functioning but no output, check that mains power is applied to the frequency converter.	Apply mains power to run the unit
	LCP Stop	Check if [Off] has been pressed	Press [Auto On] or [Hand On] (depending on operation mode) to run the motor
	Missing start signal (Standby)	Check 5-10 Terminal 18 Digital Input for correct setting for terminal 18 (use default setting)	Apply a valid start signal to start the motor
	Motor coast signal active (Coasting)	Check 5-12 Coast inv. for correct setting for terminal 27 (use default setting).	Apply 24 V on terminal 27 or program this terminal to no operation
	Wrong reference signal source	Check reference signal: Local, remote or bus reference? Preset reference active? Terminal connection correct? Scaling of terminals correct? Reference signal available?	Program correct settings. Check 3-13 Reference Site. Set preset reference active in parameter group 3-1* References. Check for correct wiring. Check scaling of terminals. Check reference signal.
Motor running in wrong direction	Motor rotation limit	Check that 4-10 Motor Speed Direction is programmed correctly.	Program correct settings
	Active reversing signal	Check if a reversing command is programmed for the terminal in parameter group 5-1* Digital inputs.	Deactivate reversing signal
	Wrong motor phase connection		See chapter 4.6.1 Motor Cable in this manual

## Diagnostics and Troubleshoo...

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Symptom	Possible cause	Test	Solution
Motor is not reaching maximum speed	Frequency limits set wrong	Check output limits in 4-13 Motor Speed High Limit [RPM], 4-14 Motor Speed High Limit [Hz] and 4-19 Max Output Frequency.	Program correct limits
	Reference input signal not scaled correctly	Check reference input signal scaling in 6-0* Analog I/O Mode and parameter group 3-1* References. Reference limits in parameter group 3-0* Reference Limit.	Program correct settings
Motor speed unstable	Possible incorrect parameter settings	Check the settings of all motor parameters, including all motor compensation settings. For closed loop operation, check PID settings.	Check settings in parameter group 1-6* Load Depen. Setting. For closed loop operation, check settings in parameter group 20-0* Feedback.
Motor runs rough	Possible overmagnetisation	Check for incorrect motor settings in all motor parameters	Check motor settings in parameter groups 1-2* Motor Data, 1-3* Adv Motor Data, and 1-5* Load Independ. Setting.
Motor will not brake	Possible incorrect settings in the brake parameters. Possible too short ramp down times	Check brake parameters. Check ramp time settings	Check parameter group 2-0* DC Brake and 3-0* Reference Limits.
Open power fuses or circuit breaker trip	Phase-to-phase short	Motor or panel has a short phase to phase. Check motor and panel phase for shorts	Eliminate any shorts detected
	Motor overload	Motor is overloaded for the application	Perform startup test and verify motor current is within specifications. If motor current is exceeding nameplate full load current, motor may run only with reduced load. Review the specifications for the application.
	Loose connections	Perform pre-startup check for loose connections	Tighten loose connections
Mains current imbalance greater than 3%	Problem with mains power (See Alarm 4 Mains phase loss description)	Rotate input power leads into the frequency converter one position: A to B, B to C, C to A.	If imbalanced leg follows the wire, it is a power problem. Check mains power supply.
	Problem with the frequency converter	Rotate input power leads into the frequency converter one position: A to B, B to C, C to A.	If imbalance leg stays on same input terminal, it is a problem with the unit. Contact the supplier.
Motor current imbalance greater than 3%	Problem with motor or motor wiring	Rotate output motor leads one position: U to V, V to W, W to U.	If imbalanced leg follows the wire, the problem is in the motor or motor wiring. Check motor and motor wiring.
	Problem with the frequency converters	Rotate output motor leads one position: U to V, V to W, W to U.	If imbalance leg stays on same output terminal, it is a problem with the unit. Contact the supplier.
Acoustic noise or vibration (e.g. a fan blade is making noise or vibrations at certain frequencies)	Resonances, e.g. in the motor/fan system	Bypass critical frequencies by using parameters in parameter group 4-6* Speed Bypass	Check if noise and/or vibration have been reduced to an acceptable limit
		Turn off over-modulation in 14-03 Overmodulation	
		Change switching pattern and frequency in parameter group 14-0* Inverter Switching	
		Increase Resonance Dampening in 1-64 Resonance Dampening	

Table 7.9 Troubleshooting

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## 8 Specifications

### 8.1 Power-Dependent Specifications

#### 8.1.1 Mains Supply 3x380-480 V AC

	P160	P200	P250
<b>Normal Overload =110% current for 60 s</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
Typical shaft output at 400 V [kW]	160	200	250
Typical shaft output at 460 V [hp]	250	300	350
Typical shaft output at 480 V [kW]	200	250	315
Enclosure IP21/54		D13	
<b>Output current</b>			
Continuous (at 400 V) [A]	315	395	480
Intermittent (60 s overload) (at 400 V) [A]	347	435	528
Continuous (at 460/480 V) [A]	302	361	443
Intermittent (60 s overload) (at 460/480 V) [A]	332	397	487
Continuous kVA (at 400 V) [kVA]	218	274	333
Continuous kVA (at 460 V) [kVA]	241	288	353
Continuous kVA (at 480 V) [kVA]	262	313	384
<b>Max. Input current</b>			
Continuous (at 400 V) [A]	304	381	463
Continuous (at 460/480 V) [A]	291	348	427
Max. pre-fuses <sup>1)</sup> [A]	400	500	630
<b>Max. cable size</b>			
Motor (mm <sup>2</sup> /AWG <sup>2)</sup> )	2x185 (2x300 mcm)		
Mains (mm <sup>2</sup> /AWG <sup>2)</sup> )			
Loadsharing (mm <sup>2</sup> /AWG <sup>2)</sup> )			
Brake (mm <sup>2</sup> /AWG <sup>2)</sup> )			
Total LHD loss 400 V AC [kW]	8868	10527	11751
Total back channel loss 400 V AC [kW]	7318	8903	10033
Total filter loss 400 V AC [kW]	4954	5714	6234
Total LHD loss 460 V AC [kW]	9059	10192	11706
Total back channel loss 460 V AC [kW]	7123	8209	9635
Total filter loss 460 V AC [kW]	5279	5819	6681
Weight, enclosure IP21, IP54 [kg]		380	406
Efficiency <sup>4)</sup>		0.96	
Output frequency [Hz]		0-800	
Heatsink overtemp. trip [°C]		105	
Power card ambient trip [°C]		85	

\*High overload = 160% torque during 60 s; Normal overload = 110% torque during 60 s

Table 8.1 Mains Supply 3x380-480 V AC

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	P315	P355	P400	P450
<b>Normal Overload =110% current for 60 s</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
Typical shaft output at 400 V [kW]	315	355	400	450
Typical shaft output at 460 V [hp]	450	500	600	600
Typical shaft output at 480 V [kW]	355	400	500	530
Enclosure IP21/54		E9		
<b>Output current</b>				
Continuous (at 400 V) [A]	600	658	745	800
Intermittent (60 s overload) (at 400 V) [A]	660	724	820	880
Continuous (at 460/480 V) [A]	540	590	678	730
Intermittent (60 s overload) (at 460/480 V) [A]	594	649	746	803
Continuous kVA (at 400 V) [kVA]	416	456	516	554
Continuous kVA (at 460 V) [kVA]	430	470	540	582
Continuous kVA (at 480 V) [kVA]	468	511	587	632
<b>Max. Input current</b>				
Continuous (at 400 V) [A]	590	647	733	787
Continuous (at 460/480 V) [A]	531	580	667	718
Max. pre-fuses <sup>1)</sup> [A]	700		900	
<b>Max. cable size</b>				
Motor (mm <sup>2</sup> /AWG <sup>2)</sup> )	4x240 (4x500 mcm)			
Mains (mm <sup>2</sup> /AWG <sup>2)</sup> )				
Loadsharing (mm <sup>2</sup> /AWG <sup>2)</sup> )				
Brake (mm <sup>2</sup> /AWG <sup>2)</sup> )	2x185 (2x350 mcm)			
Total LHD loss 400 V AC [kW]	14051	15320	17180	18447
Total back channel loss 400 V AC [kW]	11301	11648	13396	14570
Total filter loss 400 V AC [kW]	7346	7788	8503	8974
Total LHD loss 460 V AC [kW]	12936	14083	15852	16962
Total back channel loss 460 V AC [kW]	10277	10522	12184	13214
Total filter loss 460 V AC [kW]	7066	7359	8033	8435
Weight, enclosure IP21, IP54 [kg]	596	623	646	
Efficiency <sup>4)</sup>		0.96		
Output frequency [Hz]		0-600		
Heatsink overtemp. trip [°C]		105		
Power card ambient trip [°C]		85		

\*High overload = 160% torque during 60 s; Normal overload = 110% torque during 60 s

Table 8.2 Mains Supply 3x380-480 V AC

Specifications	Operating Instructions			
	P500	P560	P630	P710
Normal Overload =110% current for 60 s	NO	NO	NO	NO
Typical shaft output at 400 V [kW]	500	560	630	710
Typical shaft output at 460 V [hp]	650	750	900	1000
Typical shaft output at 480 V [kW]	560	630	710	800
Enclosure IP21/54		F18		
<b>Output current</b>				
Continuous (at 400 V) [A]	880	990	1120	1260
Intermittent (60 s overload) (at 400 V) [A]	968	1089	1232	1386
Continuous (at 460/480 V) [A]	780	890	1050	1160
Intermittent (60 s overload) (at 460/480 V) [A]	858	979	1155	1276
Continuous kVA (at 400 V) [kVA]	610	686	776	873
Continuous kVA (at 460 V) [kVA]	621	709	837	924
Continuous kVA (at 480 V) [kVA]	675	771	909	1005
<b>Max. Input current</b>				
Continuous (at 400 V) [A]	857	964	1090	1227
Continuous (at 460/480 V) [A]	759	867	1022	1129
Max. pre-fuses <sup>1)</sup> [A]	1600		2000	
<b>Max. cable size</b>				
Motor (mm <sup>2</sup> /AWG <sup>2)</sup> )		8 x 150 (8 x 300 mcm)		
Mains (mm <sup>2</sup> /AWG <sup>2)</sup> )		8 x 240 (8 x 500 mcm)		
Brake (mm <sup>2</sup> /AWG <sup>2)</sup> )		4 x 185 (4 x 350 mcm)		
Total LHD loss 400 V AC [kW]	21909	24592	26640	30519
Total back channel loss 400 V AC [kW]	17767	19984	21728	24936
Total filter loss 400 V AC [kW]	11747	12771	14128	15845
Total LHD loss 460 V AC [kW]	19896	22353	25030	27989
Total back channel loss 460 V AC [kW]	16131	18175	20428	22897
Total filter loss 460 V AC [kW]	11020	11929	13435	14776
Weight, enclosure IP21, IP54 [kg]		2009		
Efficiency <sup>4)</sup>		0.96		
Output frequency [Hz]		0-600		
Heatsink overtemp. trip [°C]		105		
Power card ambient trip [°C]		85		
*Normal overload = 110% torque during 60 s				

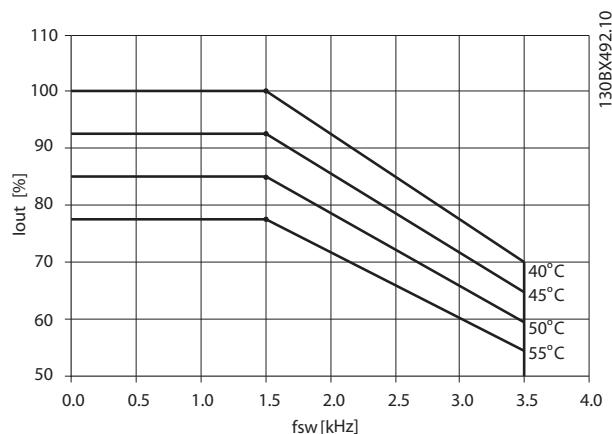
Table 8.3 Mains Supply 3x380-480 V AC

- 1) For type of fuse, see *chapter 8.5.1 Fuses*.
  - 2) American wire gauge.
  - 3) Measured using 5 m screened motor cables at rated load and rated frequency.
  - 4) The typical power loss is at nominal load conditions and expected to be within ±15% (tolerance relates to variety in voltage and cable conditions). Values are based on a typical motor efficiency (IE2/IE3 border line). Motors with lower efficiency also add to the power loss in the frequency converter and opposite. If the switching frequency is increased to the default setting, the power losses may rise significantly. LCP and typical control card power consumptions are included. Further options and customer load may add up to 30 W to the losses. (Though typical only 4 W extra for a fully loaded control card, or options for slot A or slot B, each).
- Although measurements are made with state-of-the-art equipment, some measurement inaccuracy must be allowed for (±5%).

**Specifications****Operating Instructions**

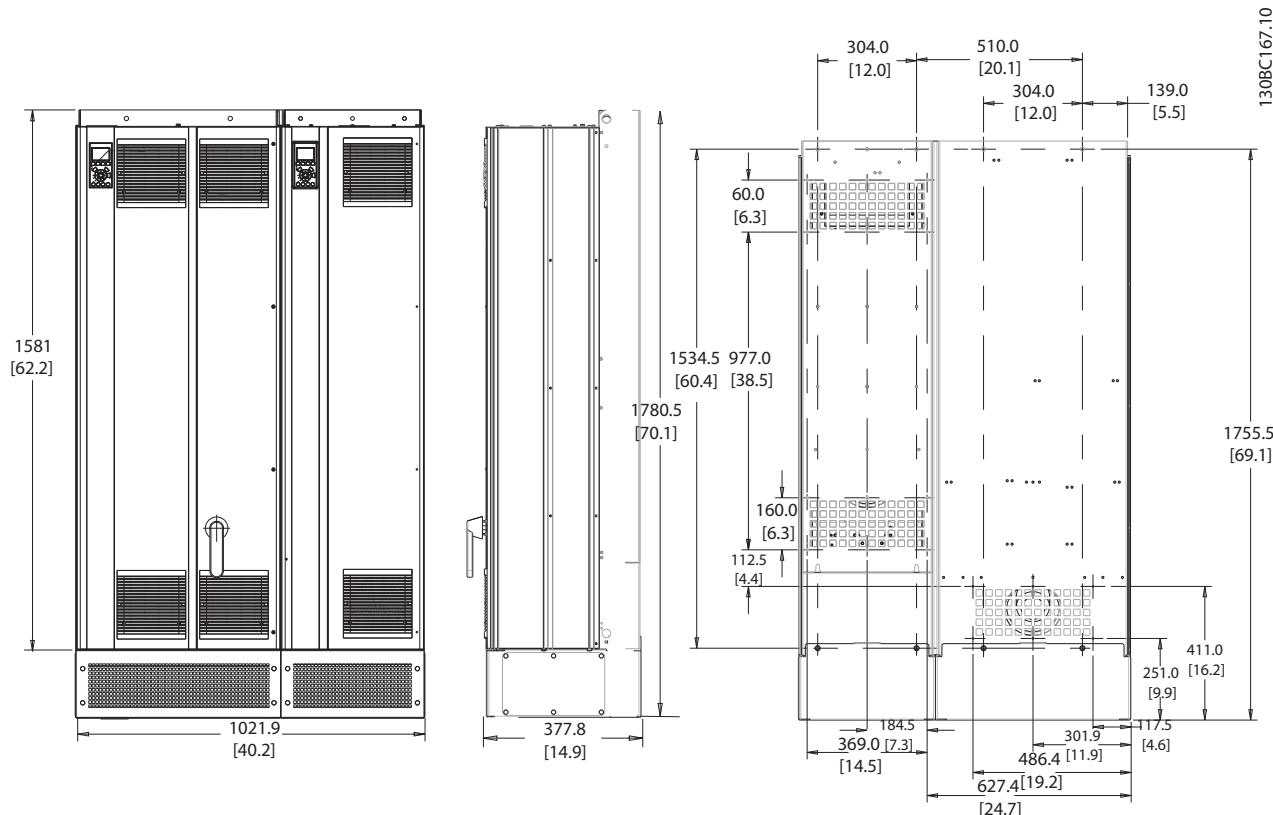
### 8.1.2 Derating for Temperature

The frequency converter automatically derates the switching frequency, switching type, or output current under certain load or ambient conditions as described below. The derating curves in *Illustration 8.1* apply to both SFAVM and 60 AVM switching modes.



**Illustration 8.1 Derating Frame Sizes D, E, and F 380-500 V (T5) Normal Overload 110%**

### 8.2 Mechanical Dimensions



**Illustration 8.2 Frame Size D13**

## Specifications

## Operating Instructions

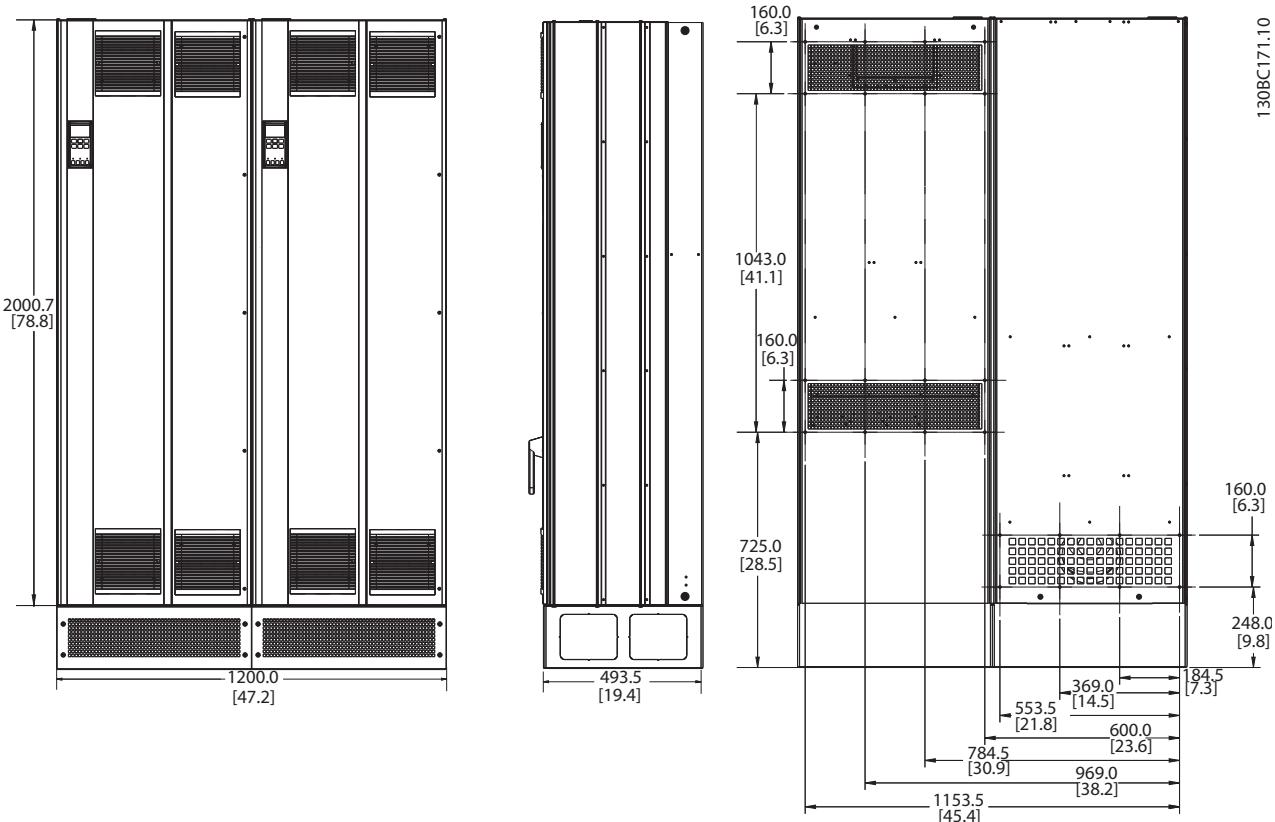


Illustration 8.3 Frame Size E9

## Specifications

## Operating Instructions

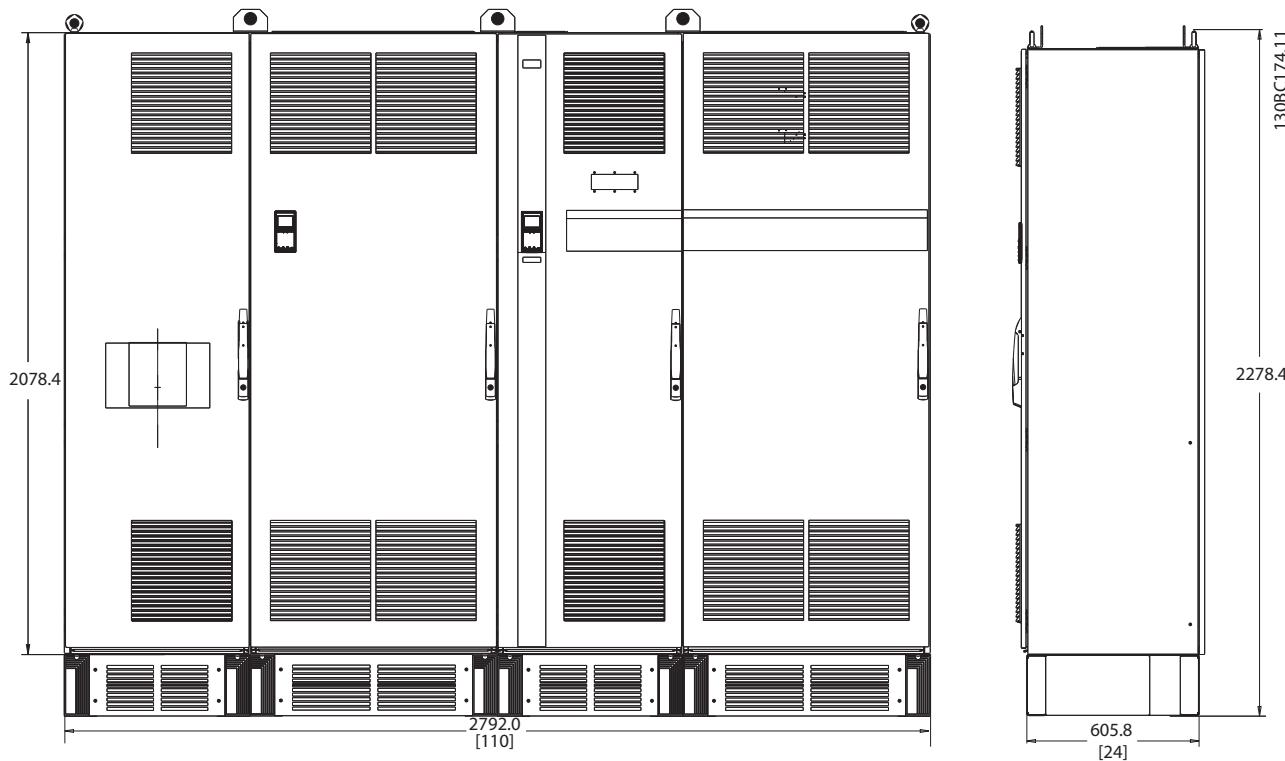


Illustration 8.4 Frame Size F18, Front and Side View

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## 8.3 General Technical Data - Frequency Converter

## Mains supply (L1, L2, L3)

Supply voltage

380–480 V +5%

## Mains voltage low/mains drop-out:

During low mains voltage or mains drop-out, the frequency converter continues until the intermediate circuit voltage drops below the minimum stop level, corresponding to 15% below the lowest rated supply voltage. Power up and full torque cannot be expected at mains voltage lower than 10% below the lowest rated supply voltage.

Supply frequency

50/60 Hz ±5%

Max. imbalance temporary between mains phases

3.0% of rated supply voltage

True power factor ( $\lambda$ )

&gt; 0.98 nominal at rated load

Displacement power factor ( $\cos\phi$ ) near unity

(&gt; 0.98)

THID

&lt; 5%

Switching on input supply L1, L2, L3 (power-ups)

maximum once/2 min.

Environment according to EN60664-1

overvoltage category III/pollution degree 2

The unit is suitable for use on a circuit capable of delivering not more than 100.000 RMS symmetrical Amperes, 480/690 V maximum.

## Motor output (U, V, W)

0-100% of supply voltage

Output voltage

0-590 Hz<sup>1)</sup>

Output frequency

Unlimited

Switching on output

Ramp times

0.01-3600 s

1) Voltage and power dependent

Specifications	Operating Instructions
Torque characteristics	
Starting torque (constant torque)	maximum 160% for 1 m <sup>1)</sup>
Starting torque	maximum 180% up to 0.5 s <sup>1)</sup>
Overload torque (constant torque)	maximum 160% for 1 m <sup>1)</sup>

1) Percentage relates to nominal torque of the unit.

Cable lengths and cross-sections	
Max. motor cable length, screened/armoured	150 m
Max. motor cable length, unscreened/unarmoured	300 m
Max. cross-section to motor, mains, load sharing, and brake <sup>1)</sup>	
Maximum cross-section to control terminals, rigid wire	1.5 mm <sup>2</sup> /16 AWG (2 x 0.75 mm <sup>2</sup> )
Maximum cross-section to control terminals, flexible cable	1 mm <sup>2</sup> /18 AWG
Maximum cross-section to control terminals, cable with enclosed core	0.5 mm <sup>2</sup> /20 AWG
Minimum cross-section to control terminals	0.25 mm <sup>2</sup>

1) See chapter 8.1.1 Mains Supply 3x380-480 V AC for more information

Digital inputs	
Programmable digital inputs	4 (6)
Terminal number	18, 19, 27 <sup>1)</sup> , 29 <sup>1)</sup> , 32, 33,
Logic	PNP or NPN
Voltage level	0-24 V DC
Voltage level, logic '0' PNP	< 5 V DC
Voltage level, logic '1' PNP	> 10 V DC
Voltage level, logic '0' NPN	> 19 V DC
Voltage level, logic '1' NPN	< 14 V DC
Maximum voltage on input	28 V DC
Input resistance, R <sub>i</sub>	approx. 4 kΩ

All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

1) Terminals 27 and 29 can also be programmed as output.

Analog inputs	
Number of analog inputs	2
Terminal number	53, 54
Modes	Voltage or current
Mode select	Switch S201 and switch S202
Voltage mode	Switch S201/switch S202 = OFF (U)
Voltage level	0 to + 10 V (scaleable)
Input resistance, R <sub>i</sub>	approx. 10 kΩ
Max. voltage	± 20 V
Current mode	Switch S201/switch S202 = ON (I)
Current level	0/4 to 20 mA (scaleable)
Input resistance, R <sub>i</sub>	approx. 200 Ω
Max. current	30 mA
Resolution for analog inputs	10 bit (+ sign)
Accuracy of analog inputs	Max. error 0.5% of full scale
Bandwidth	200 Hz

The analog inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

## Specifications

## Operating Instructions

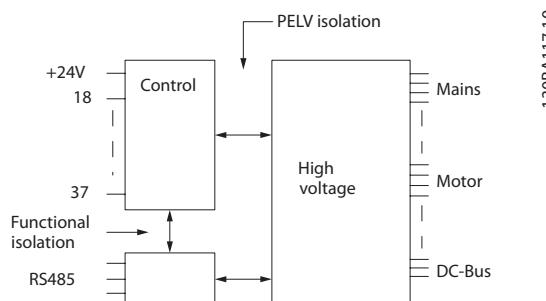


Illustration 8.5 PELV Isolation of Analog Inputs

## Pulse inputs

Programmable pulse inputs	2
Terminal number pulse	29, 33
Max. frequency at terminal, 29, 33	110 kHz (Push-pull driven)
Max. frequency at terminal, 29, 33	5 kHz (open collector)
Min. frequency at terminal 29, 33	4 Hz
Voltage level	see chapter 8.3.1 Digital inputs
Maximum voltage on input	28 V DC
Input resistance, $R_i$	approx. 4 k $\Omega$
Pulse input accuracy (0.1–1 kHz)	Max. error: 0.1% of full scale

8

## Analog output

Number of programmable analog outputs	1
Terminal number	42
Current range at analog output	0/4-20 mA
Max. resistor load to common at analog output	500 $\Omega$
Accuracy on analog output	Max. error: 0.8% of full scale
Resolution on analog output	8 bit

The analog output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

## Control card, RS-485 serial communication

Terminal number	68 (P,TX+, RX+), 69 (N,TX-, RX-)
Terminal number 61	Common for terminals 68 and 69

The RS-485 serial communication circuit is functionally seated from other central circuits and galvanically isolated from the supply voltage (PELV).

## Digital output

Programmable digital/pulse outputs	2
Terminal number	27, 29 <sup>1)</sup>
Voltage level at digital/frequency output	0-24 V
Max. output current (sink or source)	40 mA
Max. load at frequency output	1 k $\Omega$
Max. capacitive load at frequency output	10 nF
Minimum output frequency at frequency output	0 Hz
Maximum output frequency at frequency output	32 kHz
Accuracy of frequency output	Max. error: 0.1% of full scale
Resolution of frequency outputs	12 bit

1) Terminal 27 and 29 can also be programmed as input.

The digital output is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Specifications	Operating Instructions
Control card, 24 V DC output	
Terminal number	13
Output voltage	24 V (+1, -3 v)
Max. load	200 mA
<i>The 24 V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analog and digital inputs and outputs.</i>	
Relay outputs	
Programmable relay outputs	2
<b>Relay 01 Terminal number</b>	1-3 (break), 1-2 (make)
Max. terminal load (AC-1) <sup>1)</sup> on 1-3 (NC), 1-2 (NO) (resistive load)	240 V AC, 2 A
Max. terminal load (AC-15) <sup>1)</sup> (inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Max. terminal load (DC-1) <sup>1)</sup> on 1-2 (NO), 1-3 (NC) (resistive load)	60 V DC, 1 A
Max. terminal load (DC-13) <sup>1)</sup> (inductive load)	24 V DC, 0.1 A
<b>Relay 02 Terminal number</b>	4-6 (break), 4-5 (make)
Max. terminal load (AC-1) <sup>1)</sup> on 4-5 (NO) (resistive load) <sup>2)3)</sup>	400 V AC, 2 A
Max. terminal load (AC-15) <sup>1)</sup> on 4-5 (NO) (inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Max. terminal load (DC-1) <sup>1)</sup> on 4-5 (NO) (resistive load)	80 V DC, 2 A
Max. terminal load (DC-13) <sup>1)</sup> on 4-5 (NO) (inductive load)	24 V DC, 0.1 A
Max. terminal load (AC-1) <sup>1)</sup> on 4-6 (NC) (resistive load)	240 V AC, 2 A
Max. terminal load (AC-15) <sup>1)</sup> on 4-6 (NC) (inductive load @ cosφ 0.4)	240 V AC, 0.2 A
Max. terminal load (DC-1) <sup>1)</sup> on 4-6 (NC) (resistive load)	50 V DC, 2 A
Max. terminal load (DC-13) <sup>1)</sup> on 4-6 (NC) (inductive load)	24 V DC, 0.1 A
Min. terminal load on 1-3 (NC), 1-2 (NO), 4-6 (NC), 4-5 (NO)	24 V DC 10 mA, 24 V AC 20 mA
Environment according to EN 60664-1	overvoltage category III/pollution degree 2

1) IEC 60947 parts 4 and 5

The relay contacts are galvanically isolated from the rest of the circuit by reinforced isolation (PELV).

2) Overvoltage Category II

3) UL applications 300 V AC 2 A

**Control characteristics**

Resolution of output frequency at 0-1000 Hz	±0.003 Hz
System response time (terminals 18, 19, 27, 29, 32, 33)	≤ 2 ms
Speed control range (open loop)	1:100 of synchronous speed
Speed accuracy (open loop)	30-4000 RPM: Maximum error of ±8 RPM

All control characteristics are based on a 4-pole asynchronous motor

Specifications	Operating Instructions
<b>Surroundings</b>	
Enclosure, frame size D and E	IP21, IP54
Enclosure, frame size F	IP21, IP54
Vibration test	0.7 g
Relative humidity	5-95% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H <sub>2</sub> S test	class kD
Test method according to IEC 60068-2-43 H <sub>2</sub> S (10 days)	
Ambient temperature (at 60 AVM switching mode)	
- with derating	max. 55 °C
- with full output power, typical IE2 motors (see chapter 8.1.2 Derating for Temperature)	max. 50 °C
- at full continuous FC output current	max. 45 °C
Minimum ambient temperature during full-scale operation	0 °C
Minimum ambient temperature at reduced performance	- 10 °C
Temperature during storage/transport	-25 - +65/70 °C
Maximum altitude above sea level without derating	1,000 m
Maximum altitude above sea level with derating	3,000 m
<i>For more information on derating, consult the design guide</i>	
EMC standards, emission	EN 61800-3, EN 61000-6-3/4, EN 55011, IEC 61800-3 EN 61800-3, EN 61000-6-1/2,
EMC standards, immunity	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6
<b>Control card performance</b>	
Scan interval	5 ms
<b>Control card, USB serial communication</b>	
USB standard	1.1 (full speed)
USB plug	USB type B device plug

**NOTICE**

Connection to PC is carried out via a standard host/device USB cable.

The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

The USB connection is not galvanically isolated from protective earth. Use only isolated laptop/PC as connection to the USB connector on the frequency converter or an isolated USB cable/converter.

**Protection and features:**

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heat sink ensures that the frequency converter trips if the temperature reaches a predefined level. An overload temperature cannot be reset until the temperature of the heat sink is below the allowed values.
- The frequency converter is protected against short-circuits on motor terminals U, V, W.
- If a mains phase is missing, the frequency converter trips or issues a warning (depending on the load).
- Monitoring of the intermediate circuit voltage ensures that the frequency converter trips if the intermediate circuit voltage is too low or too high.
- The frequency converter is protected against earth faults on motor terminals U, V, W.

## Specifications

## Operating Instructions

## 8.4 General Technical Data - Filter

Frame size	D13	E9	F18
Voltage [V]	380–480	380–480	380–480
Current, RMS [A]	120	210	330
Response time [ms]		<0.5	
Settling time - reactive current control [ms]		<40	
Settling time - harmonic current control (filtering) [ms]		<20	
Overshoot - reactive current control [%]		<20	
Overshoot - harmonic current control [%]		<10	

Table 8.4 Power Ranges (LHD with AF)

### 8.4.1 Power Rating

## Grid conditions

Supply voltage	380–480 V
----------------	-----------

*Mains voltage low/mains drop-out:*

During low mains voltage or a mains drop-out, the filter continues until the intermediate circuit voltage drops below the minimum stop level, which corresponds to 15% below the filter lowest rated supply voltage. Full compensation cannot be expected at mains voltage lower than 10% below the filter lowest rated supply voltage. If mains voltage exceed the filter highest rated voltage, the filter continues to work but harmonic mitigation performance is reduced. The filter does not cut out until main voltages exceed 580 V.

Supply frequency	50/60 Hz ±5%
	3.0% of rated supply voltage
Max. imbalance temporary between mains phases where mitigation performance is kept high.	Filter mitigates at higher mains imbalance but harmonic mitigation performance is reduced
Max THDv pre-distortion	10% with kept mitigation performance Reduced performance for higher pre-distortion levels

## Harmonic mitigation performance

THID	Best performance <4%
Individual harmonic mitigation ability:	Depending on filter vs. distortion ratio.
2nd	10%
4th	10%
5th	70%
7th	50%
8th	10%
10th	5%
11th	32%
13th	28%
14th	4%
16th	4%
17th	20%
19th	18%
20th	3%
22nd	3%
23rd	16%
25th	14%
Total current of harmonics	90%

The filter is performance tested to the 40th order

## Reactive current compensation

Cos phi	Controllable 1.0 to 0.5 lagging
Reactive current, % of filter current rating	100%

Specifications	Operating Instructions
----------------	------------------------

Cable lengths and cross-sections	
Max grid cable length (direct internal connection to drive)	Unlimited (determined by voltage drop)
Maximum cross-section to control terminals, rigid wire	1.5 mm <sup>2</sup> /16 AWG (2 x 0.75 mm <sup>2</sup> )
Maximum cross-section to control terminals, flexible cable	1 mm <sup>2</sup> /18 AWG
Maximum cross-section to control terminals, cable with enclosed core	0.5 mm <sup>2</sup> /20 AWG
Minimum cross-section to control terminals	0.25 mm <sup>2</sup>

CT terminals specification	
CT number	3 (one for each phase)
The AAF burden equals	2 mΩ
Secondary current rating	1 A or 5 A (hardware set-up)
Accuracy	Class 0.5 or better

Digital inputs	
Programmable digital inputs	2 (4)
Terminal number	18, 19, 27 <sup>1)</sup> , 29 <sup>1)</sup>
Logic	PNP or NPN
Voltage level	0-24-V DC
Voltage level, logic'0' PNP	< 5 V DC
Voltage level, logic'1' PNP	> 10 V DC
Voltage level, logic '0' NPN	> 19 V DC
Voltage level, logic '1' NPN	< 14 V DC
Maximum voltage on input	28 V DC
Input resistance, R <sub>i</sub>	approx. 4 kΩ

All digital inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

1) Terminals 27 and 29 can also be programmed as output.

Control card, RS-485 serial communication	
Terminal number	68 (P, TX+, RX+), 69 (N, TX-, RX-)
Terminal number 61	Common for terminals 68 and 69

The RS-485 serial communication circuit is functionally separated from other central circuits and galvanically isolated from the supply voltage (PELV).

Digital output	
Programmable digital/pulse outputs	2
Terminal number	27, 29 <sup>1)</sup>
Voltage level at digital/frequency output	0-24 V
Max. output current (sink or source)	40 mA

1) Terminal 27 and 29 can also be programmed as input.

Control card, 24 V DC output	
Terminal number	13
Max. load	200 mA

The 24 V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analog and digital inputs and outputs.

Specifications	Operating Instructions
<b>Surroundings</b>	
Enclosure	IP21, IP54
Vibration test	1.0 g
Relative humidity	5% - 95% (IEC 721-3-3; class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H <sub>2</sub> S test	class kD
Test method according to IEC 60068-2-43 H <sub>2</sub> S (10 days)	
Ambient temperature	
- with derating	max. NA °C
- with full output current (short temperature overload)	max. 45 °C
- at full continuous output current (24 hours)	max. 40 °C
Minimum ambient temperature during full-scale operation	0 °C
Minimum ambient temperature at reduced performance	-10 °C
Temperature during storage/transport	-25 to +70 °C
Maximum altitude above sea level without derating	1000 m
Maximum altitude above sea level with derating	3000 m
EMC standards, Emission	EN 61800-3, EN 61000-6-3/4, EN 55011, IEC 61800-3 EN 61800-3, EN 61000-6-1/2,
EMC standards, Immunity	EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6
<b>Control card performance</b>	
Scan interval	5 ms
<b>Control card, USB serial communication</b>	
USB standard	1.1 (full speed)
USB plug	USB type B "device" plug
<b>Generic specifications</b>	
Maximum parallel filters	4 on same CT set
Filter efficiency	97%
Typical average switching frequency	3.0–4.5 kHz
Response time (reactive and harmonic)	< 0.5 ms
Settling time - reactive current control	< 20 ms
Settling time - harmonic current control	< 20 ms
Overshoot – reactive current control	<10%
Overshoot – Harmonic current control	<10%

Connection to PC is carried out via a standard host/device USB cable. The USB connection is galvanically isolated from the supply voltage (PELV) and other high-voltage terminals. The USB connection is not galvanically isolated from protective earth. Use only isolated laptop/PC as connection to the USB connector on the unit or an isolated USB cable/converter.

#### Protection and features

- Temperature monitoring of the heat sink ensures that the active filter trips if the temperature reaches a predefined level. An overload temperature cannot be reset until the temperature of the heat sink is below the acceptable values.
- If a mains phase is missing, the active filter trips.
- The active filter has a short circuit protection current rate of 100 kA if properly fused
- Monitoring of the intermediate circuit voltage ensures that the filter trips if the intermediate circuit voltage is too low or too high.
- The active filter monitors the mains current as well as internal currents to reassure that current levels do not reach critical levels. If current exceeds a critical level, the filter trips.

**Specifications****Operating Instructions**

### 8.4.2 Derating for Altitude

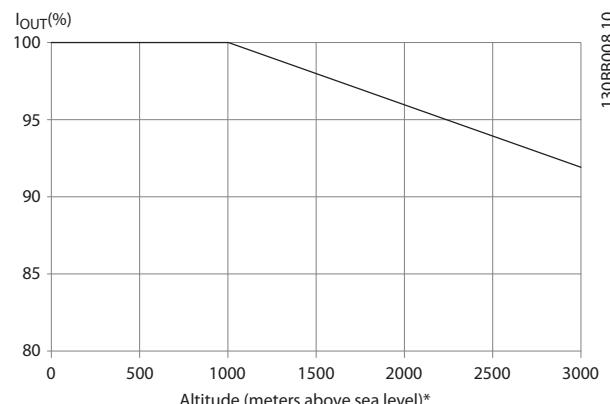
The cooling capability of air is decreased at lower air pressure.

Below 1,000 m altitude no derating is necessary but above 1,000 m the ambient temperature ( $T_{AMB}$ ) or max. output current ( $I_{out}$ ) should be derated in accordance with *Illustration 8.6*.

An alternative is to lower the ambient temperature at high altitudes and thereby ensure 100% output current at high altitudes. As an example of how to read the graph, the situation at 2,000 m is elaborated. At a temperature of 45 °C ( $T_{AMB, MAX} - 3.3$  K), 91% of the rated output current is available. At a temperature of 41.7 °C, 100% of the rated output current is available.

#### Altitude Derating

Derating of output current versus altitude at  $T_{AMB, MAX}$  for frame sizes D, E and F.



**Illustration 8.6 Altitude Derating**

### 8.5 Fuses

It is recommended to use fuses and/or circuit breakers on the supply side as protection in case of component breakdown inside the frequency converter (first fault).

**NOTICE**

This is mandatory to ensure compliance with IEC 60364 for CE or NEC 2009 for UL.

**WARNING**

Protect personnel and property against the consequence of component break-down internally in the frequency converter.

#### Branch circuit protection

To protect the installation against electrical and fire hazard, all branch circuits in an installation, switch gear, machines etc., must be protected against short-circuit and overcurrent according to national/international regulations.

**NOTICE**

The recommendations given do not cover branch circuit protection for UL.

#### Short-circuit protection

Danfoss recommends using the fuses/circuit breakers mentioned below to protect service personnel and property in case of component break-down in the frequency converter.

#### Overcurrent protection

The frequency converter provides overload protection to limit threats to human life, property damage and to avoid fire hazard due to overheating of the cables in the installation. The frequency converter is equipped with an internal overcurrent protection (4-18 Current Limit) that can be used for upstream overload protection (UL-applications excluded). Moreover, fuses or circuit breakers can be used to provide the overcurrent protection in the installation. Overcurrent protection must always be carried out according to national regulations.

The following tables list the recommended rated current. Recommended fuses are of the type gG for small to medium power sizes. For larger powers, aR fuses are recommended. Circuit breakers must be used, provided they meet the national/international regulations and they limit the energy into the frequency converter to an equal or lower level than the compliant circuit breakers. If fuses/circuit breakers according to recommendations are selected, possible damage on the frequency converter is mainly limited to damage inside the unit.

#### Non UL compliance

If UL/CUL is not to be complied with, use the following fuses, which ensure compliance with EN50178:

P160-P250	380-480 V	type gG
P315-P450	380-480 V	type gR

**Table 8.5 Fuse Types by Power Range**

## Specifications

## Operating Instructions

### 8.5.1 Fuse Specifications

#### UL compliance

#### 380-480 V, frame sizes D, E and F

The fuses below are suitable for use on a circuit capable of delivering 100,000 A<sub>rms</sub> (symmetrical), 240 V, or 480 V, or 500 V, or 600 V depending on the frequency converter voltage rating. With the proper fusing the frequency converter Short Circuit Current Rating (SCCR) is 100,000 A<sub>rms</sub>.

Size/ Type	Bussmann E1958 JFHR2 <sup>2)</sup>	Bussmann E4273 T/JDDZ <sup>2)</sup>	SIBA E180276 JFHR2	Littelfuse E91611 JFHR2 <sup>2)</sup>	Ferraz- Shawmut E60314 JFHR2 <sup>2)</sup>	Bussmann E4274 H/JDDZ <sup>2)</sup>	Bussmann E125085 JFHR2 <sup>1)</sup>	Internal Option Bussmann
P160	FWH- 400	JJS- 400	2061032.40	L50S-400	A50-P400	NOS- 400	170M4012	170M4016
P200	FWH- 500	JJS- 500	2061032.50	L50S-500	A50-P500	NOS- 500	170M4014	170M4016
P250	FWH- 600	JJS- 600	2062032.63	L50S-600	A50-P600	NOS- 600	170M4016	170M4016

Table 8.6 Frame size D, Line Fuses, 380-480 V

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Size/Type	Bussmann PN <sup>1)</sup>	Rating	Ferraz	Siba
P315	170M4017	700 A, 700 V	6.9URD31D08A0700	20 610 32.700
P355	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900
P400	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900
P450	170M6013	900 A, 700 V	6.9URD33D08A0900	20 630 32.900

Table 8.7 Frame size E, Line Fuses, 380-480 V

Size/Type	Bussmann PN <sup>1)</sup>	Rating	Siba	Internal Bussmann Option
P500	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
P560	170M7081	1600 A, 700 V	20 695 32.1600	170M7082
P630	170M7082	2000 A, 700 V	20 695 32.2000	170M7082
P710	170M7082	2000 A, 700 V	20 695 32.2000	170M7082

Table 8.8 Frame size F, Line Fuses, 380-480 V

Size/Type	Bussmann PN <sup>1)</sup>	Rating	Siba
P500	170M8611	1100 A, 1000 V	20 781 32.1000
P560	170M8611	1100 A, 1000 V	20 781 32.1000
P630	170M6467	1400 A, 700 V	20 681 32.1400
P710	170M6467	1400 A, 700 V	20 681 32.1400

Table 8.9 Frame Size F, Inverter module DC Link Fuses, 380-480 V

1) 170M fuses from Bussmann shown use the -/80 visual indicator, -TN/80 Type T, -/110 or TN/110 Type T indicator fuses of the same size and amperage may be substituted for external use

2) Any minimum 500 V UL listed fuse with associated current rating may be used to meet UL requirements.

#### Supplementary fuses

Frame size	Bussmann PN <sup>1)</sup>	Rating
D, E and F	KTK-4	4 A, 600 V

Table 8.10 SMPS Fuse

Specifications	Operating Instructions		
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Size/Type	Bussmann PN <sup>1)</sup>	Littelfuse	Rating
P160-P315, 380-480 V	KTK-4		4 A, 600 V
P355-P710, 380-480 V		KLK-15	15A, 600 V

Table 8.11 Fan Fuses

Size/Type		Bussmann PN <sup>1)</sup>	Rating	Alternative Fuses
P500-P710, 380-480 V	2.5-4.0 A	LPJ-6 SP or SPI	6 A, 600 V	Any listed Class J Dual Element, Time Delay, 6A
P500-P710, 380-480 V	4.0-6.3 A	LPJ-10 SP or SPI	10 A, 600 V	Any listed Class J Dual Element, Time Delay, 10 A
P500-P710, 380-480 V	6.3-10 A	LPJ-15 SP or SPI	15 A, 600 V	Any listed Class J Dual Element, Time Delay, 15 A
P500-P710, 380-480 V	10-16 A	LPJ-25 SP or SPI	25 A, 600 V	Any listed Class J Dual Element, Time Delay, 25 A

Table 8.12 Manual Motor Controller Fuses

Frame size	Bussmann PN <sup>1)</sup>	Rating	Alternative Fuses
F	LPJ-30 SP or SPI	30 A, 600 V	Any listed Class J Dual Element, Time Delay, 30 A

Table 8.13 30 A Fuse Protected Terminal Fuse

Frame size	Bussmann PN <sup>1)</sup>	Rating	Alternative Fuses
D	LP-CC-8/10	0.8A, 600V	Any listed Class CC, 0.8A
E	LP-CC-1 1/2	1.5A, 600V	Any listed Class CC, 1.5A
F	LPJ-6 SP or SPI	6 A, 600 V	Any listed Class J Dual Element, Time Delay, 6 A

Table 8.14 Control Transformer Fuse

Frame size	Bussmann PN <sup>1)</sup>	Rating
F	GMC-800MA	800 mA, 250 V

Table 8.15 NAMUR Fuse

Frame size	Bussmann PN <sup>1)</sup>	Rating	Alternative Fuses
F	LP-CC-6	6 A, 600 V	Any listed Class CC, 6 A

Table 8.16 Safety Relay Coil Fuse with PILZ Relay

1) 170M fuses from Bussmann shown use the -/80 visual indicator, -TN/80 Type T, -/110 or TN/110 Type T indicator fuses of the same size and amperage may be substituted for external use

## 9 Appendix

### 9.1 Abbreviations and Conventions

AC	Alternating Current
AEO	Automatic Energy Optimization
AMA	Automatic Motor Adaptation
AWG	American Wire Gauge
°C	Degrees Celsius
DC	Direct Current
EMC	Electromagnetic Compatibility
ETR	Electronic Thermal Relay
$f_{M,N}$	Nominal Motor Frequency
FC	Frequency Converter
$I_{LIM}$	Current Limit
$I_{INV}$	Rated Inverter Output Current
$I_{M,N}$	Nominal Motor Current
$I_{VLT,MAX}$	The Maximum Output Current
$I_{VLT,N}$	The Rated Output Current Supplied by the Frequency Converter
IP	Ingress Protection
LCP	Local Control Panel
N.A.	Not applicable
$P_{M,N}$	Nominal Motor Power
PCB	Printed Circuit Board
PE	Protective earth
PELV	Protective Extra Low Voltage
Regen	Regenerative Terminals
RPM	Revolutions Per Minute
$T_{LIM}$	Torque Limit
$U_{M,N}$	Nominal Motor Voltage

Table 9.1 Abbreviations

#### Conventions

Numbered lists indicate procedures.

Bullet lists indicate other information and description of illustrations.

Italicised text indicates

- cross reference
- link
- footnote
- parameter name, parameter group name, parameter option

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# **TECHNICAL DATA SHEET**

**Equipment Type:** Thermostat

**Location:** Motor Starter Section

**Model Numbers:** FZK011

**Manufacturer:** Stego

**Supplier:** NHP Pty Ltd

16 Riverview Place  
Murarrie  
(07) 3909 4999



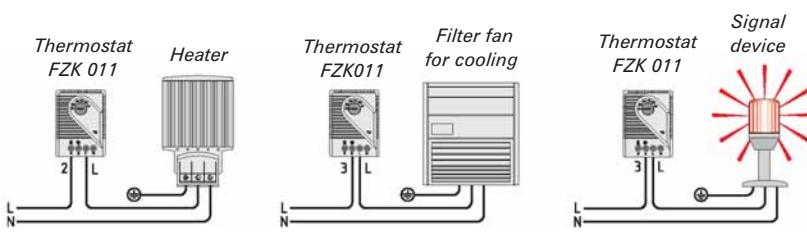
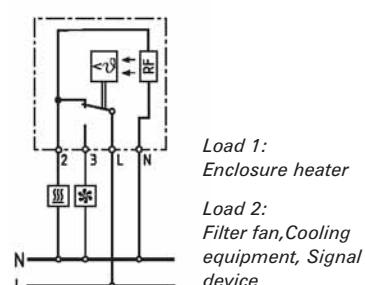
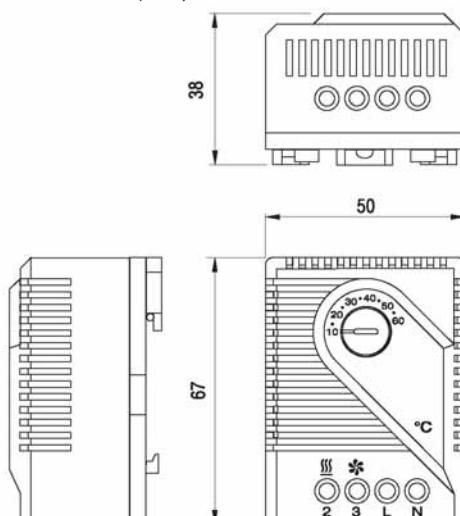
## STEGO FZK 011 SERIES

### MECHANICAL THERMOSTAT SERIES FZK 011

The mechanical thermostat is used for controlling heating and cooling equipment, filter fans or signal devices. The thermostat registers the surrounding air and can switch both inductive and resistive loads via snap-action contact.

- Adjustable temperature
- Small hysteresis
- Changeover contact

*Dimensions (mm)*



#### Technical Data:

**Operating voltage:** 230 V AC

**Switch temperature difference:** 4K ( $\pm 1.5\text{K}$  tolerance)<sup>1)</sup>

**Sensor element:** Thermostatic bimetal

**Contact type:** Changeover snap-action contact

**Contact resistance:** < 10 mOhm

**Service life:** > 100,000 cycles

**Max. Switching capacity, NC:** 250 V AC, 10 A  
DC 30 W

**Max. Switching capacity, NO:** 250 V AC, 5 A  
DC 30 W

**EMC:** Acc. to EN 55014-1-2,  
EN 61000-3-2,  
EN 61000-3-3

**Connection:** 4-pole terminal for  
2.5 mm<sup>2</sup>, clamping  
torque 0.8 Nm

**Mounting:** Clip for 35 mm DIN rail,  
EN50022

**Casing:** Plastic according to  
UL-94 V-0, light grey

**Dimensions:** 67 x 50 x 38 mm

**Weight:** Approx. 0.10 kg

**Operating/Storage temperature:** -20 to +80 °C  
/-45 to +80 °C

**Protection type:** IP 20



**Note:** 1) Connecting terminal "N" (RF heating resistor) causes the thermal feedback to work and so reduces the switch temperature difference to approx. 0.5K.

# TECHNICAL DATA SHEET

**Equipment Type:** MTR Relays

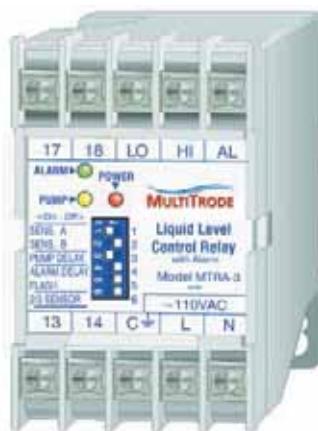
**Location:** RTU Section

**Model Numbers:** MTR

**Manufacturer:** Xylem

**Supplier:** Brisbane Technology Park  
Unit 1, 18 Brandl Street  
P.O. Box 4633  
Eight Mile Plains  
Queensland 4113  
Australia

# MTR Level Relay



The MTR level relay has proven itself to be simple and extremely reliable in pump stations everywhere. The MTR controls one pump or one alarm. The MTRA controls one pump and one alarm.

#### ■ Safe

The extra low sensing voltage ensures maintenance staff and operators are protected at all times.

#### ■ Four sensitivities

Allows the relay to operate effectively in a wide range of conductive liquids.

#### ■ Activation delays

Each output can have a different time delay to overcome wave action and turbulence.

#### ■ LED indication

High intensity LED indicators ensure clear signals.  
Power On (green). Alarm On (red). Pump On (yellow).

#### ■ Dipswitch programmable

All settings are easily selectable from the front panel.

#### ■ Proven reliability

The proven design and performance of the relay ensures long-term reliability of the MultiTrode system.

#### ■ I.S application

Perfect for I.S application when used with an MTISB.

#### ■ Unique two-sensor operation (MTRA only)

Pump and alarm can be controlled using two or three sensors. Two-sensor operation is ideal for budget applications or where space is limited.

#### ■ DIN rail or screw mounting

#### ■ Low installed cost

# Specifications

#### Mode of operation:

<b>MTR Mode</b>	Charge/Discharge (Fill or Empty)
<b>MTRA Mode</b>	Discharge ONLY

#### Probe Inputs:

Sensor inputs	<b>MTR : 2 / MTRA : 3</b>
Sensor voltage	10/12VAC Nominal
Sensor current	0.8mA max. (per sensor)
Sensitivity	1k, 4k, 20k, 80k

#### Relay Outputs:

<b>MTR</b> relay output	2 contact sets : 1 N/O & 1 C/O
<b>MTR</b> Output delay	0, 2.5, 5, 10, 20, 40, 80, 160 sec
<b>MTRA</b> relay output	2 relays : both N/O
<b>MTRA</b> Output delay	Pump: 0.5, 10; Alarm: 0.5, 15 sec
Relay contact rating	250 VAC 5A Resistive, 2A Inductive
Relay contact life	10 <sup>5</sup> Operations
Terminal size	2 x 13 AWG / 2.5mm <sup>2</sup>

#### Display

LEDs:	Power On	Pump	Alarm
<b>MTR</b>	Green	Red	Red
<b>MTRA</b>	Green	Yellow	Red

#### Physical Product:

Dimensions	2.7/8H x 1.3/4W x 4.1/2D (Inches) 72Hx45Wx114D (mm)
Mounting	DIN Rail or 2 x #6 Screws / 2 x M4 Screws
Enclosure	Makrolon (self-extinguishing)



#### Power Supply:

Supply Voltage AC	24, 110, 240, <b>415VAC*</b> - 50/60Hz
Power Consumption	3.5 Watts max      *(MTR only)
Supply Voltage DC	12 or 24VDC,
Power Consumption	3 Watts max

#### Environmental Range:

Centigrade	-10° to +60°C
Fahrenheit	+14° to +140°F



#### Available Models & Ordering Information

415VAC	<b>MTR-1</b>	n/a
240VAC	<b>MTR-2</b>	MTRA-2
110VAC	<b>MTR-3</b>	MTRA-3
24VAC	<b>MTR-4</b>	MTRA-4
24VDC	<b>MTR-5</b>	MTRA-5
12VDC	<b>MTR-6</b>	MTRA-6



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# TECHNICAL DATA SHEET

<b>Equipment Type:</b>	SAFE FSP Relays
<b>Location:</b>	RTU Section
<b>Model Numbers:</b>	SAFE FSP
<b>Manufacturer:</b>	Xylem
<b>Supplier:</b>	Brisbane Technology Park Unit 1, 18 Brandl Street P.O. Box 4633 Eight Mile Plains Queensland 4113 Australia



# SAFESMART Backup Controller SAFE-FSP

Installation & Operation Manual





# SAFE-FSP Relay Manual

This Manual is the support documentation for the installation,  
commissioning and operation of the  
SafeSmart FSP Backup Controller

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Last updated 2 June 2009

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# SAFE-FSP Relay Manual

## 1 Warnings & Cautions

### 1.1 Information to User

Read this manual prior to installing or operating the SafeSmart-FSP Backup Controller. It contains all the information necessary to configure it for maximum performance for your application. After reading, place the manual in a safe place for future reference.

### 1.2 Documentation Standards


**DANGER:**

This symbol is used where non-compliance could result in injury or death.


**WARNING:**

This symbol is used where non-compliance could result in incorrect operation, damage to or failure of the equipment.


**NOTE:**

This symbol is used to highlight an issue or special case within the body of the manual.

### 1.3 Installation Notes


**WARNING:**

The SafeSmart-FSP installation and wiring must be performed by qualified personnel.


**DANGER:**

The SafeSmart-FSP has no user serviceable parts. To reduce the risk of electric shock leave all servicing to qualified Multitrode technical staff.

## 2 Introduction

The SAFE-FSP Backup Controller is a solid-state electronic level control module housed in a hi-impact plastic case with a DIN rail attachment on the back. It is used to control a pump (via a contactor or soft starter) in response to a liquid level sensor such as a MultiTrode probe.

The FSP Controller can be used as the primary source of control for a single pump or as a backup control device (for a single pump) when the primary control equipment fails. When using an FSP Controller as a backup controller, it only controls the pump in response to high or low level signals from dedicated level sensors.

A thermal sensor can be connected to the FSP Controller for pump protection. During operation, the LED indicators on the front panel display the current status including – Power, Pump On/Off, Level alarm, Thermal fault and Probe fault.

The FSP Backup Controller is designed to be easy to install and configure. All connections are clearly labelled on the side of the device and options are configured using a set of Dip switches on the front of the Controller.

### 3 Specifications

<b>Dimensions</b>	
Width	22.5mm (7/8")
Height	101mm (4")
Length (depth)	120mm (4 3/4")
<b>Environmental</b>	
Ambient Temperature	-10 to 60 °C (14 to 140 °F)
Humidity	5% to 90% non-condensing
<b>AC Power Supply</b>	
Voltage Range	85 – 265V AC
Frequency	50/60Hz
Power	3.5W
<b>DC Power Supply</b>	
Voltage Range	12 – 30V DC
Current	0.15A max
<b>Relay Outputs</b>	
Type	Form A
Current (Resistive)	5A
Current (Inductive)	2A
Voltage Rating DC	30V DC
Voltage Rating AC	250V AC
<b>Thresholds*</b>	
Thermal Fault Present	> 4k ohms
Thermal Fault Cleared	< 2k ohms
Thermal BU Input	0.15V DC

Table 1 - SAFE-FSP Specifications

\* Where applicable, values include a 56 ohm series resistor on the thermal input.

# SAFE-FSP Relay Manual

## 4 Installation

The FSP Backup Controller is designed to be mounted onto a standard DIN rail. The power supply, input and output connections are located on the top of the Controller housing.

The features of the Controller are listed below and are discussed in the following sections.

- Power Supply Options
  - Four Configurations
- Operation Modes & Probe Inputs
  - Empty (Discharge) Mode
  - Fill (Charge) Mode
- Level Alarm Fault
  - Level Alarm (AL Probe)
- Pump Faults
  - Thermal Pump Fault
- Probe Faults
  - Failsafe Probe Fault
  - Assumed Probe Fault
- Digital Output and Pump Sensor Connection Options
  - Local or Remote Monitoring of Pump Status & Faults
  - MultiSmart Connections - Conductive Thermal Sensor
  - MultiSmart Connections - FLS Thermal Sensor
- Manual (Hand) Operation
- Alarm Activation and Deactivation Delays
- Probe Sensitivity
- LED Status Summary
- DIP Switch Settings

## 5 Power Supply Options

The FSP Controller can be supplied power in the following ways:

- 85 – 240V AC Supply Only
- 12 – 30V DC Supply Only
- 85 – 240V AC with 12 – 14V DC as Backup
- 15\* – 30V DC with 85 – 240V AC as Backup

\* When the DC supply is 15V or greater, the DC supply is the primary source.

A Power LED (steady green) indicates when the Controller is powered. If the LED flashes, supply voltage is too low.

**NOTE:**

 If the power supply is below 24 VDC, the voltage alarm threshold is automatically set to 11.5 V. If the supply is 24 VDC or above, the voltage alarm threshold is automatically set to 23 V.

A switch or circuit-breaker and an over-current protection device must be included in the installation. The protection device must be in close proximity to the equipment, within easy reach of the operator, and be marked as the protection device for the equipment.

The input wiring and the switch/circuit-breaker/over-current device must be rated to at least the nominal input voltage being used. The recommended current ratings are below.

Unit Supply Range	Recommended Switch/Circuit-Breaker/Overcurrent Protection Device Rating	Minimum Supply Wiring Rating
85 - 180VAC	0.1A	0.1A
180 - 265VAC	0.05A	0.05A
12 – 20VDC	0.3A	0.3A
20 – 30VDC	0.15A	0.15A

Table 2 – Current Ratings



**NOTE:**

The MultiTrode probe uses an earth/ground return path for the signal. Ensure that the GROUND (DC-) terminal on the FSP Controller is also grounded.

# SAFE-FSP Relay Manual

## 6 Operation Modes & Probe Inputs

The SafeSmart-FSP Backup Controller can be configured to operate in either Empty (Discharge) or Fill (Charge) mode.

- Empty (Discharge) Mode - Dip Switch 1 = OFF
- Fill (Charge) Mode - Dip Switch 1 = ON

The Controller has three (3) probe inputs, High, Low and Alarm. The Alarm probe input can be configured as a low or high level alarm.

- High Level Alarm - Dip Switch 2 = OFF
- Low Level Alarm - Dip Switch 2 = ON

### 6.1 Empty (Discharge) Mode

This mode is used to pump liquid out of a well once it reaches a preset level. (Figure 1) In this mode the Controller operates as follows:

- The pump activates when the liquid reaches the sensor in the high level probe.
- The pump continues to operate until the liquid level drops below the low level probe and the pump deactivation period expires.
- When a thermal fault occurs, the Pump Control output is deactivated regardless of the liquid level. The pump stops, the Pump Fault output (DO1) is deactivated and the Thermal LED flashes.

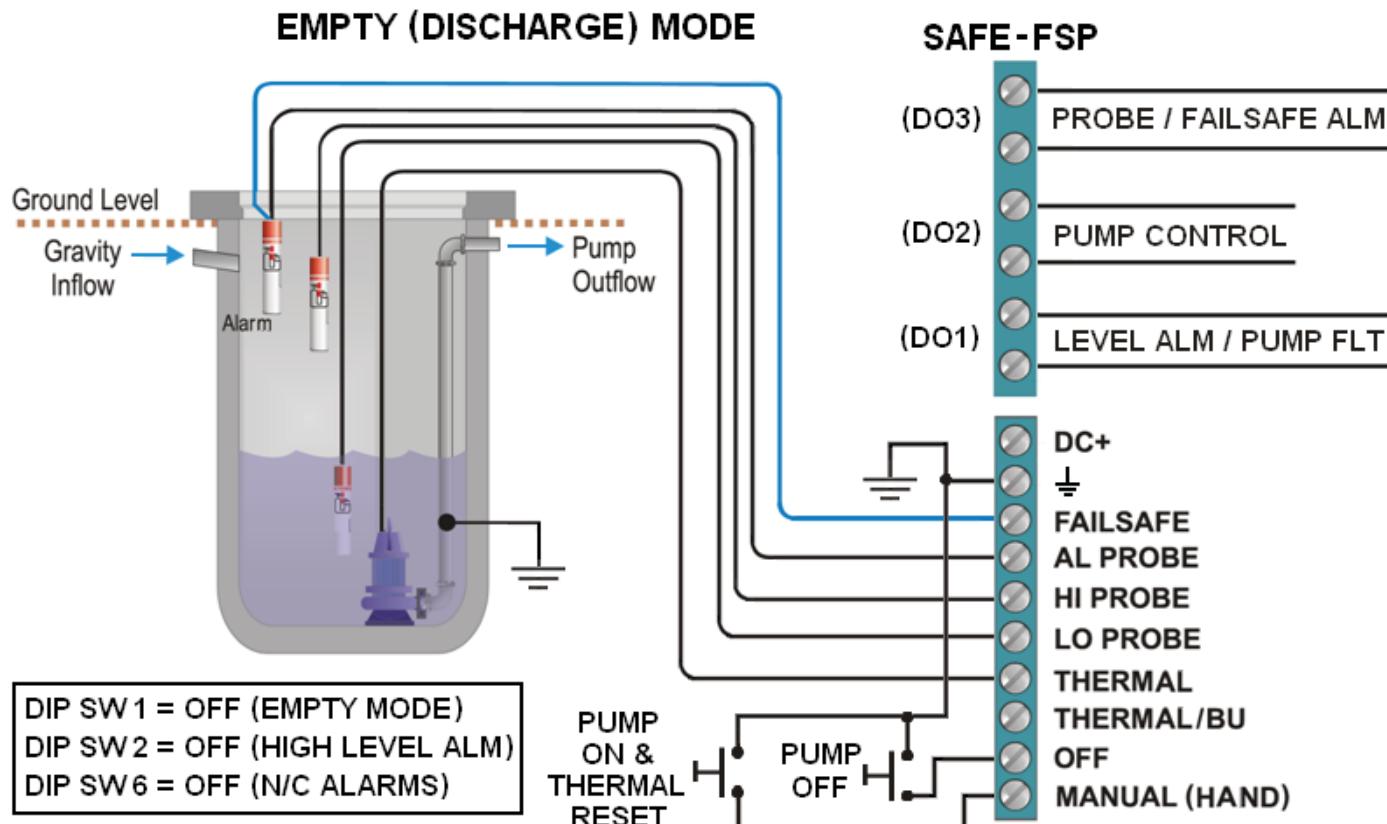


Figure 1 – Empty (Discharge) Mode

## 6.2 Fill (Charge) Mode

This mode is used to fill up a well with liquid when the level falls to a preset level. (Figure 2) In this mode the Controller operates as follows:

- The pump activates when the liquid falls just below the sensor in the low level probe.
- The pump continues to operate until the liquid level reaches the sensor in the high level probe and the pump deactivation period expires.
- When a thermal fault occurs the Pump Control output deactivates regardless of the liquid level. The pump stops, the Pump Fault output is deactivated and the Thermal LED flashes.

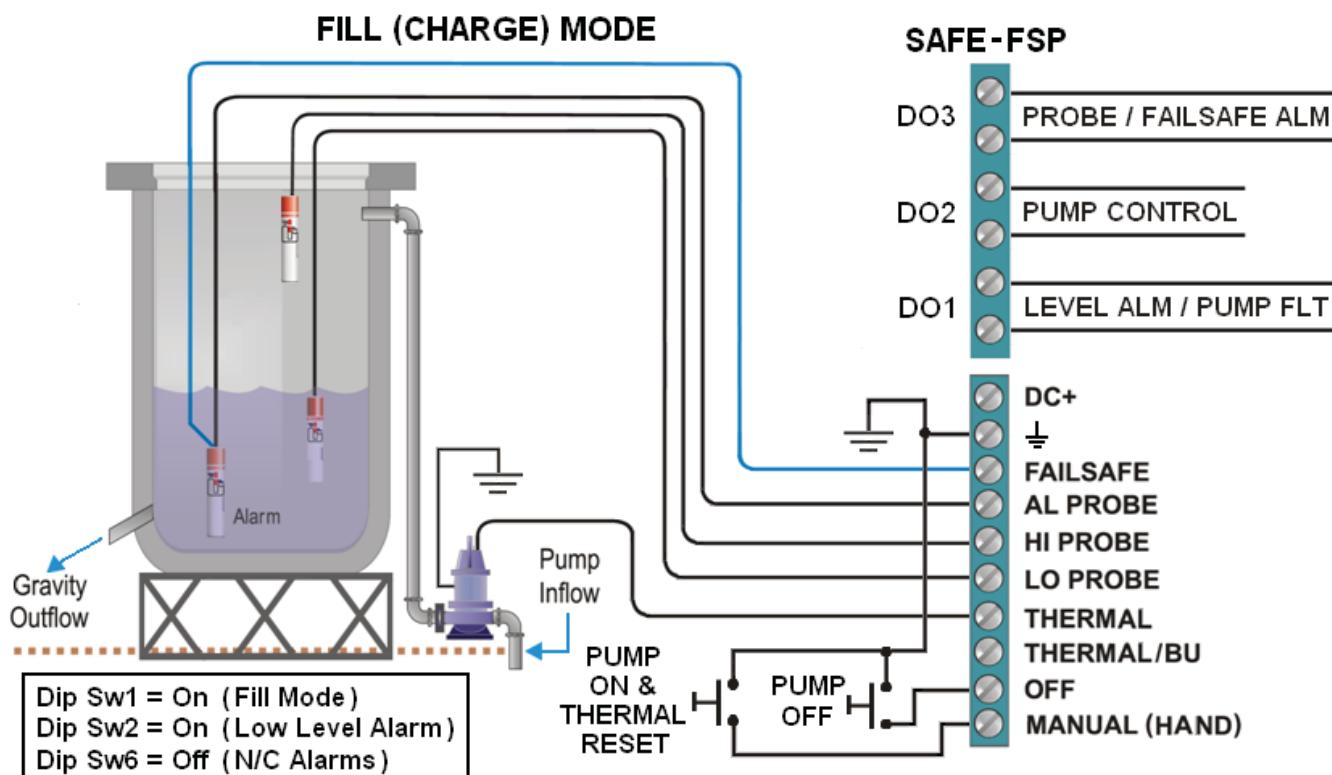


Figure 2 - Fill (Charge) Mode

## 7 Level Alarms (AL Probe)

A conductive level sensor is connected to the AL Probe input to detect when the liquid level has risen above or fallen below an acceptable level.

In Empty (Discharge) mode this is typically a high level alarm and is activated when the AL Probe input detects liquid and the activation delay has expired.

In Fill (Charge) mode this is typically a low level alarm and is activated when the AL Probe input is no longer detecting level (i.e. the level has dropped below the sensor) and the activation delay has expired.

When a level alarm is detected the Level Alarm output (DO1) changes state and the Level Alarm LED flashes at 1Hz. The Level Alarm/Pump Fault output can be used to operate an alarm device such as a beacon.

The Level Alarm/Pump Fault output (DO1) can be configured as normally open or normally closed.

- Normally Closed Output - Dip Switch 6 = OFF
- Normally Open Output - Dip Switch 6 = ON



### NOTE:

Dip Sw6 also has the same effect on the Probe/Failsafe Alarm output (DO3).

## SAFE-FSP Relay Manual

### 8 Thermal Pump Fault

The FSP Controller can detect thermal and FLS thermal faults. The FSP Controller can not detect a Seal fault. Types of sensors that maybe connected are FLS (Flygt Leakage Sensor), FLS10 or a thermal only sensor such as non-linear PTC thermistor or bi-metallic switch.

A thermal sensor is connected as illustrated in Figure 3. No Dip Switch setting change is required.

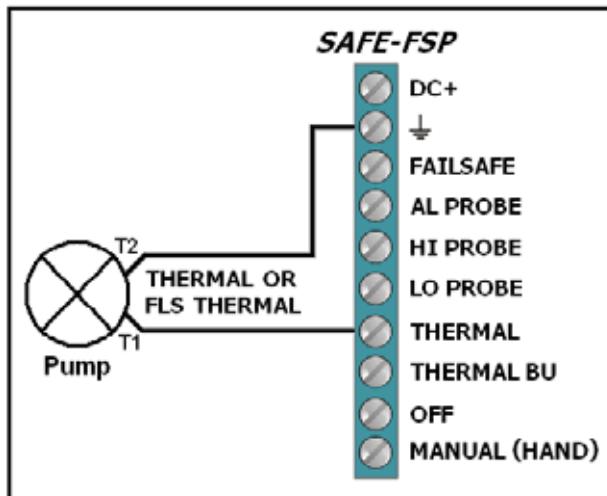


Figure 3 - Thermal Sensor Connection (Flygt and Non-Flygt Pumps)

When a thermal fault is detected, the pump stops, (DO2 is deactivated), the Level Alarm / Pump Fault output (DO1) changes state and the Thermal Fault LED begins to flash.

A thermal fault is automatically reset when the pump returns to normal operating temperature (i.e. the fault is no longer present). The flashing Thermal LED becomes steady and the pump is free to run.

A manual acknowledgement is required to clear the Thermal LED. A manual acknowledgement is performed by momentarily connecting Ground/Earth to the Manual (Hand) terminal. See Figure 4 below. (Note, the pushbutton switch is not supplied).

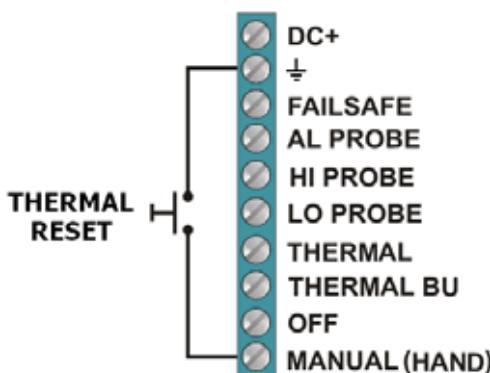


Figure 4 - Manual Thermal Fault Reset & Manual (Hand) Operation

The Level Alarm/Pump Fault output (DO1) can be configured as normally open or normally closed.

- Normally Closed Output - Dip Switch 6 = OFF
- Normally Open Output - Dip Switch 6 = ON



**NOTE:**

Dip Sw6 also has the same effect on the Probe/Failsafe Alarm output (DO3).

## 9 Probe Faults

The FSP Controller detects two types of probe faults, a Failsafe Probe fault and an Assumed Probe fault. When either fault is detected the Probe/Failsafe Alarm output (DO3) changes state. This output can be configured as normally open or normally closed.

- Normally Closed Output - Dip Switch 6 = OFF
- Normally Open Output - Dip Switch 6 = ON



**NOTE:**

Dip Sw6 also has the same effect on the Level Alarm/Pump Fault output (DO1).

### 9.1 Failsafe Probe Fault

MultiTrode probes are available with a failsafe connection to the top-most sensor to enable detection of a sensor fault. If a broken cable is detected to the top-most sensor, the Probe/FailSafe fault output (DO3) changes state, the Probe Fault LED flashes and the pump stops.

A Failsafe probe is typically used in discharge (empty) applications only. By its very nature the probes used in a charge or fill application are covered, so for example if the low level alarm probe goes open circuit, a low level alarm would be present immediately.



**NOTE:**

If a non-failsafe probe is used, then a jumper must be connected between the Alarm Probe and the Failsafe Probe inputs to suppress erroneous probe faults.



**NOTE:**

When using single sensor probes, the Failsafe Probe input should be connected to the highest probe in the system.

### 9.2 Assumed Probe Fault

For an Empty (Discharge) application, if a High Level probe is activated and the Low Level probe is deactivated, then the Controller assumes the Low Level probe is faulty. This condition is called an "Assumed Probe Fault" and the Probe Fault LED illuminates.

The Controller changes its pumping behaviour to a timed method until the fault condition is no longer present. So the pump continues to run for 60s after the High Level probe has deactivated and during this time the Pump LED flashes.

For a Fill (Charge) application, if a High Level probe is activated and the Low Level probe is deactivated, then the Controller assumes the Low Level probe is faulty. This condition is called an "Assumed Probe Fault" and the Probe Fault LED illuminates.

The Controller changes its pumping behaviour to a timed method until the fault condition is no longer present. So the Controller waits for 60 seconds after the High Level probe has deactivated then starts the pump, and during this time the Pump LED flashes.

When an Assumed Probe fault occurs, the Probe/FailSafe fault output (DO3) changes state.

# SAFE-FSP Relay Manual

## 10 Digital Output and Pump Sensor Connection Options

### 10.1 Local or Remote Monitoring of Pump Status & Faults

The FSP Controller's digital outputs can be wired into the inputs of a wide range of devices (e.g. a PLC, RTU or Dialler etc.) and the state of the pump monitored. The valid states and what they signify are tabled below.

FSP Outputs*			Level Alarm or Thermal Fault	Pump Status	As\Probe Fit or Failsafe Fault
DO1	DO2	DO3	DO1	DO2	DO3
0	0	0	-	Off	-
0	0	1	-	Off	Y
1	0	0	Y	Off	-
1	0	1	Y	Off	Y
0	1	0	-	On	-
0	1	1	-	On	Y
1	1	0	Y	On	-
1	1	1	Y	On	Y

Table 3 – FSP Controller Output States

\* Dip Sw 6 = On (Normally Open)

### 10.2 MultiSmart and FSP Controller Thermal Sensor Options

The FSP Controller can be used in conjunction with a MultiSmart Pump Station Manager.

The MultiSmart is indirectly connected to the thermal sensor via a relay within the FSP Controller. The Controller monitors this line and if it detects that the MultiSmart is no longer connected, the internal relay switches over and the FSP Controller drives the sensor.

The Controller monitors the voltage on the Thermal BU input to the MultiSmart. If the MultiSmart fails, the Controller takes over and controls the pump (but does not inhibit the MultiSmart pump control) and monitors for a thermal fault – thus providing backup control and thermal overload protection to the pump.

#### 10.2.1 MultiSmart Connections - Conductive Thermal Sensor

The conductive thermal sensor is connected to the Thermal input. The Thermal BU (backup) is connected to a digital input on the MultiSmart (configured as a Motor OverTemp fault). See Figure 5 below.

The MultiSmart and FSP controller are both capable of responding to a thermal fault. When a thermal fault is detected, the pump stops, if running. A Motor OverTemp fault is displayed on the MultiSmart and a thermal fault is displayed on the Controller. The pump can not be restarted until the thermal fault clears. The FSP Controller automatically resets the fault when the fault condition is no longer present, this allows the pump to run again but only via the Controller. The fault must be reset at the MultiSmart before the MultiSmart is able to run the pump again.

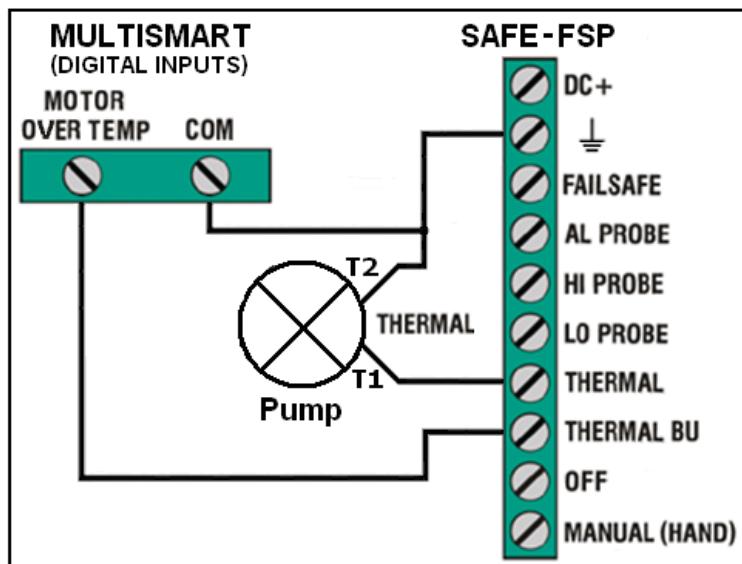


Figure 5 –Thermal Sensor Connections to a MultiSmart

#### 10.2.2 MultiSmart Connections - FLS Thermal Sensor

The FLS sensor is connected to the Thermal input. The Thermal BU is connected to a digital input on the MultiSmart (configured as an FLS fault). (See Figure 6 below). The FSP Controller is not able to detect a seal fault however the MultiSmart can.

When an FLS thermal fault is detected, the pump stops, if running - shut down by the MultiSmart and/or the FSP Controller. An FLS Flygt Thermal fault is displayed on the MultiSmart and on the Controller. The pump can not be restarted until the thermal fault clears. The FSP Controller automatically resets the fault when the fault condition is no longer present, this allows the pump to run again but only via the Controller. The fault must be reset at the MultiSmart before the MultiSmart is able to run the pump again.

When an FLS Seal fault occurs the FSP Controller is unable to detect it however the MultiSmart can and will display an FLS Flygt Seal fault. By default, the MultiSmart allows the pump to continue to run when a seal fault occurs.

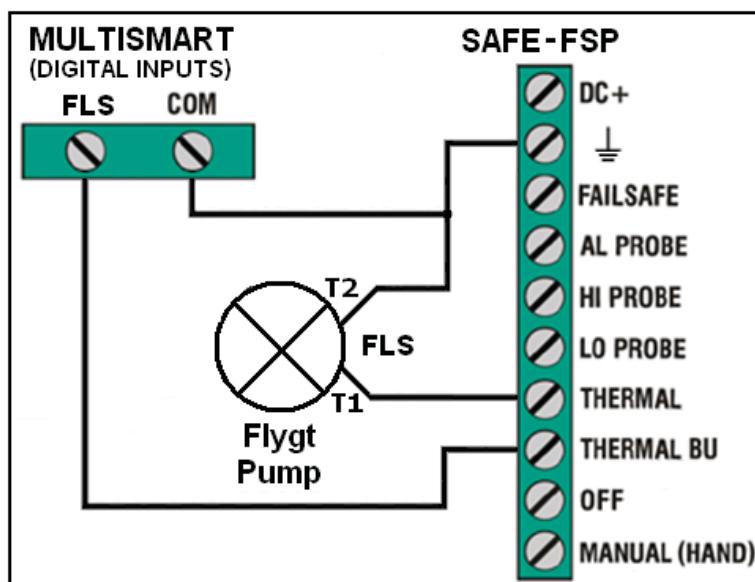


Figure 6 - FLS Connections to a MultiSmart (Flygt Pump)

# SAFE-FSP Relay Manual

## 11 Manual (Hand) Operation

A momentary action pushbutton (not supplied) may be connected to the Manual (Hand) input and used to operate the pump directly. (See Figure 7). Once pressed the pump begins to operate immediately irrespective of the liquid level. A second momentary action pushbutton switch is required to switch the pump off. It is connected across the Off input and Ground/Earth.

### **WARNING:**



If operating the pump manually via the Manual (Hand) switch, the pump does **NOT** automatically turn off when the level falls below the low sensor. So ensure that the pump is switched off via the Pump Off switch before the level becomes critically low to avoid potential **damage** to the pump.

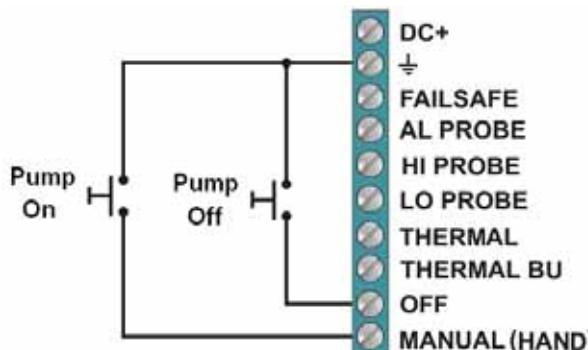


Figure 7 – Manual Pump Operation – On & Off Switches

## 12 Pump Activation and Deactivation Delays

Activation delays are used to prevent spurious pump starts. The delay allows the level device to positively detect the liquid before operating the pump.

There are two delay periods for Pump Activation delay:

- 0.5 sec - Dip Switch 3 = OFF
- 30 sec - Dip Switch 3 = ON

There are two delay periods for Pump Deactivation delay:

- 0.5 sec - Dip Switch 4 = OFF
- 30 sec - Dip Switch 4 = ON

## 13 Alarm Activation and Deactivation Delays

Activation and Deactivation delays are used to prevent spurious level alarms. The delay allows the level device to positively detect the liquid before triggering the alarm.

There are two delay periods:

- 0.5 sec - Dip Switch 5 = OFF
- 10 sec - Dip Switch 5 = ON

This delay applies to both the alarm activation and deactivation delay.

## 14 Probe Sensitivity

The Controller is used in conjunction with a conductive level sensing device, such as the MultiTrode probe. Conductive probes rely on conductivity through the liquid to earth in order to detect level. Highly conductive liquids, such as saltwater, generally require the Controller be set to a lower sensitivity than for low conductivity liquids, such as distilled water.

For most applications, the default probe setting of 20k ohms is satisfactory but the Controller allows the operator to adjust its sensitivity as needed for specific conditions. The sensitivity is set using Dip Switches 7 and 8.

Dip Sw 7	Dip Sw 8	Sensitivity	Typical Application
OFF	OFF	1k ohm	Concentrates Acids, Minerals, Alkalies
ON	OFF	4k ohm	Acids, Alkalies, Diluted Brine, Sea Water
OFF	ON	20k ohm	Sullage, Sewage Effluent, Town Water
ON	ON	80k ohm	Industrial Effluent, Purified Water*

*Table 4 - Probe Sensitivity*

\* Not recommended for use with purified de-ionised water or pristine rain water.

## 15 LED Status Summary

Five LEDs on the front of the Controller indicate the power, level alarm, pump status, thermal and probe fault status of the Controller.

LED	Status	Indication
Power	Power on	Steady
	Low voltage	Flashing
Level	Level alarm	Flashing
Pump	Pump on	Steady
	Activation delay period	Flashing
Thermal	Manual ack required	Steady
	Thermal fault active	Flashing
	Standalone locked mode*	Flashing - Double
Probe	Assumed probe fault	Steady
	Failsafe probe fault **	Flashing

*Table 5 - LED Summary Status*

\* In Standalone Locked mode the FSP Controller ignores the THERMAL BU input. Standalone Locked mode occurs if the voltage on the THERMAL BU input is unstable (i.e. voltage is < 0.15V and > 6V in less than 0.5s for 30 seconds). To exit Standalone Locked mode, press the Manual (Hand) button.

\*\* Failsafe probe fault has higher priority than Assumed probe fault.

## 16 DIP Switch Settings

The Controller is configured using the DIP switches located on the front of the enclosure.

DIP #	Setting	Mode Description	Section
1	OFF	Empty (Discharge) Mode	6
	ON	Fill (Charge) Mode	6
2	OFF	High Level Alarm	6
	ON	Low Level Alarm	6
3	OFF	0.5 sec Pump Activation Delay	12
	ON	30 sec Pump Activation Delay	12
4	OFF	0.5 sec Pump Deactivation Delay	12
	ON	30 sec Pump Deactivation Delay	12
5	OFF	0.5 sec Alarm Activation &	13
	ON	10 sec Alarm Activation &	13
6	OFF	N/C (Normally Closed) (DO3 & DO1)	7,8,9
	ON	N/O (Normally Open) (DO3 & DO1)	7,8,9
7	8	Probe Sensitivity	14
OFF	OFF	1k ohm	
ON	OFF	4k ohm	
OFF	ON	20k ohm	
ON	ON	80k ohm	

*Table 6 - Dip Switch Settings*

# SAFE-FSP Relay Manual

## 17 Example Applications

### 17.1 Backup Operation

Following is an example an empty (discharge) application using the FSP Controller as backup to a pump controller (the primary control device). In this configuration the FSP Controller does not control the pump until the High Level probe is covered which should only occur if the pump controller fails.

If the level continues to rise and it reaches the Alarm probe, a high level alarm is tripped. This indicates that the pump for whatever reason is unable to cope and the level has risen to an excessively high level (and overflow is possibly imminent).

The Alarm and High Level probes are positioned higher than the highest activation point used by the pump controller.

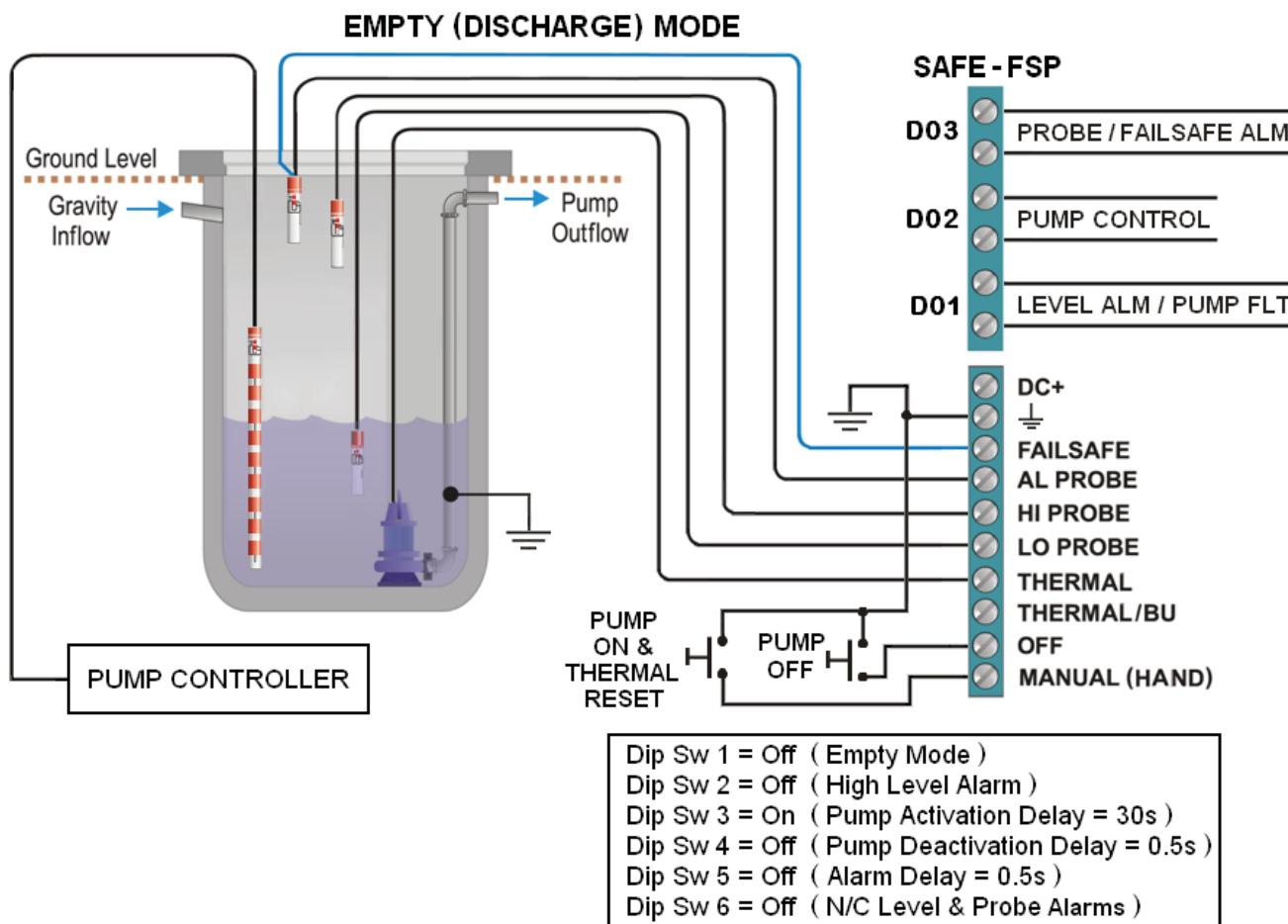


Figure 8 - Example of a Backup Application

If the pump controller is located at a site with no telemetry, a low level alarm could be configured (rather than a high level alarm). If the alarm trips, it indicates (by means of say a beacon) that the primary pump controller has most likely failed. However in this case no further alarm can be generated by the FSP Controller to indicate an excessively high level has been reached.



#### NOTE:

The actual probe position is at the discretion of the end user, the only requirement for a discharge (empty) application is that the high probe must be positioned higher than the (highest\*) activation setpoint. (\* In some pump controllers, more than one activation setpoint may be defined).

## 17.2 Dual Thermal Fault Monitoring (with MultiSmart)

The following wiring diagram (Figure 9), illustrates an application where the FSP Controller and a MultiSmart pump controller operate in parallel.

The thermal sensor is connected to the FSP Controller and the Thermal Bu input is connected to the MultiSmart. This allows both devices to act on a thermal fault.

If a seal sensor is present it is connected to the MultiSmart.

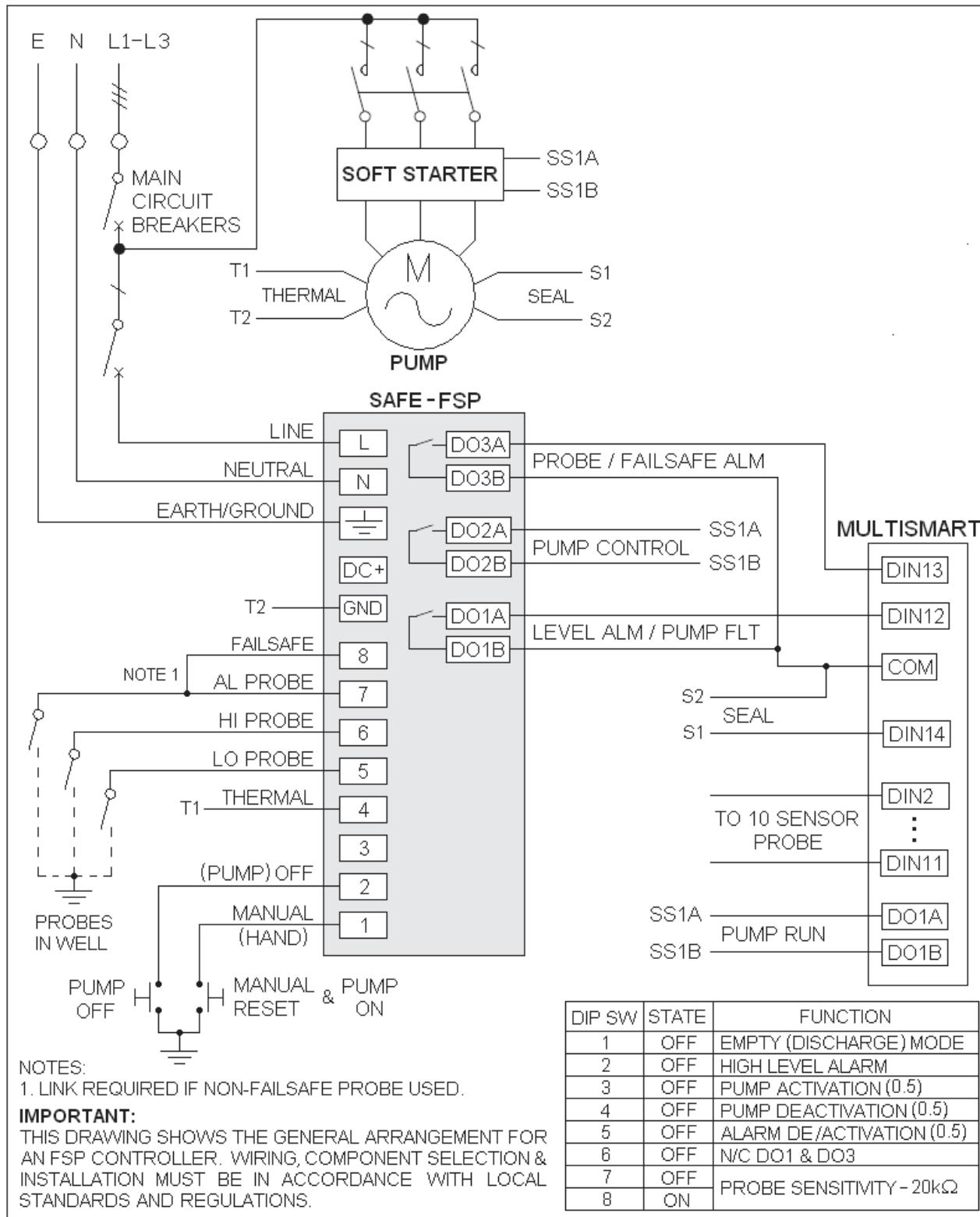


Figure 9 – Dual Thermal Fault Monitoring

# SAFE-FSP Relay Manual

## 17.3 Simplex Pump Controller

In this example the FSP Controller is configured as the primary pump controller for a single pump. The FSP Controller takes no action until the High Level probe is covered. When it is covered, the Pump Control output (DO2) closes turning on the pump.

When the Alarm Level probe is covered, a high level alarm is generated and the Level Alarm/Pump Fault output (DO1) changes state.

The FSP Controller monitors the thermal sensor. If a seal sensor is present it is not connected to the FSP Controller.

The FSP Controller and associated probes can control a maximum of one pump. The wiring is illustrated in Figure 10 below.

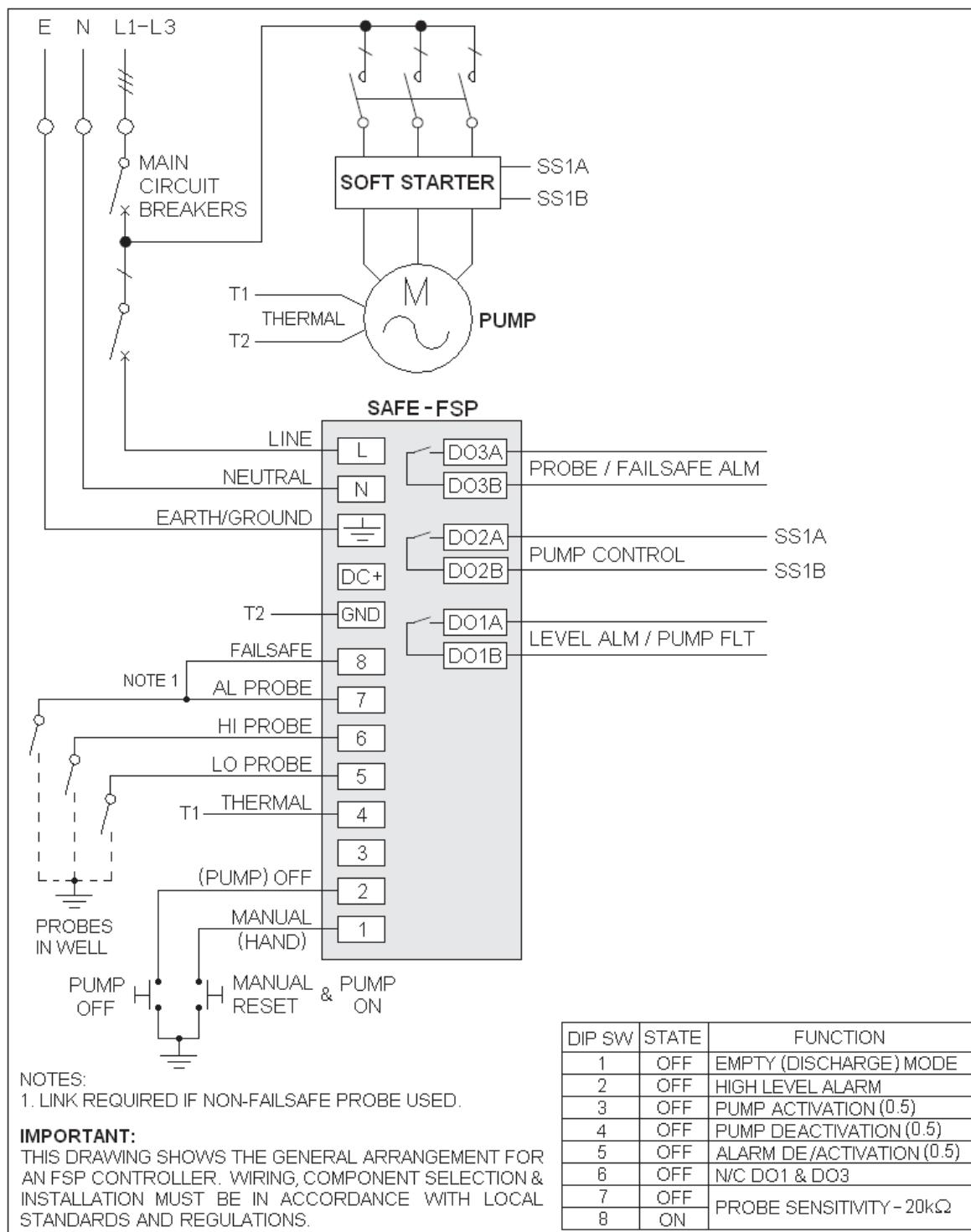
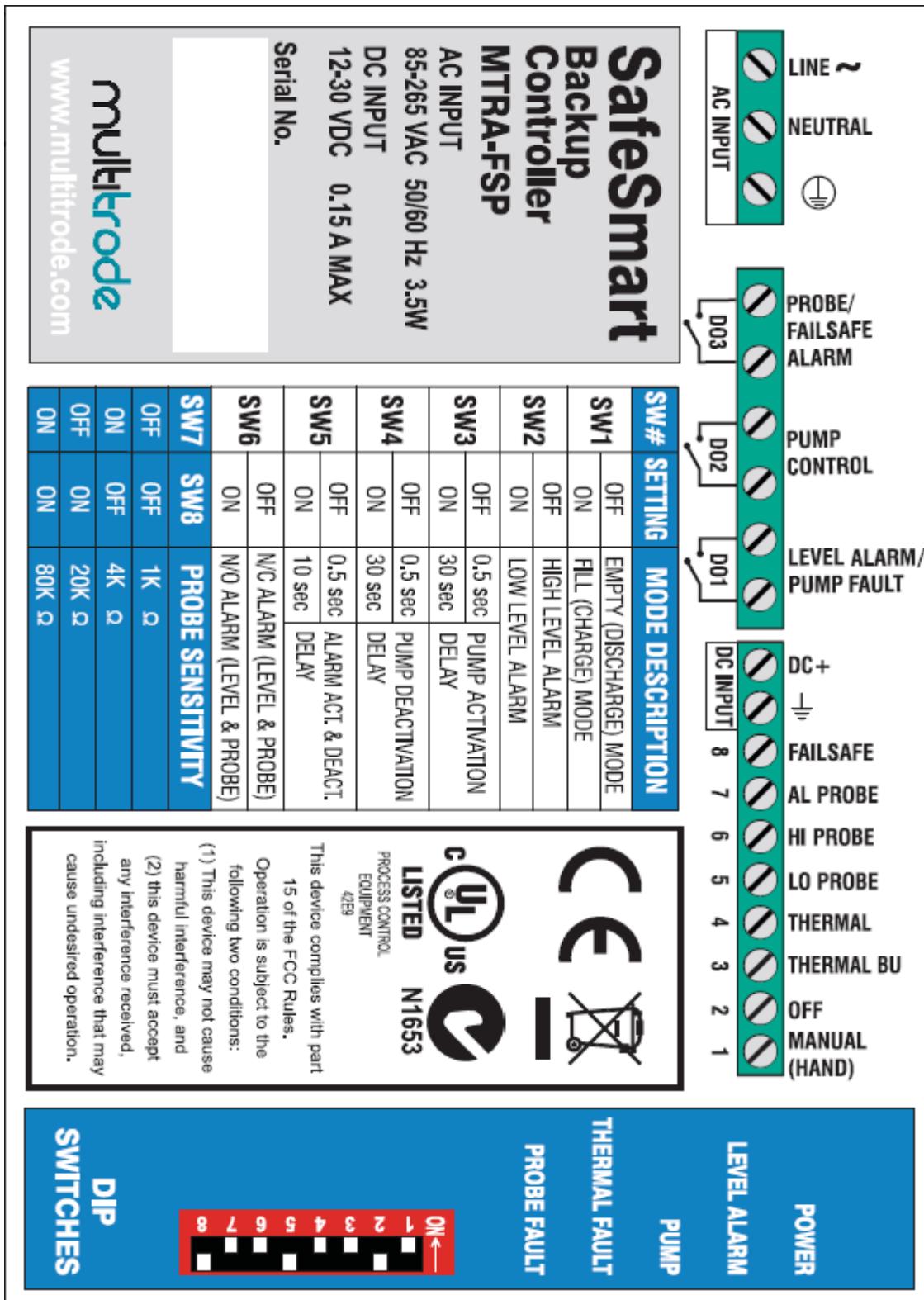


Figure 10 - Simplex Pump Controller

## 18 Backup Controller SAFE-FSP Label



*Figure 11 – SafeSmart SAFE-FSP Label.*

## SAFE-FSP Relay Manual



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# TECHNICAL DATA SHEET

**Equipment Type:** Satec Power Meter

**Location:** RTU Section

**Model Numbers:** PM130EH

**Manufacturer:** Satec

**Supplier:** Control Logic  
25 Lavarack Ave,  
Eagle Farm QLD 4009  
(07) 3623 1212



# PM130 PLUS Powermeter Series

## PM130P/PM130E/PM130EH

### Installation and Operation Manual



BG0425 Rev. A15

## LIMITED WARRANTY

The manufacturer offers the customer a 24-month functional warranty on the instrument for faulty workmanship or parts from date of dispatch from the distributor. In all cases, this warranty is valid for 36 months from the date of production. This warranty is on a return to factory basis.

The manufacturer does not accept liability for any damage caused by instrument malfunction. The manufacturer accepts no responsibility for the suitability of the instrument to the application for which it was purchased.

Failure to install, set up or operate the instrument according to the instructions herein will void the warranty.

Only a duly authorized representative of the manufacturer may open your instrument. The unit should only be opened in a fully anti-static environment. Failure to do so may damage the electronic components and will void the warranty.

The greatest care has been taken to manufacture and calibrate your instrument. However, these instructions do not cover all possible contingencies that may arise during installation, operation or maintenance, and all details and variations of this equipment are not covered by these instructions.

For additional information regarding installation, operation or maintenance of this instrument, contact the manufacturer or your local representative or distributor.

## WARNING

**Read the instructions in this manual before performing installation and take note of the following precautions:**

	<b>Ensure that all incoming AC power and other power sources are turned OFF before performing any work on the instrument. Protect the measurement AC Inputs voltage (V1, V2, V3) with 2A external overcurrent protection device and the power supply source inputs with 5A external overcurrent protection device, located close to the equipment.</b>
	<b>Before connecting the instrument to the power source, check the labels on the back of the instrument to ensure that your instrument is equipped with the appropriate power supply voltage, input voltages and currents. Failure to do so may result in serious or even fatal injury and/or equipment damage.</b>
	<b>Under no circumstances should the instrument be connected to a power source if it is damaged.</b>
	<b>To prevent potential fire or shock hazard, do not expose the instrument to rain or moisture.</b>
	<b>The secondary of an external current transformer must never be allowed to be open circuit when the primary is energized. An open circuit can cause high voltages, possibly resulting in equipment damage, fire and even <u>serious or fatal injury</u>. Ensure that the current transformer wiring is secured using an external strain relief to reduce mechanical strain on the screw terminals, if necessary.</b>
	<b>Only qualified personnel familiar with the instrument and its associated electrical equipment must perform setup procedures.</b>
	<b>Do not open the instrument under any circumstances when it is connected to a power source.</b>



**Do not use the instrument for primary protection functions where failure of the device can cause fire, injury or death. The instrument can only be used for secondary protection if needed.**



**Read this manual thoroughly before connecting the device to the current carrying circuits. During operation of the device, hazardous voltages are present on input terminals. Failure to observe precautions can result in serious or even fatal injury or damage to equipment.**



**This equipment does not require cleaning for proper operation**

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# Quick Start Guide

This section can be used by a licensed electrician to install and perform basic PM130 PLUS setup. For more detailed PM130 PLUS setup and use instructions, see the following chapters in this manual.

This quick start guide will assist you to have the unit running for the first time.

**During the operation of the meter, hazardous voltages are present in the input terminals. Failure to observe precautions can result in serious or even fatal injury, or damage to equipment.**

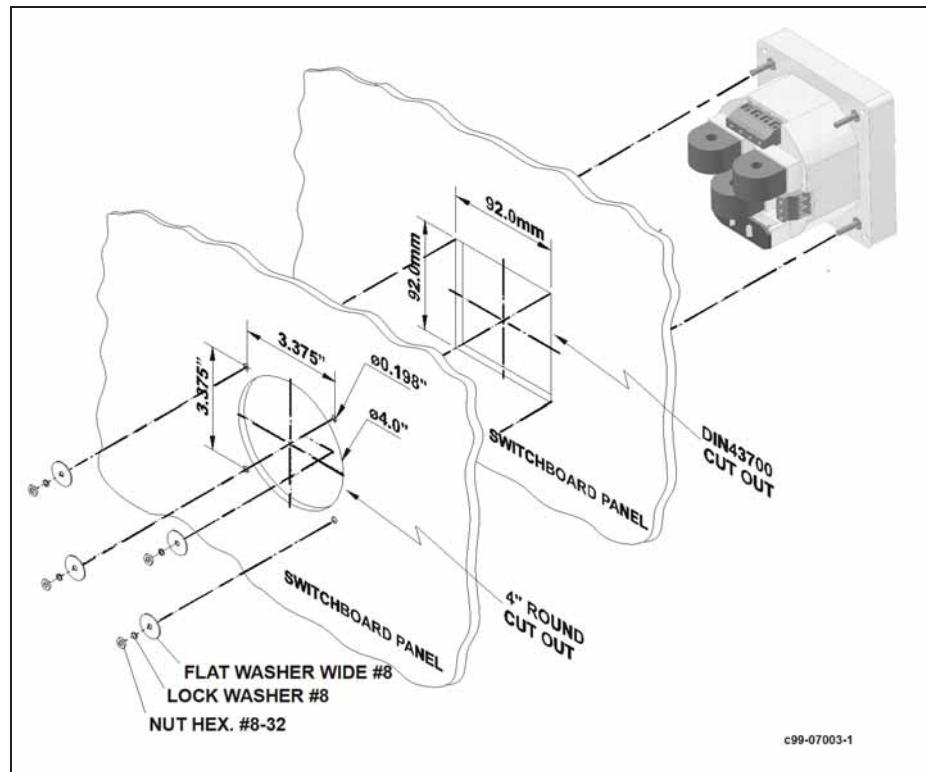
For complete and accurate in-depth instructions, refer to the following chapters in this manual.

## 1. Installing the PM130 PLUS

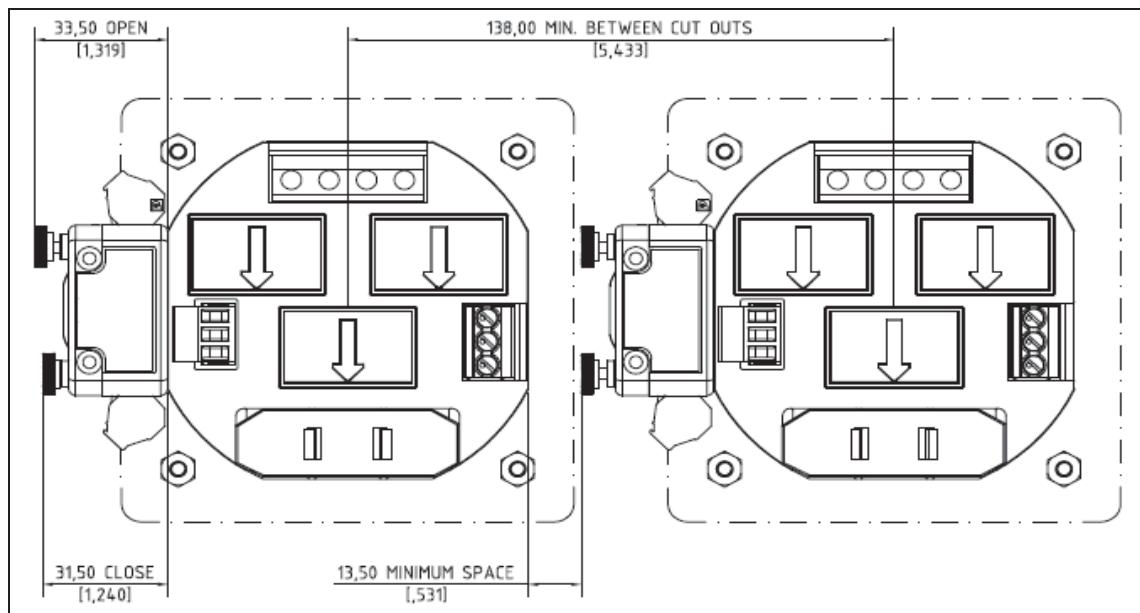
### Mounting the PM130 PLUS Unit

#### To mount the PM130 PLUS:

1. Position the PM130 PLUS unit in the square or round cutout. If two PLM130 PLUS are positioned side by side, take care of proper interval between them.
2. Attach the PM130 PLUS unit using washers and nuts. Make sure that the unit is securely attached into the wall or cabinet fixture.



Mounting the PM130 PLUS (Square or Round Cut-out)

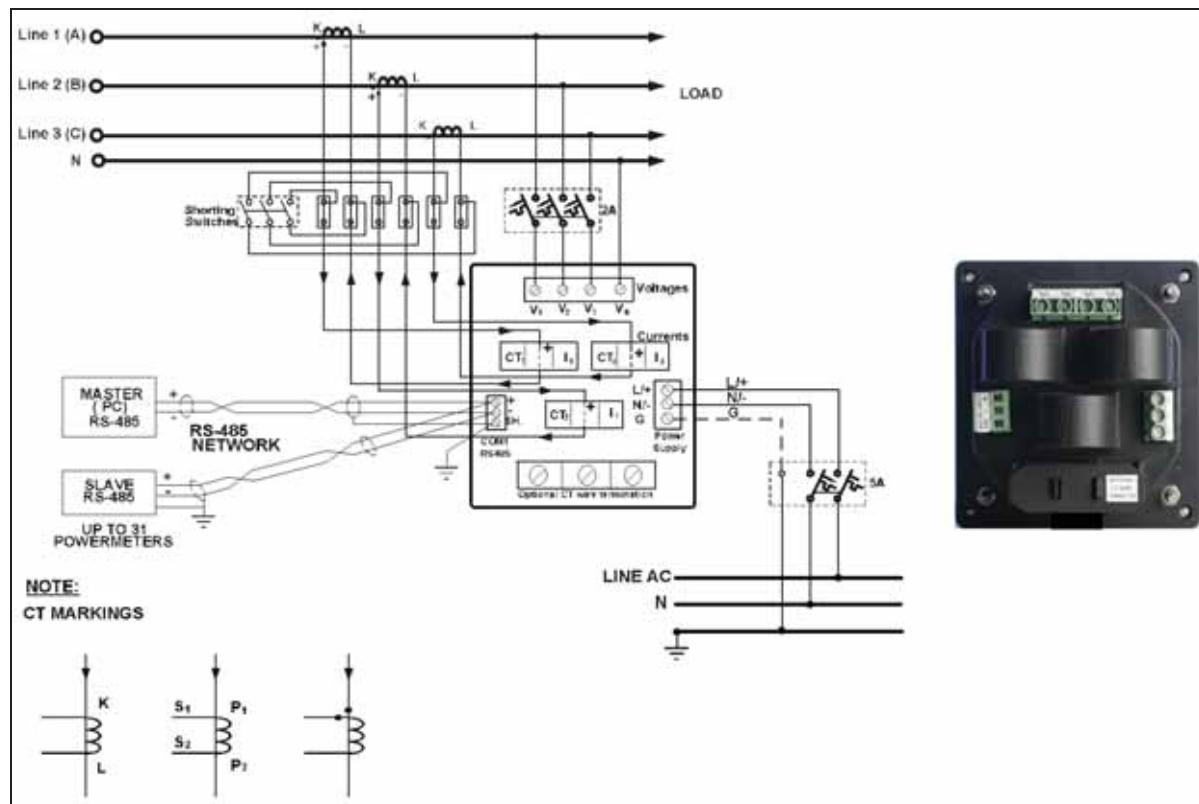


**Mounting two PM130 PLUS side by side**

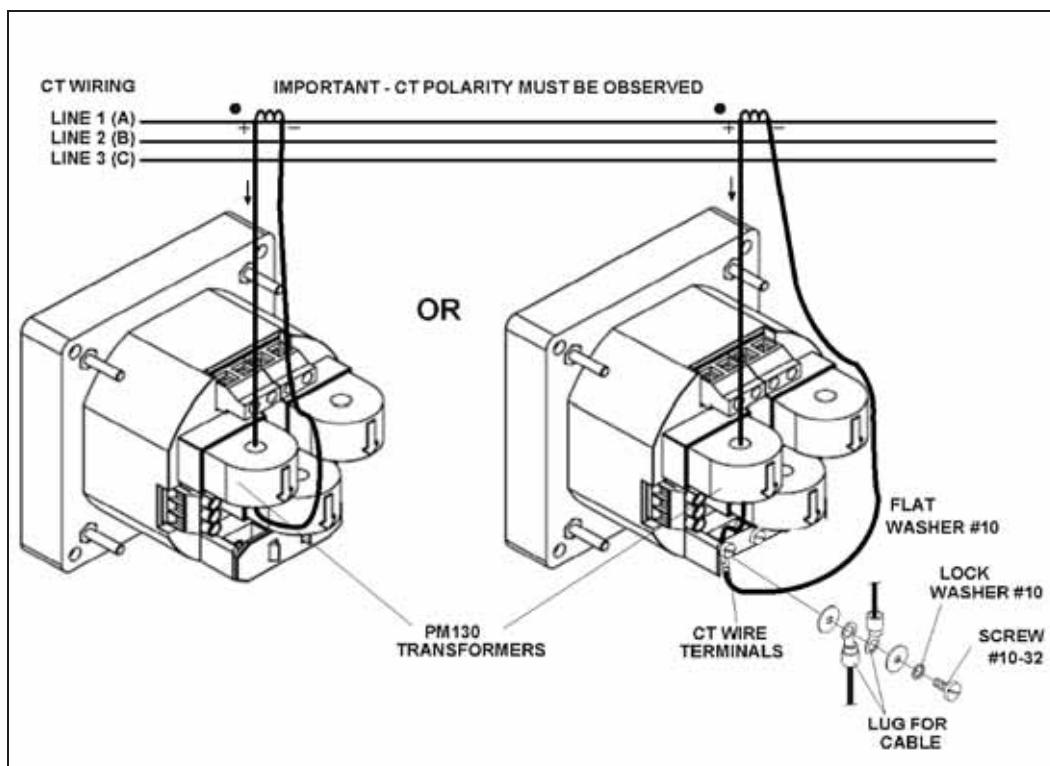
## Connecting the PM130 PLUS Unit

### To connect the PM130 PLUS:

1. Ensure that all incoming power sources are OFF.
2. Check that you have the appropriate power supply.
3. Connect to the external CT by passing the external CT wire through the meter CT core. Observe the arrow that indicates the current direction.
4. In case of a retrofit application where each external CT ends with two wires:
  - Pass one wire through the meter CT core.
  - Connect the wire to one of the meter termination screws.
  - Connect the second wire from the external CT to the termination screw.
5. Connect the measured voltage inputs
6. Connect COM1 – RS-485 communication port
7. Connect the Power Supply inputs using 1.5 mm<sup>2</sup>/14AWG-dedicated wires.



Common Wiring Mode: 4LL3 or 4Ln3



CT wiring

**To connect an Option module:**

1. Assemble the module on the meter.
2. Power the PM130 PLUS unit on.



**Assembling a module**

**To operate the PM130 PLUS:**

1. Perform device diagnostics.
2. Configure the device through the PM130 PLUS unit front panel display.

## 2. Configuring the PM130 PLUS remotely

1. Install the PAS application software on your PC.
2. Configure the PAS database for your meter.

3. Configure the PAS communications settings.
4. Upgrade the meter firmware if a new version is available.
5. Set up the meter using the PAS application software.
6. Configure your security settings through the meter security setup.
7. Configure your communication protocol settings.
8. Configure Billing/TOU registers.

At this stage, the PM130 PLUS should be ready for operation.

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Designations used throughout the manual:

E - available in the PM130E

EH - available in the PM130EH

# Chapter 1 General Information



The PM130 PLUS is a compact, multi-function, three-phase AC powermeter specially designed to meet the requirements of users ranging from electrical panel builders to substation operators.

⇒ The PM130 PLUS measuring and power supply inputs comply with Measuring Category II

The PM130 PLUS comprises of three types of models:

- **PM130P:** the basic model which offers standard voltage, current, power and frequency measurements, and control capabilities. A special amp-demand version can be ordered with a simplified display layout especially suitable for current measurements.
- **PM130E:** offers all the features of the basic model plus energy measurements and data logging.
- **PM130EH:** offers all the features of the **PM130E** plus harmonic analysis capabilities.

The PM130 PLUS units include:

- A bright 3-row LED display enabling easy reading of local meters.
- A standard RS-485 communication port and a second optional Ethernet, Profibus or RS-232/RS-422/RS-485 port. These ports allow local and remote automatic meter readings and setup through the supplemental communication or user data acquisition software.
- Different communication options for remote communications with the meter. These options enable LAN and Internet communication with the unit.

All models are suitable for mounting on both 4-inch round and 92×92mm square cutouts.

## 1.1 Features

### Multifunctional 3-phase Power Meter

- 3 voltage inputs and 3 current transformer-isolated AC inputs for direct connection to power line or via potential and current transformers

- True RMS, volts, amps, power, power factor, neutral current, voltage and current unbalance, frequency
- Ampere/Volt demand meter
- 25/50/60/400 Hz measurement capabilities

#### Billing/TOU Energy Meter (PM130E and PM130EH)

- Class 0.5S IEC 62053-22 four-quadrant active and reactive energy polyphase static meter
- Three-phase total and per phase energy measurements; active, reactive and apparent energy counters
- Time-of-Use, 4 totalization and tariff energy/demand registers x 8 tariffs, 4 seasons x 4 types of days, 8 tariff changes per day,
- One-time easy programmable tariff calendar schedule
- Automatic daily energy and maximum demand profile log for total and tariff registers

#### Harmonic Analyzer (PM130EH)

- Voltage and current THD, current TDD and K-Factor, up to 40th order harmonic
- Voltage and current harmonic spectrum and angles

#### Real-time Waveform Capture

- Real-time “scope mode” waveform monitoring capability
- Simultaneous 6-channel one-cycle waveform capture at a rate of 64 samples per cycle

#### Programmable Logical Controller

- Embedded programmable controller
- 16 control setpoints; programmable thresholds and delays
- Relay output control (see [Available Options](#))
- 1-cycle response time

#### Event and Data Recording (PM130E and PM130EH)

- Non-volatile memory for long-term event and data recording
- Event recorder for logging internal diagnostic events and setup changes
- Two data recorders; programmable data logs on a periodic basis; automatic daily energy and maximum demand profile log

#### Digital I/O

- Optional four or twelve digital inputs with 1-ms scan time; automatic recording of last five digital input change events with timestamps (see the PM130 PLUS Modbus Reference Guide)
- Optional two or four relay outputs with 1-cycle update time; unlatched, latched, pulse and KYZ operation; energy pulses

#### Display

- Easy to read 3-row (2x4 characters + 1x5 characters) bright LED display, adjustable update time and brightness
- Auto-scroll option with adjustable page exposition time; auto-return to a default page

- LED bar graph showing percent load with respect to user-definable nominal load current

### Real-time Clock

- Internal clock with 20-second retention time
- Optional battery-operated clock unit (see [Available Options](#))

### Communications

- Standard 2-wire RS-485 communication port; Modbus RTU, DNP3, SATEC ASCII communication protocols and IEC 61870-5-101
- Optional second communication port (see [Available Options](#)); Modbus RTU, Modbus/TCP, DNP3, DNP3/TCP, IEC 61870-5-101/104, SATEC ASCII and Profibus DP communication protocols
- eXpertPower™ client for communicating with the SATEC proprietary eXpertPower™ Internet services (with the Ethernet or GPRS module), see [Setting Up eXpertPower Client](#)
- TCP notification client for communicating with a remote Modbus/TCP server on events or periodically on a time basis (with the Ethernet or GPRS module), see [Setting Up TCP Notification Client](#)

### Meter Security

- Password security for protecting meter setups and accumulated data from unauthorized changes

### Upgradeable Firmware

- Easy upgrading device firmware through a serial or Ethernet port.

### Software Support

- PAS – free meter configuration and data acquisition tool
- eXpertPower™ – SATEC proprietary Internet services

## 1.2 Available Options

The PM130 PLUS can be provided with an optional expansion module from the following list:

- Digital I/O
- Analog outputs
- TOU - Battery-operated clock unit
- Ethernet communication port
- Profibus DP communication port
- RS-232/RS-422/RS-485 communication port
- GPRS communication port

### Digital I/O

The PM130 PLUS digital I/O expansion module provides:

#### 4DI / 2DO module

- 4 dry contact digital inputs (DI) for monitoring external contacts and receiving pulses from energy, water, and gas meters
- Programmable de-bounce time; 1-ms scan time.

- 2 electro-mechanical or solid-state relay outputs (RO) for alarms and controls, and for output energy pulses; unlatched, latched and pulse operations, failsafe operation for alarm notifications; programmable pulse width; direct remote relay control through communications; 1-cycle update time.

#### **12DI/4DO module**

- 12 dry contact digital inputs (DI) for monitoring external contacts and receiving pulses from energy, water, and gas meters
- Programmable de-bounce time; 1-ms scan time.
- 4 electro-mechanical relay outputs (RO) for alarms and controls, and for output energy pulses; unlatched, latched and pulse operations, failsafe operation for alarm notifications; programmable pulse width; direct remote relay control through communications; 1-cycle update time.

### **Analog Output**

The PM130 PLUS analog output (AO) expansion module provides:

- 4 optically isolated analog outputs with an internal power supply;
- Options for 0-20mA, 4-20mA, 0-1mA, and  $\pm$  1mA output; 1-cycle update time.

### **Additional Communication Port – COM2**

A second COM2 communication port can be ordered as an expansion module. COM2 options available:

- Ethernet 10/100BaseT port; MODBUS/TCP , DNP3/TCP and IEC 60870-5-104 communications protocols
- Profibus DP port
- RS-232/RS-422/RS-485 port; MODBUS RTU, DNP3, SATEC ASCII and IEC 60870-5-101 communication protocols;
- GPRS communications port

### **TOU - Battery-Operated Clock Unit**

The TOU module provides:

- A precise clock with battery backup; 6-year clock retention time
- 4 dry contact digital inputs (DI) for monitoring external contacts and receiving pulses from energy, water and gas meters; programmable de-bounce time; 1-ms scan time.

### **1.3 Customized Options**

Presentation of data on the front display and via communications can be customized to best suit the user application.

### **Device Resolution**

A low or high-resolution option can be selected for the presentation of voltage, current, and power for use in high and low power applications. See [Measurement Units](#) for more information.

### **Energy Rollover**

The energy rollover limit can be changed in the meter to provide 4-digit to 9-digit energy resolution. See [Device Options](#) in Chapter 5 for details. The meter display is capable of showing full 9-digit energy counters using two LED windows.

## Display Options

Different display options are available for customization to be used in dark or non-safe locations, or in places that are hardly accessible for observation. See [Configuring the Display](#) in Chapter 5 for more information.

## 1.4 Measured Parameters

**Table 1: Measured and Displayed Parameters**

Parameter	Display	Comm.	Analog	Pulse	Alarm
<b>1-cycle Real-time Measurements</b>					
RMS Voltage per phase		✓	✓		✓
RMS Current per phase		✓	✓		✓
kW per phase		✓			✓
kvar per phase		✓			✓
kVA per phase		✓			✓
Power Factor per phase		✓			✓
Total kW		✓	✓		✓
Total kvar		✓	✓		✓
Total kVA		✓	✓		✓
Frequency		✓	✓		✓
Neutral Current		✓	✓		✓
Total Power Factor		✓	✓		✓
Voltage & Current unbalance		✓			✓
<b>1-sec Average Measurements</b>					
RMS Voltage per phase	✓	✓	✓		✓
RMS Current per phase	✓	✓	✓		✓
kW per phase	✓	✓			✓
kvar per phase	✓	✓			✓
kVA per phase	✓	✓			✓
Power Factor per phase	✓	✓			✓
Total kW	✓	✓	✓		✓
Total kvar	✓	✓	✓		✓
Total kVA	✓	✓	✓		✓
Total Power Factor	✓	✓	✓		✓
Frequency	✓	✓	✓		✓
Neutral Current	✓	✓	✓		✓
Voltage & Current unbalance	✓	✓			✓
<b>Amps &amp; Volt Demands</b>					
Ampere & Volt Demand per phase		✓			✓
Ampere Maximum Demand per phase	✓	✓			✓
Voltage Maximum Demand per phase	✓	✓			✓
<b>Power Demands E, EH</b>					
kW Accumulated Demand Import & Export		✓	✓		✓
kvar Accumulated Demand Import & Export		✓	✓		✓
kVA Accumulated Demand		✓	✓		✓
kW Demand Import & Export		✓			✓
kvar Demand Import & Export		✓			✓
kVA Demand		✓			✓
kW Sliding Demand Import & Export		✓			✓
kvar Sliding Demand Import & Export		✓			✓
kVA Sliding Demand		✓			✓

Parameter	Display	Comm.	Analog	Pulse	Alarm
kW Predicted Demand Import & Export		✓			✓
kvar Predicted Demand Import & Export		✓			✓
kVA Predicted Demand		✓			✓
kW Maximum Demand Import	✓	✓			
kW Maximum Demand Export		✓			
kvar Maximum Demand Import	✓	✓			
kvar Maximum Demand Export		✓			
kVA Maximum Demand	✓	✓			
<b>Total Energy E, EH</b>					
Total kWh Import & Export	✓	✓		✓	
Total kvarh Import & Export	✓	✓		✓	
Total kvarh Net		✓			
Total kVAh	✓	✓		✓	
<b>Energy per Phase E, EH</b>					
kWh Import per phase	✓	✓			
kvarh Import per phase		✓			
kVAh per phase	✓	✓			
<b>TOU Registers E, EH</b>					
4 TOU energy registers (kWh and kvarh import & export, kVAh, 4 pulse sources)	✓	✓			
4 TOU maximum demand registers		✓			
8 tariffs, 4 seasons x 4 types of day	✓				✓
<b>Harmonic Measurements EH</b>					
Voltage THD per phase	✓	✓	✓		✓
Current THD per phase	✓	✓	✓		✓
Current TDD per phase	✓	✓	✓		✓
K-factor per phase	✓	✓	✓		✓
Voltage harmonics per phase up to order 40	✓	✓			
Current harmonics per phase up to order 40	✓	✓			
Voltage harmonic angles up to order 40		✓			
Current harmonic angles up to order 40		✓			
<b>Fundamental Component EH</b>					
Voltage and Current per phase		✓			
kW, PF per phase	✓	✓			
kvar, KVA per phase		✓			
Total kW, PF	✓	✓			
Total kvar, KVA		✓			
<b>Min/Max Logging</b>					
Min/Max A, V, total kW, kvar, kVA, PF	✓	✓			
Min/Max Frequency, Neutral current	✓	✓			
<b>Phase Rotation</b>	✓	✓			✓
<b>Voltage and Current Phase Angles</b>	✓	✓			
<b>Day and Time</b>	✓	✓			
<b>Pulse Counters</b>	✓	✓			✓
<b>Digital Inputs (optional)</b>	✓	✓			✓
<b>Relay Outputs (optional)</b>	✓	✓			✓
<b>Remote Relay Control (optional)</b>		✓			
<b>Alarm Triggers/Setpoints</b>		✓			✓
<b>Self-diagnostics</b>	✓	✓			

# Chapter 2 Installation

This chapter discusses the following types of physical installations for the PM130 PLUS Powermeter:

- Mechanical Installation
- Electrical Installation
- I/O Connections
- COM Port Connections.

## 2.1 Site Requirements

- Environmental conditions: as specified in Technical Specifications in Appendix A
- Electrical requirements: as specified in Technical Specifications in Appendix A

See [Technical Specifications](#) in Appendix A for more details

## 2.2 Package Contents

The PM130 PLUS Powermeter package contains the following items:

- PM130 PLUS Powermeter unit
- Technical Documentation CD
- Optional accessories (depending on the options ordered, if any)
- Cables

## 2.3 Mechanical Installation

Refer to the figures provided in this section to properly perform the mechanical installation.

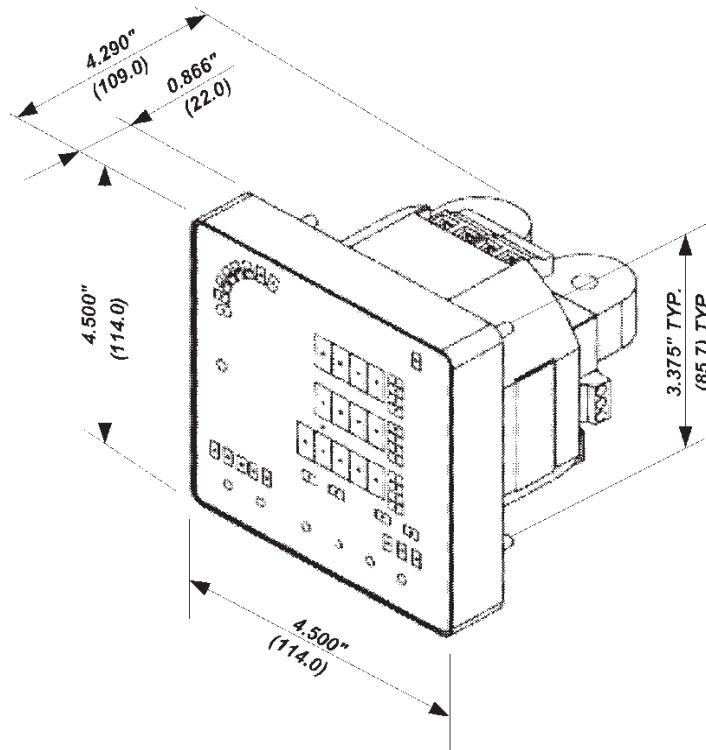


Figure 2-1. Dimensions

## Panel Mounting

**To mount the meter in cutout (ANSI 4" round or DIN 92x92mm square cutout):**

1. Position the meter in the cutout.
2. Affix the meter using washers and nuts. (Add short text on Panel Mounting, a heading should always have text)

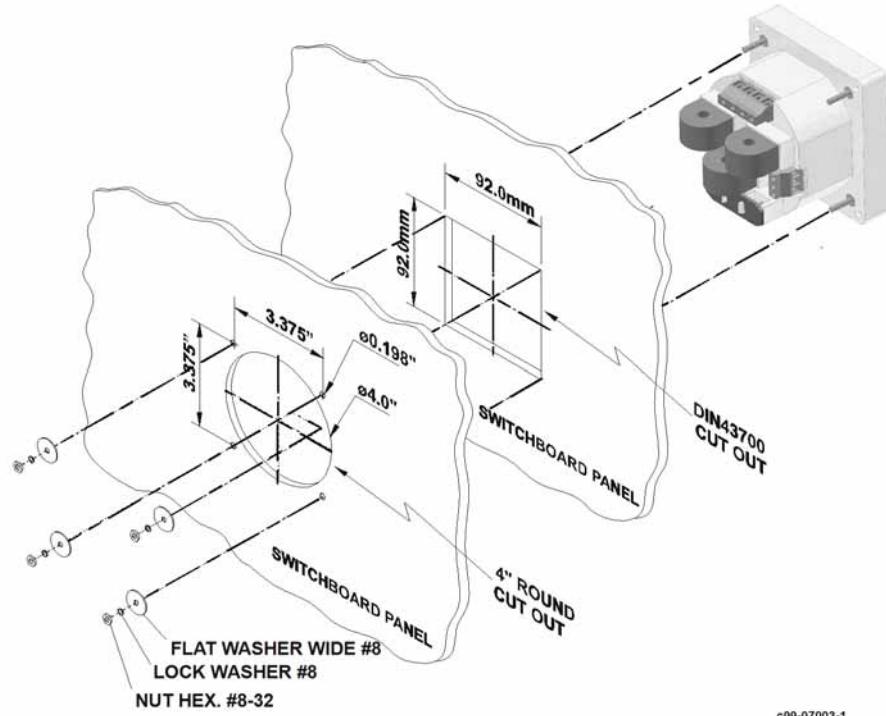


Figure 2-2. Mounting

## DIN Rail Mounting

The PM130 can be mounted on a 35-mm DIN rail.

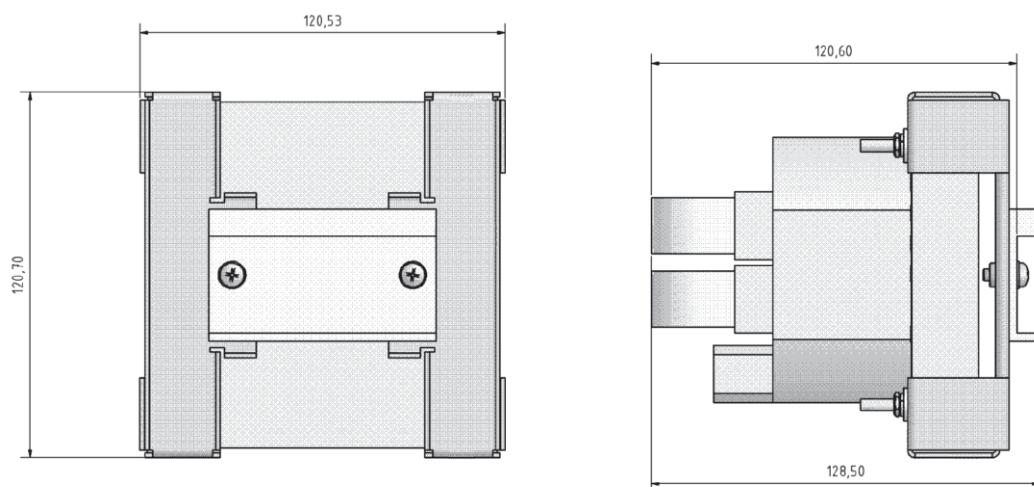


Figure 2-3. Dimensions

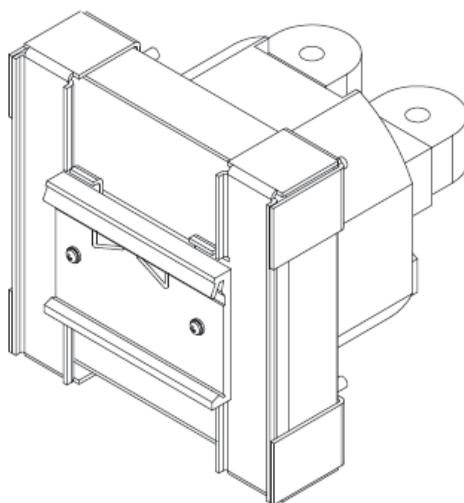


Figure 2-4. DIN Rail Mounting

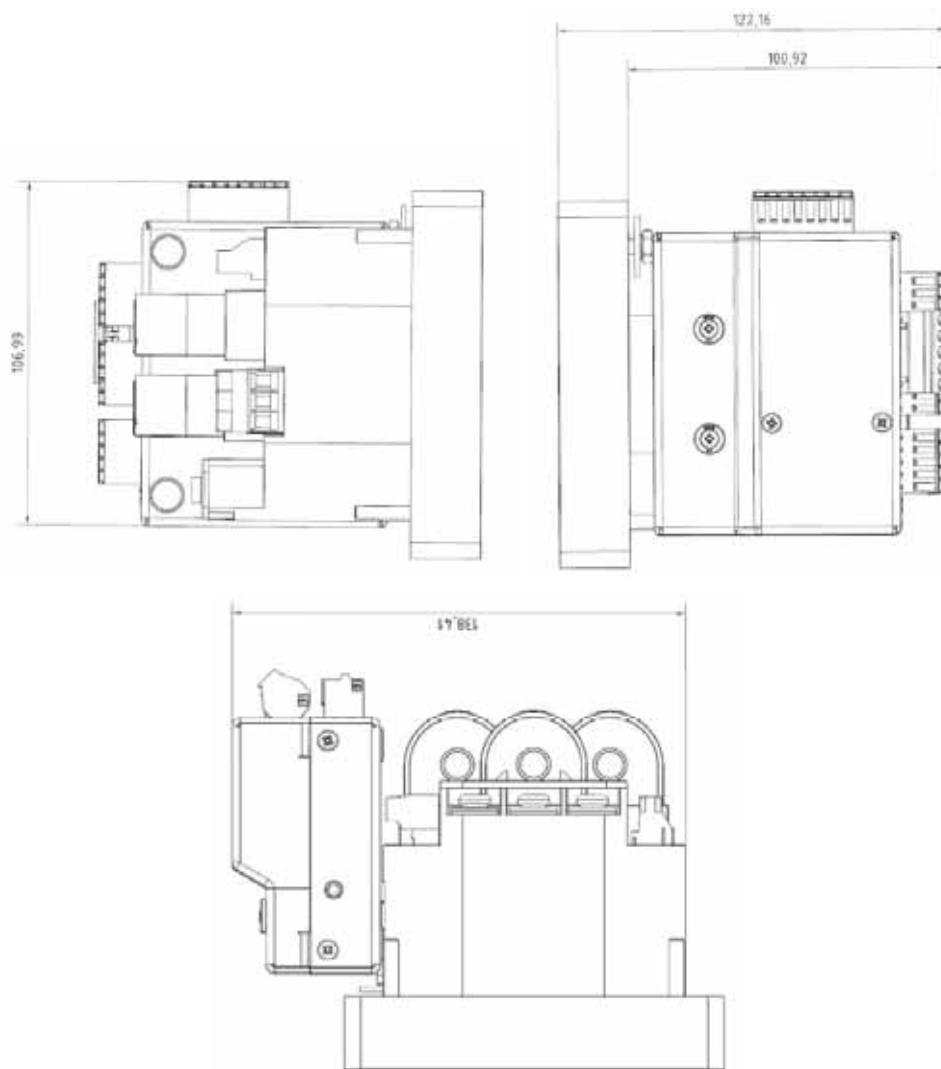
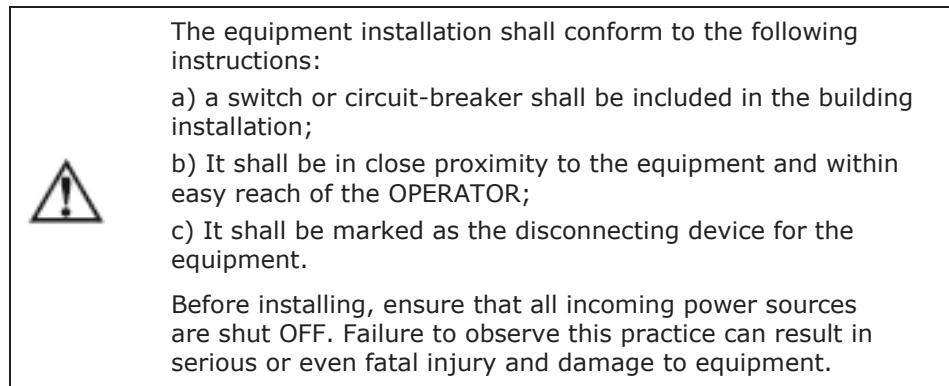


Figure 2-5 PM130 PLUS with 12DI/4RO module

## 2.4 Electrical Installation



### Typical Installation

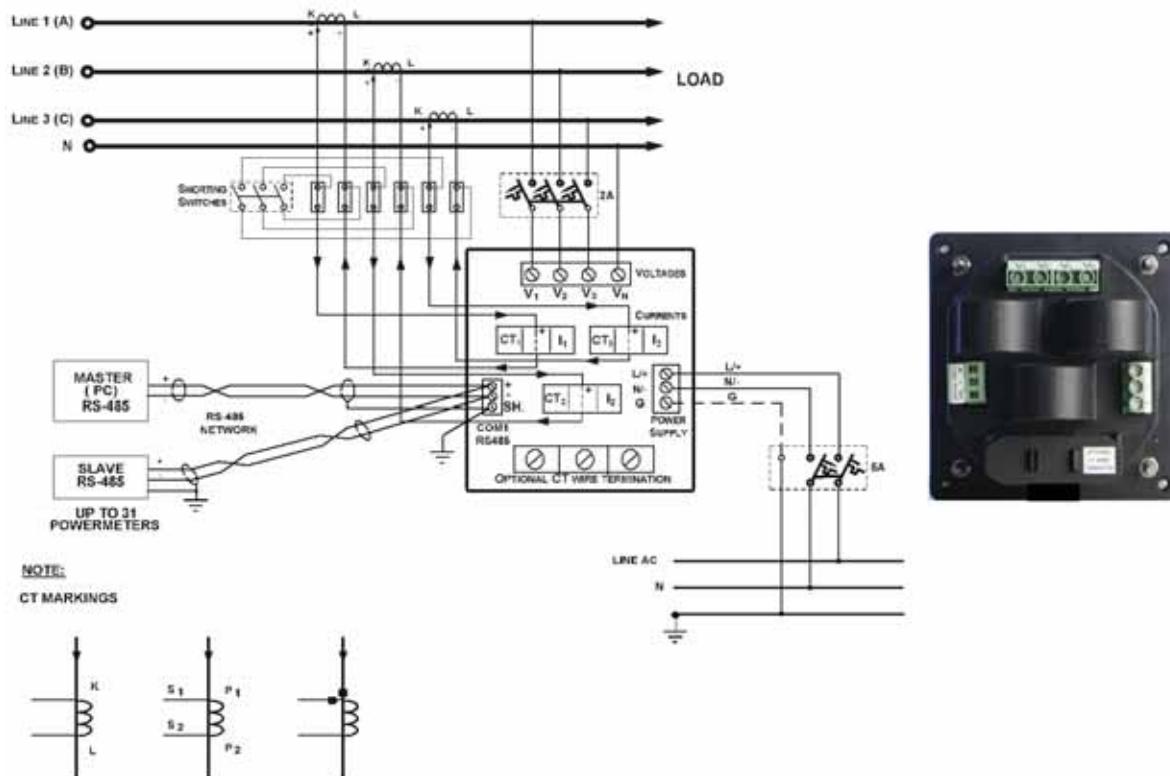


Figure 2-6 Typical Installation Diagram

## Terminals



**Figure 2-7 Terminals - Rear View**

## Power Source Connection

The equipment installation shall conform to the following instructions:

- a) a switch or circuit-breaker shall be included in the building installation;
- b) It shall be in close proximity to the equipment and within easy reach of the OPERATOR;
- c) It shall be marked as the disconnecting device for the equipment.



Before installing, ensure that all incoming power sources are shut OFF. Failure to observe this practice can result in serious or even fatal injury and damage to equipment.

The power source can be a dedicated fuse, or a monitored voltage if it is within the instrument power supply range.

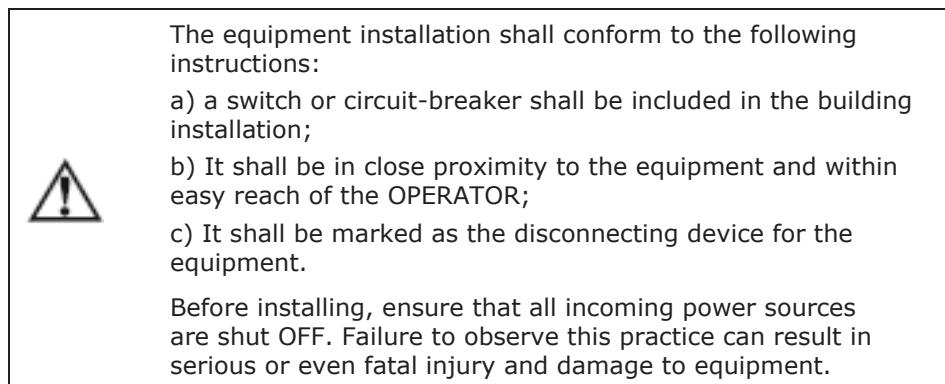
**To connect an AC power supply:**

1. Connect the Line wire to terminal L/+.
2. Connect the Neutral wire to terminal N/-.

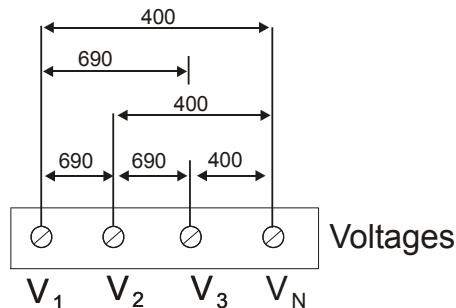
**To connect to a DC power supply:**

1. Connect the positive wire to terminal L/+
2. Connect the negative wire to terminal N/-.

## Voltage Input connection

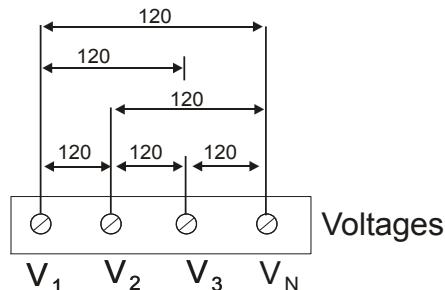


### 690V Inputs (Standard)



690V inputs are usually used with direct connection. Use any of the seven wiring configurations shown in Figures 2-8 through 2-15.

### 120V Inputs (Option U)



120V inputs usually imply use of a potential transformer (PT). The PT requires use of any of the four wiring configurations shown in Figures 2-7 through 2-10.

## Current Input Connection

The PM130 does not have current terminals.

- Using internal CT, the PM130 PLUS does not have current terminals
- Using external CT (HACS – High Accuracy SATEC Current Sensor), the PM130 PLUS provides current terminals

To connect to the external CT, pass the external CT wire through the meter CT core, see Figure 2-8 for details and observe the arrow that indicates the current direction.

In case of a retrofit application where each external CT ends with two wires:

1. Pass one wire through the meter CT core.
2. Connect the wire to one of the meter termination screws.
3. Connect the second wire from the external CT to the termination screw to close the loop.

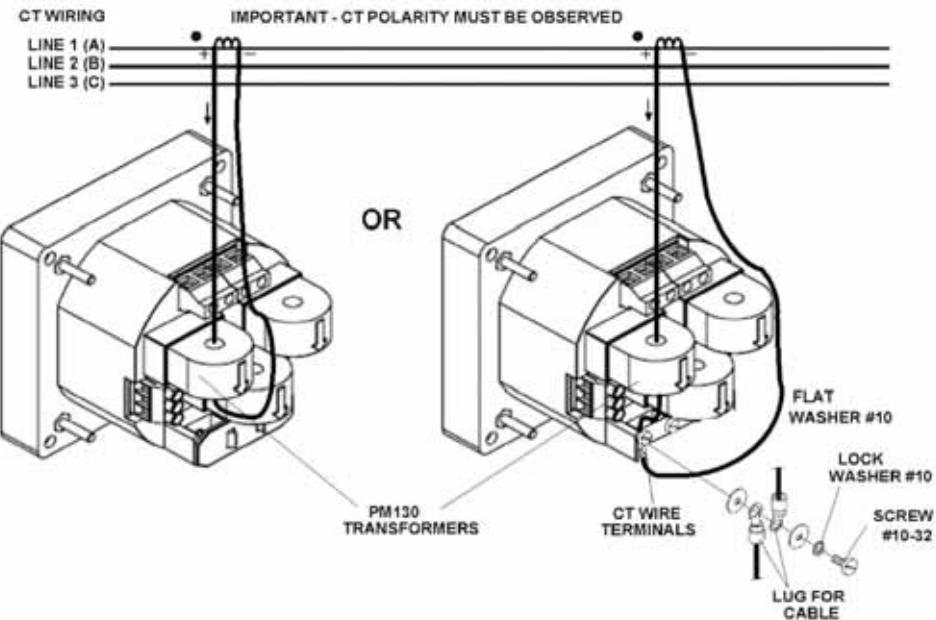


Figure 2-8 Current Input Connection

## Wiring Diagrams

For AC input ratings, see [Technical Specifications](#) in Appendix A for more details.

Table 2 presents the available wiring configurations in the meter. For more details, see [Basic Meter Setup](#) in Chapter 5.

Table 2: Wiring Configurations

Wiring Configuration	Setup Code	Figure
3-wire 2-element Delta direct connection using 2 CTs	3dir2	2-9
4-wire 3-element Wye direct connection using 3 CTs	4Ln3 or 4LL3	2-10
4-wire 3-element Wye connection using 3 PTs, 3 CTs	4Ln3 or 4LL3	2-11
3-wire 2-element Open Delta connection using 2 PTs, 2 CTs	3OP2	2-12
4-wire 2½-element Wye connection using 2 PTs, 3 CTs	3Ln3 or 3LL3	2-13
3-wire 2½-element Open Delta connection using 2 PTs, 3 CTs	3OP3	2-14
4-wire 3-element Delta direct connection using 3 CTs	4Ln3 or 4LL3	2-15
3-wire 2½-element Broken Delta connection using 2 PTs, 3 CTs	3bLn3 or 3bLL3	2-16

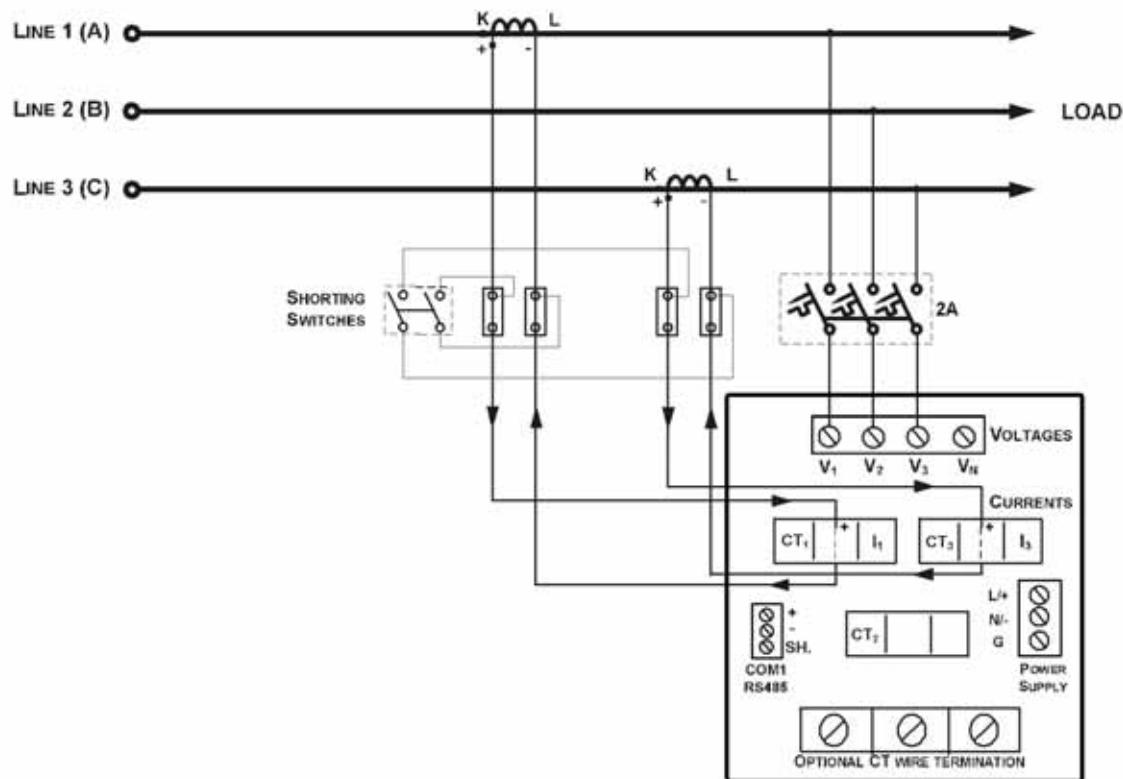


Figure 2-9 3-Wire 2-Element Delta Direct Connection Using 2 CTs (Wiring Mode = 3dir2)

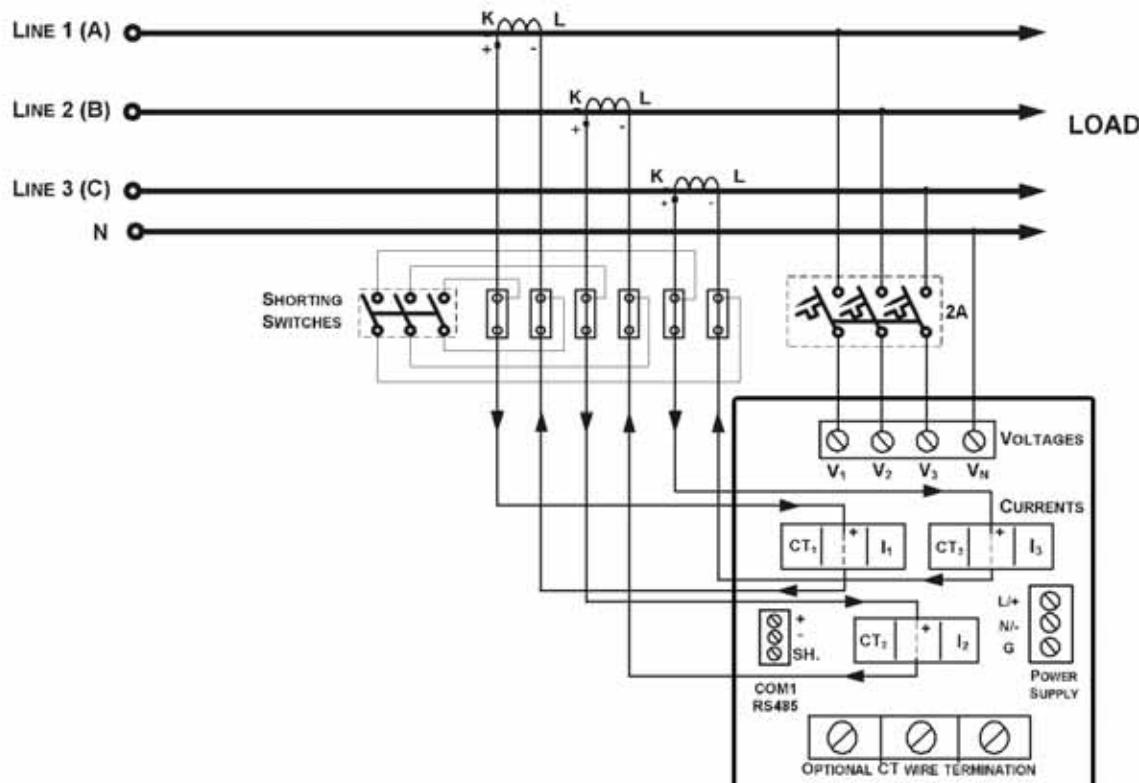


Figure 2-10 4-Wire Wye 3-Element Direct Connection Using 3 CTs (Wiring Mode = 4LL3 or 4Ln3)

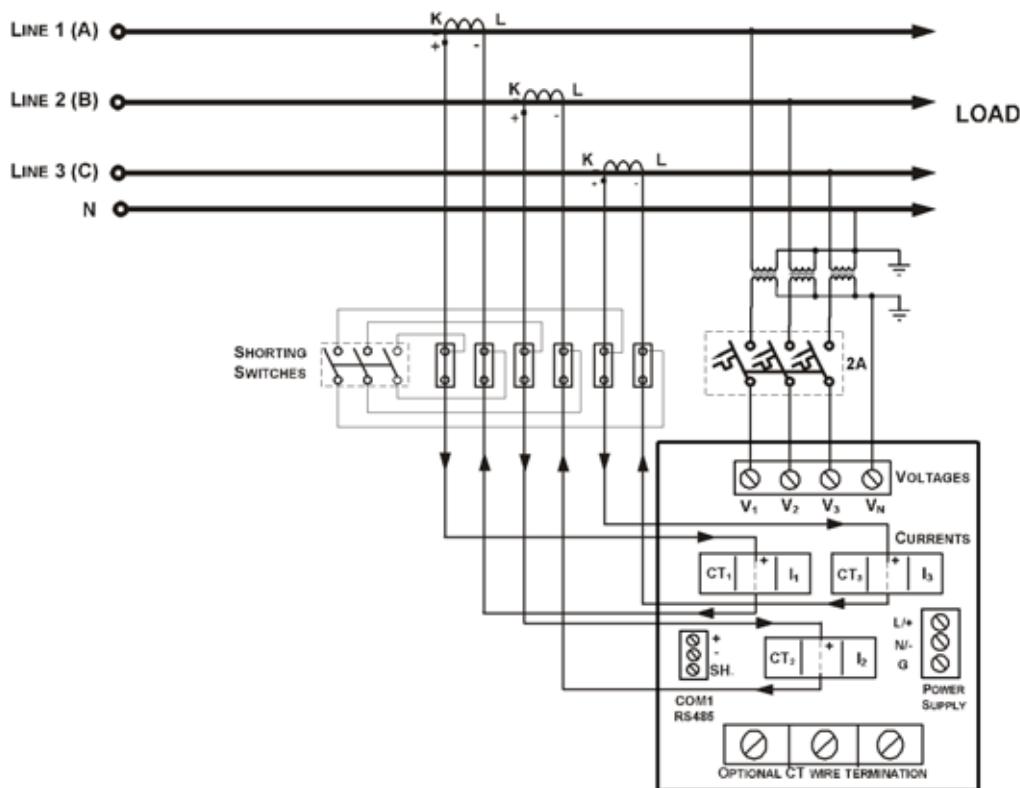


Figure 2-11 4-Wire Wye 3-Element Connection Using 3 PTs, 3 CTs (Wiring Mode = 4LL3 or 4Ln3)

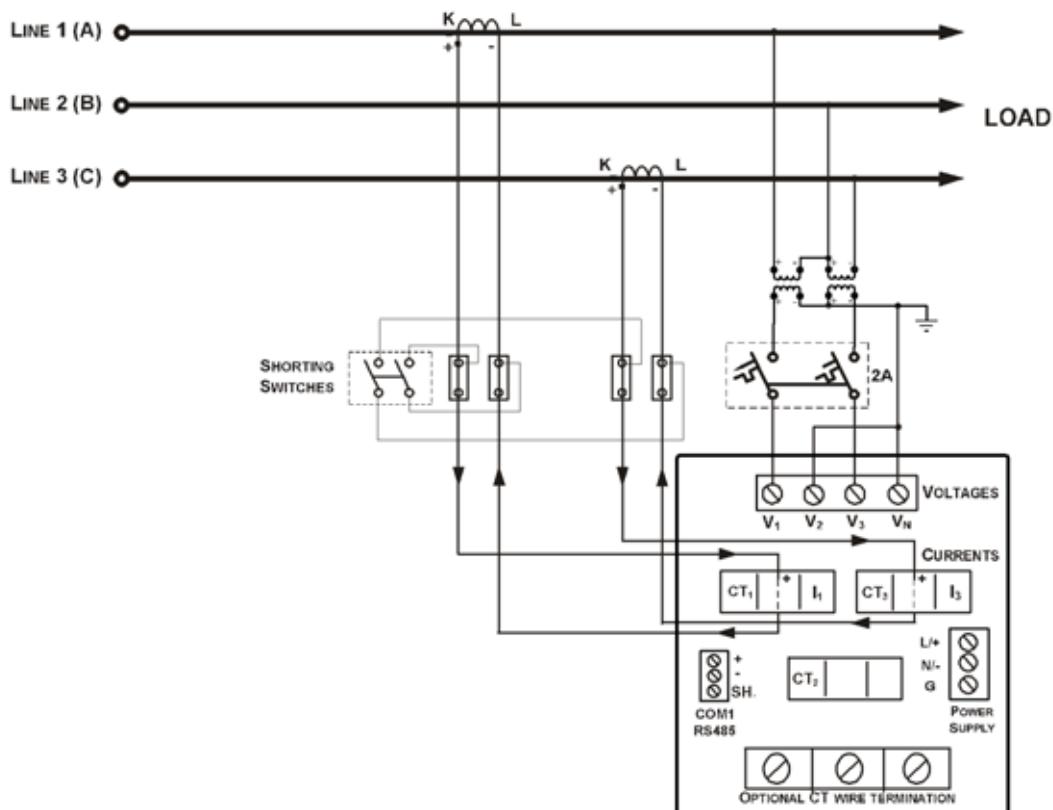
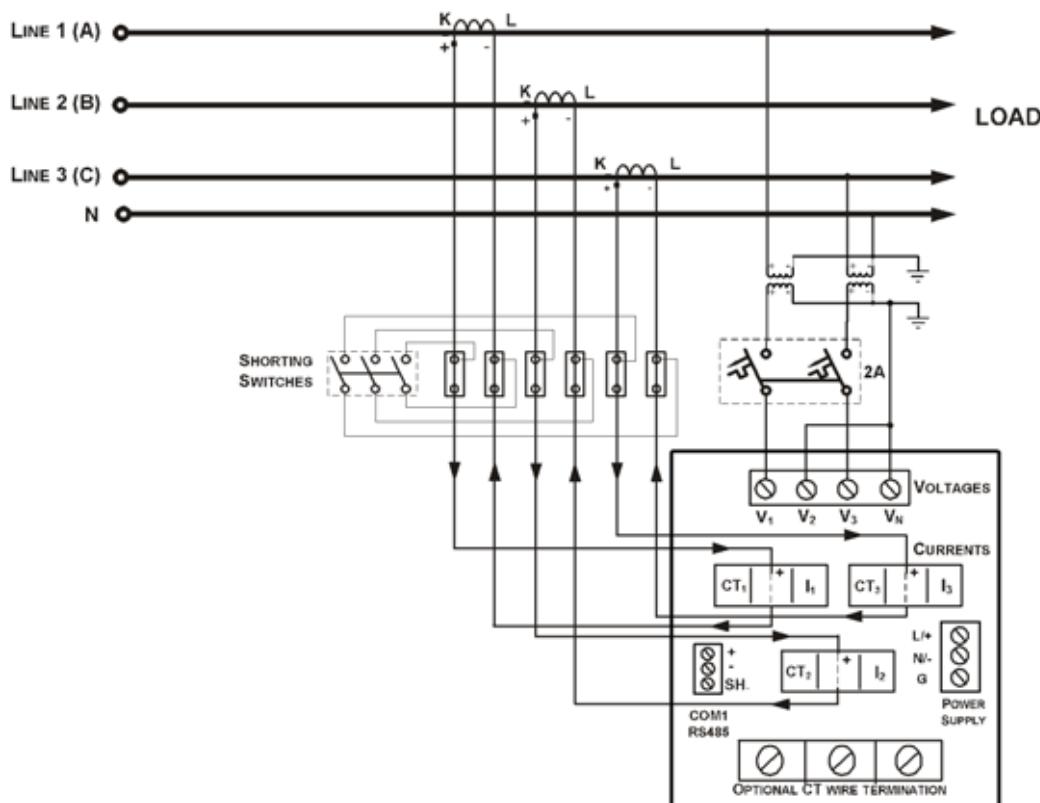
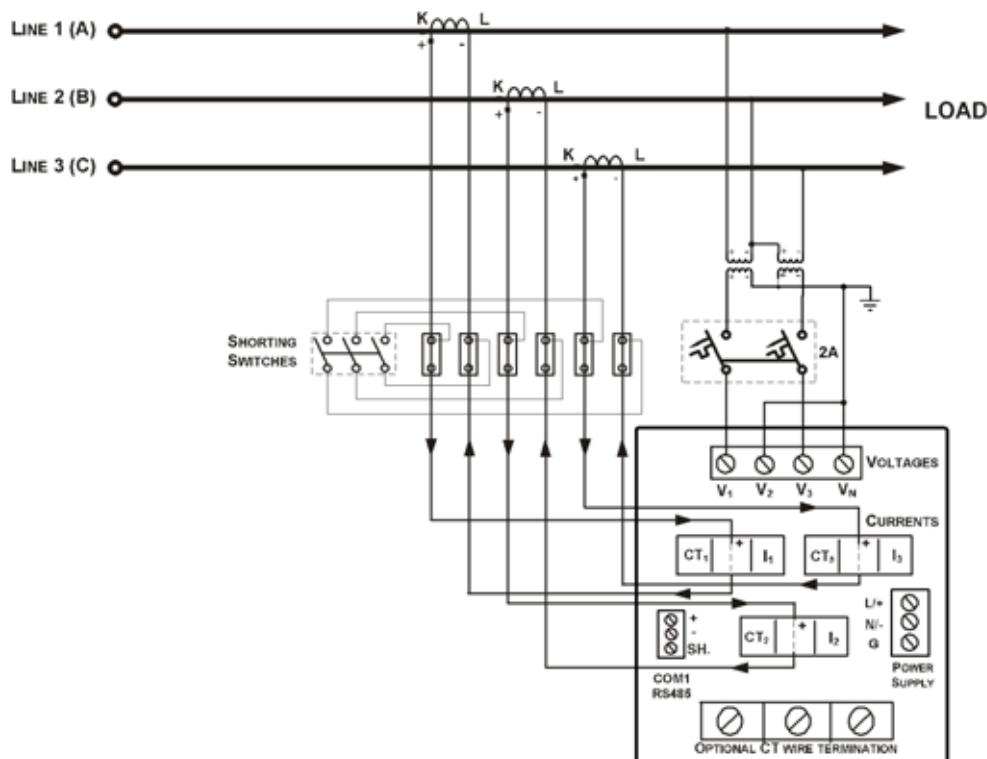


Figure 2-12 3-Wire 2-Element Open Delta Connection Using 2 PTs, 2 CTs (Wiring Mode = 3OP2)



This configuration provides accurate power measurements only if the voltages are balanced.

**Figure 2-13 4-Wire Wye 2½-Element Connection Using 2 PTs, 3 CTs (Wiring Mode = 3LL3 or 3Ln3)**



**Figure 2-14 3-Wire 2½-Element Open Delta Connection Using 2 PTs, 3 CTs (Wiring Mode = 3OP3)**

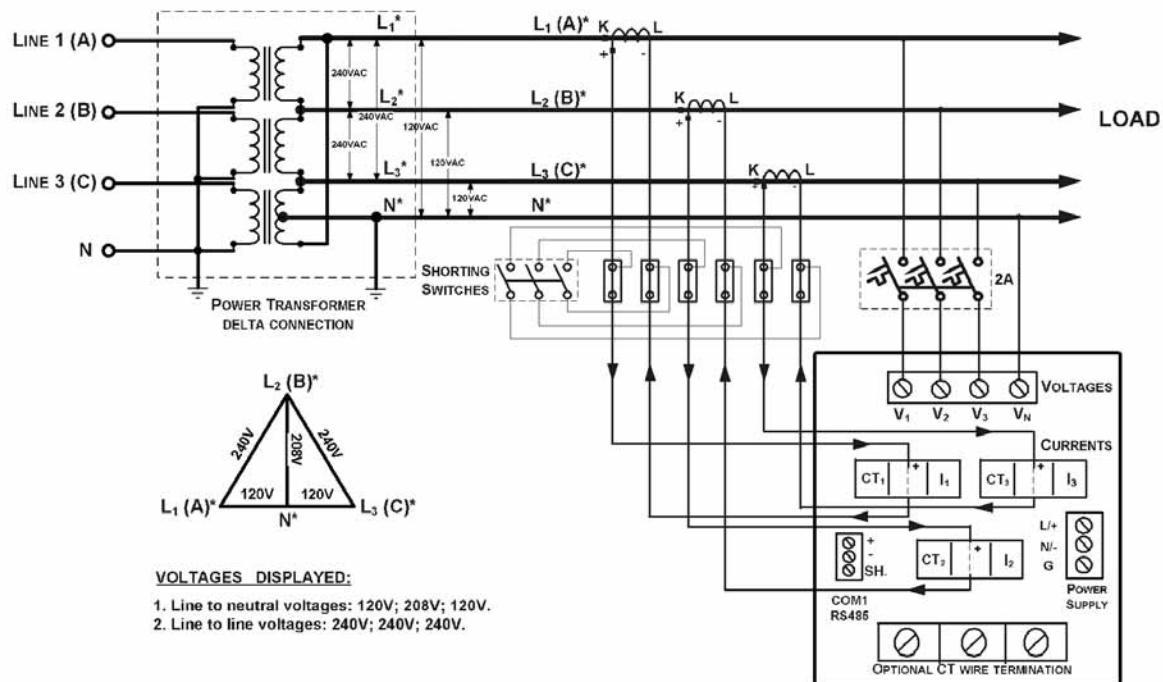


Figure 2-15 4-Wire 3-Element Delta Connection Using 3 CTs (Wiring Mode = 4LL3 or 4Ln3)

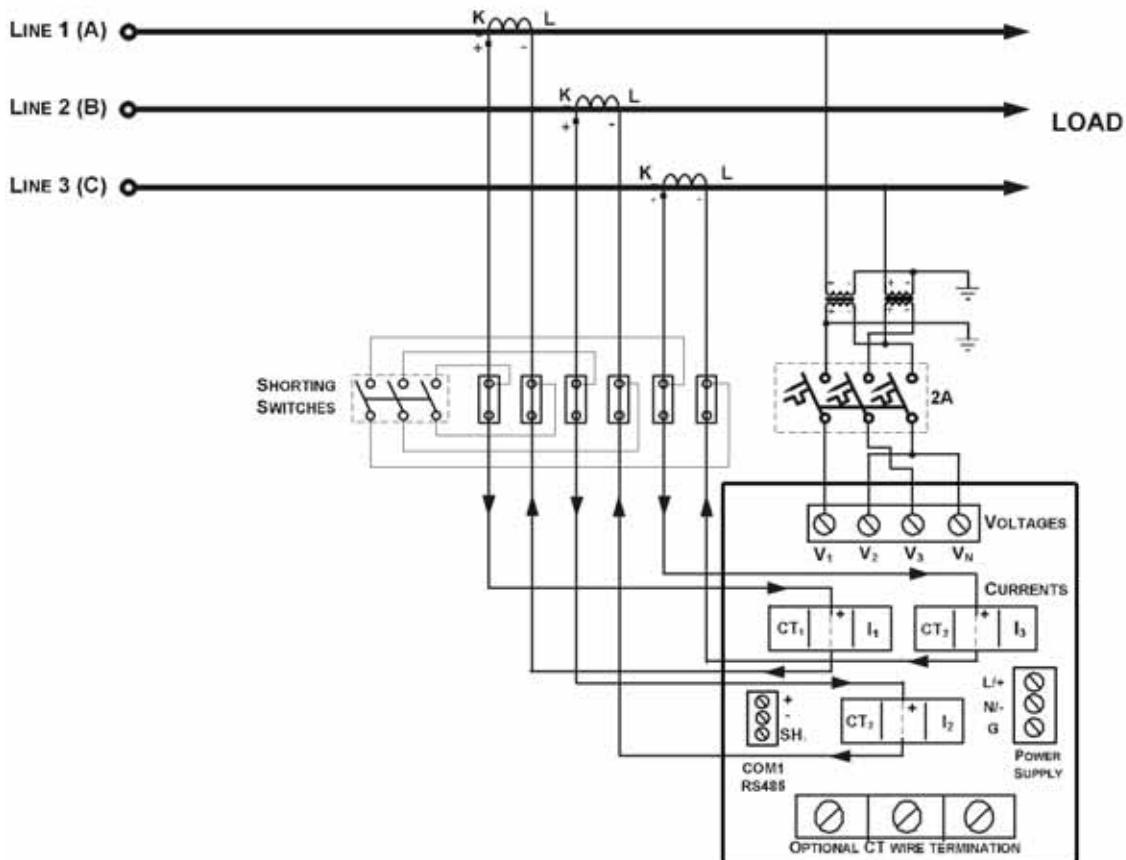


Figure 2-16 3-Wire 2½-Element Broken Delta Connection Using 2 PTs, 3 CTs (Wiring Mode = 3bLn3 or 3bLL3)

## 2.5 I/O Connections



Before I/O Module installation ensure that all incoming power sources are shut OFF. Failure to observe this practice can result in serious or even fatal injury and damage to equipment.



Figure 2-17 Module Connector Cover – Before Module Assembly

For I/O ratings, see [Technical Specifications](#) in Appendix A.

### 4DI/2DO Module



Figure 2-18 4DI / 2DO Module Assembly

### Relay Outputs

There are two relay outputs provided for energy pulsing, alarms, or remote control.

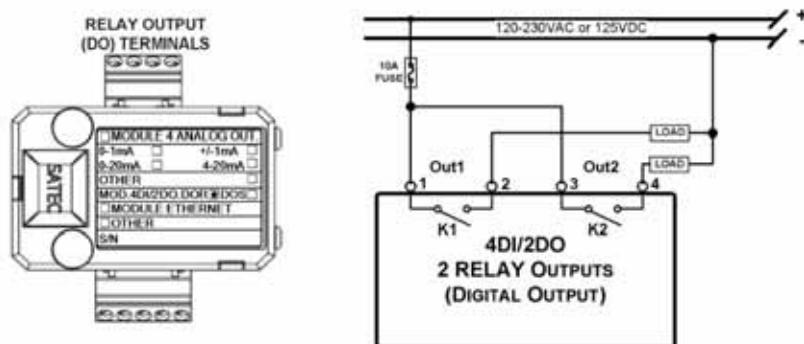


Figure 2-19 Relay Output Connection

### Digital Inputs

Four optically isolated status inputs are provided for status monitoring, pulse counting, external power demand period, and time synchronization.

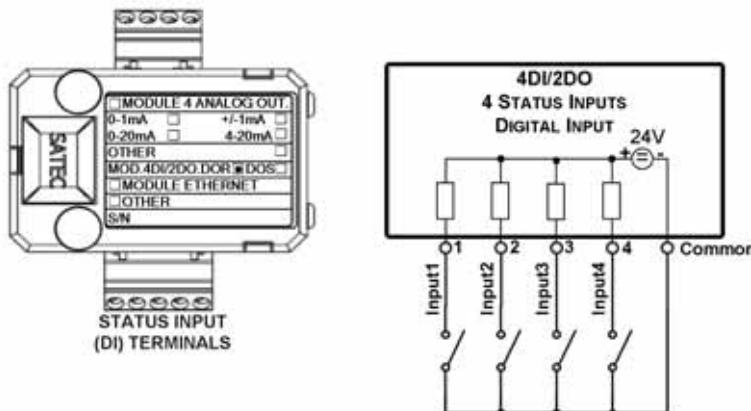


Figure 2-20 Digital Input Connection

### 12DI/4RO Module

The 12DI/4RO module can be equipped with optional communication port COM2 – ETHERNET or RS-422/485.

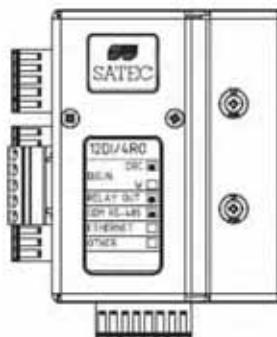


Figure 2-21 12DI/4RO Module



Before I/O Module installation ensure that all incoming power sources are shut OFF. Failure to observe this practice can result in serious or even fatal injury and damage to equipment.

## Relay Outputs

There are four electro-mechanic relay outputs provided for energy pulsing, alarms, or remote control.

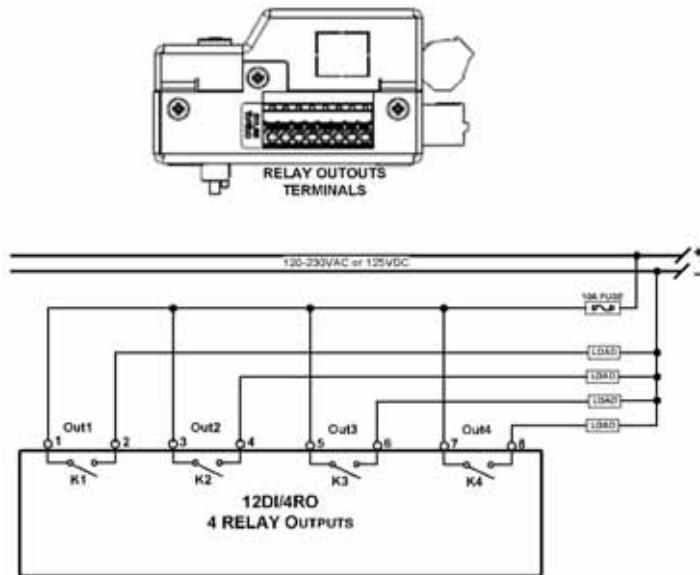


Figure 2-22 Relay Output Connection

## Digital Inputs

12 optically isolated status inputs are provided for status monitoring, pulse counting, external power demand period, and time synchronization.

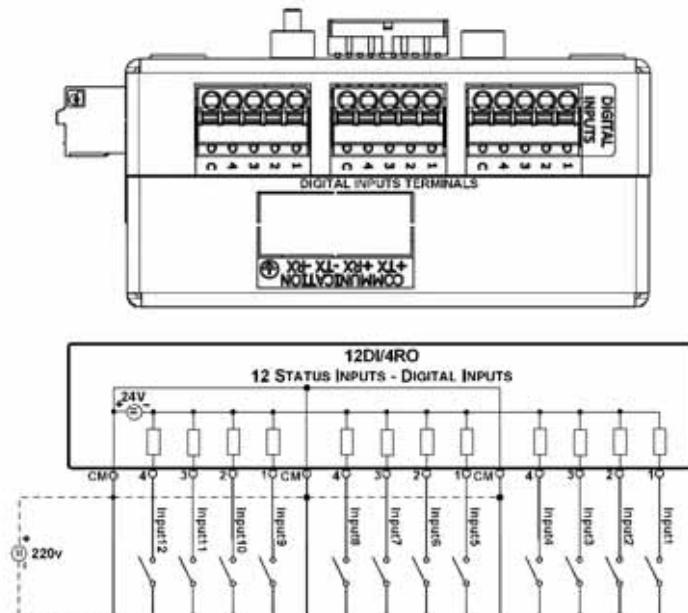


Figure 2-23 12 Digital Input Connection

## 4AO Module - Analog Outputs

The 4AO module has four optically isolated analog outputs with an internal power supply and current output options of 0-20 mA and 4-20 mA (current loop load of up to 500 Ohm), 0-1 mA and  $\pm 1$  mA (2mA 100% overload, current loop load of up to 5 kOhm).

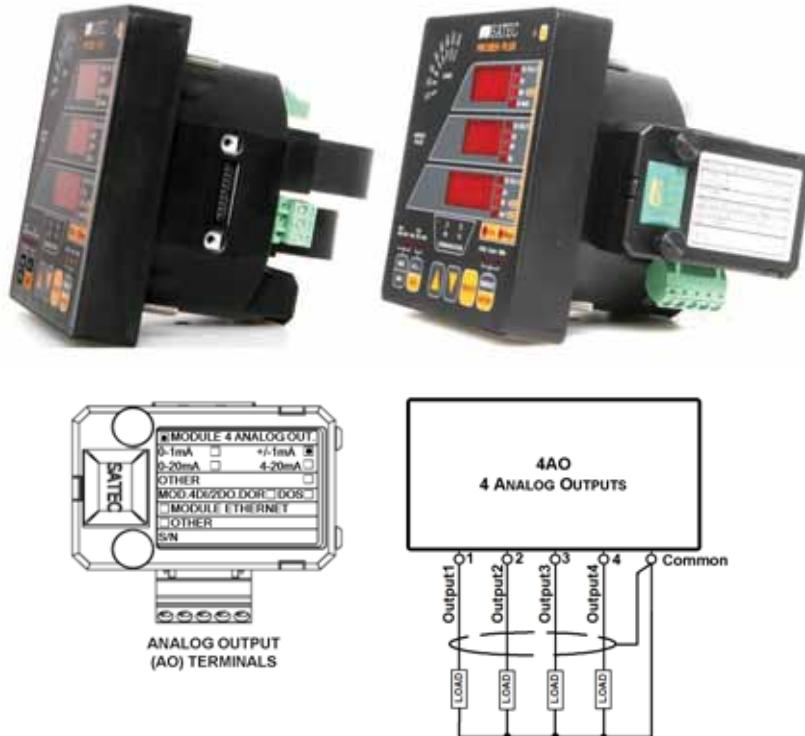


Figure 2-24 Analog Output Connection



It is recommended to connect unused Analog output channels to Common terminal.

- The 4AO module TERMINAL is for use only with equipment which has no live parts which are ACCESSIBLE
  - The RATING of the insulation of the external equipment for use with the 4AO module, shall comply according to Installation Category II for insulation to be suitable for SINGLE FAULT CONDITION
- ⇒
- The external equipment TERMINAL connection type is normally terminal block for wire size 14 AWG (up to 1.5 mm<sup>2</sup>)
  - The type of equipment that might be connected to the TERMINAL is:
    - Programmable Logic Controller for automation – PLC
    - Digital or Analog meter

## TOU module – RTC and 4 Digital Inputs

The TOU provides a battery-operated real time clock (RTC) with four optically isolated inputs for status monitoring, time synchronization, pulse counting, and external power demand period.

## Digital Inputs

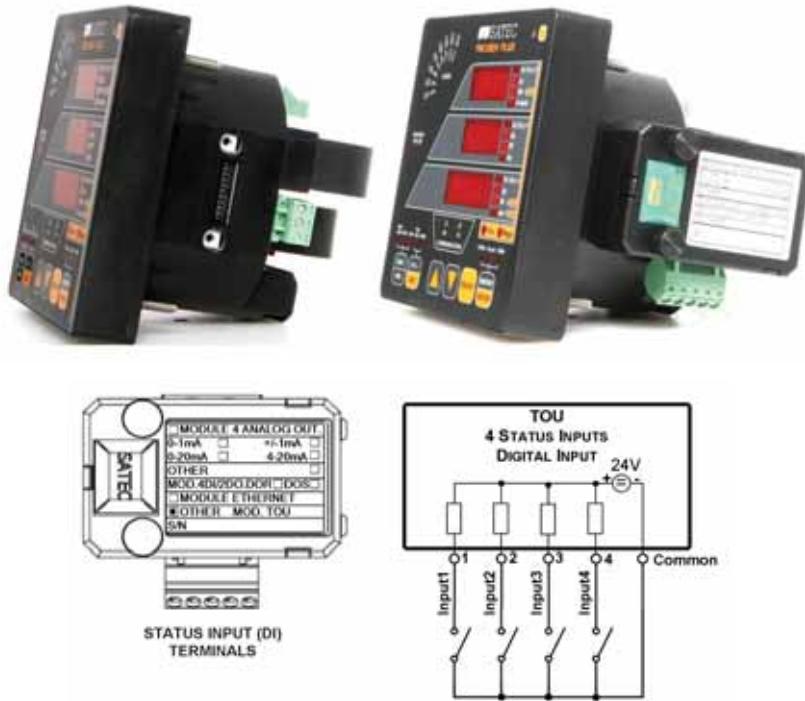


Figure 2-25 TOU Digital Input Connection

## TOU – Battery Replacement

### WARNING!

**Only qualified personnel familiar with the instrument and its associated electrical equipment must perform the RTC battery backup replacement.**

#### To replace the CR1632 RTC battery:

1. Remove the TOU module from the PM130 PLUS compartment
2. Open the TOU MODULE case by applying a flat screwdriver at three snap-in slit (1, 2 and 3), as shown in Figure 2-26.
3. Remove the old battery by lifting up the battery holder retractable tab.
4. Place the new CR1632 battery into the battery holder while holding up the battery holder retractable tab in such a way that the (+) battery pole is toward the battery holder, as shown in Figure 2-26.

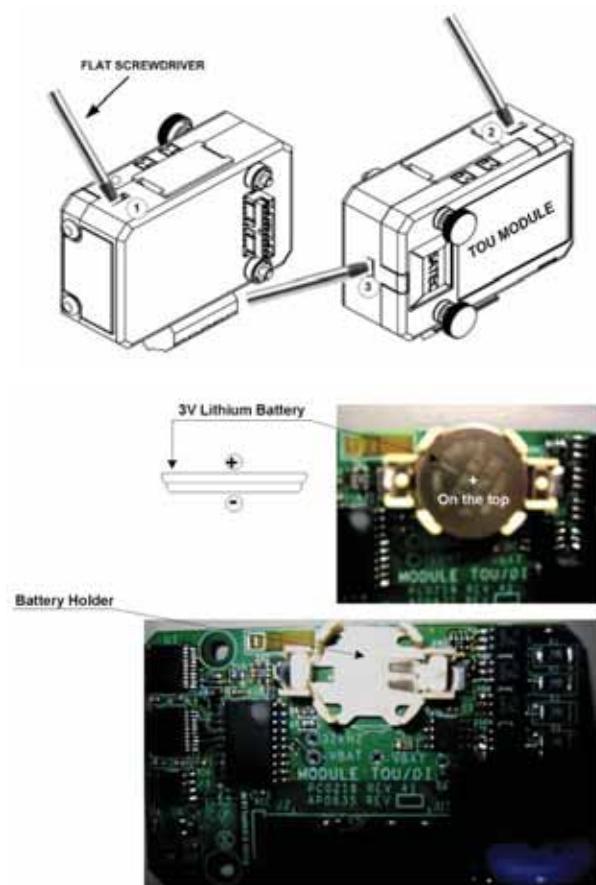


Figure 2-26 TOU RTC Battery Replacement

## 2.6 Communications Connections



Before installing the Communication Module, ensure that all incoming power sources are shut OFF. Failure to observe this practice can result in serious or even fatal injury and damage to equipment.

Several communication options are available for the PM130:

- **COM1:** RS-485
- **COM2:**
  - Ethernet 10/100BaseT
  - Profibus DP
  - GPRS
  - RS-232 or RS-422/485

A connection to the Ethernet connector is made through a cable adaptor provided with your meter.

A full description of the communication protocols is found in the PM130 protocol guides that come with your meter.

## COM1 RS-485 Connection

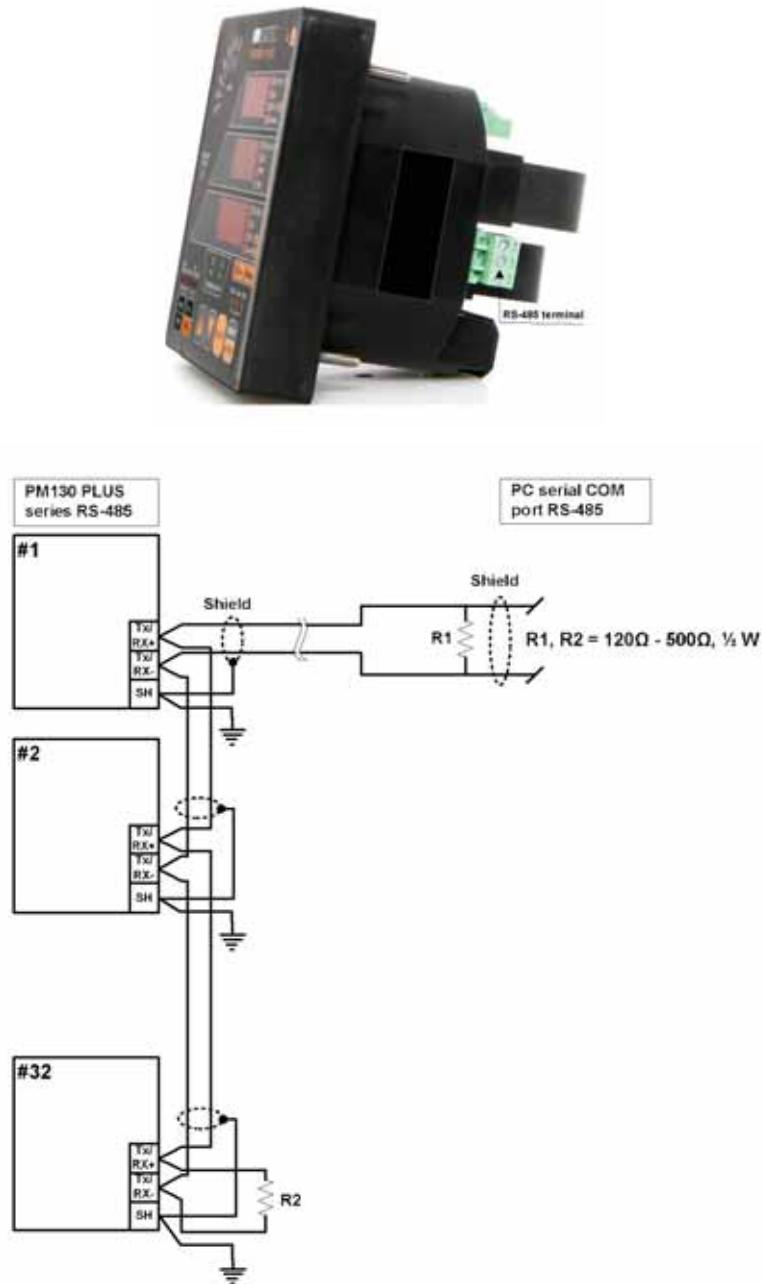


Figure 2-27 COM1 RS-485 2-Wire Connection

The connector is removable with three captured-wire terminals.

## ETH module – COM2 Ethernet Connection



**Figure 2-28 COM2 Ethernet Connection**

- The ETH module TERMINAL is for use only with equipment which has no live parts which are ACCESSIBLE
  - The RATING of the insulation of the external equipment for use with the ETH module, shall comply according to Installation Category II for insulation to be suitable for SINGLE FAULT CONDITION
- ⇒
- The external equipment TERMINAL connection type is RJ-45
  - The type of equipment that might be connected to the TERMINAL is:
    - Personal Computer – PC or LAPTOP
    - 10/100Base-T LAN HUB and/or Switch

## PRO module – COM2 PROFIBUS Connection

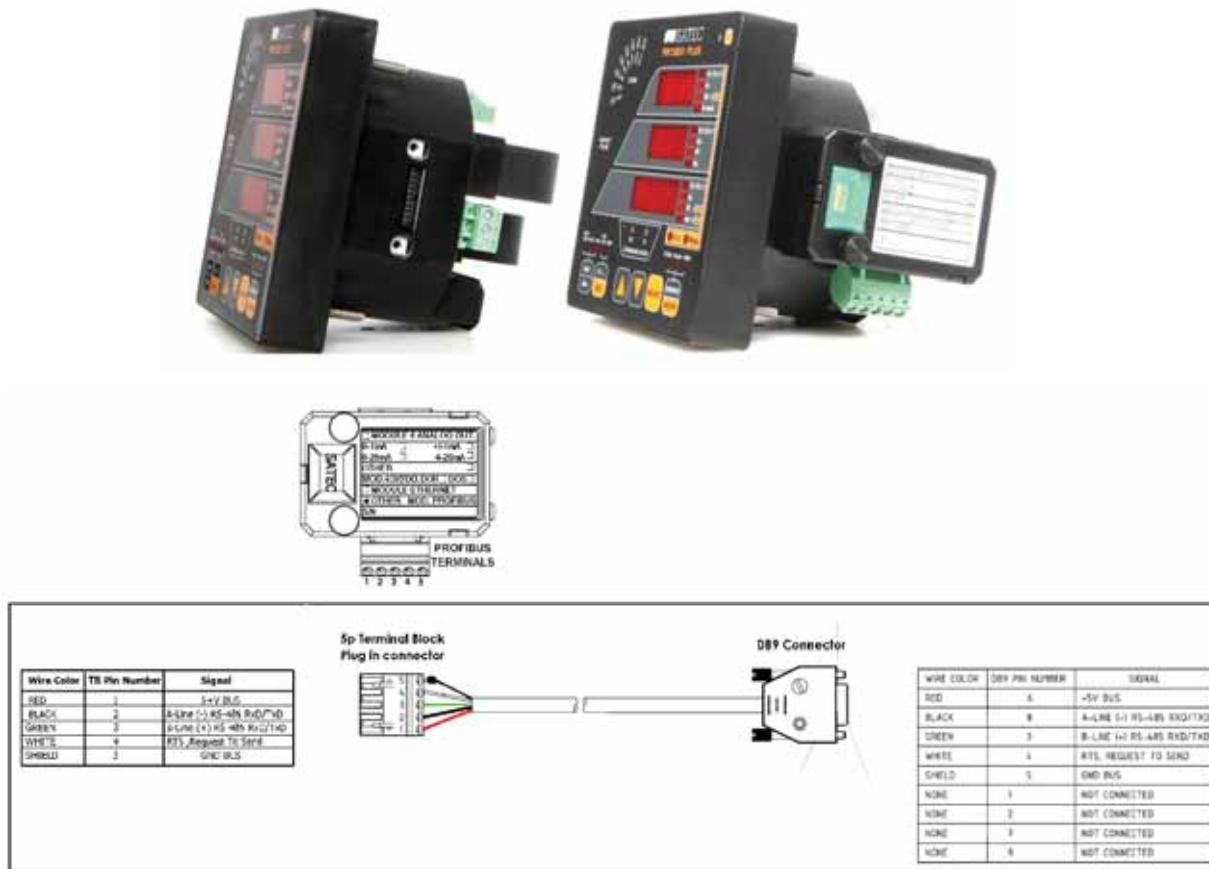


Figure 2-29 COM2 PROFIBUS Connection

- ⇒
- The PRO module TERMINAL is for use only with equipment which has no live parts which are ACCESSIBLE
  - The RATING of the insulation of the external equipment for use with the PRO module, shall comply according to Installation Category II for insulation to be suitable for SINGLE FAULT CONDITION
  - The external equipment TERMINAL connection type is DB9
  - The type of equipment that might be connected to the TERMINAL is:
    - Programmable Logic Controller for automation – PLC

## RS-232/422-485 module – COM2 Connection



Figure 2-30: COM2 RS-232 connection

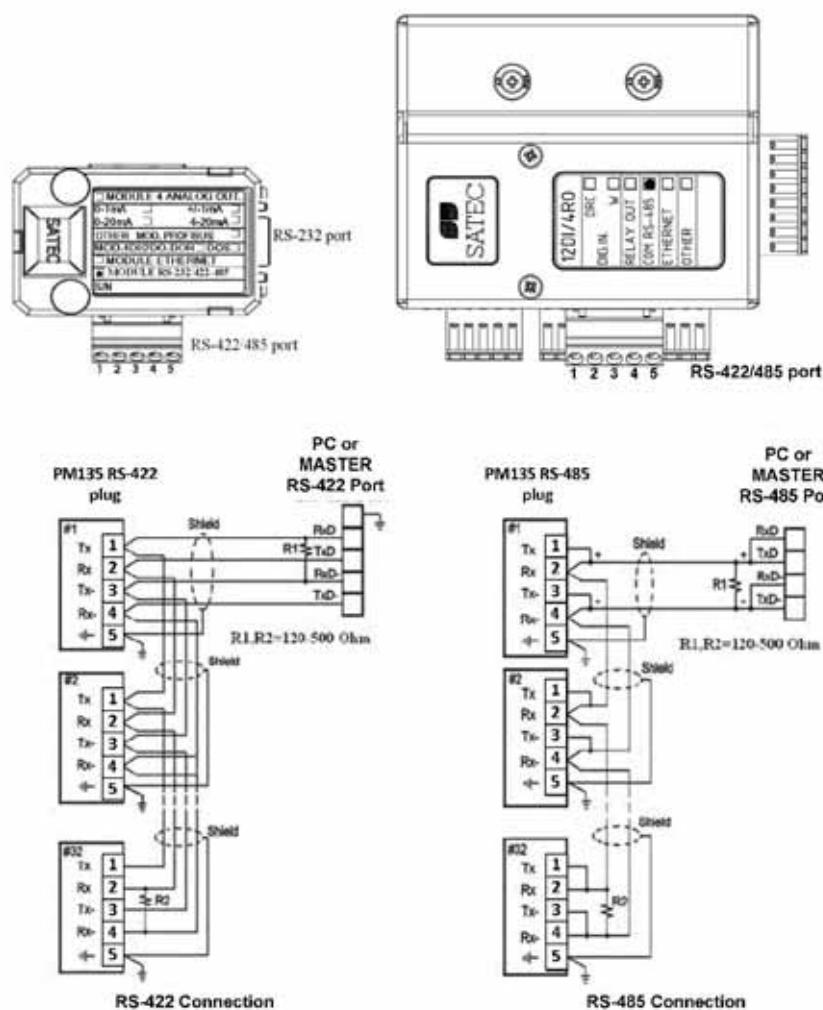
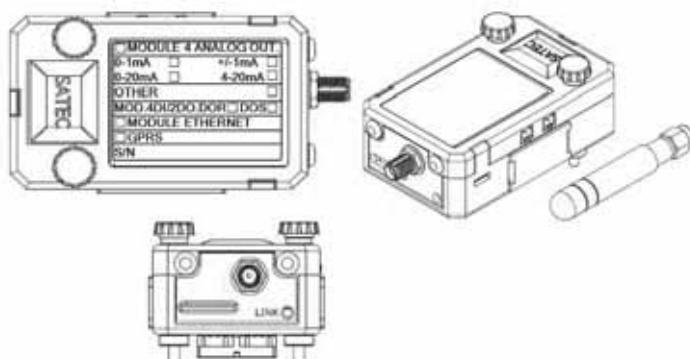


Figure 2-31 COM2 RS-422/485 connection

- The RS-232/422-485 module TERMINALS are for use only with equipment which has no live parts which are ACCESSIBLE
- The RATING of the insulation of the external equipment for use with The RS-232/422-485 module, shall comply according to Installation Category II for insulation to be suitable for SINGLE FAULT CONDITION
- ⇒
  - The external equipment TERMINAL connection type is normally terminal block for wire size 14 AWG (up to 1.5 mm<sup>2</sup>) – RS-422/485 port and DB9 male-to-female cable more than 22 AWG (0.3mm<sup>2</sup>)
  - The type of equipment that might be connected to the TERMINAL is:
    - Personal Computer – PC or LAPTOP

## Connecting a GSM/GPRS modem

A GSM/GPRS modem module can be connected to the meter COM2 port to provide communications with the remote MODBUS/TCP server via a wireless GPRS network.



The GSM/GPRS SIM must not have any incoming voice call.  
The customer must require from the Service Provider for DATA services only  
⇒ The GPRS modem module can be equipped with two different antennas: internal Antenna for installation into plastic closet or no-metallic environment. For metallic installation use external antenna

See [Setting Up GPRS Network](#) in Chapter 5 for information on configuring GPRS communications in your meter.

# Chapter 3 Using Front Display

This chapter provides PM130 PLUS Power meter series front panel information and operating procedures.

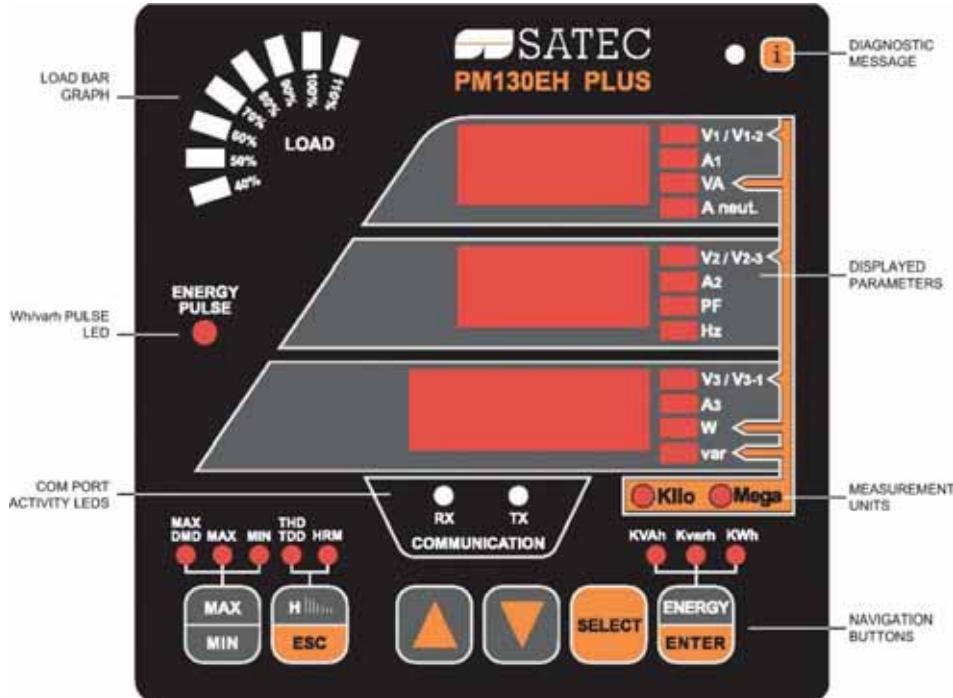


Figure 3-1: PM130 PLUS Unit

## 3.1 Indicators and Controls

### Device Diagnostics

After applying power to the meter, a one-digit start-up diagnostic code is shown for 1 second on all LEDs. Code 8 indicates a normal power-up sequence. You can observe the list of device diagnostic codes recorded during restart and meter operation via the [Status Display](#).

When the meter records a diagnostic message, the diagnostic "i" LED flashes until you reset the device diagnostics via the [Status Display](#). The diagnostic LED can be disabled or enabled through the display setup (see [Configuring the Display](#)).

### Numeric LED Display

The meter has a simple user interface that allows you to view numerous measurement parameters by scrolling through different display pages. The numeric LED display shows up to three parameters at a time. Small rectangular or round LEDs at the right and below the display indicate the displayed parameters and their measurement units.

The display layout may change depending on the meter type and mode of operation.

There are three modes of display operation:

- Data display
- Status display
- Programming mode display.

## Load Bar Graph

The load bar graph displays the amount, in percent (40% to 110%), of the present current load with respect to user-defined nominal load current. The reference nominal current can be set up in amps through the display setup (see [Configuring the Display](#)). If it is set to 0 (default), the current load is referenced to the specified CT primary current.

## Energy Pulse LED

The PM130E and PM130EH have a red “Energy Pulse” LED. It flashes at a constant rate when a load is applied to the meter.

There are two modes of LED operation:

- **NORMAL mode:** the LED pulses indicate imported Wh at a rate of 1,000 pulses per kWh
- **TEST mode:** the LED pulses indicate either imported Wh, or imported (inductive) varh at a rate of 10,000 pulses per kWh/kvarh

The energy test mode can be enabled through the [Device Options](#) setup. When in test mode, the energy and demand accumulators do not account for consumed energy.

## Port Activity LEDs

The meter has two green LEDs “RX” and “TX”, which indicate activity on the COM1 communication port. The LEDs flash when the port is receiving or transmitting data.

## Navigation Buttons

The PM130 is provided with six push buttons that are normally used to navigate between different measurement displays.

The function of buttons changes depending on what operating mode the display is in. In programming mode, the buttons access the device setup menus where the default factory-set device settings can be changed.

## 3.2 Data Display

In data mode, the display is normally updated once every second. You can adjust the display update rate via the display setup (see [Configuring the Display](#)).

## Display Features

### Measurement Units

The PM130 PLUS has a selectable resolution for volts, amps and powers presented on the front display and via communications. See [Device Options](#) in Chapter 5 for information on selecting the data resolution in the PM130 PLUS.

#### Low Resolution Option

Currents are displayed in whole amperes below 10,000 A, and in kilo amperes above 10,000 A.

Measurement units for voltage and power depend on the voltage connection scheme:

- For direct wiring (PT=1) or wiring via PT with the PT ratio up to and including 4.0, voltages are displayed in volts, and power in kilowatts.

- For the PT ratio above 4.0, voltages are displayed in kilovolts with three decimal places, and power in megawatts with three decimal places.

### High Resolution Option

Currents are displayed in amperes with up to two decimal places below 10,000 A, and in kilo amperes above 10,000 A.

Measurement units for voltage and power depend on the voltage connection scheme:

- When direct wiring is used (PT=1), voltages are displayed in volts with one decimal place, and power in kilowatts with three decimal places.
- When wiring via PT is used with the PT ratio up to and including 4.0, voltages are displayed in volts, and power in whole kilowatts.
- For the PT ratio above 4.0, voltages are displayed in kilovolts with three decimal places, and power in megawatts with three decimal places.

The small round "Kilo" and "Mega" LEDs light up showing the appropriate measurement units for a displayed page.

### Primary and Secondary Volts

Volts can be displayed in primary (default) or secondary units. The volts display mode can be changed through the display setup (see [Configuring the Display](#)).

### Phase Power Readings

In configurations with the neutral wire, in addition to total three-phase powers, the meter can show per-phase power readings. By default, they are disabled. See [Configuring the Display](#) on how to enable per-phase power readings in your meter.

### Fundamental Component

The PM130EH can display total displacement power factor and active power for the fundamental component if it is enabled through the display setup (see [Configuring the Display](#)).

When phase power readings are allowed, the PM130EH also displays per-phase displacement power factor and active power for the fundamental component.

### Auto Return

If no buttons are pressed for 30 seconds while the display Auto Return option is enabled, the display automatically returns to the main screen from any other measurement display.

The Auto Return option can be enabled through the display setup (see [Configuring the Display](#)).

### Auto Scroll

If no buttons are pressed for 30 seconds while in the common measurements display, and the Auto Scroll option is enabled in the meter, the display automatically scrolls through all available pages. The scroll interval can be adjusted through the display setup (see [Configuring the Display](#)).

To stop auto scrolling, press briefly the **UP** or **DOWN** button.

## Brightness

The PM130 display has a 3-level adjustable brightness. It is normally preset at the factory to the highest level. You can adjust the display through the display setup (see [Configuring the Display](#)).

## Navigation Buttons



Figure 3-2: Navigation Buttons

See the following table for button operations in data display mode.

Button	Action	Operations
UP	Press and release	Scroll through pages backwards. Hold down the button for continuous scrolling.
DOWN	Press and release	Scroll through pages forwards. Hold down the button for continuous scrolling.
UP + DOWN	Press and release	Return to the start page within a present display.
SELECT	Press and release	Enter programming mode.
MAX/MIN	Press and release	Enter (return from) the minimum/maximum display. Switch between the Max/Min and Maximum Demands displays.
H/ESC	Press and release	Enter (return from) the harmonics display. Switch between the Total Harmonics and Individual Harmonics displays.
ENERGY/ENTER	Press and release	Enter (return from) the energy display. Switch between the total and per phase energy display and TOU registers display (if configured). The button is not operational in the PM130P.
SELECT + ENERGY/ENTER (in selected pages)	Press and hold for 5 seconds or longer	Reset accumulators or minimum/maximum on the currently displayed page (see <a href="#">Simple Reset of Accumulated Data</a> below).

## Simple Reset of Accumulated Data

You can clear the Min/Max log, maximum demands or energies from the data display mode without accessing the reset menu with the simple "two-button" reset option:

1. Select a display page where the data you want to reset is displayed:
  - **Min/Max log:** select a Min/Max page from the Min/Max Display
  - **Ampere and volt maximum demands:** select the Ampere or Volt maximum demand page from the Min/Max Display.
  - **Power maximum demands:** select the power maximum demand page from the Min/Max Display.
  - **Total and phase energies:** select a total energy, or a phase energy page from the Energy Display.
2. While holding the **SELECT** button down, press and hold the **ENTER** button for about 5 seconds.

The displayed data is reset to zero.

This function is not operational if the meter is password protected and the simple reset is not allowed in protected mode (see [Configuring the Display](#)).

## Common Measurements Display

Scroll through pages with the **UP** and **DOWN** arrow buttons.

**Table 3: Common Measurements (Regular version)**

1	L	V12 V23 V31	Line-to-line volts
2	P	V1 V2 V3	Line-to-neutral volts (in 4LN3, 3LN3, 3BLN3 configurations)
3		I1 I2 I3	Amps
4		kVA/MVA PF kW/MW	Total VA Total PF Total W
5		In Hz kvar/Mvar	Neutral current Frequency Total var
6		<b>Ph.L1</b> PF kW/MW	Phase L1 powers (if enabled)
7		kVA/MVA <b>Ph.L1</b> kvar/Mvar	Phase L1 powers (if enabled)
8		<b>Ph.L2</b> PF kW/MW	Phase L2 powers (if enabled)
9		kVA/MVA <b>Ph.L2</b> kvar/Mvar	Phase L2 powers (if enabled)
10		<b>Ph.L3</b> PF kW/MW	Phase L3 powers (if enabled)
11		kVA/MVA <b>Ph.L3</b> kvar/Mvar	Phase L3 powers (if enabled)
12		<b>H01</b> PF kW/MW	Fundamental total powers (PM130EH, if enabled)
13		<b>H1.L1</b> PF kW/MW	Fundamental phase L1 powers (PM130EH, if enabled)
14		<b>H1.L2</b> PF kW/MW	Fundamental phase L2 powers (PM130EH, if enabled)
15		<b>H1.L3</b> PF kW/MW	Fundamental phase L3 powers (PM130EH, if enabled)
16		<b>U.Unb</b> V% unb	Voltage unbalance, percent
17		<b>C.Unb</b> I% unb	Current unbalance, percent

**Table 4: Common Measurements (Amp-Demand version)**

1		I1 I2 I3	Amps
2		In	Neutral current

## Min/Max and Maximum Demand Display



1. Press the **MAX/MIN** button.
- The **MIN**, **MAX**, or **MAX DMD** LED is illuminated when in the Min/Max display.
2. Use the **UP** and **DOWN** arrow buttons to scroll through the Min/Max and Max. Demand pages.

To see the time and date of the event occurrence:

1. Press simultaneously the **SELECT** and **UP** buttons.
2. Use the **UP** and **DOWN** arrow buttons to scroll through the parameters displayed on the page. A corresponding LED at the right is illuminated showing the parameter for which the timestamp is displayed.

The time is displayed in format hh.mm, and the date in format MM-DD-YY (default) or in any other format you can select via the display setup (see [Configuring the Display](#)).

Note that Volts readings are line-to-neutral in 4LN3, 3LN3 and 3BLN3 wiring modes, and line-to-line in other modes.

**Table 5: Min/Max and Maximum Demands (Regular version)**

1	<b>MIN</b>	V1/V12 V2/V23 V3/V31	Minimum volts
2	<b>MIN</b>	I1 I2 I3	Minimum amps
3	<b>MIN</b>	kVA/MVA PF kW/MW	Minimum total VA Minimum total PF (absolute) Minimum total W
4	<b>MIN</b>	In Hz kvar/Mvar	Minimum neutral current Minimum frequency Minimum total var
5	<b>MAX</b>	V1/V12 V2/V23 V3/V31	Minimum volts
6	<b>MAX</b>	I1 I2 I3	Maximum amps
7	<b>MAX</b>	kVA/MVA PF kW/MW	Maximum total VA Maximum total PF (absolute) Maximum total W
8	<b>MAX</b>	In Hz kvar/Mvar	Maximum neutral current Maximum frequency Maximum total var
9	<b>MAX</b>	V1/V12	Maximum volt demands

	<b>DMD</b>	V2/V23 V3/V31	
10	<b>MAX DMD</b>	I1 I2 I3	Maximum ampere demands
11	<b>MAX DMD</b>	kVA/MVA PF kW/MW	Maximum VA demand PF at maximum VA demand Maximum W demand
12	<b>MAX DMD</b>	A neut. var	Maximum neutral current demand Maximum var demand

**Table 6: Min/Max and Maximum Demands (Amp-Demand version)**

1	<b>MAX DMD</b>	I1 I2 I3	Maximum ampere demands
2	<b>MAX DMD</b>	A neut.	Maximum neutral current demand

## Harmonics Display (PM130EH)



1. Press the **H/ESC** button.
- The **THD/TDD** LED is illuminated.
2. Use the **UP** and **DOWN** arrow buttons to scroll through total harmonics measurements.
3. Press the **H/ESC** button again to move to the individual harmonics.

Note that voltage harmonics readings are line-to-neutral in the 4LN3, 3LN3, 3BLN3 wiring modes, and line-to-line in all other modes.

**Table 7: Total Harmonics**

1	<b>thd.</b>	V1/V12 THD V2/V23 THD V3/V31 THD	Voltage THD
2	<b>thd.</b>	I1 THD I2 THD I3 THD	Current THD
3	<b>tdd.</b>	I1 TDD I2 TDD I3 TDD	Current TDD
4	<b>HF</b>	I1 K-Factor I2 K-Factor I3 K-Factor	Current K-Factor

**Table 8: Individual Voltage Harmonics**

1	<b>3.</b>	V1/V12 HD% V2/V23 HD% V3/V31 HD%	Order 3 harmonic distortion
2	<b>5.</b>	V1/V12 HD% V2/V23 HD% V3/V31 HD%	Order 5 harmonic distortion
	...		

19		V1/V12 HD% V2/V23 HD% V3/V31 HD%	Order 39 harmonic distortion
	39.		

**Table 9: Individual Current Harmonics**

1	3.	I1 HD% I2 HD% I3 HD%	Order 3 harmonic distortion
2	5.	I1 HD% I2 HD% I3 HD%	Order 5 harmonic distortion
	...		
19	39.	I1 HD% I2 HD% I3 HD%	Order 39 harmonic distortion

## Energy Display (PM130E/EH)



1. Press the **ENERGY** button.  
The kVAh, kvarh, or kWh LED is illuminated.
2. If TOU registers are configured in the meter, you can press the button again to scroll through all active TOU registers.
3. Use the **UP** and **DOWN** arrow buttons to scroll through energy pages.

Per phase energy accumulators are displayed along with total energies if phase energy calculation is enabled in the Device Options setup.

**Table 10: Total and Phase Energies**

1		<b>Ac.i</b> 1234 56789	Total kWh import
2		<b>rE.i</b> 1234 56789	Total kvarh import
3		<b>AP.</b> 1234 56789	Total kVAh
4		<b>Ac.E</b> 1234 56789	Total kWh export
5		<b>rE.E</b> 1234 56789	Total kvarh export
6		<b>Ac.i 1</b> 1234 56789	Phase L1 kWh import
7		<b>rE.i 1</b> 1234 56789	Phase L1 kvarh import
8		<b>AP. 1</b> 1234 56789	Phase L1 kVAh

9		<b>Ac.i 2</b> 1234 56789	Phase L2 kWh import
10		<b>rE.i 2</b> 1234 56789	Phase L2 kvarh import
11		<b>AP. 2</b> 1234 56789	Phase L2 kVAh
12		<b>Ac.i 3</b> 1234 56789	Phase L3 kWh import
13		<b>rE.i 3</b> 1234 56789	Phase L3 kvarh import
14		<b>AP. 3</b> 1234 56789	Phase L3 kVAh

**Table 11: TOU Energy Register 1**

1		<b>r1.t1</b> 1234 56789	Tariff 1 reading kWh
2		<b>r1.t2</b> 1234 56789	Tariff 2 reading kWh
	...		
4		<b>r1.t8</b> 1234 56789	Tariff 8 reading kWh

...

**Table 12: TOU Energy Register 4**

1		<b>r4.t1</b> 1234 56789	Tariff 1 reading kWh
2		<b>r4.t2</b> 1234 56789	Tariff 2 reading kWh
	...		
4		<b>r4.t8</b> 1234 56789	Tariff 8 reading kWh

### 3.3 Status Display

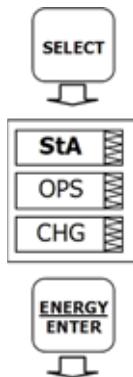
The meter has a separate status information display accessible through the primary meter menu. See [Using the Menus](#) for information on navigating in menus.

The Status Display shows rarely used information that is especially helpful for troubleshooting or when connecting the meter to an external equipment.

#### To access the Status Display:

1. From the Data display, press the **SELECT** button to access the primary meter menu.  
The **StA** window is highlighted.
2. Press **ENTER** to access the Status Display.

3. Use the **UP** and **DOWN** arrow buttons to scroll through the status pages.



**Figure 3-3: Status Display**

**To exit the Status Display:**

1. Press **ESC** to return to the primary device menu.
2. Press **ESC** to return to the Data display.

**Table 13: Status Display Parameters**

1		<b>PhS rot</b> POS/nEG/Err	Phase rotation order
2	A.	V1 angle V2 angle V3 angle	Voltage angles ( $\pm 180^\circ$ , referenced to V1)
3	A.	I1 angle I2 angle I3 angle	Current angles ( $\pm 180^\circ$ , referenced to V1)
4		<b>rEL</b> 1.2 00	Relay status (with a digital I/O module)
5		<b>St.In</b> 1.2.3.4 0000	Status inputs (with a digital I/O module)
6		<b>Cnt.1</b> <hour> 12345	Counter #1 value (a time counter – in 0.1 hour units)
7		<b>Cnt.2</b> <hour> 12345	Counter #2 value (a time counter – in 0.1 hour units)
8		<b>Cnt.3</b> <hour> 12345	Counter #3 value (a time counter – in 0.1 hour units)
9		<b>Cnt.4</b> <hour> 12345	Counter #4 value (a time counter – in 0.1 hour units)
10		<b>Alar</b> SP.<Setpoint Number> <Alarm Trigger >	Setpoint alarms (see <a href="#">Alarm Display</a> below)
11		<b>diAG</b> <Diagnostic Code> <Diagnostic Message>	Device diagnostics (see <a href="#">Diagnostics Display</a> below)
12		<b>SEr.n</b> 1 23456	Device serial number
13		<b>SoFt</b>	Firmware version number

		11. 01.01	
14		<b>rSSI</b> <RSSI> <GPRS status>	GPRS communications status (with an external GPRS modem): RSSI = received signal strength, dBm GPRS status: Uncon = not connected, UnrEG = not registered, rEG = registered

## Pulse and Time Counters

You can use the 5-digit meter counters either as regular pulse/event counters to count external pulses or setpoint events, or as time counters to count setpoint operation time.

See [Configuring Counters](#) in Chapter 5 for information on configuring pulse/event counters.

See [Using Time Counters](#) in [Configuring Alarm/Control Setpoints](#) for information on configuring time counters. Time counters have the **hour** label in the middle window and indicate the setpoint operation time in 0.1-hour units.

You can clear a counter using the simple “two-button” reset option if the meter is not password protected, or if the meter security is overridden by the “two-button” reset mode setting (see [Configuring the Display](#)).

**To clear a counter:**

1. Select a counter page.
2. While holding the **SELECT** button, press and hold the **ENTER** button for about 5 seconds.

The displayed data is reset to zero.

## Alarm Display

The alarm display shows a list of operated alarm setpoints along with the alarm trigger labels if there are alarms recorded during meter operation.

Use the **UP** and **DOWN** arrow buttons to scroll through the alarm list.

The setpoint status is latched into a non-volatile register, which is not affected by loss of power and may only be cleared via communications or from the meter display.

**To clear alarms:**

1. Select an alarm page.
2. While holding the **SELECT** button, press and hold the **ENTER** button for about 5 seconds until the alarm code is reset to none.

## Diagnostics Display

The diagnostics display shows a list of the device diagnostic codes recorded as a result of the meter self-test diagnostics during start-up and operation. When there are recorded diagnostic messages, the “i” diagnostic LED on the front display briefly flashes two times to indicate that the meter may require servicing.

The diagnostic LED can be disabled or enabled via the display setup menu (see [Configuring the Display](#)).

Use the **UP** and **DOWN** arrow buttons to scroll through the diagnostic message list. See [Device Diagnostic Codes](#) in Appendix G for the list of diagnostic codes and their meanings.

Frequent hardware failures may be the result of excessive electrical noise in the region of the device. If the meter continuously resets itself, contact your local distributor.

A configuration reset may also be a result of the legal changes in the meter configuration when other configuration data is affected by the changes.

The diagnostics codes are stored in a non-volatile register, which is not affected by loss of power and may be cleared via communications (see [Viewing and Clearing Device Diagnostics](#) in Chapter 6) or from the meter display.

**To clear the meter diagnostics:**

1. Select a diagnostics page.
2. While holding the **SELECT** button, press and hold the **ENTER** button for about 5 seconds until the diagnostic message is reset to **none**.

## 3.4 Using the Menus

### Navigation Buttons



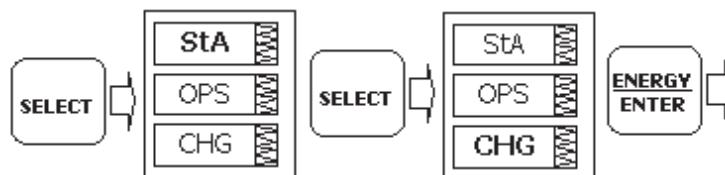
The PM130 PLUS has a menu-driven setup. Press and release the **SELECT** button to access the meter menus.

See the following table for button operations in menus.

Button	Action	Operations
<b>SELECT</b>	Press and release	Highlight (activate) a menu window.
<b>UP</b>	Press and release	Scroll through menu items forwards or increment a number in the highlighted window. Hold down the button for continuous scrolling.
<b>DOWN</b>	Press and release	Scroll through menu items backwards or decrement a number in the highlighted window. Hold down the button for continuous scrolling.
<b>ENERGY/ENTER</b>	Press and release	Confirm the selection and store the changed item or perform an action indicated in a highlighted window.
<b>H/ESC</b>	Press and release	Quit the highlighted window without saving a selected item or return to the upper level menu.

### Selecting Menus

To access the menus, press and release the **SELECT** button. The primary meter menu is displayed as shown in the picture below.



The menu has three entries:

- **StA:** Status Display entry (see the [Status Display](#) section)
- **OPS:** Main setup menu entry allowing to review setup options
- **CHG:** Main setup menu entry allowing changing setups, updating the clock and resetting accumulated values.

#### To access the Status Display:

1. If the **StA** window is not highlighted, use the **SELECT** button to activate it.
2. Press the **ENTER** button to access the Status Display

#### To review the meter setup options:

1. Press the **SELECT** button to activate the OPS window.
2. Press the **ENTER** button to access the main menu.

#### To change the meter setup:

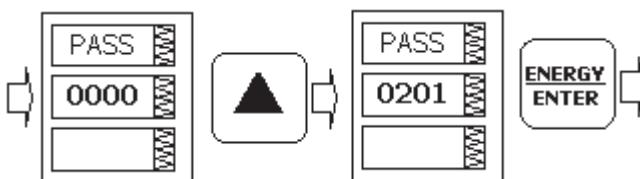
1. Press the **SELECT** button to activate the **CHG** window.
2. Press the **ENTER** button to access the main menu.

## Entering the Password

The Setup Change menu can be secured by a four-digit user password.

You can change the password and enable password protection through the Access Control menu (see [Configuring Meter Security](#)). The meter is primarily shipped with the password preset to 0 and password protection disabled.

If password protection is enabled, you are prompted for a password when entering the setup change menu.



#### To enter the password:

1. Adjust the first digit with the **UP** or **DOWN** arrow buttons.
2. Press the **SELECT** button to advance to the next digit. As you move to the next place, the entered digit is saved and then zeroed. If you missed a digit, you should re-type all preceding digits before you reach the missed place again.
3. Adjust the remaining digits in the same manner.
4. Press **ENTER** to confirm the password.

If the password you entered is correct, you are moved to the Main menu, otherwise you return back to the primary menu.

## Selecting a Menu Entry

Selecting the **OPS** or **CHG** entry moves you to the Main menu that is represented by two entries:

- the upper window displays a list of menu entries

- the bottom item acts as an assisting exit window.

**To select a menu entry from the main menu:**

- If the upper item is not highlighted, use the **SELECT** button to activate it.

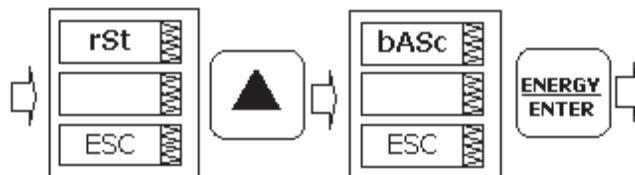


Figure 3-4: Main Menu

- Scroll through the menu list by pressing briefly the **UP** or **DOWN** arrow buttons until the required menu entry appears.
- Press the **ENTER** button.

## Viewing and Changing Setup Options

A second level menu normally consists of three items:

- the upper static window indicates the menu name
- the middle window represents a list of setup parameters you can scroll through
- the lower window shows the parameter value.

**To select a parameter you want to view or change:**

- Highlight the middle window by pressing the **SELECT** button.

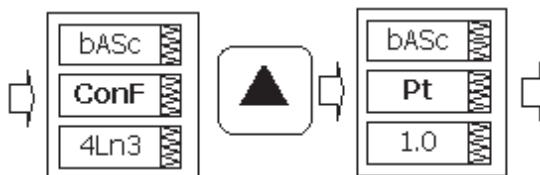


Figure 3-5: Selecting a Parameter

- Scroll through the parameter list with the **UP** or **DOWN** arrow buttons until the required parameter name appears.

**To change the selected parameter:**

- Press the **SELECT** button to highlight the lower item.

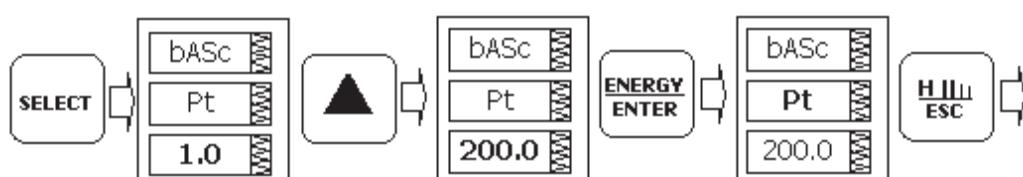


Figure 3-6: Changing a Parameter

- If the parameter is represented by a list of values, select the required option with the **UP** or **DOWN** arrow buttons.
- If the parameter is represented by a numeric value, adjust the number with the **UP** or **DOWN** arrow buttons. When the button is briefly pressed and released, the number is incremented or decremented by one. When the button is

pressed continuously, the number is changed approximately twice per second.

4. Press the **ENTER** button to store your selection or press the **ESC** button to leave the parameter unchanged.

You return to the middle window and can continue scrolling through the remaining parameters or return to the main menu.

5. Press **ESC** to exit the menu.

# Chapter 4 Using PAS Software

The support PAS software is a configuration and data acquisition tool that allows you to configure all of the PM130 PLUS features, monitor your meters on-line, retrieve recorded files and view reports. PAS can communicate with your PM130 PLUS via a serial port and via the Ethernet.

This chapter gives information on how to install and run PAS on your computer, and how to prepare information for your meter using PAS.

See Chapter 5 [Configuring the PM130 PLUS](#) for instructions on how to configure particular features in your meter. Refer to Chapters 7 and 8 for instructions on retrieving data from the meters and viewing reports.

## 4.1 Installing PAS

You need PAS V1.4 Build 4 or higher to take advantage of the meter data logging options.

**To install PAS on your PC:**



1. Insert the installation CD supplied with your meter into CD drive.
2. Open **My Computer** on your Desktop.
3. Click on your CD drive icon, select the PAS directory, and then double click on Setup (shown as an Application type file).
4. Follow InstallShield® Wizard instructions on the screen.

PAS is installed by default to the C:\Pas folder.

When installation is complete, the PAS icon appears on your Desktop. Double click on the PAS icon to run PAS.

For general information on how to work with PAS, see the "PAS Getting Started" guide supplied on the installation CD.

## 4.2 Creating a New Site for your Meter

PAS keeps all communication and configuration data for your meter in a configuration database called a site database. During configuration, store all setup data to the site database so that PAS recognizes device properties regardless of whether the meter is online or offline.

To communicate with the meters, create a separate site database for each device.

**To create a new database for your meter:**

1. Select **Configuration** from the **Tools** menu.

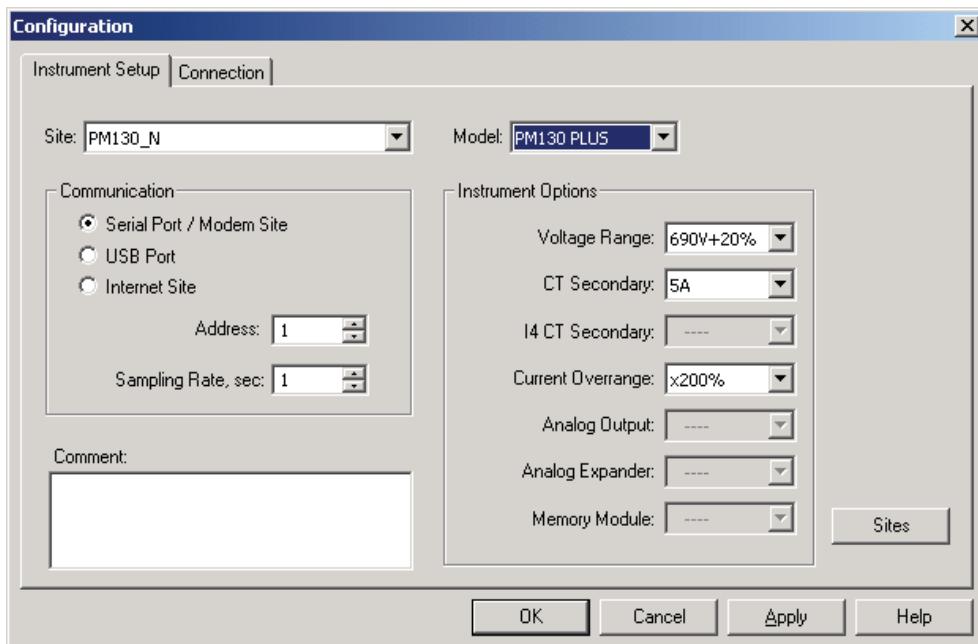
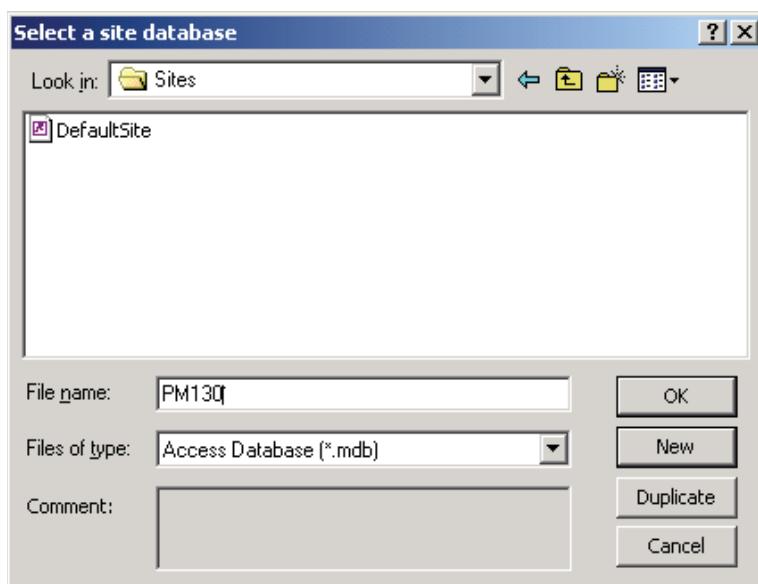


Figure 4-1: Configuration Dialog Box – Instrument Setup Tab

- Click the **Sites** button on the right-hand-side.



- From the **Look in** box, select the directory where a new database will be stored. By default, it is the **Sites** directory.
- Type a site name for your device in the **File name** box, click **New**, and then click **OK**.
- On the **Instrument Setup** tab, select **PM130 PLUS** in the **Model** box. PAS automatically selects the appropriate instrument options for your meter.
- Select a correct CT secondary current (5A or 1A) for your meter.
- If you wish to add any comments for your meter, type the comments in the **Comment** box.

## 4.3 Setting up Communications

You can communicate with the PM130 PLUS via a PC RS-232 serial port or through the Internet.

### To configure communications with the PM130 PLUS:

1. Select **Configuration** from the **Tools** menu. Under the **Communication** group on the **Instrument Setup** tab, select the type of connection for your device.
2. Set the device communication address you assigned to the PM130 PLUS port. When communicating via the Ethernet, the PM130 PLUS responds to any address you select.
3. In the **Sampling Rate** box, select a rate at which PAS updates data on your screen when you continuously poll the device in the PAS Data Monitor.

The communication protocol and port settings must match the settings you made in your meter.

### Communicating through a Serial Port

Select **Serial Port/Modem Site** on the **Configuration** tab, and then click on the **Connection** tab to configure your serial port settings.

#### Configuring a Serial Port

1. On the **Connection** tab, select a COM port from the **Device** box, and then click **Configure**.



Figure 4-2: Serial Port Setup Dialog Box

2. Specify the baud rate and data format for the port. Choose the same baud rate and data format as you have set in the meter, and then click OK.

The factory settings for the local PM130 PLUS RS-232 and RS-422/485 ports are 9600 baud, 8 bits with no parity.

#### Selecting the Communications Protocol

1. On the **Connection** tab, click **Protocol**.

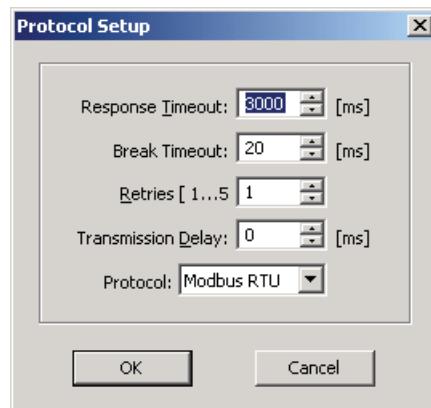


Figure 4-3: Protocol Setup Dialog Box

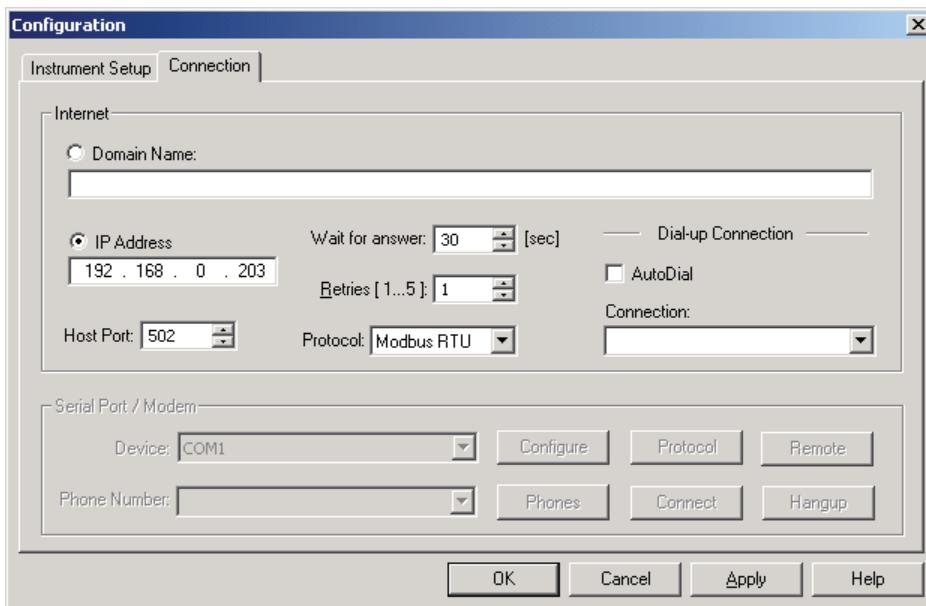
2. In the **Protocol** box, select the same communications protocol as you have set in your meter.
3. In the **Response Timeout** box, define the maximum time that PAS should wait for the meter response before announcing a failure.
4. In the **Break Timeout** box, define the maximum line idle time that PAS should wait after receiving the last message character before closing a connection with the Modbus RTU or DNP3 protocol. It does not affect ASCII communications. Note that this time is added to the message transfer time, and excessive increasing it may slow down communications. If you frequently receive the "Communication error" message, try to increase **Break Timeout**.
5. In the **Retries** box, define the number of attempts that PAS should use to receive a response from the meter in the event the communication fails, before announcing a communication failure.

## Communicating through the Internet

If you are communicating through the Ethernet port, define the IP address of your meter on the network.

### To configure the meter IP address:

1. On the **Instrument Setup** tab, select **Internet Site**.
2. Click on the **Connection** tab.
3. Click on the **IP address** and type in the IP address of your meter. The default IP address preset in the meter at the factory is 192.168.0.203.
4. In the **Protocol** box, select the communications protocol for the TCP port. The meter provides Modbus/TCP connections on TCP port 502 and DNP3/TCP connections on port 20000. The host port is set automatically as you select the protocol. Select **Modbus RTU/TCP** for Modbus/TCP or **DNP3** for DNP3/TCP.
5. In the **Wait for answer** box, adjust the time that PAS waits for a connection before announcing an error.



**Figure 4-4: Configuration Dialog Box – Connection Tab**

6. In the **Retries** box, specify the number of retries PAS will use to receive a response from the meter if communications fail.
7. Click **OK**.

## 4.4 Setting Up the Meter

### Preparing Setups for the Meter

PAS allows you to prepare setup data for your meter off-line without the need to have it connected to your PC.

**To prepare a setup for your meter:**

1. Select the device site from the list box on the PAS toolbar.
2. Select the desired setup group from the **Meter Setup** menu. Click on the tab with the setup you want to create or modify.
3. Fill in the boxes with the desired configuration data for your meter.
4. Click the **Save as...** button to store the data to the meter site database.
5. Click **OK**.



Always set up and store the Basic Setup data to the site database first. PAS uses this data as a reference when arranging other meter setups.

**To save your setup to another site database:**

1. Click the **Save as...** button.
2. Select the target database from the file pane.
3. Click **OK**.

You can also reuse a setup from another site by copying it to your present site database.

**To copy a setup from another site's database:**

1. Click **Open**.
2. Select the desired source site database.
3. Click **OK**. The opened setup is copied to your dialog window.
4. Click the **Save as...** button.
5. Select the target database from the file pane.
6. Click **OK**.

**To copy all setups from one site database to another site's database:**

1. In the list box on the toolbar, select a source device site from which you wish to copy setups.
2. Select **Copy to...** from the **Meter Setup** menu.
3. Select the target site database to which you wish to copy setups, and click **OK**.

## Downloading Setups to the Meter

You can update each setup in your meter one at a time or download all setups together from the site database.

**Individual Download**

To update a particular setup in your meter:

1. Check the **On-line** button on the PAS toolbar
2. Select a meter site from the list box on the toolbar.
3. Select the desired setup group from the **Meter Setup** menu. Click on the setup tab you want to download to the meter. As the setup dialog box opens, PAS retrieves and displays the present meter setup data.
4. If you wish to download a setup saved in the site database, click **Open**, and then click **OK**, or fill in the boxes with the desired configuration data for your device.
5. Click **Send**.

**Batch Download**

To download all setups to your device at once:

1. Check the **On-line** button on the PAS toolbar
2. Select the device site from the list box on the toolbar.
3. Select **Download Setups** from the **Meter Setup** menu.

## Uploading Setups from the Meter

**Individual Upload**

To get a particular setup from your device:

1. Check the **On-line** button on the PAS toolbar.
2. Select a meter site from the list box on the toolbar, and then select the desired setup group from the **Meter Setup** menu.

3. Click on the tab of the setup you want to read from the meter. As the dialog box opens, PAS retrieves and displays the present setup data from the meter. Click **Receive** if you wish to retrieve the meter setup once again.
4. To store the setup to the meter site database, click **Save As**, and then click **OK**.

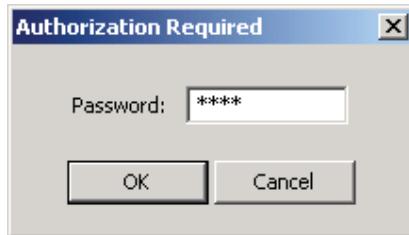
#### Batch Upload

To upload all setups from the device to the site database at once:

1. Check the **On-line** button on the toolbar.
2. Select the device site from the list box on the toolbar.
3. Select **Upload Setups** from the **Meter Setup** menu.

## 4.5 Authorization

If communications with your meter is secured, you are prompted for the password when you send new setup data to the meter.



**Figure 4-5: Authorization Dialog Box**

Enter the password and click **OK**.

If your authorization was successful, you are not prompted for the password again until you close the dialog box.

See [Configuring Meter Security](#) in Chapter 5 for more information on the meter password security.

# Chapter 5 Configuring the PM130 PLUS

This chapter describes how to configure different options in your meter from the front panel display or via PAS.

## 5.1 Configuring Communications

### Setting Up Serial Communication Ports

#### Using the Front Display

Select **Prt1** for COM1 or **Prt2** for COM2 from the main menu. See [Viewing and Changing Setup Options](#) in Chapter 3 for information on configuring parameters via the front display.



See Table 14 below for available communication options.

#### Using PAS

Select **Communications Setup** from the **Meter Setup** menu, and then click on the **Serial Ports Setup** tab. In the **Port** box, select the desired device port.

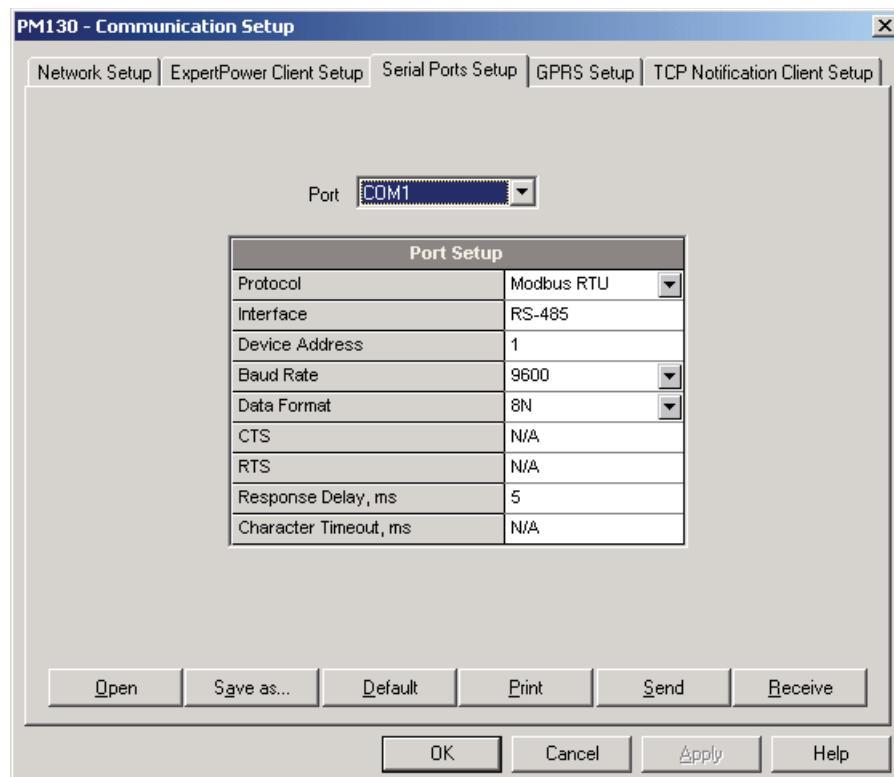


Figure 5-1: Communication Setup Dialog Box – Serial Ports Setup Tab

## Chapter 5 Configuring THE PM130 PLUS

### Configuring COMMUNICATIONS

---

See Table 14 below for available communication options.

**Table 14: COM Port Options**

Display Label	Parameter	Options	Default	Description
Prot	Protocol	ASCII = SATEC ASCII rtu = Modbus RTU dNP3 = DNP3 PrFb = Profibus DP (COM2)	Modbus RTU	The communications protocol for the port Not changeable on COM2 with the Profibus module
rS	Interface	COM1: 485 = RS-485 COM2: 232 = RS-232 485 = RS-485 422 = RS-422 Eth = Ethernet PrFb = Profibus DP GPrS = GPRS modem	RS-485	Communication interface. Not changeable on COM2 with the Ethernet and Profibus modules
Addr	Device address	SATEC ASCII: 0-99 Modbus: 1-247 DNP3: 0-65532 Profibus: 0-126	1 (126 for Profibus)	Device network address
bAud	Baud rate	300 bps-115.2 kbps	9600 bps	The port baud rate
dAtA	Data format	7E, 8N, 8E	8N	Data format and parity. 7E data format should not be used with the Modbus RTU and DNP3 protocols
dLAY	Response delay	0-1000 ms	5 ms	The minimum time after the last request character is received to start the transmission.
CPtb	ASCII compatibility mode	diS = Disabled En = Enabled	Disabled	Enables a low-resolution device emulation for ASCII request "0" in high-resolution devices (see <a href="#">Device Options</a> )

**NOTES:**

1. The meter provides the permanent Modbus TCP server on port 502.
2. Selecting the DNP3 protocol launches the second DNP3 TCP server in addition to the Modbus server allowing simultaneous connections on both ports. Selecting the Modbus protocol disables the DNP3 TCP server.
3. When you change the COM2 settings through the Ethernet port, the device port restarts so communications will be temporarily lost. You may need to wait some additional time until PAS restores a connection with your device.

## Setting Up Ethernet

### Using the Front Display

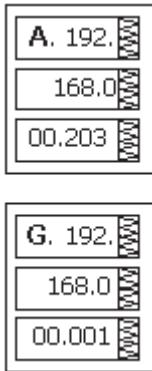
Select **nEt** from the main menu. **This menu entry appears only if the optional Ethernet module is plugged into the meter.** It allows you to set up the meter network address and the default gateway.

See [Viewing and Changing Setup Options](#) in Chapter 3 for information on configuring parameters via the front display.

## Chapter 5 Configuring THE PM130 PLUS

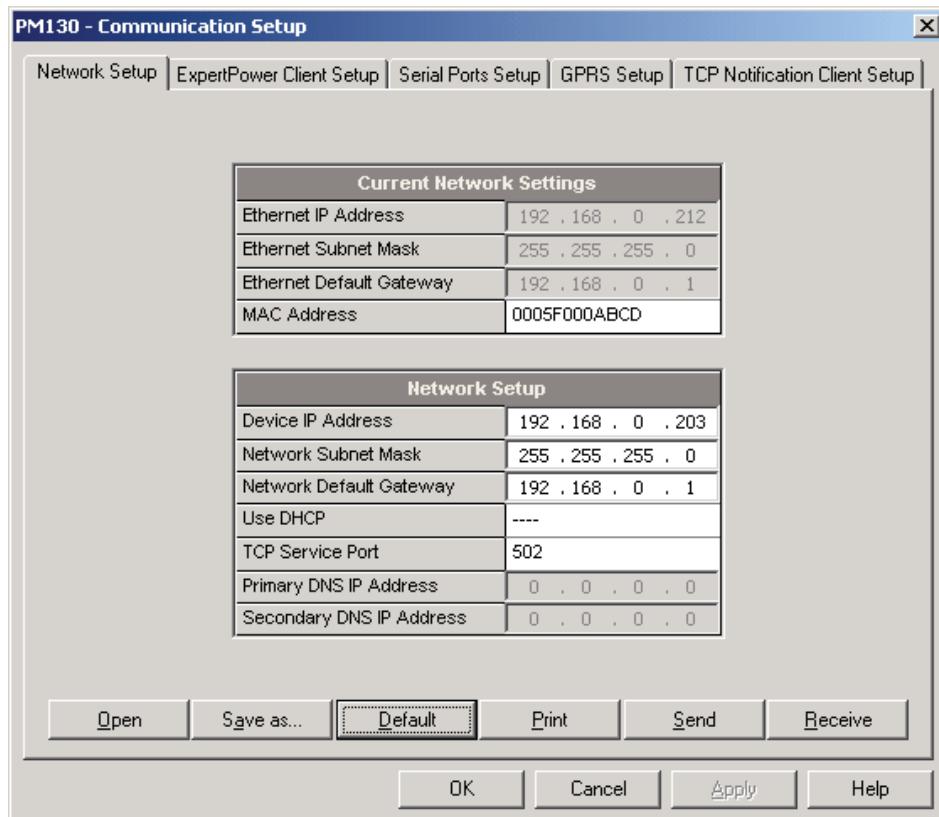
### Configuring COMMUNICATIONS

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### Using PAS

Select **Communications Setup** from the **Meter Setup** menu, and then click on the **Network Setup** tab.



**Figure 5-2: Communication Setup Dialog Box – Network Setup Tab**

The table below lists available network options.

**Table 15: Ethernet Setup Options**

Display Label	Parameter	Options	Default
A	Device IP Address		192.168.0.203
-	Network Subnet Mask		255.255.255.0
G	Network Default Gateway		192.168.0.1
-	TCP Service Port	502 = Modbus/TCP 20000 = DNP3/TCP	502

## Chapter 5 Configuring THE PM130 PLUS

### Configuring COMMUNICATIONS

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**NOTES**

1. The meter provides the permanent Modbus TCP server on port 502.
2. Selecting the DNP3 TCP service port launches the second DNP3 TCP server allowing simultaneous connections on both TCP ports. Selecting the Modbus TCP port disables the DNP3 TCP server.

**⚠** The TCP service port can also be changed through the COM2 serial port setup. Changing the communication protocol for the port automatically changes the TCP port for the Ethernet.

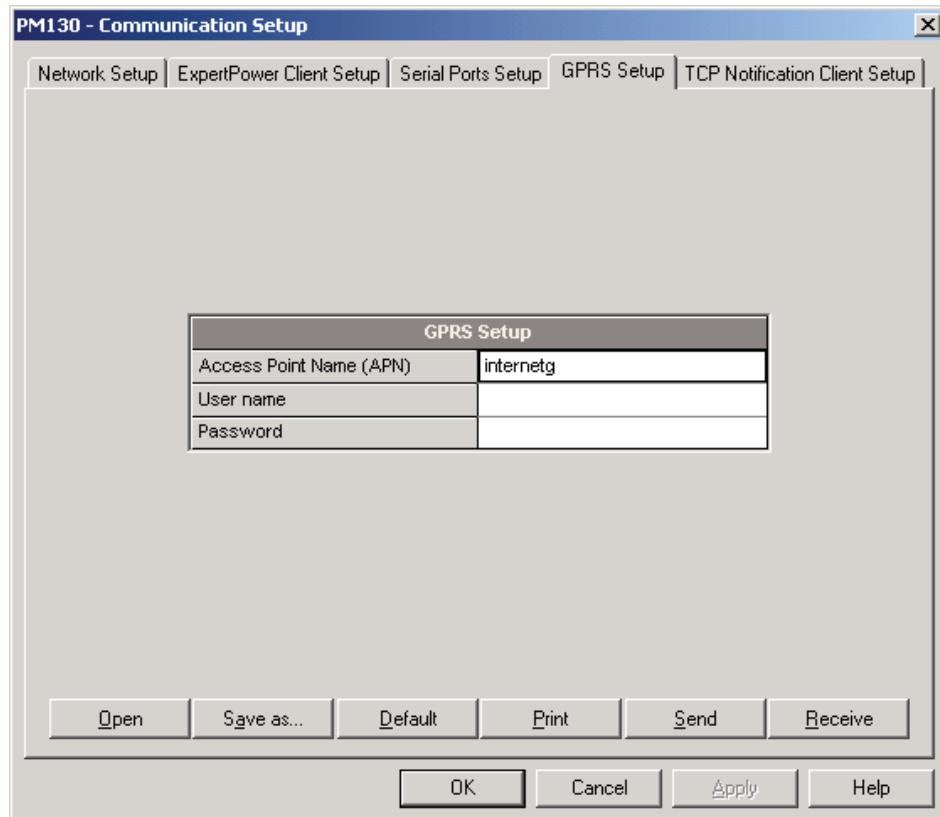
3. When you change the device network settings through the Ethernet port, the device port restarts so communication will be temporarily lost. You may need to wait some additional time until PAS restores a connection with your device.

## Setting Up GPRS Network

The PM130 PLUS can provide wireless GPRS communications with the remote Modbus/TCP server via GPRS modem module. See [Connecting a GSM/GPRS modem](#) in Chapter 2 on how to connect a modem to your meter.

### To set up GPRS communications:

1. Select **Communications Setup** from the **Meter Setup** menu, and then click on the **GPRS Setup** tab.



**Figure 5-3: Communication Setup Dialog Box – GPRS Setup Tab**

The following table lists available GPRS options.

## Chapter 5 Configuring THE PM130 PLUS

### Configuring COMMUNICATIONS

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**Table 16: GPRS Setup Options**

Parameter	Default	Description
Access Point Name (APN)	internetc	The mobile network APN name
User name		Username (if required)
Password		Password (if required)

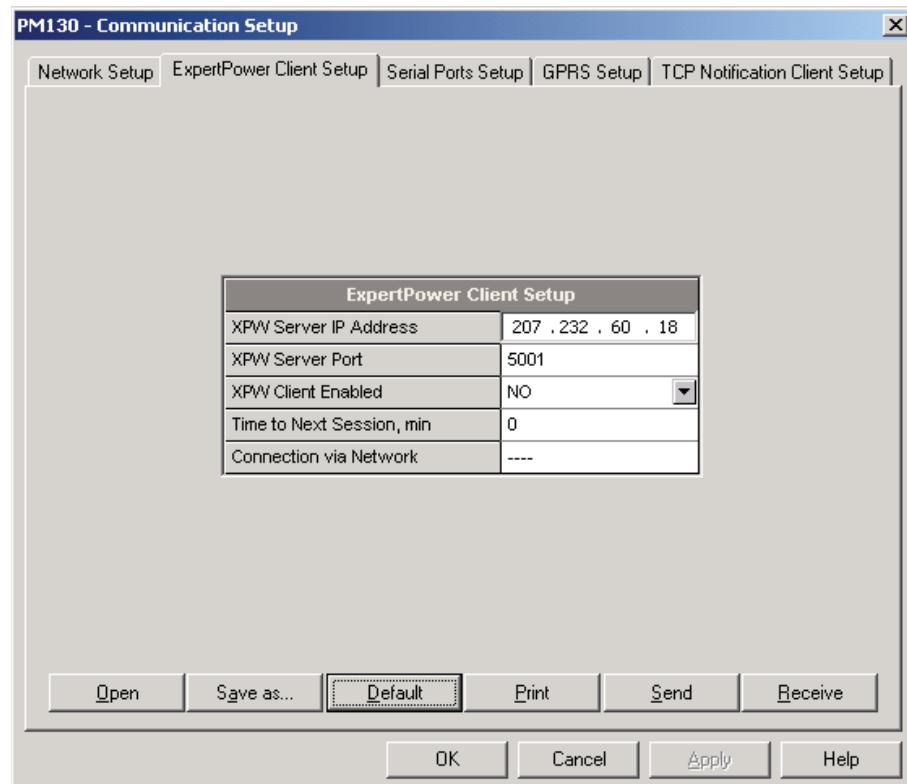
2. Configure your mobile network APN, username and password. Consult your network operator regarding proper network settings. Leave the username and password fields blank if network authorization is not required.
3. Send your GPRS settings to the meter.
4. Select the GPRS interface in the COM2 port setup (see [Setting Up Serial Communication Ports](#)).
5. Configure your eXpertPower client (see [Setting Up eXpertPower Client](#)) or/and TCP Notification client (see [Setting Up TCP Notification Client](#)) for communicating with a remote server.

You can check the status of the GPRS communications from the front panel via the [Status Display](#) or via the Device Control dialog in PAS (see [Viewing Communication Status and Statistics](#)).

### Setting Up eXpertPower Client

The PM130 PLUS has an embedded eXpertPower™ client that provides communications with the eXpertPower™ server – the SATEC proprietary Internet services. Connections to the eXpertPower™ server are handled on a periodic basis.

To set up communications with the eXpertPower™ server, select **Communication Setup** from the **Meter Setup** menu, and then click on the **ExpertPower Client Setup** tab.



## Chapter 5 Configuring THE PM130 PLUS

### Configuring COMMUNICATIONS

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**Figure 5-4: eXpertPower Client Setup Tab**

The following table lists available options. Refer to your eXpertPower service provider for the correct network settings.

**Table 17: eXpertPower Client Setup Options**

Parameter	Options	Default	Description
XPW Server IP Address		207.232.60.18	The IP address of the eXpertPower server
XPW Server Port	0-65535	5001	The TCP service port of the eXpertPower server
XPW Client Enabled	NO, YES	NO	Enables operations of the eXpertPower client
Time to Next Session, min	1-99999		The time remaining to the next connection session

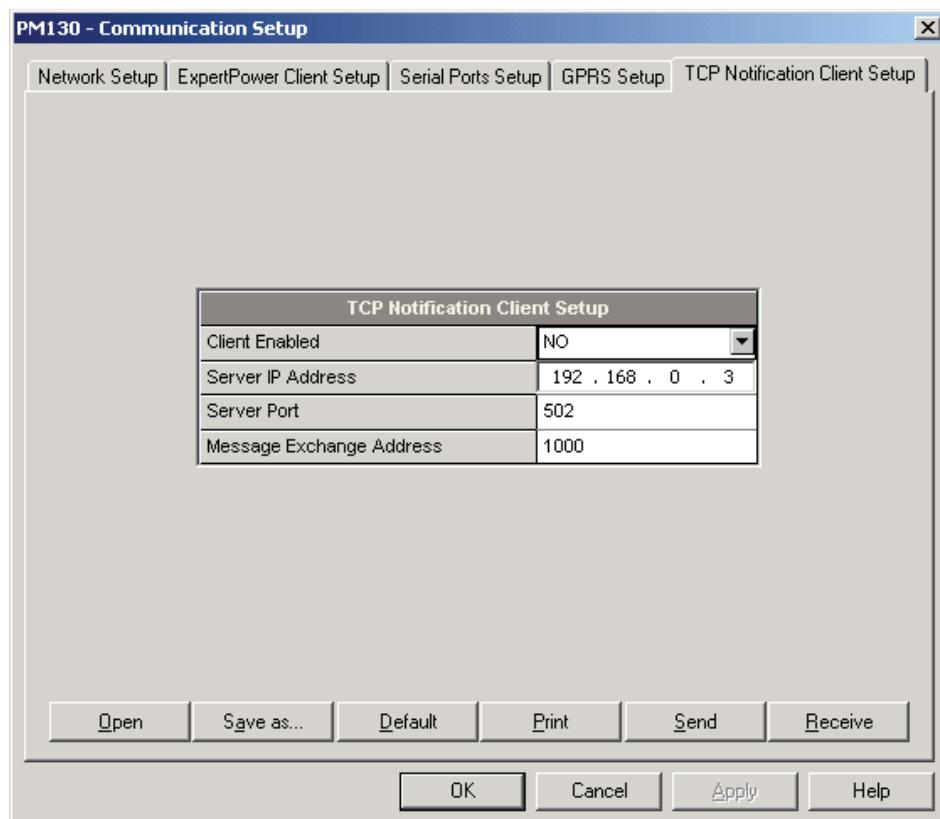
**NOTES**

1. Do not enable the eXpertPower client in your meter if you do not use the eXpertPower™ service.
2. Do not change the connection time setting. It is for information only. The eXpertPower server updates it automatically.

## Setting Up TCP Notification Client

The TCP notification client can establish connections with a remote Modbus/TCP server and send notification messages either on events, or periodically on a time basis.

To set up communications with a remote TCP Notification server, select **Communication Setup** from the **Meter Setup** menu, and then click on the **TCP Notification Client Setup** tab.



## Chapter 5 Configuring THE PM130 PLUS

### Configuring COMMUNICATIONS

---

**Figure 5-5: TCP Notification Client Setup Tab**

The following table lists available client options.

**Table 18: TCP Notification Client Setup Options**

Parameter	Options	Default	Description
Client Enabled	NO, YES	NO	Enables operations of the notification client
Server IP Address		192.168.0.3	The IP address of the notification server
Server Port	0-65535	502	The TCP service port of the notification server
Message Exchange Address	0-65535	1000	The start address of a block of 16 Modbus registers for receiving notification messages

Connections with a remote server are triggered via programmable setpoints. To send event notifications to a server, configure a setpoint to respond to desired triggers or to periodic time events and put the "Notification" action to the setpoint action list (see [Configuring Alarm/Control Setpoints](#)).

See the PM130 PLUS Modbus Reference guide for more information on operation of the notification client and the notification message structure.

## 5.2 General Meter Setup

### Basic Meter Setup

This section describes how to configure the PM130 PLUS for your particular environment and application.

Before operating your meter, provide the device with basic information about your electrical network.

### Using the Front Display

Select the **baSc** entry from the main menu. See [Viewing and Changing Setup Options](#) in Chapter 3 for information on configuring parameters via the front display.



See the table below for the Basic Setup options.

#### Using a shortcut to the Basic Setup menu:

From the Data Display, press and release the **SELECT** button to enter the primary meter menu and then simultaneously press the **SELECT** and **UP** buttons. You are directly moved to the CT setting entry.

The shortcut is not operational if the meter is password protected.

### Using PAS

Select **General Setup** from the **Meter Setup** menu. See the table below for the Basic Setup options.

**Table 19: Basic Setup Options**

Display Label	Parameter	Options	Default	Description
<b>Basic Configuration</b>				
Conf	Wiring Mode	See <a href="#">Table 20</a>	4Ln3	The wiring connection of the device
Pt	PT Ratio	1.0-6500.0	1.0	The phase potential transformer's primary to secondary ratio
Pt.F	PT Ratio Multiplier	×1, ×10	×1	PT Ratio multiplication factor. Used in extra high voltage networks to accommodate the PT ratio for 500 kV and higher networks.
Ct	CT Primary Current	1-50000 A	5 A	The primary rating of the phase current transformer
Freq	Nominal Frequency	50,60,25,400 Hz	60 Hz	The nominal line frequency
LoAd	Maximum Demand Load Current	0-50000 A	0	The maximum demand load current (0 = CT primary current)
<b>Demand Setup</b>				
d.P	Power block demand period E, EH	1, 2, 3, 5, 10, 15, 20, 30, 60 min, E=external sync	15 min	The length of the demand period for power demand calculations. If the external synchronization is selected, a pulse front on the digital input DI1 denotes the start of the demand interval.

## Chapter 5 Configuring THE PM130 PLUS

### General METER SETUP

Display Label	Parameter	Options	Default	Description
nd.P	The number of blocks in the sliding demand window E, EH	1-15	1	The number of blocks to be averaged for sliding window demands
Ad.P	Volt/Ampere Demand Period	0-1800 sec	900 sec	The length of the demand period for ampere and volt demand calculations



1. Always specify the wiring mode and transformer ratings prior to setting up setpoints and analog outputs.
2. The maximum value for the product of the phase CT primary current and PT ratio is 57,500,000. If the product is greater, power readings are zeroed.

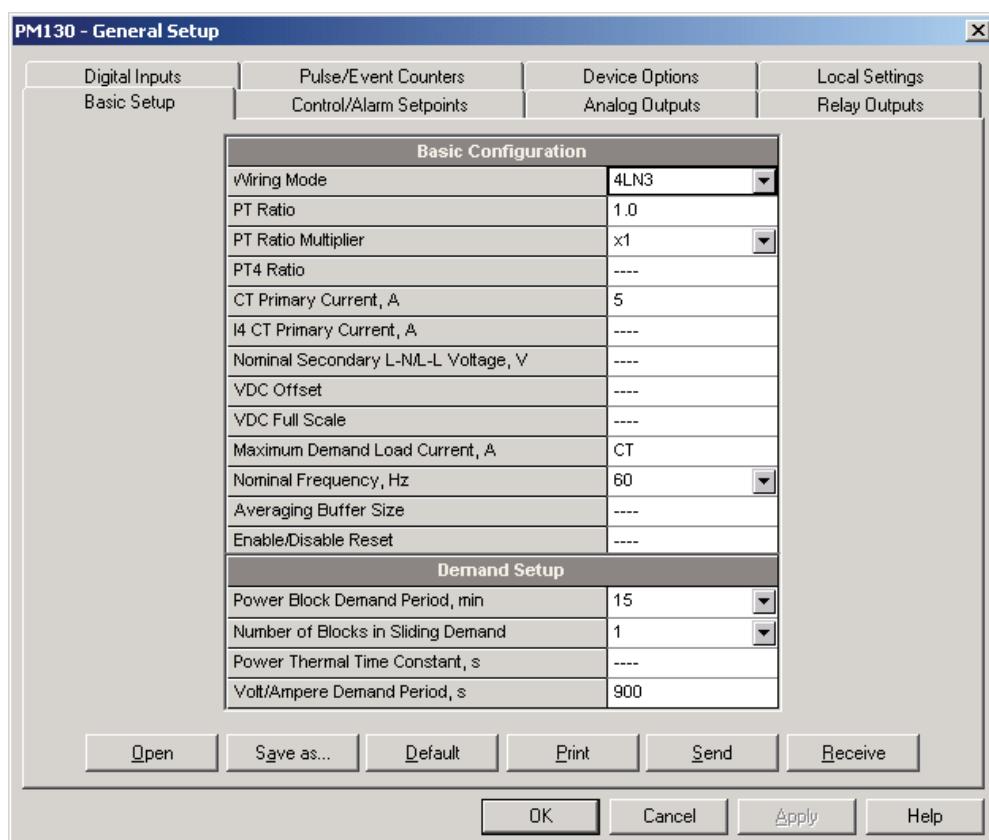


Figure 5-6: General Setup Dialog Box – Basic Setup Tab

Table 20 lists the available wiring modes.

Table 20: Wiring Modes

Wiring Mode	Description
3OP2	3-wire Open Delta using 2 CTs (2 element)
4LN3	4-wire Wye using 3 PTs (3 element), line-to-neutral voltage readings
3DIR2	3-wire Delta Direct Connection using 2 CTs (2 element)
4LL3	4-wire Wye using 3 PTs (3 element), line-to-line voltage readings
3OP3	3-wire Open Delta using 3 CTs (2½ element)
3LN3	4-wire Wye using 2 PTs (2½ element), line-to-neutral voltage readings

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Wiring Mode	Description
3LL3	4-wire Wye using 2 PTs (2½ element), line-to-line voltage readings
3BLN3	3-wire Broken Delta using 2 PTs, 3 CTs (2½ element), line-to-neutral voltage readings
3BLL3	3-wire Broken Delta using 2 PTs, 3 CTs (2½ element), line-to-line voltage readings



In 4LN3, 3LN3 and 3BLN3 wiring modes, Min/Max volts, volt demands and voltage harmonics represent line-to-neutral voltages; otherwise, they will be line-to-line voltages.

## Device Options

The Device Options setup allows changing user-configurable device options or putting the meter into energy test mode.

### Using the Front Display

Select **OPtS** from the main menu. See [Viewing and Changing Setup Options](#) in Chapter 3 for information on configuring parameters via the front display.



### Using PAS

Select **General Setup** from the **Meter Setup** menu, and then click on the **Device Options** tab.

Table 21 lists available device options.

**Table 21: User-configurable Device Options**

Display Label	Parameter	Options	Default	Description
P.cAL	Power Calculation Mode	rEAc = using reactive power $S=f(P, Q)$ , nAct = using non-active power $Q=f(S, P)$	S=f(P, Q)	The method used for calculating reactive and apparent powers (see <a href="#">Power Calculation Modes</a> below)
roLL	Energy Roll Value E, EH	10.E4 = 10000 kWh 10.E5 = 100000 kWh 10.E6 = 1000000 kWh 10.E7 = 10000000 kWh 10.E8 = 100000000 kWh 10.E9 = 1000000000 kWh	10000000	The value at which energy counters roll over to zero
Ph.En	Phase Energy Calculation E, EH	diS = Disabled En = Enabled	Disabled	Enables phase energy calculations
tEST	Energy Test Mode E, EH	OFF = disabled Ac.Ei = Wh pulses rE.Ei = varh pulses	Disabled	Setting this option puts the meter into the energy test mode (see <a href="#">Energy Pulse LED</a> in Chapter 3)
U.Str	Starting Voltage	1.5-5.0%	1.5%	The device starting voltage in percent of FS (120V or 400V)

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Display Label	Parameter	Options	Default	Description
rESL	Device Resolution	Lo = Low Hi = High	Low	The voltage, current and power resolution on the front display (see <a href="#">Measurement Units</a> in Chapter 3) and in communications (see communication guides)
U.ScL	Volts Scale, V	60-828 V	144 V	The maximum voltage scale allowed, in secondary volts. See <a href="#">Data Scales</a> in Appendix F
C.ScL	Amps Scale, A	1.0-10.0 A	2 x CT secondary	The maximum current scale allowed, in secondary amps. See <a href="#">Data Scales</a> in Appendix F

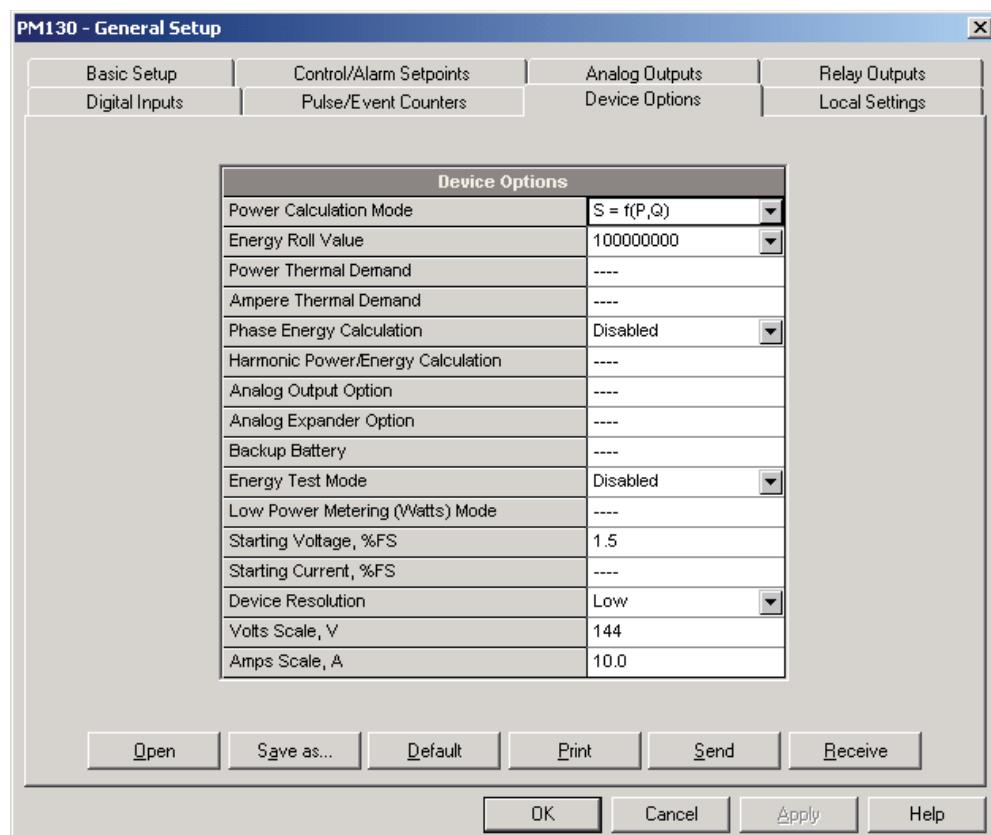


Figure 5-7: General Setup Dialog Box – Device Options Tab

#### Power Calculation Modes

The power calculation mode option allows you to change the method for calculating reactive and apparent powers in presence of high harmonics. The options work as follows:

- When the reactive power calculation mode is selected, active and reactive powers are measured directly and apparent power is calculated as:

$$S = \sqrt{P^2 + Q^2}$$

This mode is recommended for electrical networks with low harmonic distortion, commonly with THD < 5%

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for volts, and THD < 10% for currents.  
In networks with high harmonics, the second method is preferable.

- When the non-active power calculation mode is selected, active power is measured directly, apparent power is taken as product  $S = V \times I$ , where  $V$  and  $I$  are the RMS volts and amps, and reactive power (called non-active power) is calculated as:

$$N = \sqrt{S^2 - P^2}$$

## Configuring Digital Inputs

The PM130 PLUS can be provided with four digital inputs that can be linked to control setpoints to give an indication on input status change (see [Configuring Alarm/Control Setpoints](#)), or can be linked to general pulse counters to count incoming pulses (see [Configuring Counters](#)). They can also be linked to the Billing/TOU registers to count pulses from external wattmeters or gas and water meters.

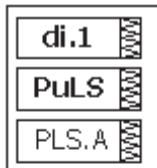
### Using the Front Display

Select **dinP** from the main menu. **This menu entry appears only if the digital I/O module is plugged into the meter.**

Use the **UP** and **DOWN** arrow buttons to scroll to the required digital input.

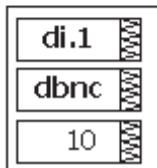
#### To select a digital input parameter:

- Press the **SELECT** button to activate the middle window.
- Use the **UP** and **DOWN** arrow buttons to scroll to the required parameter.



#### To change the parameter value:

- Press the **SELECT** button to activate the lower window.
- Use the **UP** and **DOWN** arrow buttons to select the required value.
- Press **ENTER** to confirm the new parameter setting or press **ESC** to discard changes. You are returned to the middle window and can configure other parameters.



#### To store your new settings:

- Press the **ENTER** button when the middle window is highlighted.

You are returned to the upper window and can select another digital input or exit the menu.

- Press **ESC** to exit the menu.

The available options are shown in Table 22.

## Using PAS

Select **General Setup** from the **Meter Setup** menu, and then click on the **Digital Inputs** tab.

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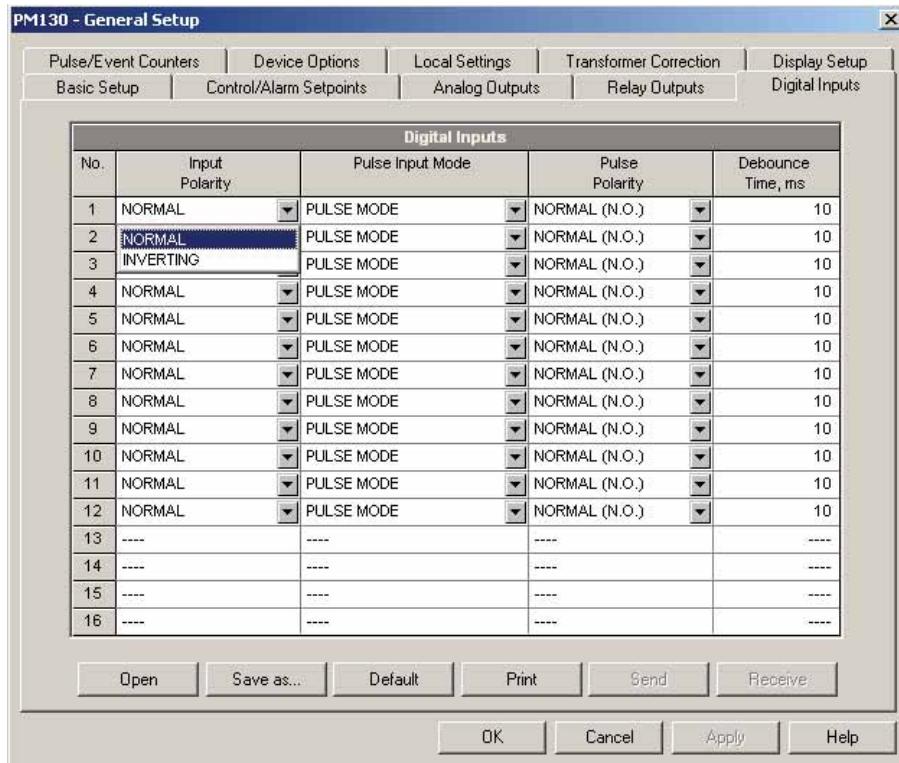


Figure 5-8: General Setup Dialog Box – Digital Inputs Dialog Box

The available options are shown in Table 22.

Table 22: Digital Input Options

Display Label	Parameter	Options	Default	Description
	Input Polarity	NORMAL INVERTING	NORMAL	For the normal polarity, the open to closed transition is considered closed. For the inverting polarity, the closed to open transition is considered closed
PuLS	Pulse Input Mode	PLS.A = PULSE MODE, PLS.C = KYZ MODE	PULSE MODE	In pulse mode, either leading, or trailing edge of the input pulse is recognized as an event. In KYZ mode, both leading and trailing edges of the input pulse are recognized as separate events.
Polr	Pulse Polarity	nor = NORMAL (N.O.), InS = INVERTING (N.C.)	NORMAL	For the normal polarity, the open to closed transition is considered a pulse. For the inverting polarity, the closed to open transition is considered a pulse. It has no meaning in KYZ mode where both transitions are used.
dbnc	Debounce Time	1-100 ms	10 ms	The amount of time while the state of the digital input should not change to be recognized as a new state. Too low debounce time could produce multiple events on the input change.

The debounce time is applied the same for all digital inputs. If you change the debounce time for a digital input, the same debounce time is automatically assigned to the others.

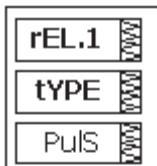
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## Configuring Relay Outputs

The PM130 PLUS can be provided with two optional relay outputs. Each relay can be operated either locally from the alarm/control setpoints in response to an event or by a remote command sent through communications. It can also be linked to an internal pulse source to produce energy pulses.

### Using the Front Display



Select **reL** from the main menu. **This menu entry appears only if the digital I/O module is plugged into the meter.**

Use the **UP** and **DOWN** arrow buttons to scroll to the required relay.

**To select a relay parameter:**

1. Press the **SELECT** button to activate the middle window.
2. Use the **UP** and **DOWN** arrow buttons to scroll to the required parameter.

**To change the parameter value:**

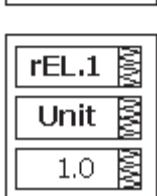
1. Press the **SELECT** button to activate the lower window.
2. Use the **UP** and **DOWN** arrow buttons to select the required value.
3. Press **ENTER** to confirm the new parameter setting or press **ESC** to discard changes.

You are returned to the middle window and can configure other relay parameters.

**To store your new settings:**

1. Press the **ENTER** button when the middle window is highlighted.  
You are returned to the upper window and can select another relay output or exit the menu.
2. Press **ESC** to exit the menu.

See Table 23 for the available relay outputs options.



## Using PAS

Select **General Setup** from the **Meter Setup** menu, and then click on the **Relay Outputs** tab.

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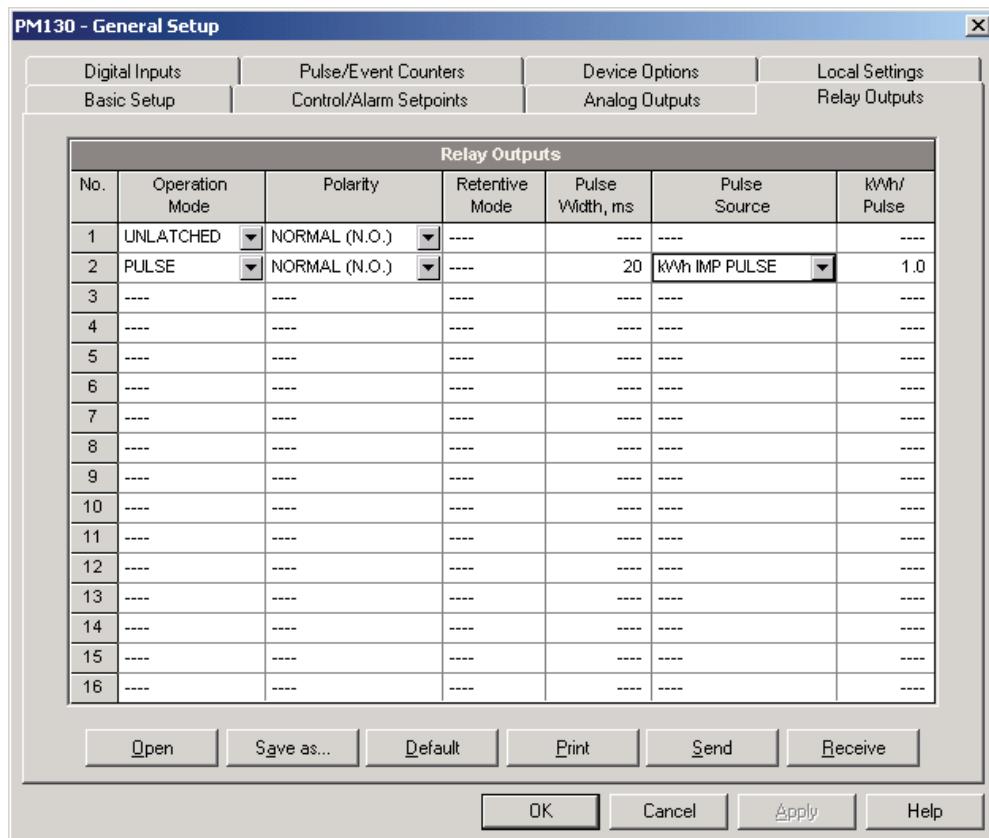


Figure 5-9: General Setup Dialog Box – Relay Outputs Tab

The available relay outputs options are shown in Table 23.

Table 23: Relay Output Options

Display Label	Parameter	Options	Default	Description
tYPE	Operation mode	UnLt = UNLATCHED Ltch = LATCHED PLS.A = PULSE PLS.C = KYZ pulse	UNLATCHED	Unlatched mode: the relay goes into its active state when the control setpoint is in active (operated) state, and returns into its non-active state when the setpoint is released.  Latched mode: the relay goes into its active state when the control setpoint goes into active state and remains in the active state until it is returned into its non-active state by a remote command.  Pulse mode (normal pulse): the relay goes into its active state for the specified time, goes into non-active state for the specified time and remains in the non-active state.  KYZ mode (transition pulse): the relay generates transition pulses. The relay changes its output state upon each command and remains in this state until the next command.
Polr	Polarity	nor = NORMAL (N.O.) InS = INVERTING (N.C.)	NORMAL	Normal polarity: the relay is normally de-energized in its non-active state and is energized in its active (operated) state.  Inverting polarity: the relay is normally energized in its non-active state and is de-energized in its active (operated) state. It is called failsafe relay operation.

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Display Label	Parameter	Options	Default	Description
PuLS	Pulse width	20-1000 ms	100 ms	The actual pulse width is a multiple of the 1-cycle time rounded to the nearest bigger value. The pause time between pulses is equal to the pulse width.
Src	Pulse source	NONE Ac.Ei = kWh IMP Ac.EE = kWh EXP rE.Ei = kvarh IMP rE.EE = kvarh EXP rE.Et = kvarh TOT AP.Et = kVAh TOT	NONE	Links a pulse relay to the internal energy pulse source. The relay must be set into either pulse, or KYZ mode.
Unit	Pulse rate, kWh/Pulse	0.1-1000.0	1.0 kWh/Pulse	Defines the pulse weight in kWh units per pulse

#### Generating Energy Pulses through Relay Outputs

To generate energy pulses through a relay output:

1. Set a relay to either pulse, or KYZ mode, and then select a polarity (active pulse edge) for energy pulses and a pulse width.
2. Select a source energy accumulator and the pulse rate for your output.
3. Send your new setup to the meter.

#### Configuring Analog Outputs

The meter can be ordered with two optional analog outputs with options for 0-1mA, ±1mA, 0-20mA and 4-20mA current outputs.

#### Using the Front Display

Select **Aout** from the main menu. **This menu entry appears only if the optional analog output module is plugged into the meter.**

Use the **UP** and **DOWN** arrow buttons to scroll to the required analog output.

**To select the analog output option:**

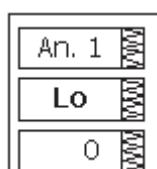
1. Press the **SELECT** button to activate the middle window.
2. Use the **UP** and **DOWN** arrow buttons to scroll to the required parameter.

**To change the parameter value:**

1. Press the **SELECT** button to activate the lower window.
2. Use the **UP** and **DOWN** arrow buttons to select the required value.
3. Press **ENTER** to confirm the new parameter setting or press **ESC** to discard changes.

You are returned to the middle window and can configure other parameters.

**To store your new settings:**



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1. Press the **ENTER** button when the middle window is highlighted.

You are returned to the upper window and can select another analog output or exit the menu.

2. Press **ESC** to exit the menu.

See Table 24 for the available analog output options.

## Using PAS

Select **General Setup** from the **Meter Setup** menu, and then click on the **Analog Outputs** tab.

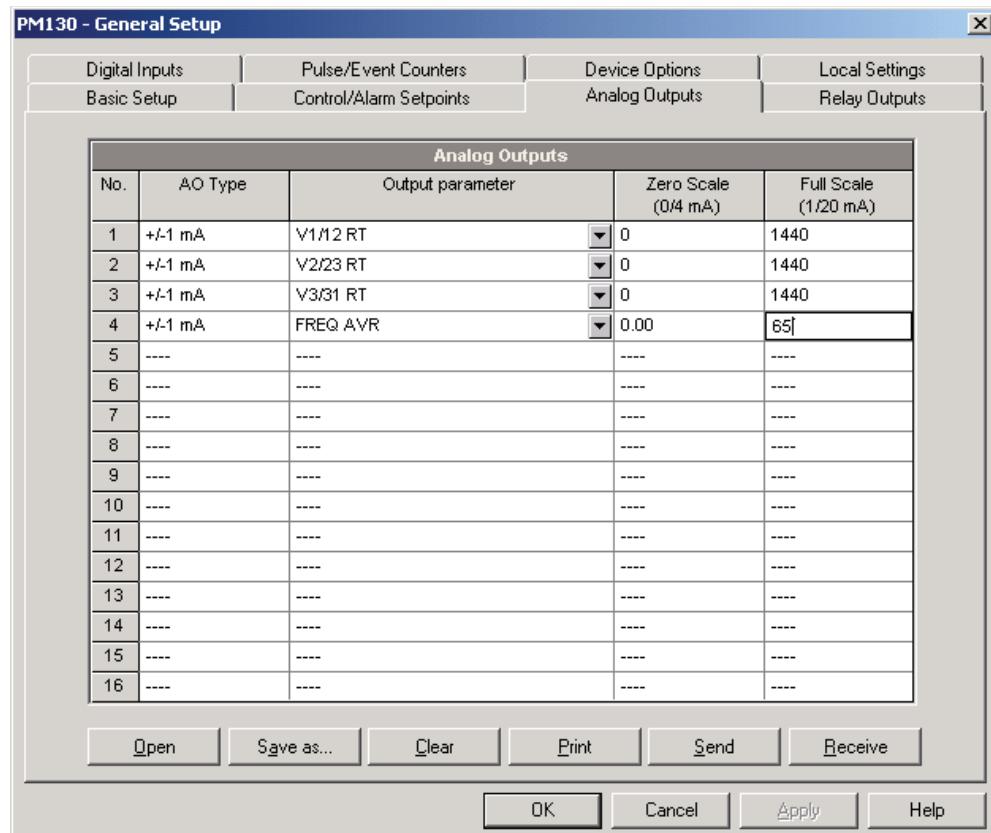


Figure 5-10: General Setup Dialog Box – Analog Outputs Tab

The available analog output options are described in Table 24.

Table 24: Analog Output Options

Display Label	Option	Range	Description
-	AO type	0-1mA ±1mA 0-20mA 4-20mA	The analog output type. When connected to the meter, shows the actual AO type received from the device. When working off-line, select the analog output option corresponding to your analog module.
OutP	Output parameter	See Appendix B	Selects the measured parameter to be transmitted through the analog output channel.
Lo	Zero scale		Defines the low engineering scale (in primary units) for the analog output corresponding to a lowest (zero) output current (0 or 4 mA)

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Display Label	Option	Range	Description
Hi	Full scale		Defines the high engineering scale (in primary units) for the analog output corresponding to a highest output current (1 or 20 mA)

When you select an output parameter for the analog output channel, the default engineering scales are set automatically. They correspond to the maximum available scales. If the parameter actually covers a lower range, you can change the scales to provide a better resolution on an analog output.

#### Scaling Non-Directional Analog Outputs

For non-directional analog outputs with a 0-1mA, 0-20mA or 4-20mA current option, you can change both zero and full engineering scales for any parameter. The engineering scale need not be symmetrical.

#### Scaling Directional Power Factor

The engineering scale for the signed power factor emulates analog power factor meters.

The power factor scale is -0 to +0 and is symmetrical with regard to  $\pm 1.000$  ( $-1.000 = +1.000$ ). The negative power factor is scaled as -1.000 minus the measured value, and non-negative power factor is scaled as +1.000 minus the measured value. To define the entire power factor range from -0 to +0, the default scales are specified as -0.000 to 0.000.

#### Scaling $\pm 1\text{mA}$ Analog Outputs

Programming engineering scales for directional  $\pm 1\text{mA}$  analog outputs depends on whether the output parameter represents unsigned (as volts and amps) or signed (as powers and power factor) values.

For an unsigned output value, you can change both zero and full engineering scales.

For a signed (directional) value, you should only provide the engineering scale for the +1 mA output current.

The engineering scale for the 0 mA output current is always equal to zero for all values except the signed power factor, for which it is set to 1.000 (see [Scaling Directional Power Factor](#) above).

The meter does not allow access to the low scale setting if the parameter is directional. Whenever the sign of the output parameter is changed to negative, the meter automatically uses the full engineering scale setting for +1 mA with a negative sign.

#### Scaling Analog Outputs for 0-2 mA and $\pm 2\text{mA}$

The 0-1mA and  $\pm 1\text{mA}$  current outputs provide a 100% overload, and actually output currents up to 2 mA and  $\pm 2\text{mA}$  whenever the output value exceeds the engineering scale you set for the 1 mA or  $\pm 1\text{mA}$ .

The output scales for 0-1 mA and  $\pm 1$  mA analog outputs are programmed for 0 mA and +1 mA regardless of the required output current range.

To use the entire output range of 2 mA or  $\pm 2\text{mA}$ , set the analog output scales as follows:

- **0-2 mA:** set the 1 mA scale to  $1/2$  of the required full scale output for uni-directional parameters, and set the 0 mA scale to the negative full scale and the 1 mA scale to zero for bi-directional parameters.

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- **$\pm 2 \text{ mA}$** : set the 1 mA scale to  $\frac{1}{2}$  of the required full-scale output for both uni-directional and bi-directional parameters.

For example, to provide the 0 to 2 mA output current range for Volts measured by the meter in the range of 0 to 120V, set the 1 mA scale to 60V; then the 120V reading will be scaled to 2 mA.

## Configuring Counters

The PM130 PLUS has four six-digit general counters that can count pulses delivered through the device digital inputs with a programmable scale factor. Each counter can also be incremented in response to any internal or external event, checked and cleared through the Control Setpoints.

### Using the Front Display

Select **Cnt** from the main menu. **This menu entry appears only if the optional digital I/O module is plugged into the meter.**

Use the **UP** and **DOWN** arrow buttons to scroll to the required counter.

#### To select a counter parameter:

1. Press the **SELECT** button to activate the middle window.
2. Use the **UP** and **DOWN** arrow buttons to scroll to the required parameter.

#### To change the parameter value:

1. Press the **SELECT** button to activate the lower window.
2. Use the **UP** and **DOWN** arrow buttons to select the required value.
3. Press **ENTER** to confirm the new parameter setting or press **ESC** to discard changes.

You are returned to the middle window and can configure another parameter.

#### To store your new settings:

1. When the middle window is highlighted, press the **ENTER** button.  
You are returned to the upper window and can select another counter or exit the menu.
2. Press **ESC** to exit the menu.

See Table 25 for the counter options.

## Using PAS

Select **General Setup** from the **Meter Setup** menu, and then click on the **Pulse/Event Counters** tab.

Table 25 lists available counter options.

**Table 25: Counter Options**

Display Label	Option	Range	Default	Description
InP	Pulse Input	None, DIGITAL INPUT #1 - #12	None	Links a digital input to the counter

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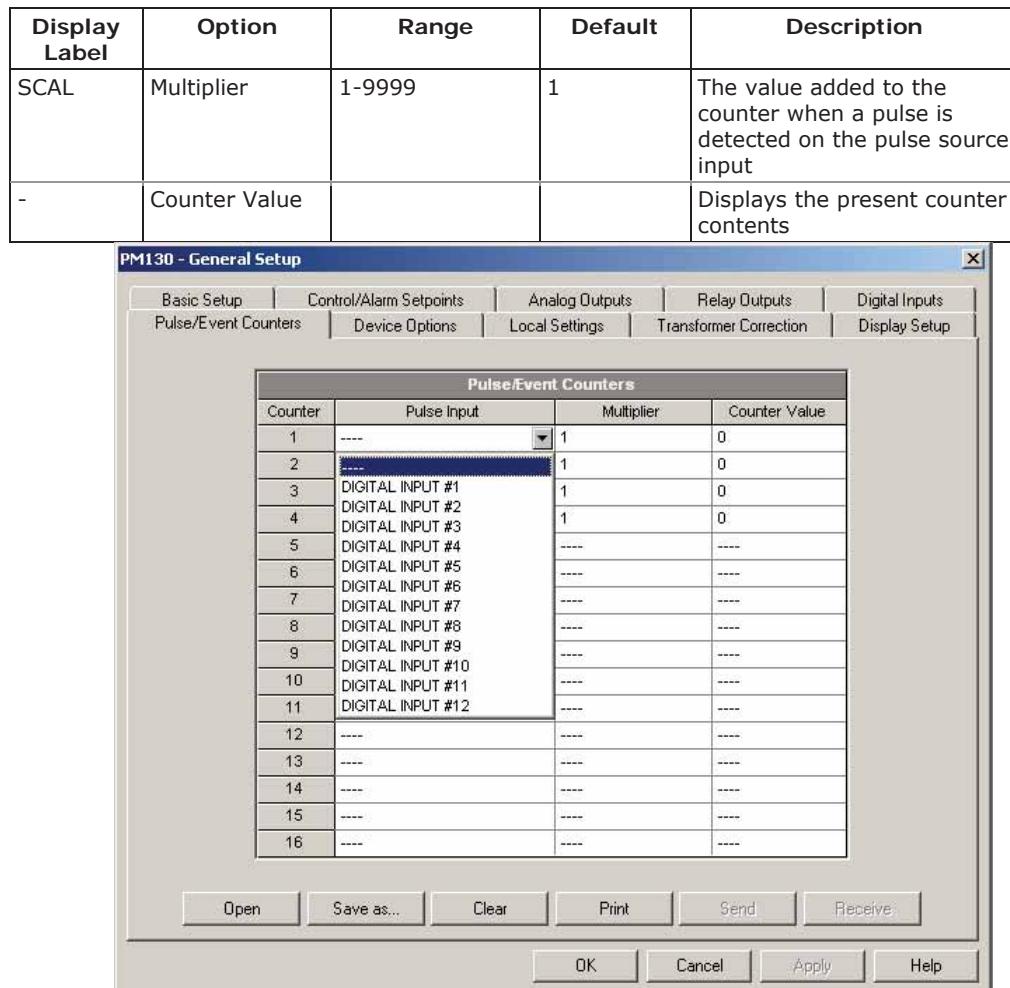


Figure 5-11: General Setup Dialog Box – Pulse/Event Counters

You can preset a counter to a required value or clear it without affecting the counter setup.

**To preset or clear a counter:**

1. Click the Online button on the PAS toolbar before accessing the setup dialog box.
2. Type in the required value into the **Counter Value** field.
3. Click **Send**.

## Configuring Alarm/Control Setpoints

The PM130 PLUS has an embedded logical controller that can perform different actions in response to user-defined internal and external events. Unlike a PLC, the meter uses a simplified programming technique based on setpoints that allows the user to define a logical expression based on measured analog and digital values that produce a required action.

The meter provides 16 control setpoints with programmable operate and release delays. Each setpoint evaluates a logical expression with one trigger argument. Whenever an expression is evaluated as "true", the setpoint performs a programmable action that can send a command to the output relay, or increment a counter.

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The logical controller provides very fast response to events. The scan time for all setpoints is 1 cycle time (16.6 ms at 60Hz and 20 ms at 50/400 Hz).

### Using the Front Display

Select **SEtP** from the main menu to enter the setup menu.

Use the **UP** and **DOWN** arrow buttons to scroll to the required setpoint.

#### To select a setpoint parameter:

1. Press the **SELECT** button to activate the middle window.
2. Use the **UP** and **DOWN** arrow buttons to scroll to the required parameter.

#### To change the parameter value:

1. Press the **SELECT** button to activate the lower window.
2. Use the **UP** and **DOWN** arrow buttons to select the required value.
3. Press **ENTER** to confirm the new setting or press **ESC** to discard changes.

You are returned to the middle window and can configure another parameter.

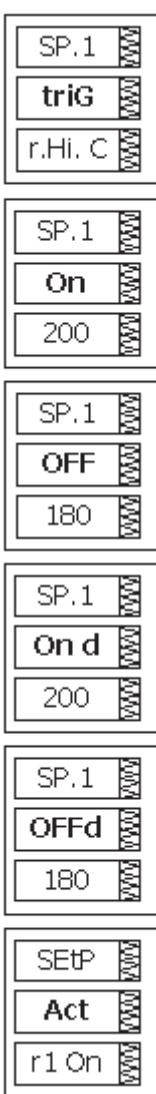
#### To store your new setpoint settings after you configured all setpoint parameters:

1. Press the **ENTER** button when the middle window is highlighted.

You are returned to the upper window and can select another setpoint or exit the menu.

2. Press **ESC** to exit the menu.

See the table below for the available setpoint options.



### Using PAS

Select **General Setup** from the **Meter Setup** menu, and then click on the **Control/Alarm Setpoints** tab.

The following table lists the available setpoint options.

**Table 26: Setpoint Options**

Display Label	Option	Range	Description
TriG	Trigger parameter	See Appendix C	The trigger parameter that is used as an argument in the logical expression
On	Operate limit		The threshold (in primary units) at which the conditional expression would be evaluated to true. Not applicable for digital triggers.

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Display Label	Option	Range	Description
OFF	Release limit		The threshold (in primary units) at which the conditional expression would be evaluated to false. Defines the hysteresis for analog triggers. Not applicable for digital triggers.
On d	Operate delay	0.1-999.9 sec	The time delay before operation when the operate conditions are fulfilled
OFFd	Release delay	0.1-999.9 sec	The time delay before release when the release conditions are fulfilled
Act	Action	See Appendix C	The action performed when the setpoint expression is evaluated to true (the setpoint is in operated state)

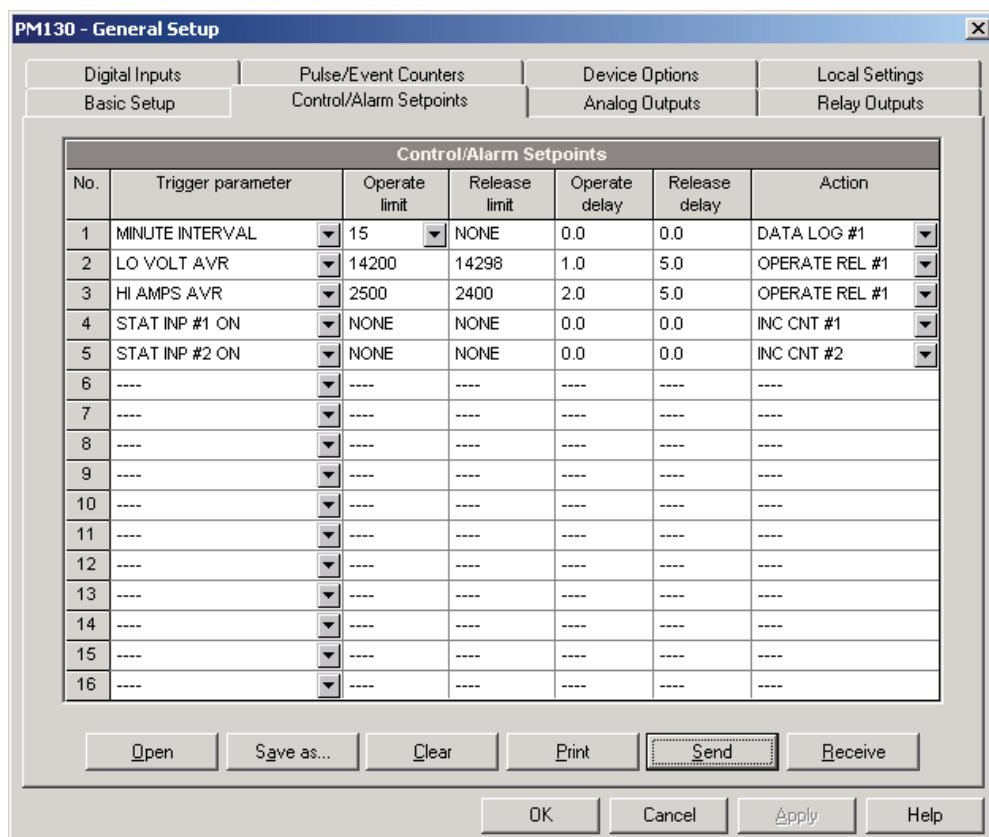


Figure 5-12: General Setup Dialog Box – Control/Alarm Setpoints Tab

### Using Numeric Triggers

For numeric (analog) triggers, you can specify two thresholds for each trigger to provide hysteresis (dead band) for setpoint operations.

The Operate Limit defines the operating threshold, and the second Release Limit defines the release threshold for the trigger. The trigger thresholds are specified in primary units.

If you do not want to use hysteresis for the trigger, set the Release Limit to the same value as the Operate Limit.

### Using Binary Triggers

Binary (digital) triggers like digital inputs and relays are tested for ON/CLOSED or OFF/OPEN status.

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In the PM130, the binary events are level-sensitive events. An event is asserted all the time while the corresponding condition exists.

#### Delaying Setpoint Operations

Two optional delays can be added to each setpoint to extend monitoring triggers for a longer time before reaching a decision on whether the expected event occurred or not. When a delay is specified, the logical controller changes the setpoint status only if all conditions are asserted for a period of at least as long as the delay time.

#### Using Setpoint Events and Actions

When a setpoint status changes, i.e., a setpoint event is either asserted or de-asserted, the following happens in your meter:

- The new setpoint status is logged to the setpoint status register that can be monitored through communications from the SCADA system or from a programmable controller in order to give an indication on the expected event.
- The operated setpoint status is latched to the setpoint alarm latch register that can be inspected through communications and via the display (see [Status Display](#) in Chapter 3). The register holds the last setpoint alarm status until it is explicitly cleared through communications or via the display.
- A programmable action is performed on setpoint status transition when a setpoint event is asserted.

Generally, setpoint actions are performed independently for each setpoint and can be repeated a number of times for the same target. The exceptions are relay operations that are shared for each target relay between all setpoints using an OR scheme.

A relay output is operated when one of the setpoints linked to the relay is activated and remains operated until all of these setpoints are released (except for latched relays that require a separate release command to be deactivated).

#### Using Time Counters

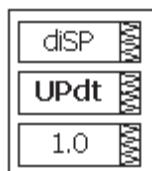
Any of the general counters can be used to count the setpoint operation time. If you select the **TIME CNT n** action for a setpoint, the target counter measures the time while the setpoint is in the operated state. The counter resolution is 0.1 hour. See [Status Display](#) in Chapter 3 on how to examine the counters via the front display.

## Configuring the Display

This setup allows configuring the meter display. It also has an entry for launching the meter Flash Loader.

#### Using the Front Display

Select the **diSP** entry from the main menu. See [Viewing and Changing Setup Options](#) in Chapter 3 for information on configuring parameters via the front display.



See Table 27 for the available options.

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**Table 27: Display Setup Options**

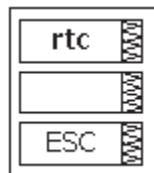
Display Label	Parameter	Options	Default	Description
UPdt	Display update rate	0.1-10.0 sec	1 sec	Defines the interval between display updates
ScrL	Auto scroll interval	None, 2-15 sec	None	Defines the scroll interval for the main data display or disables auto scroll
rEtn	Auto return to the main screen	diS = disabled, En = Enabled	Enabled	Enables automatic return to the main display if no buttons are pressed for 5 minutes
bAr	Reference load current for LED bar graph	0-10,000A (0 = CT primary current)	0	Defines the nominal load (100%) level for the bar graph display
Uolt	Primary/Secondary volts units	Pri = primary SEc = secondary	Primary	Selects primary or secondary units for volts display
Ph.P	Phase powers display mode	diS, En	Disabled	Disables or enables phase powers in the main display
Fund.	Fundamental component display mode	diS, En	Disabled	Disables or enables fundamental values in the main display
dAtE	Date order	dnY, ndY, Ynd (d=day, n=month, y=year)	mm.dd.yy	Defines the date order in the RTC display
rSt	Simple reset mode	PASS = password protected En = always enabled	PASS	PASS = the simple reset is not allowed if password protection is enabled En = enables the simple reset buttons regardless of password protection
brGt	Brightness	1-3	3	Sets the LED brightness
diAG	Diagnostic LED	diS, En	Disabled	Enables the diagnostic LED
FLSH	Flash Loader call	N/A	N/A	Launches the Flash Loader

## Local Time Settings

This setup allows you to specify your time zone, daylight saving time, and clock synchronization options.

### Using the Front Display

Select **rtc** from the main menu. See [Viewing and Changing Setup Options](#) in Chapter 3 for information on configuring parameters via the front display.

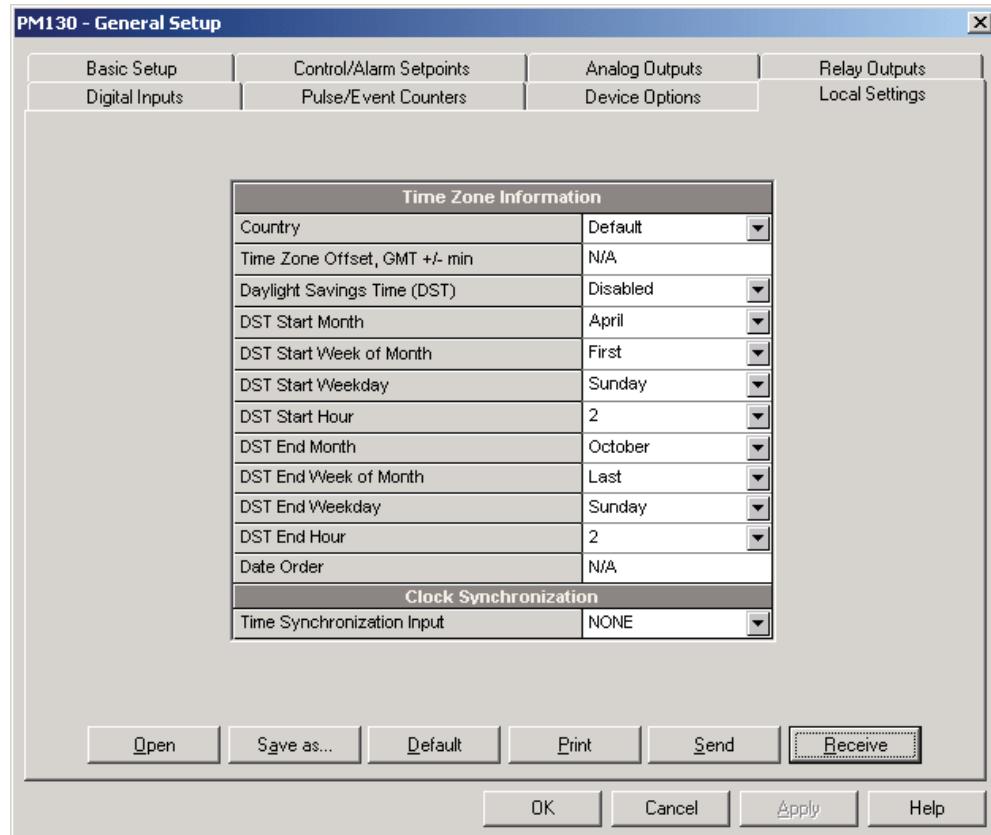


### Using PAS

Select **General Setup** from the **Meter Setup** menu, and then click on the **Local Settings** tab.

## Chapter 5 Configuring THE PM130 PLUS

### General METER SETUP



**Figure 5-13: General Setup Dialog Box – Local Settings Tab**

The available options are described in Table 28.

**Table 28: Local Time Options**

Display Label	Parameter	Options	Default	Description
-	Country	Default, or country name	Default	Defines calendar setting. The default setting stands for the U.S.A.
dSt	Daylight Saving Time	diS = disabled En = enabled	Disabled	When DST is disabled, the RTC operates in standard time only. When enabled, the meter automatically updates the time at the pre-defined DST switch dates.
dSt.S	DST Start Month DST Start Week DST Start Weekday	Month-week-weekday Week = 1, 2, 3, 4 or L (last week of the month)	Second Sunday in March	The date when Daylight Saving Time begins.
dSt.S Hour	DST Start Hour	1-6	2	The hour when Daylight Saving Time begins.
dSt.E	DST End Month DST End Week DST End Weekday	Month-week-weekday Week = 1, 2, 3, 4 or L (last week of the month)	First Sunday in November	The date when Daylight Saving Time ends.
dSt.E Hour	DST End Hour	1-6	2	The hour when Daylight Saving Time ends.
SYnC	Time Synchronization Input	None di.1 = DI1 di.2 = DI2 di.3 = DI3 di.4 = DI4	None	The external port receiving the time synchronization pulses

## Chapter 5 Configuring THE PM130 PLUS

### Configuring METER SECURITY

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#### Daylight Saving Time

When the daylight saving time is enabled, the meter automatically advances the device clock by one hour when daylight saving time begins and puts the clock back one hour when it ends. The default daylight saving time change points are preset for the U.S.A.

The daylight saving time option is disabled in the PM130 by default. If the daylight saving time option is disabled, you need to manually adjust the device clock for daylight saving time.

#### Time Synchronization Pulses

External time synchronization pulses can be delivered through one of the digital inputs.

If a digital input is selected as the time synchronization source, the edge of an external pulse adjusts the device clock at the nearest whole minute. The time accuracy could be affected by the debounce time of the digital input, and by the operation delay of the external relay.

## 5.3 Configuring Meter Security

This setup allows changing the user password and enabling or disabling password protection.

The password in your meter is preset to 0 at the factory, and password protection is disabled.

#### Using the Front Display

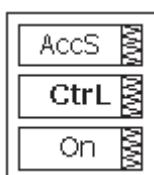
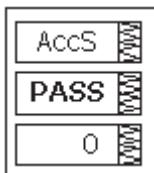
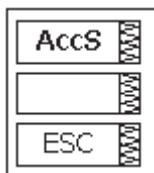
Select the **AccS** entry from the main menu. See [Viewing and Changing Setup Options](#) in Chapter 3 for information on configuring parameters via the front display.

##### To change the password:

1. Select the **PASS** entry in the middle window with the **UP** and **DOWN** arrow buttons.
2. Press the **SELECT** button to activate the lower window.
3. Use the **UP** and **DOWN** arrow buttons to adjust the password.
4. Press **ENTER** to confirm the new password.



The new password is effective for both the display and communication ports.



##### To enable or disable password protection:

1. Select **CtrL** in the middle window using the **UP** and **DOWN** arrow buttons.
2. Press the **SELECT** button to activate the lower window.
3. Use the **UP** and **DOWN** arrow buttons to select the option.  
**ON** enables password protection and **OFF** disables password protection.
4. Press **ENTER** to confirm your new setting, or **ESC** to discard changes.
5. Press **ESC** to exit the menu.

## Chapter 5 Configuring THE PM130 PLUS

### Configuring METER SECURITY



When password protection is enabled, you are not able to change the device settings through the display or communications unless you provide a correct password.

If you cannot provide a proper password, contact your local distributor for the appropriate password to override password protection.

### Using PAS

Ensure that the **On-line** button on the PAS toolbar is checked, select **Administration** from the **Monitor** menu, and then select **Change Password -> Password 1**.



Figure 5-14: Password Setup Dialog Box

#### To change the password:

1. Type in a new 4-digit password
2. Repeat the password in the **Confirm new password** box
3. Check **Enable password protection** to enable password checking
4. Click **Send**.

## 5.4 Configuring Billing/TOU

**The TOU battery-backed clock unit is highly recommended in case of using time-scheduled tariff rates, otherwise a long power outage may cause the meter clock to lose time so your tariff counters would not comply with the calendar schedule.**

### Billing Energy Registers

The PM130E/EH PLUS has 4 fully programmable billing energy registers that can be linked to any internal energy source or to an external pulse source that delivers pulses through the meter digital inputs.

Any energy register can provide either a single-tariff energy accumulation or be individually linked to the TOU system providing both total and multi-tariff energy billing.

### Tariff Rates

The meter tariff structure supports 8 different tariff rates using an arbitrary tariff schedule. A total of 4 types of days and 4 seasons are supported with up to eight tariff changes per day.

### Maximum Demand Registers

Any of billing energy registers can be individually linked to the maximum demand register providing the same demand tariff structure as you selected for energy registers.

### Recording Billing Data and Load Profiling

The PM130E/EH PLUS can provide automatic recording of the daily energy and maximum demand profile to a data log file. Maximum demand profiling can be individually configured for every register.

See [Factory Preset Data Log Files](#) in Chapter 5 and [Billing Profile Log File](#) in Appendix E for more information on the file layout and contents.

**To configure the billing registers and the tariff system in your meter:**

1. Link the billing registers to the respective energy sources.
2. Configure the options for the registers to whether the only totalization or both total and tariff registers would be used, and whether daily profiling should be enabled for the energy usage and maximum demand registers.
3. Configure the daily tariff schedule using the TOU daily profiles for all types of days and seasons.
4. Configure the season tariff schedule using the TOU calendar.

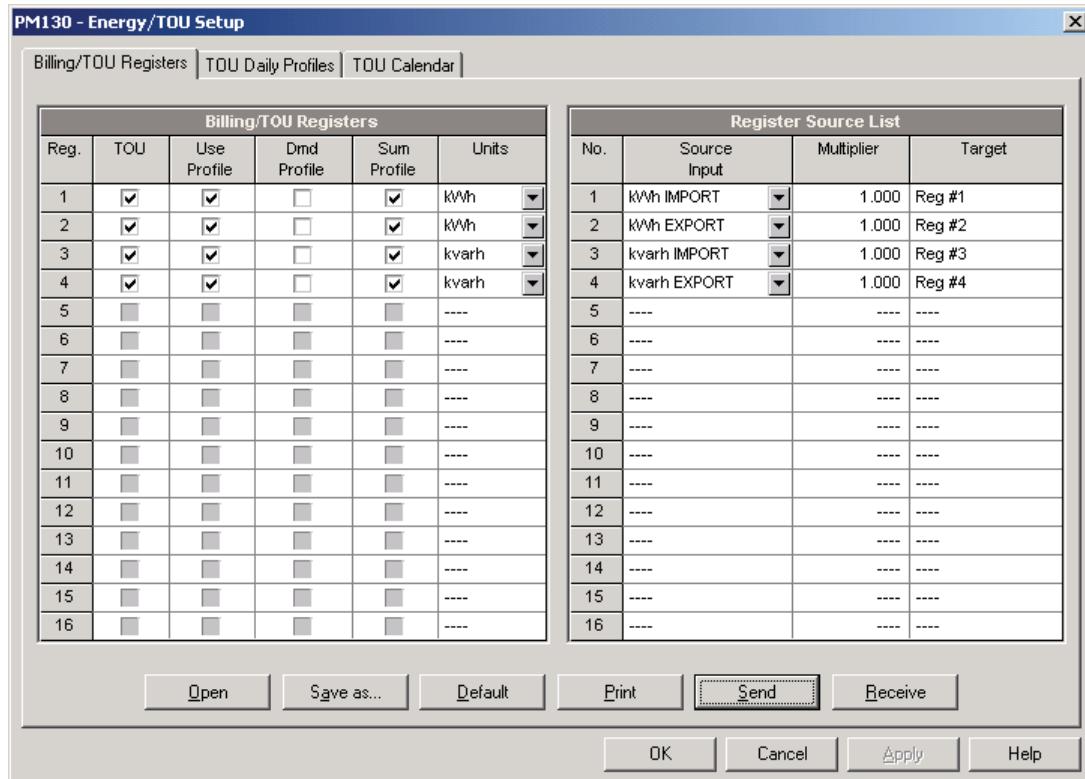
## Configuring Billing/Tariff Registers

To configure the billing/TOU registers in your meter:

1. Select **Energy/TOU** from the **Meter Setup** menu.

Chapter 5 Configuring T H E P M 1 3 0 P L U S  
Configuring B I L L I N G / T O U

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**Figure 5-15: Energy/TOU Setup Dialog Box – Billing/TOU Registers tab**

2. Configure the register options according to the valid parameters shown in Table 29.

**Table 29: Billing/TOU Register Options**

Parameter	Options	Default	Description
<b>Billing/TOU Registers</b>			
TOU	Unchecked Checked	Unchecked	Links tariff registers to the selected energy source
Use Profile	Unchecked Checked	Checked	Enables recording energy registers in a daily billing profile file (both total and tariff registers if TOU is enabled).
Dmd Profile	Unchecked Checked	Unchecked	Enables recording maximum demand registers in a daily billing profile file (both total and tariff registers if TOU is enabled)
Sum Profile	Unchecked Checked	Checked	Enables recording total (summary) registers in a daily billing profile file.
Units	kWh, kvarh, kVAh, m <sup>3</sup> , CF (cubic foot), CCF (hundred cubic feet)	None	The register measurement units. When a register is linked to an internal energy source, it is set automatically. When an external pulse source is used, the user can select a measurement unit for the register.
<b>Register Source List</b>			
Source Input	None kWh Import kWh Export kvarh Import kvarh Export kVAh, DI1-DI4	None	Links an energy source to the register

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Configuring BILLING / TOU

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Parameter	Options	Default	Description
Multiplier	0.001 to 100.000	1.000	The multiplication factor for the energy source. Unchangeable for internal energy sources.
Target	Reg#1- Reg#4	None	Defines the target billing register for the energy source. It is set automatically.

## Configuring the Daily Tariff Schedule

To configure your daily tariff schedule, select **Energy/TOU** from the **Meter Setup** menu, and then click on the **TOU Daily Profiles** tab.

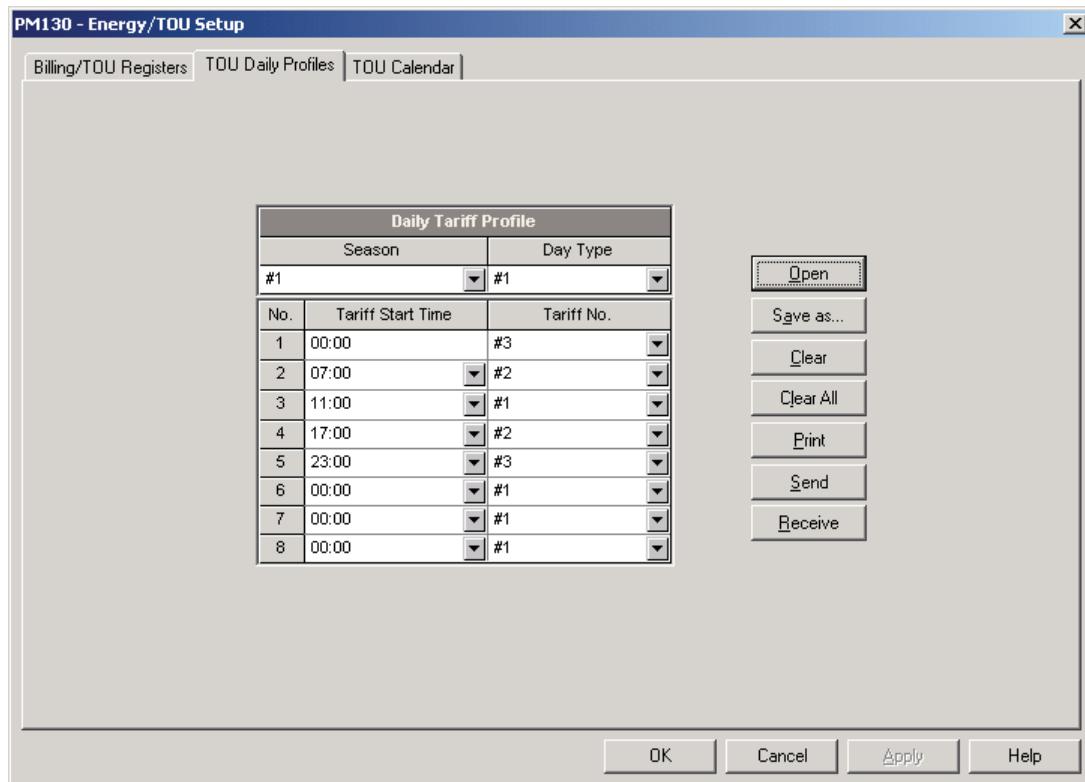


Figure 5-16: Energy/TOU Setup Dialog Box – TOU Daily Profiles Tab

The daily profile setup allows you to specify the daily tariff change points with a 15-minute resolution for 4 seasons using 4 different daily schedules for each season.

**To configure your daily profiles:**

1. Select the desired season and day type.
2. Select the start time for each tariff change point and the corresponding active tariff number.
3. Repeat the setup for all active profiles.

The first tariff change point is fixed at 00:00 hours, and the last tariff change you specified will be in use until 00:00 hours on the next day.

**NOTE**

The billing daily profile log file is automatically configured for the number of active tariffs you defined in the meter TOU daily profiles.

Chapter 5 Configuring THE PM130 PLUS  
Configuring BILLING / TOU

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## Configuring the Season Tariff Schedule

To configure your season tariff schedule, select **Energy/TOU** from the **Meter Setup** menu, and then click on the **TOU Calendar** tab.

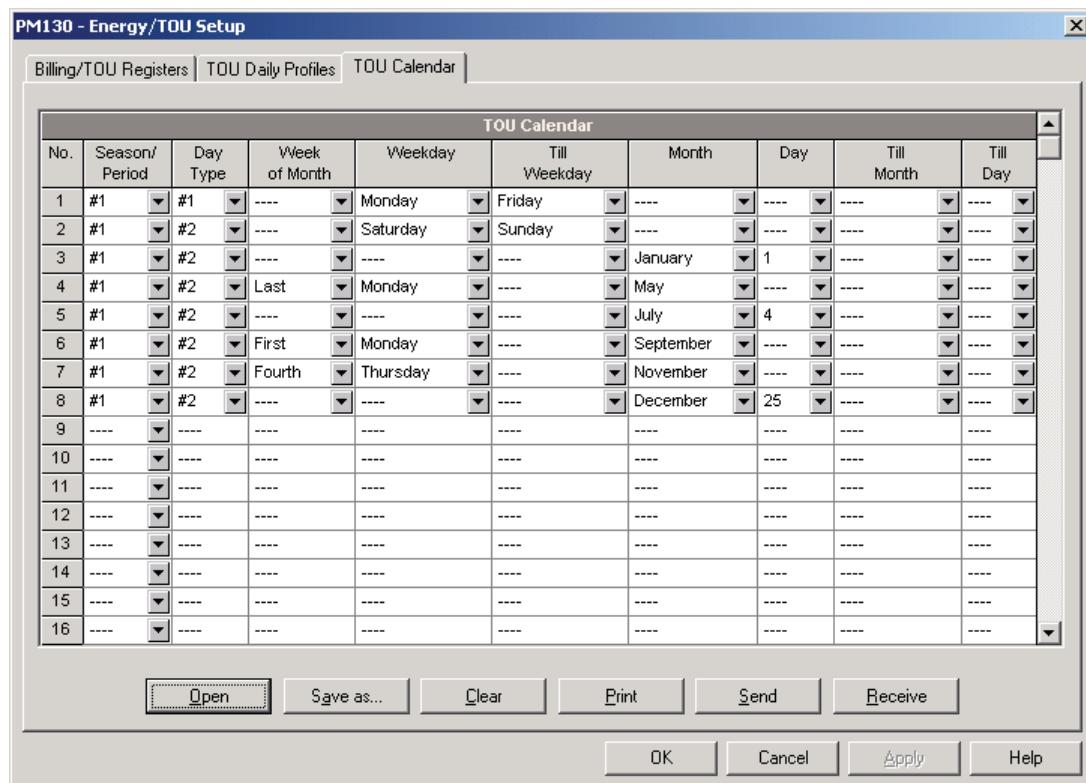


Figure 5-17: TOU Calendar Setup Dialog Box – TOU Calendar Tab

The meter TOU calendar allows you to configure any tariff schedule based on any possible utility regulation. The calendar provides 32 entries that allow you to specify profiles for working days and holidays through all seasons in any order that is convenient for you, based on simple intuitive rules.

### To configure your season tariff schedule:

1. In the **Season/Period** box, select the season, and in the **Day Type** box, select a day type for this calendar entry.
2. Define the time interval when this daily tariff schedule is effective, based on the start and end weekdays and, for a multi-season schedule, on the start and end month for the selected season. It does not matter which order of weekdays or months you select: the meter recognizes the correct order.
3. For exception days like weekends and designated holidays, define a specific day either by a month and a month day, or by selecting a month, a week and a weekday within the month.

There are no limitations on how to build your schedule. A common recommendation is to use minimum time constraints and only when it is needed to avoid ambiguity. You need not to define month days if a daily schedule is effective all days of the month, or to define the start and end months if it is effective through all the year. If you wish to define a specific period within a month using the start and end days, put this entry

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### Configuring BILLING / TOU

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before allocating the remaining days to another daily schedule without specified month days, so it would be checked first for a match.

The above picture shows a typical single-season tariff schedule with two daily tariff profiles configured for working days, and weekends and the designated U.S.A. holidays.

Chapter 5 Configuring THE PM130 PLUS  
Configuring RECORDERS

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## 5.5 Configuring Recorders

The PM130E/EH PLUS has a 58-KByte onboard non-volatile memory for data and event recording. The memory is fully configurable and can be freely partitioned between log files.

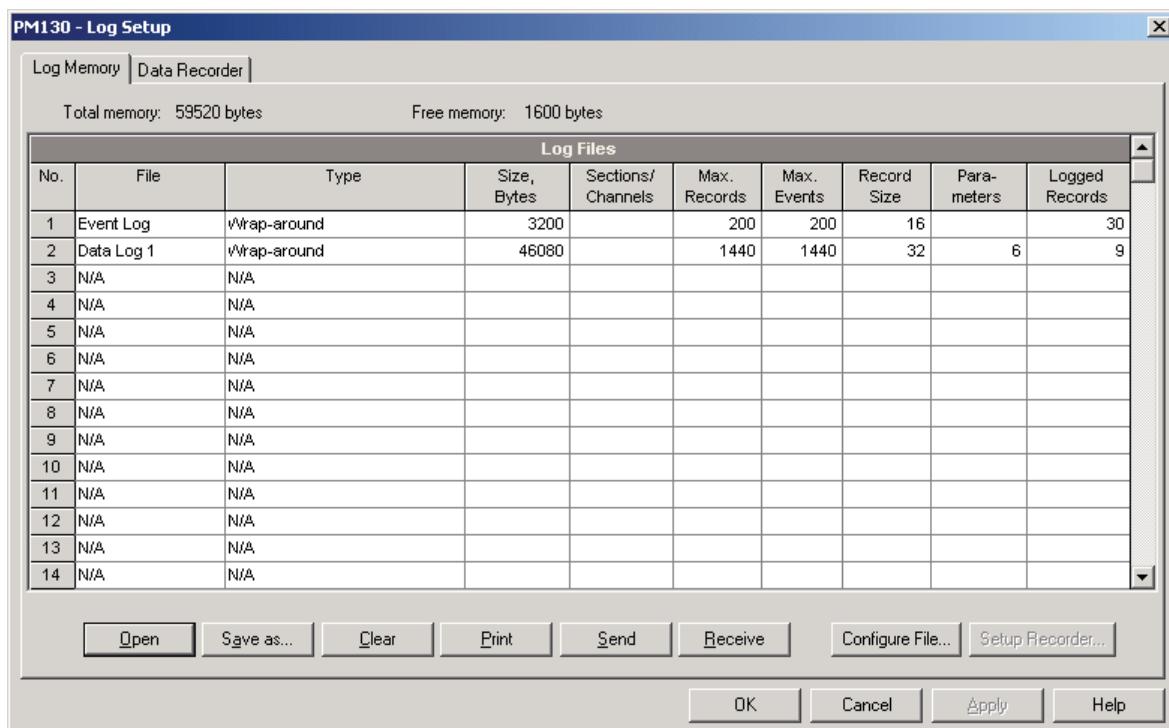
The meter provides memory for a total of 3 log files:

- Event log
- Two data logs

The two data log files are pre-configured at the factory for recording a 15-minute energy and demand profile and for the daily billing energy data profile. If you wish to change the factory settings, follow the guidelines in the next section.

### Configuring Meter Memory

To view the present memory settings, select **Memory/Log** from the **Meter Setup** menu, and then click on the **Log Memory** tab.



**Figure 5-18: Log Setup Dialog Box – Log Memory Tab**

The following table describes file options.

Option	Range	Description
Type	Wrap-around Non-wrap	Wrap-around: recording continues over the oldest records. Non-wrap: recording is stopped until the file is cleared.
Size		The size of memory allocated to the file.
Sections/Channels	0-8	The numbers of sections in a multi-section profile data log file
Num. of Records	0-65535	Allocates the file memory for predefined number of records
Record size		The size of the file record for a single channel or a single section. It is set automatically depending on the file and on the number of parameters in the data records
Parameters	0-9	The number of parameters in a single data log record

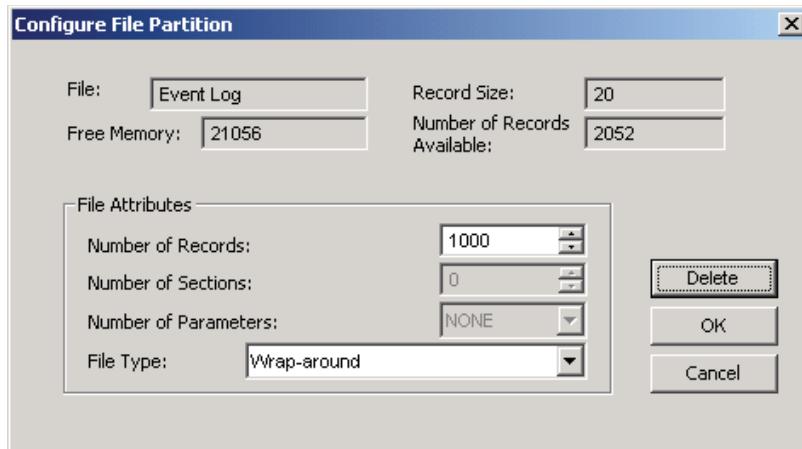
**To change the file properties or to create a new file:**

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### Configuring RECORDERS

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1. Double click on the file you want to change.



2. Select desired parameters for your log.
3. Click **OK**.

For your reference, the record size and the number of records available for your file are reported in the dialog box.

**To delete an existing file partition:**

1. Click on **Delete**.
2. Click **OK**.

**NOTES**

1. Memory is allocated for a file statically when you set up your files and will not change unless you re-organize files.
2. The meter automatically performs de-fragmentation of the memory each time you re-organize your files. This prevents possible leakage of memory caused by fragmentation. It may take a couple of seconds.

For more information on configuring specific files, see the following sections.

The following table can help you calculate an estimated file size when planning your memory allocation.

File	Record Size, Bytes	File Size, Bytes
Event Log	16	Record size x Number of records
Conventional data Log	$12 + 4 \times \text{Number of parameters}$	Record size x Number of records
Billing/TOU daily profile log	$12 + 4 \times (\text{Number of season tariffs} + 1 \text{ for the TOU summary/total register})$	Record size x Number of billing registers ( $\times 2$ for the maximum demand profile) x Number of records

The factory pre-set file configuration is shown in the following table.

No.	File	Size, Bytes	Channels	Number of Records	Number of Events	Factory-set Configuration
1	Event log	3200		200	200	200 last events
2	Data log #1	46080		5760	5760	15-min data profile for 15 days

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### Configuring RECORDERS

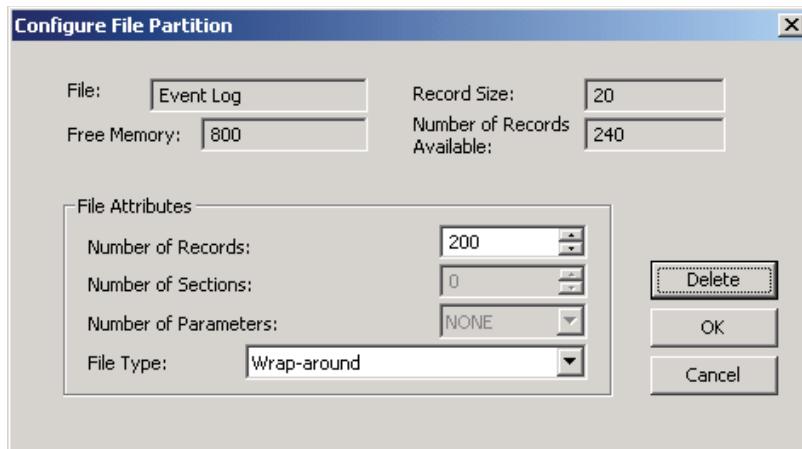
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No.	File	Size, Bytes	Channels	Number of Records	Number of Events	Factory-set Configuration
17	Data log #16	8640	4	90	90	Daily billing/TOU profile for 90 days, 4 registers, totals + 3 tariffs

## Configuring the Event Recorder

### To configure the Event log file:

1. Double click on the Event Log file partition with the left mouse button.



2. Select a desired file type for your file.
3. Select the maximum number of records you want to be recorded in the file.
4. Click OK, then send your new setup to the meter or save to the device database.

By default, the Event recorder stores all events related to configuration changes, resets, and device diagnostics.

## Configuring the Data Recorder

### Conventional Data Log Files

The Data recorder is programmable for recording up to 9 data parameters per record in each of the conventional data log files. The list of parameters to be recorded to a data log is configurable individually for each file.

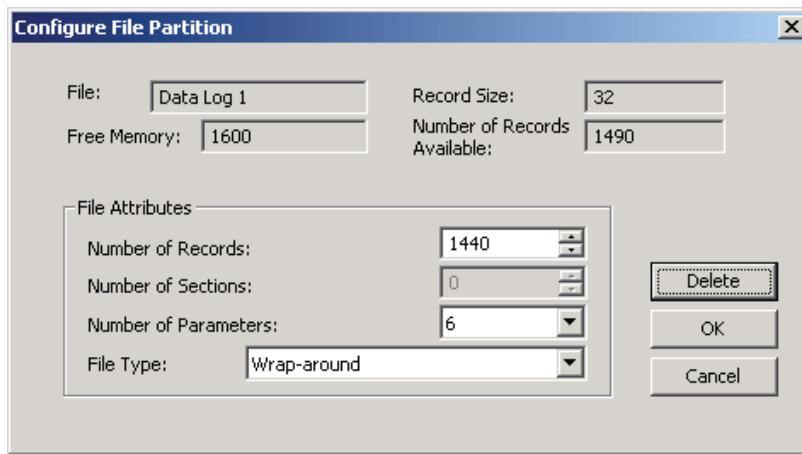
### To create a new data log file or re-configure an existing file:

1. Double click on the file partition with the left mouse button.

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### Configuring RECORDERS

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2. Select a partition type for your file.
3. Select the number of parameters you want to be recorded in the file records.
4. Select the maximum number of records you want to be recorded in the file.
5. Click **OK**, and then send your new setup to the meter, or save to the device database.

**To define the contents of the file:**

1. Highlight the data log file row with the left mouse button, and then click on the **Setup Recorder** button, or click on the **Data Recorder** tab and select the corresponding log number.

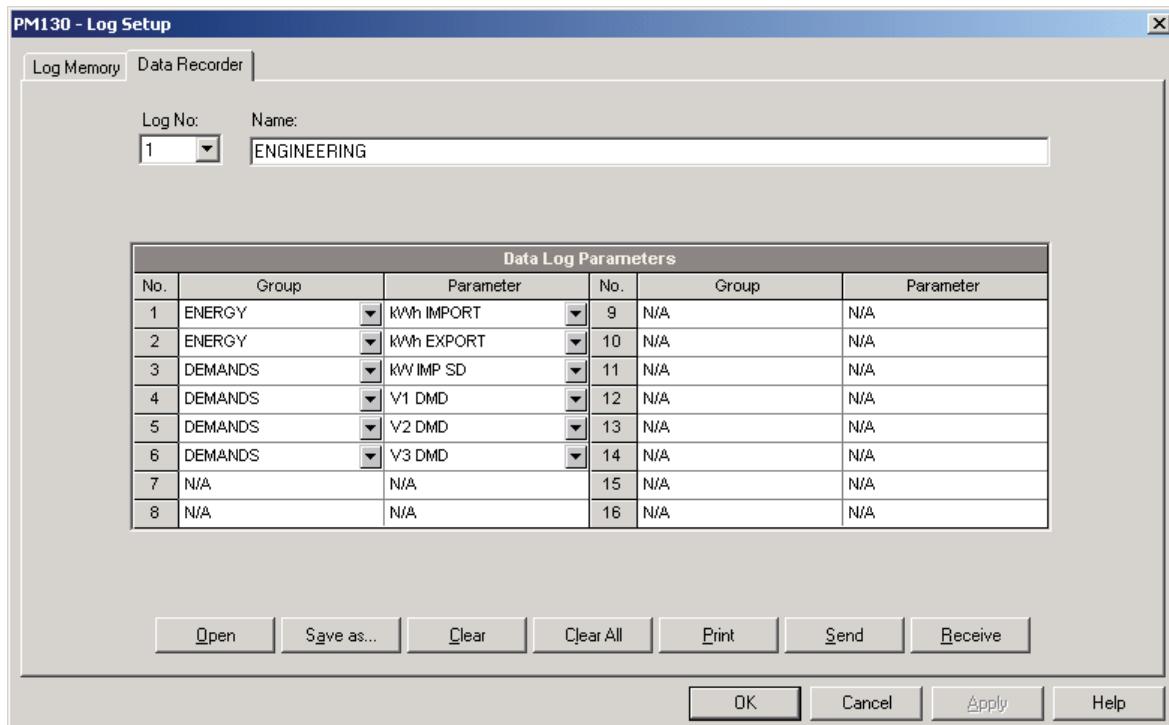


Figure 5-19: Log Setup Dialog Box – Data Recorder Tab

## Chapter 5 Configuring THE PM130 PLUS

### Configuring RECORDERS

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2. Configure the list of parameters to be recorded in a log file. You are not allowed to select more parameters than you defined when configuring your file. Refer to Appendix D for a list of available parameters.
3. For your convenience, PAS follows your selection and helps you configure a series of the neighboring parameters: when you open the **Group** box for the next parameter, PAS highlights the same group as in your previous selection; if you select this group again, PAS automatically updates the **Parameter** box with the following parameter in the group.
4. Add the name for your data log file in the **Name** box. It will appear in the data log reports.
5. Save your new setup to the device database, and send it to the meter.

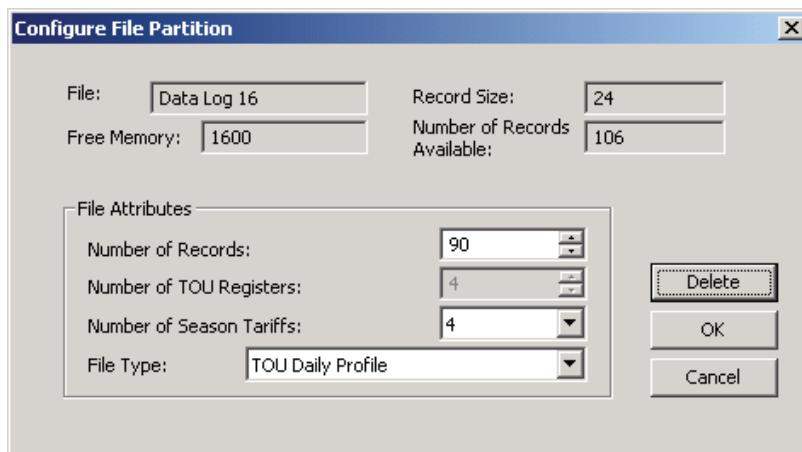
### Billing/TOU Daily Profile Log File

Data log #16 is configurable to store TOU daily profile log records on a daily basis.

The file is organized as a multi-section file that has a separate section of the same structure for each billing energy and maximum demand register. The number of sections is taken automatically from the Billing/TOU Registers setup (see [Configuring Billing/Tariff Registers](#)). If the maximum demand profiling is used, then the number of sections in the file will be twice the number of the allocated billing registers.

#### To configure a daily profile log file:

1. Configure your Billing/TOU registers and tariff schedule in the meter (see [Configuring Billing/Tariff Registers](#)) first.
2. Double click on the **Data Log#16** partition with the left mouse button.



3. Select the **TOU Daily Profile** file type.
4. Select the number of season tariffs in your TOU schedule. Add one additional parameter if you selected to record the Summary (TOU total) registers as well.
5. Select the maximum number of records you want to be recorded in the file assuming that a new record will be added once a day.
6. Click **OK** and send your setup to the meter or save to the meter database.

Chapter 5 Configuring THE PM130 PLUS  
Configuring RECORDERS

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## Factory Preset Data Log Files

### Conventional Data Log #1

Data log #1 is factory preset for 15-min periodic recording of the standard energy and demand quantities. You can freely change the list of recorded parameters and the file update rate.

The default list of parameters is shown in the following table.

No.	Parameter
1	kWh import
2	kWh export
3	kW import sliding demand
4	V1 demand
5	V2 demand
6	V3 demand

Periodic recording data is triggered by Setpoint #1 that is linked to the meter clock. To change the periodic rate at which data is recorded, change the time interval for the MINUTE INTERVAL trigger in Setpoint #1 (see [Configuring Alarm/Control Setpoints](#)).

### Billing/TOU Profile Data Log #16

Data log #16 is pre-configured for daily billing energy and maximum demand recording for the last 90 days. It is automatically updated once a day.

See [Billing Profile Log File](#) in Appendix E for the file record structure.

## 5.6 Configuring Communication Protocols

This section describes how to customize protocol options for use with your application software.

### Configuring Modbus

#### Modbus Point Mapping

The PM130 PLUS provides 120 user assignable registers at addresses 0 to 119. You can re-map any register available in the meter to any assignable register so that registers found at different locations may be accessed with a single request by re-mapping them to adjacent addresses.

Initially these registers are reserved and none of them points to an actual data register. To build your Modbus register map:

1. Select **Protocol Setup** from the **Meter Setup** menu, and click on the **Modbus Registers** tab.
2. Click on the **Default** button to cause the assignable registers to reference the actual default meter register 6656 (0 through 119 are not allowable register addresses for re-mapping).

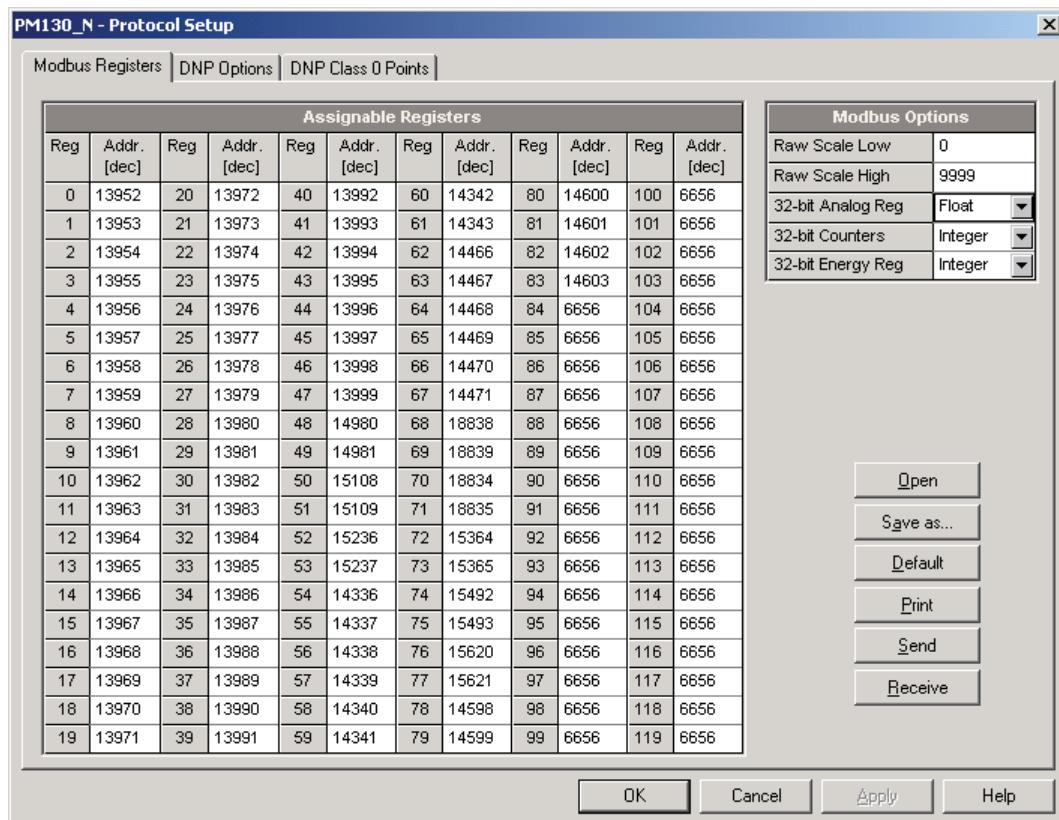


Figure 5-20: Protocol Setup Dialog Box – Modbus Registers Tab

3. Type in the actual addresses you want to read from or write to via the assignable registers. Refer to the PM130 PLUS Modbus Reference Guide for a list of the available registers. Note that 32-bit Modbus registers should always start at an even register address.
4. Click **Send** to download your setup to the meter.

Chapter 5 Configuring THE PM130 PLUS  
Configuring COMMUNICATION PROTOCOLS

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## Changing 32-bit Register Format

The PM130 PLUS allows you to read 32-bit Modbus analog registers, energy counters and binary counters either in integer format, or in IEEE single precision floating point format.

The 32-bit Modbus registers are factory-set to integer format. To change the register format:

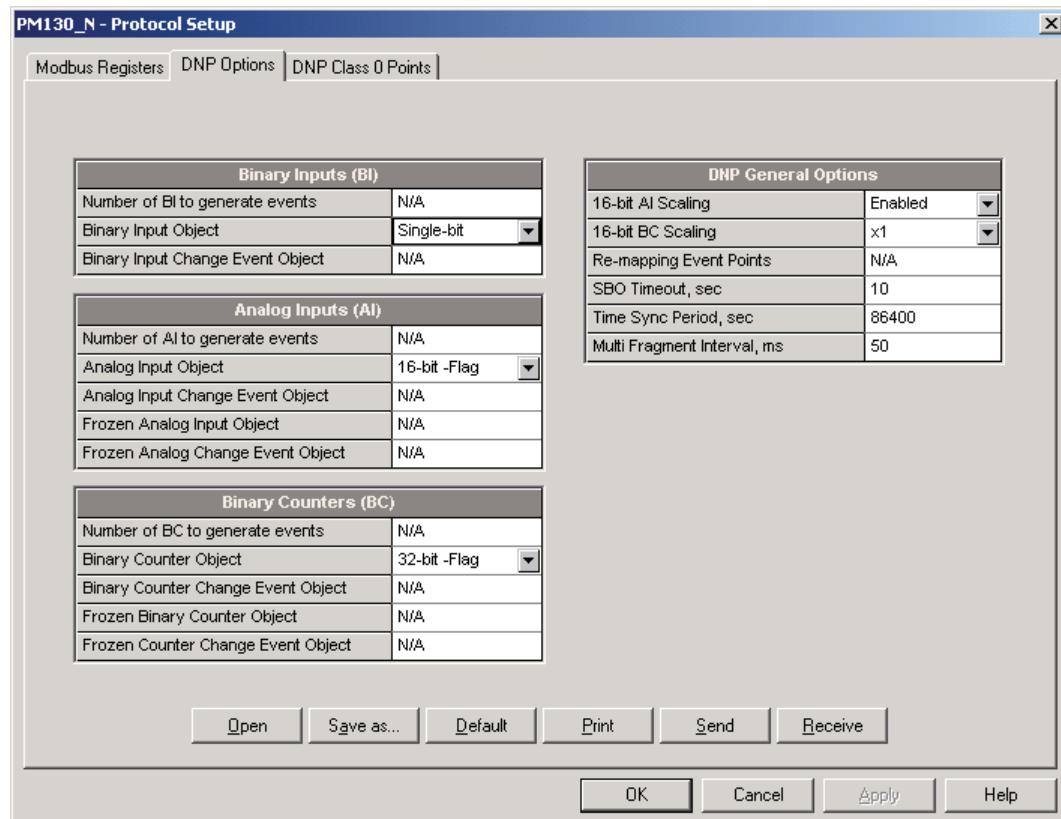
1. Select **Protocol Setup** from the **Meter Setup** menu, and click on the **Modbus Registers** tab.
2. Change the 32-bit register format in the **Modbus Options** pane.
3. Click **Send** to download your setup to the meter.

## Configuring DNP3

Refer to the PM130 DNP3 Reference guide for information on the DNP3 protocol implementation and a list of the available data points.

### DNP Options

Select **Protocol Setup** from the **Meter Setup** menu and click on the **DNP Options** tab.



**Figure 5-21: Protocol Setup Dialog Box – DNP Options Tab**

The following table describes available options. Refer to the DNP3 Data Object Library document available from the DNP User's Group on the DNP3 object types.

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Configuring COMMUNICATION PROTOCOLS

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**Table 30: DNP Options**

Parameter	Options	Default	Description
<b>Binary Inputs (BI)</b>			
Binary Input Object	Single-bit With Status	Single-bit	The default BI object variation for requests with qualifier code 06 when no specific variation is requested
<b>Analog Inputs (AI)</b>			
Analog Input Object	32-bit 32-bit-Flag 16-bit 16-bit-Flag	16-bit-Flag	The default AI object variation for requests with qualifier code 06 when no specific variation is requested
<b>Binary Counters (BC)</b>			
Binary Counter Object	32-bit+Flag 32-bit-Flag 16-bit+Flag 16-bit-Flag	32-bit-Flag	The default BC object variation for requests with qualifier code 06 when no specific variation is requested
<b>DNP General Options</b>			
16-bit AI Scaling	Disabled Enabled	Enabled	Allows scaling 16-bit analog input objects (see description below)
16-bit BC Scaling	x1, x10, x100, x1000	x1	Allows scaling 16-bit binary counter objects (see description below)
SBO Timeout <sup>1</sup>	2-30 sec	10	Defines the Select Before Operate (SBO) timeout when using the Control-Relay-Output-Block object
Time Sync Period <sup>2</sup>	0-86400 sec	86400	Defines the time interval between periodic time synchronization requests
Multi Fragment Interval	50-500 ms	50	Defines the time interval between fragments of the response message when it is fragmented

**Scaling 16-bit AI objects**

Scaling 16-bit AI objects allows accommodating native 32-bit analog input readings to 16-bit object format; otherwise it may cause an over-range error if the full-range value exceeds a 16-bit point limit.

Scaling is enabled by default. It is not related to points that are read using 32-bit AI objects.

Refer to the PM130 DNP3 Reference Guide for information on the data point scales and a reverse conversion that should be applied to the received scaled values.

**Scaling 16-bit Binary Counters**

Scaling 16-bit Binary Counters allows changing a counter unit in powers of 10 to accommodate a 32-bit counter value to 16-bit BC object format.

If the scaling unit is greater than 1, the counter value is reported being divided by the selected scaling unit from 10 to 1000. To get the actual value, multiply the counter reading by the scaling unit.

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<sup>1</sup> The Select Before Operate command causes the meter to start a timer. The following Operate command must be sent before the specified timeout value expires.

<sup>2</sup> The meter requests time synchronization by bit 4 in the first octet of the internal indication word being set to 1 when the time interval specified by the Time Sync Period elapses. The master should synchronize the time in the meter by sending the Time and Date object to clear this bit. The meter does not send time synchronization requests if the Time Sync Period is set to 0.

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Configuring COMMUNICATION PROTOCOLS

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## Configuring DNP Class 0 Responses

The most common method of getting static object information from the meter via DNP is to issue a read Class 0 request. The PM130 allows you to configure the Class 0 response by assigning ranges of points to be polled via Class 0 requests.

**To view or build a DNP Class 0 response message:**

1. Select **Protocol Setup** from the **Meter Setup** menu and click on the **DNP Class 0 Points** tab.
2. Select the object and variation type for a point range.
3. Specify the start point index and the number of points in the range. Refer to the PM130 DNP3 Reference Guide for available data points.
4. Repeat these steps for all point ranges you want to be included into the Class 0 response.
5. Click **Send** to download your setup to the meter.

The factory-set Class 0 point ranges are shown in the picture below.

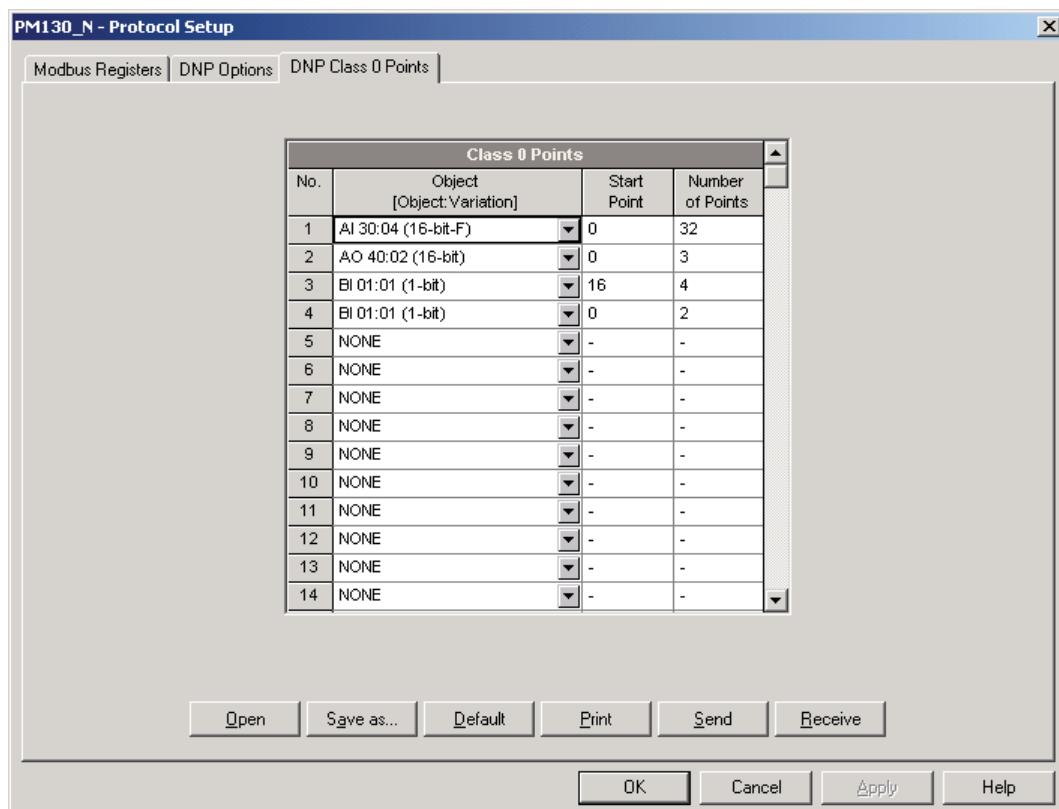


Figure 5-22: Protocol Setup Dialog Box – DNP Class 0 Points Tab

# Chapter 6 Device Control and Upgrading

This section describes operations on the meter you can perform from the front display or via PAS. To access device control options from PAS, you should have your meter online.

## 6.1 Resetting Accumulators, Maximum Values and Files

### Using the Front Display

Select the **rst** entry from the main menu. See [Viewing and Changing Setup Options](#) in Chapter 3 for information on configuring parameters via the front display.



#### To reset the desired values:

1. Highlight the middle window by pressing briefly the **SELECT** button.
2. Select a reset entry by scrolling through the list with the **UP** and **DOWN** arrow buttons.
3. Press the **SELECT** button briefly to highlight the lower item.
4. Press and hold the **ENTER** button for 5 seconds.
5. Release the button.

The **do** entry is replaced with **done** showing the operation is complete.

Table 31 shows the reset options available from the front display.

**Table 31: Front Display Reset Options**

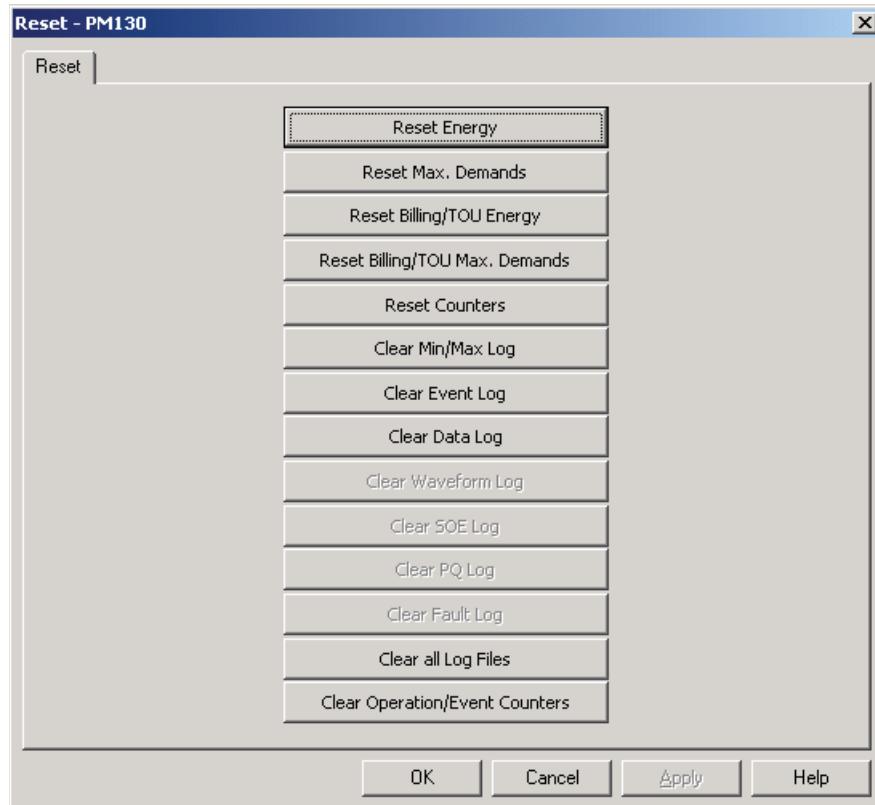
Display Label	Description
EnrG	Clears all total energies
dnd	Clears all maximum demands
P.dnd	Clears power maximum demands
A.dnd	Clears ampere and volt maximum demands
Lo.Hi	Clears Min/Max log
Cnt	Clears all counters
Cnt1 – Cnt4	Clears counter #1-#4
diAG	Clears device diagnostics

### Using PAS

Ensure that the **On-line** button on the PAS toolbar is checked, and then select **Reset** from the **Monitor** menu.

**Chapter 6 Device C O N T R O L A N D U P G R A D I N G**  
**Updating THE METER CLOCK**

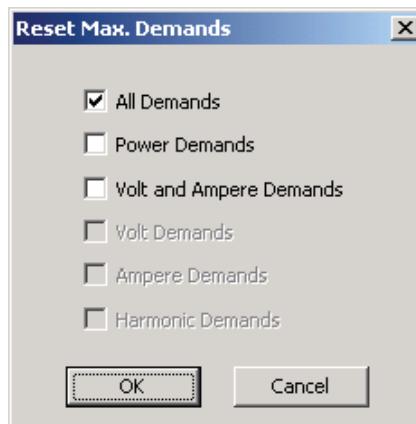
---



**Figure 6-1: Reset Dialog**

**To reset the desired values or files:**

1. Click on the corresponding button, and then confirm your command.
2. If an entry has more than one target, you are allowed to select targets to reset.
3. Check the corresponding boxes, and then click OK.



**Figure 6-2: Reset Maximum Demands Dialog Box**

## 6.2 Updating the Meter Clock

### Using the Front Display

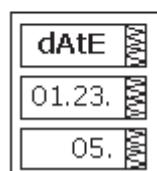
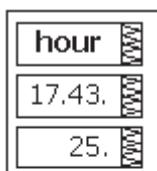
Select the **rtc** entry from the main menu.

## Chapter 6 Device C O N T R O L A N D U P G R A D I N G

### Updating THE METER C L O C K

---

#### To change the time or date:



1. Use the **UP** and **DOWN** arrow buttons to select a setup option
2. Highlight an item you want to change by pressing briefly the **SELECT** button.
3. When you access the time setup display, the hours and minutes are frozen allowing you to adjust the time.
4. Adjust the selected item with the **UP** and **DOWN** arrow buttons.
5. Highlight the next item to change and adjust it in the same manner.
6. Press **ENTER** to confirm your changes or press **ESC** to leave the clock settings unchanged.
7. If you confirm the time change while the seconds are highlighted, the seconds are zeroed; otherwise they stay unchanged.
8. Press **ESC** to exit the menu.

Table 32 describes available options.

**Table 32: Clock Setup Options**

Display Label	Parameter	Options	Description
hour	Time	hh.mm.ss	The time is displayed as hh.mm.ss, where the hours and minutes are shown in the middle window separated by a dot, and the seconds - in the lower window.
dAtE	Date	YY.MM.DD MM.DD.YY DD.MM.YY	The date is displayed as per the user definition, where the first two items are shown in the middle window, and the last one - in the lower window. See <a href="#">Configuring the Display</a> for instructions on how to select the date format.
dAY	Day of week	Sun = Sunday Mon = Monday Tue = Tuesday Wed = Wednesday Thu = Thursday Fri = Friday Sat = Saturday	The day of the week is set automatically when you change the date.

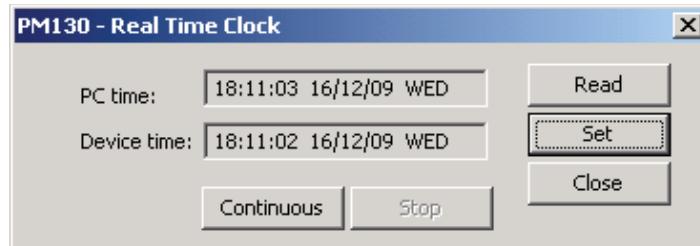
#### Using PAS

Ensure that the **On-line** button on the PAS toolbar is checked, and then select **RTC** from the **Monitor menu** or click on the **Real-Time Clock** button on the PAS toolbar.

The RTC dialog box displays the current PC time and the time in your meter.

**Chapter 6 Device CONTROL AND UPGRADING**  
**Viewing and Clearing Device Diagnostics**

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**Figure 6-3: Real Time Clock Window**

To synchronize the meter clock with the PC clock, click **Set**.

## 6.3 Viewing and Clearing Device Diagnostics

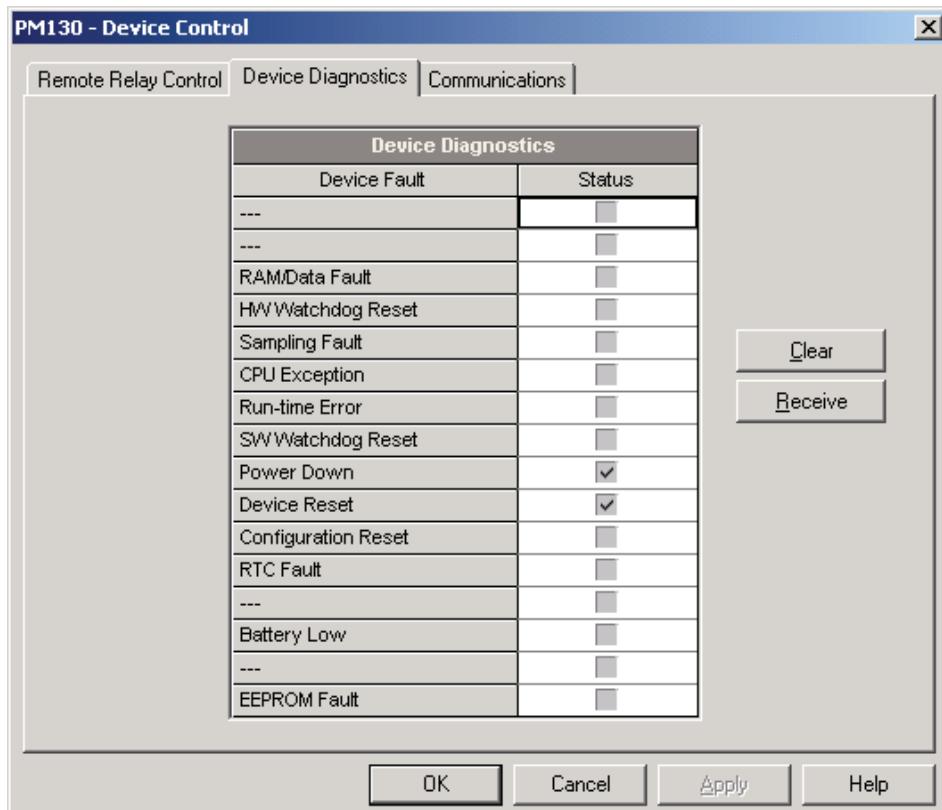
### Using the Front Display

See [Diagnostics Display](#) in Chapter 3 on how to view and clear device diagnostics from the front display.

### Using PAS

Ensure that the **On-line** button on the PAS toolbar is checked, select **Device Control** from the Monitor menu, and then click on the **Device Diagnostics** tab.

See [Device Diagnostic Codes](#) in Appendix G for the list of diagnostic codes and their meaning.

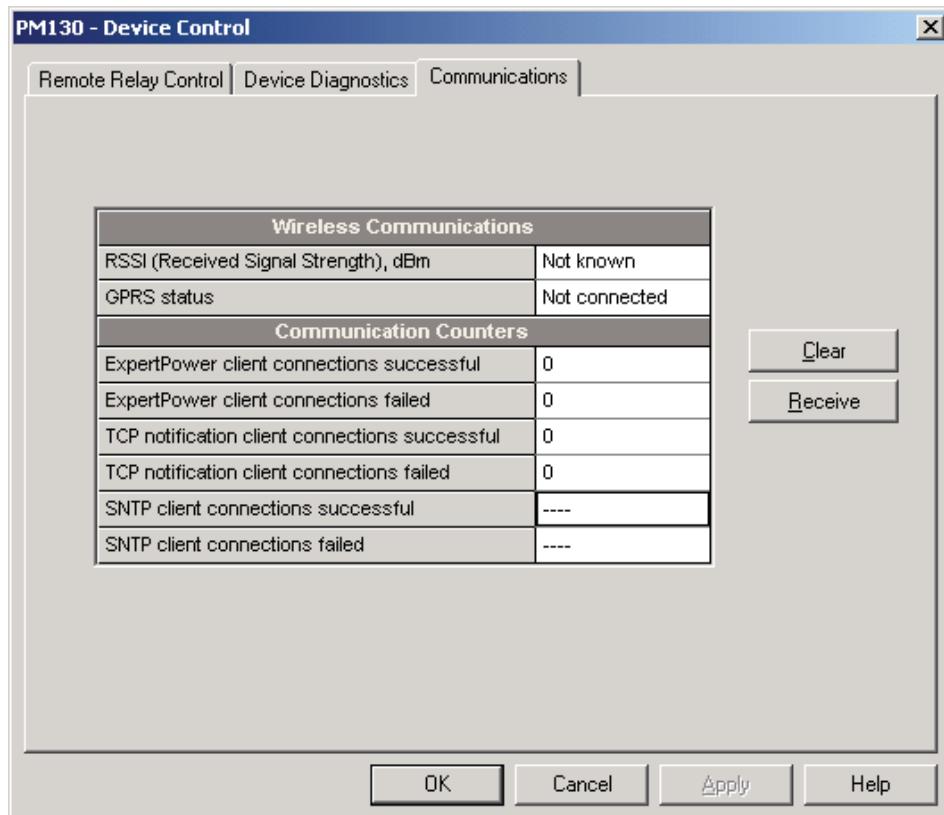


**Figure 6-4: Device Control Dialog Box – Device Diagnostics Tab**

To clear the device diagnostics events, click on **Clear**.

## 6.4 Viewing Communication Status and Statistics

Ensure that the **On-line** button on the PAS toolbar is checked, select **Device Control** from the Monitor menu, and then click on the **Communications** tab.



**Figure 6-5: Device Control Dialog Box – Communications Tab**

This window indicates the present GPRS communication status (see [Setting Up GPRS Network](#) in Chapter 5) and connection statistics of the TCP clients (see [Setting Up eXpertPower Client](#) and [Setting Up TCP Notification Client](#) in Chapter 5).

To clear the communication counters, click on **Clear**.

You can also clear the communications counters via the PAS Reset dialog (see [Resetting Accumulators, Maximum Values and Files](#)).

## 6.5 Remote Relay Control

You can use PAS to send a remote command to your meter to operate any relay output or release a latched relay, except of the relays linked to an internal pulse source. These relays are blocked for operating from outside of the meter.

To access the relay control dialog, ensure that the **On-line** button on the PAS toolbar is checked, select **Device Control** from the Monitor menu, and then click on the **Remote Relay Control** tab.

## Chapter 6 Device CONTROL AND UPGRADE

## Upgrading DEVICE FIRMWARE

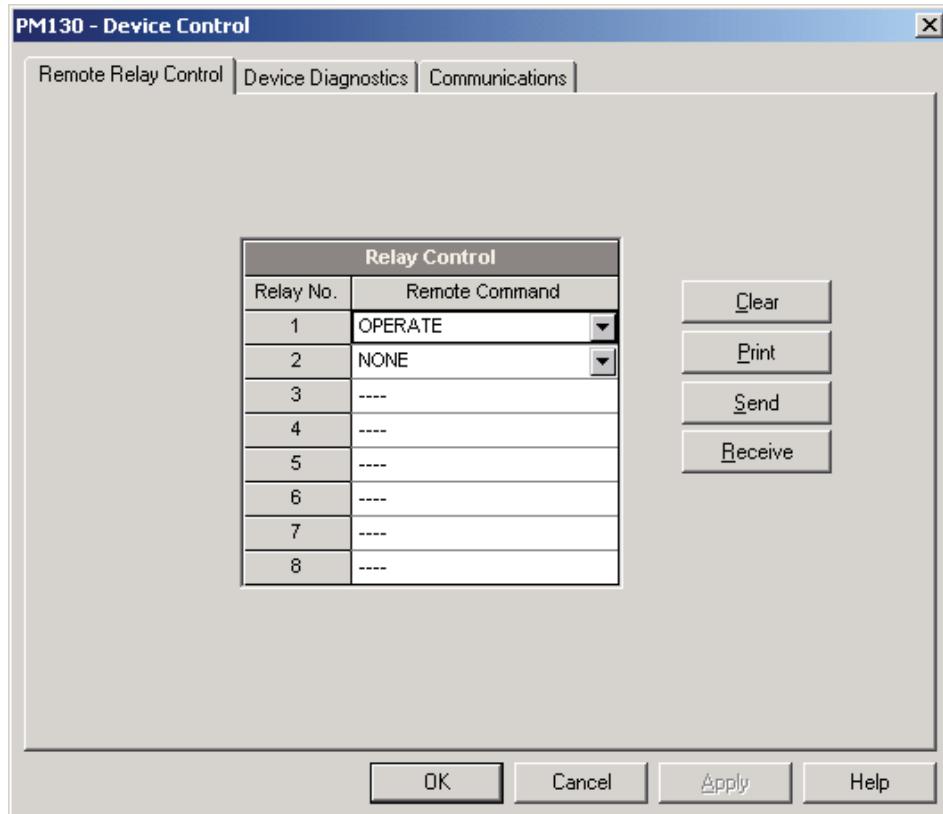


Figure 6-6: Device Control Dialog Box – Remote Relay Control Tab

**To send a remote command to a relay:**

1. Select a desired command in the **Relay Command** box for a relay:  
**OPERATE** – to operate a relay  
**RELEASE** – to remove your remote command, or to release a latched relay
2. Click **Send**.

## 6.6 Upgrading Device Firmware

Your meter has upgradeable firmware. If you need to upgrade your device, download a new firmware file to the meter through PAS.

Firmware can be downloaded via the Modbus RTU or Modbus/TCP protocol through any communication port.

**To download a new firmware file to your device:**

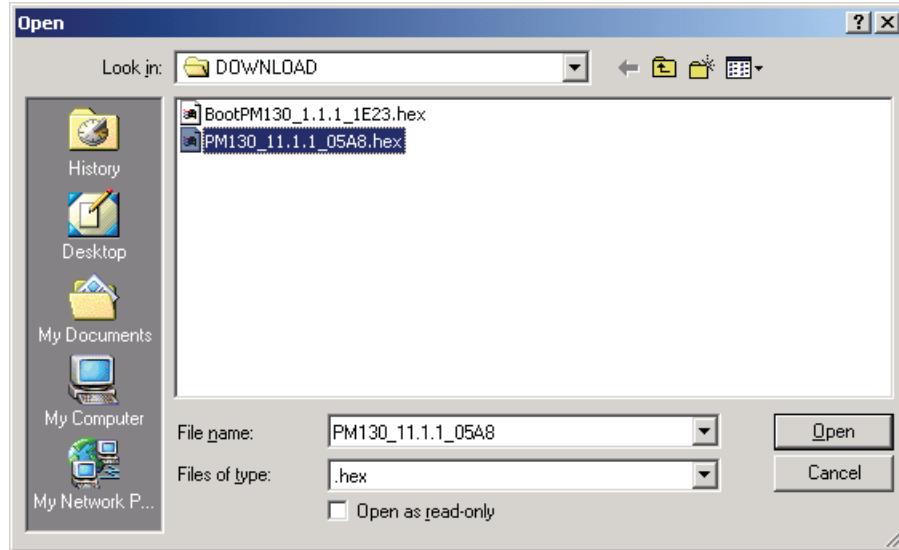
1. Ensure that the communication port you are connected through to the meter operates in Modbus mode.
2. If you are connected to the meter through a serial interface, it is recommended to set the port baud rate to 115,200 bps. See [Setting Up Serial Communication Ports](#) on how to remotely change the protocol and baud rate in your meter.
3. Ensure that the **On-line** button on the PAS toolbar is checked, and then select **Flash Downloader** from the **Monitor menu** and confirm downloading.

## Chapter 6 Device control and upgrading

### Upgrading device firmware

---

4. Point to the firmware upgrade file for your meter, click Open, and then confirm upgrading the meter.



5. You are asked for the password regardless of the password protection setting in your meter. Type the meter password, and click OK. If you did not change the password in the meter, enter the default password 0.



6. Wait until PAS completes upgrading your device. It takes about 3-4 minutes at 115,200 bps to download the file to the meter.



7. After upgrading firmware is completed, the meter restarts, so communications can be temporarily lost. You may need to wait a short duration until PAS restores a connection with your device.



# Chapter 7 Monitoring Meters

## 7.1 Viewing Real-time Data

Real-time data can be continuously retrieved from your devices and updated on the screen at the rate you defined in the Instrument Setup.

To get real-time data from your meter:

1. Ensure that the **On-line** button on the PAS toolbar is checked.
2. Select the device site from the list box on the PAS toolbar.
3. Point to **RT Data Monitor** on the **Monitor** menu, and then select a data set you want to view.

### Polling Devices

Click on the “Poll”  or “Continuous poll”  button to poll the meter once or continuously.

Click on the **Stop** button  to stop continuous polling.

The following picture shows a typical data monitor window.

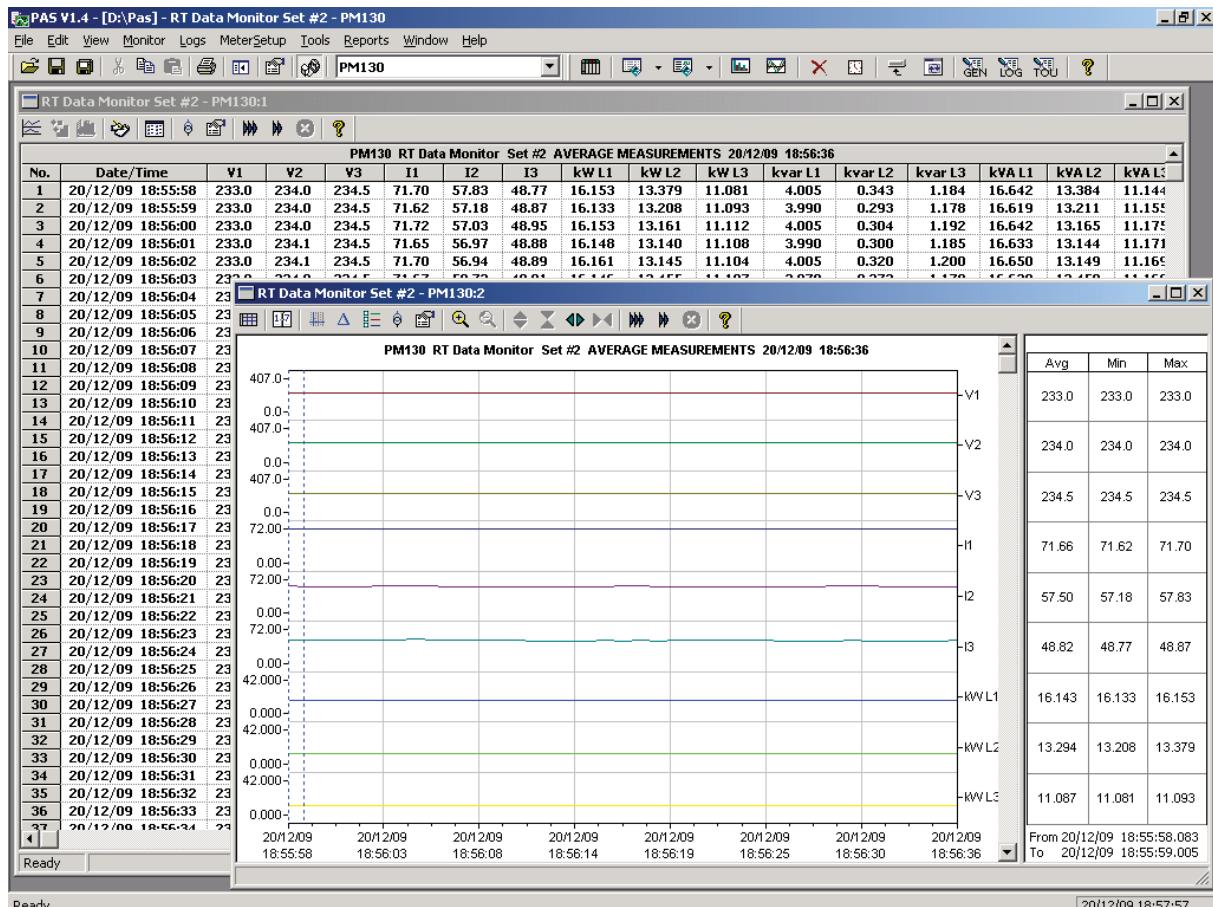


Figure 7-1: RT Data Monitor Window

You can open as many monitor windows as you wish, either for different sites, or for the same site using different data sets. An open data monitor

window is linked to the current site and does not change if you select another site in the site list.

You can view acquired data in a tabular form or in a graphical form as a data trend.

## Organizing Data Sets

PAS supports 33 programmable data sets with up to 40 data parameters. Set #0 is intended for simple meters, which have a limited number of parameters, and is not recommended for the use with the PM130 PLUS. To re-organize data sets, select **RT Data Sets** from the **Monitor** menu or click on the button  on the local toolbar.

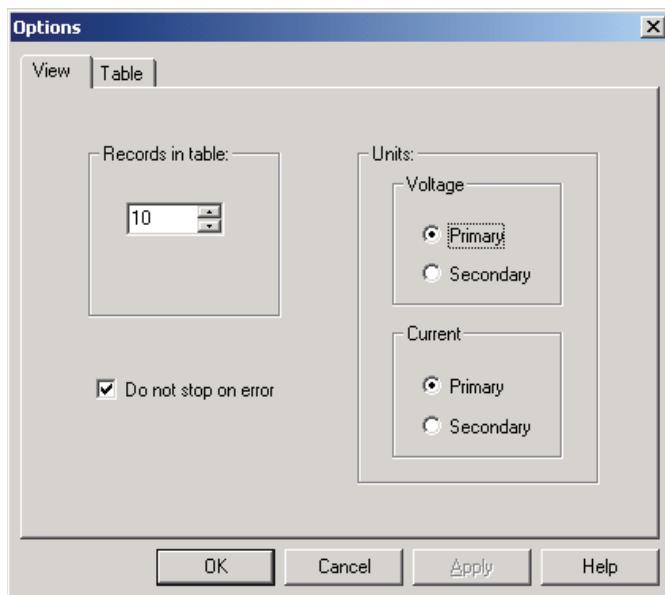
Some data sets are preset for your convenience and others are empty. You can freely modify data sets.

See Appendix D for a list of data available in your meter.

## Polling Options

To change the polling options, click on the Data Monitor window with the right mouse button and select Options.

If you check **Do not stop on errors**, polling is resumed automatically when a communication error occurs, otherwise polling stops until you restart it manually.



## Viewing a Data Table

### Changing the Data View

PAS displays data in either a single record or multi-record view. To change the view, click on the **Data Monitor** window with the right mouse button and select either **Wrap** to see a single record, or **UnWrap** to go to the multi-record view.

### Adjusting the Number of Rows in a Multi-Record View

Click the window with the right mouse button, select Options, adjust the number of records you want to see in the window, and then click OK. When the number of retrieved records exceeds the number of rows in the window, the window scrolls up so that older records are erased.

See [Working with Tables](#) in Chapter 9 for more information on working with tables.

## Viewing Data Trend

To view a data trend, click on the  button on the local toolbar.

To change the time range for your graph, click on the  button on the local toolbar, and then select the desired date and time range.

See [Working with Graphic Windows](#) in Chapter 9 for more information on working with graphs.

## Saving Data to a File

To save retrieved data to a file for later analysis, click on the Save button , select an existing database or type the name for a new database, and then click Save.

To avoid confusion, do not store data files into the **Sites** directory where site databases are located.

## Printing Data

To check the report, as it will look when printed, select **Print Preview** from the **File** menu.

To print retrieved data, click on the  button on the PAS toolbar, select a printer, and then click **OK**.

## Real-time Data Logging

PAS allows you to store data records to a database automatically at the time it updates data on the screen.

### To setup the real-time logging options:

1. Open the **Data Monitor** window.
2. Click on the **RT Logging On/Off**  button on the local toolbar, or select **RT Logging Options** from the Monitor menu.
3. Select a database, or type the name for a new database and select a directory where you want to save it.
4. Select the number of tables, and the number of records in each table you want recorded.
5. Adjust the file update rate for automatic recording. It must be a multiple of the sampling rate that you defined in the Instrument Setup dialog.
6. Click **Save**.

When you run real-time data polling, PAS automatically saves retrieved records to a database at the rate you specified.

The **RT Logging On/Off** button  on the toolbar should be checked all the time. You can suspend logging by un-checking the button, and then resume logging by checking it again.

## 7.2 Viewing Real-time Min/Max Log

To retrieve the real-time Min/Max log data from your meter:

1. Select the device site from the list box on the PAS toolbar.
2. Point to **RT Min/Max Log** on the **Monitor** menu, and then select a data set you want to view.

3. Ensure that the **On-line** button  on the PAS toolbar is checked.
4. Click on the **Poll** button .

PAS supports 9 programmable data sets that you can organize as you wish. To build your data sets, select **MinMax Data Sets** from the **Monitor** menu or click on the  button on the local toolbar.

See [Working with Tables](#) in Chapter 9 for more information on working with tables.

### 7.3 Viewing Real-time Waveforms

To retrieve real-time waveforms from your meter:

1. Ensure that the **On-line** button  on the PAS toolbar is checked.
2. Select the device site from the list box on the toolbar.
3. Select **RT Waveform Monitor** from the **Monitor** menu or click on the  button on the PAS toolbar.

Use the Poll button  for a single-step poll or the Continuous poll  button for continuous polling.

To stop continuous polling, click on the Stop button .

The meter provides simultaneous capture of six one-cycle voltage and current AC waveforms at a rate of 64 samples per cycle. To give you a more representative picture, PAS extends the waveforms across the window up to eight cycles by repeating the captured waveforms.

To select the channels you want to view, click with the right mouse button on the waveform window, select **Channels...**, check the channels for the phase you want displayed, and then click **OK**.

See [Working with Graphic Windows](#) in Chapter 9 for more information on working with waveforms.

Retrieved waveforms can be displayed in different views as overlapped or non-overlapped waveforms, as RMS cycle-by-cycle plot, or as a harmonic spectrum chart or table.

#### Viewing a Waveform Graph

When you open a new file, PAS shows you a waveform graph with non-overlapped waveforms as shown in the picture above.

Click on the  button on the local toolbar to see overlapped waveforms.

Click on the  button for non-overlapped waveforms.

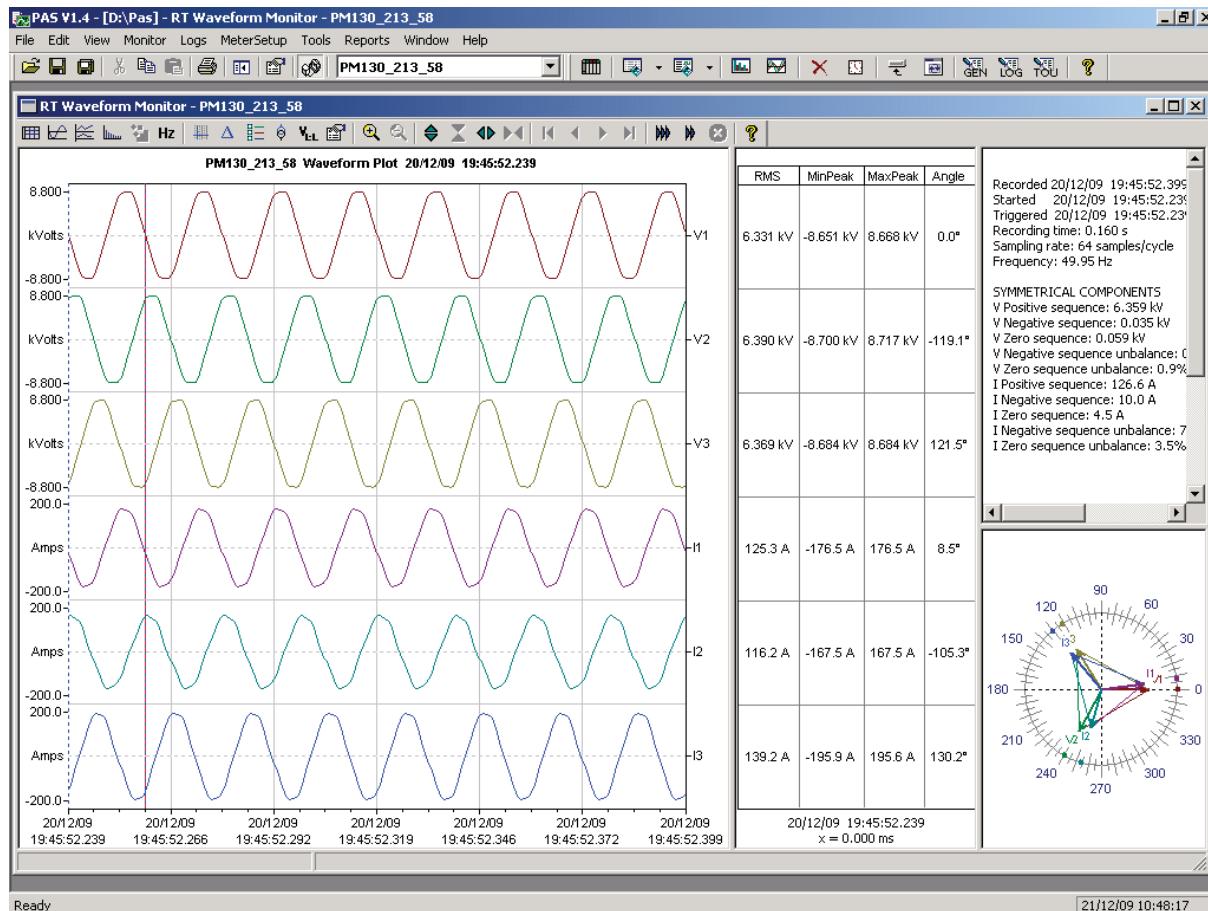


Figure 7-2: RT Waveform Monitor Window

## Viewing a Frequency Plot

Click on the **Hz** button to view a cycle-by-cycle frequency plot for the sampled voltage waveforms.

## Viewing a Harmonic Spectrum

Click on the **Spectrum** button to view a spectrum chart for the selected waveform channel. PAS provides voltage, current, active power and reactive power spectrum charts. See [Viewing Real-time Harmonic Spectrum](#) for more information on viewing options.

## Viewing Phasor Diagrams

The phasor diagrams show you relative magnitudes and angles of the three-phase voltage and current fundamental component. All angles are shown relative to the reference voltage channel.

To change the reference channel, click on the waveform window with the right mouse button, select **Options...**, click on the **Phasor** tab, check the channel you want to make a reference channel, and then click **OK**.

## Viewing Symmetrical Components

Waveform views have an additional pane at the right where PAS displays the symmetrical components for voltages and currents, calculated for the point indicated by the left marker line.

To enable or disable the symmetrical components, click on the waveform window with the right mouse button, select **Options...**, check or uncheck

the **Symmetrical components** box on the **Channels** tab, and then click **OK**.

### Viewing Phase-to-phase Voltages

PAS can transform phase-to-neutral voltage waveforms in configurations with a neutral into phase-to-phase waveforms allowing you to view the waveshape, angle relationships and harmonics of the phase-to-phase voltages.

Click on the button on the waveform window toolbar. Click the button once again to return to phase-to-neutral waveforms.

## 7.4 Viewing Real-time Harmonic Spectrum

To retrieve real-time harmonic spectrum from your meter:

1. Ensure that the **On-line** button on the PAS toolbar is checked.
2. Select the device site from the list box on the toolbar.
3. Select **RT Harmonic Monitor** from the Monitor menu or click on the button on the PAS toolbar.

Click on the "Poll" or "Continuous poll" button to poll the meter once or continuously. Click on the **Stop** button to stop continuous polling.

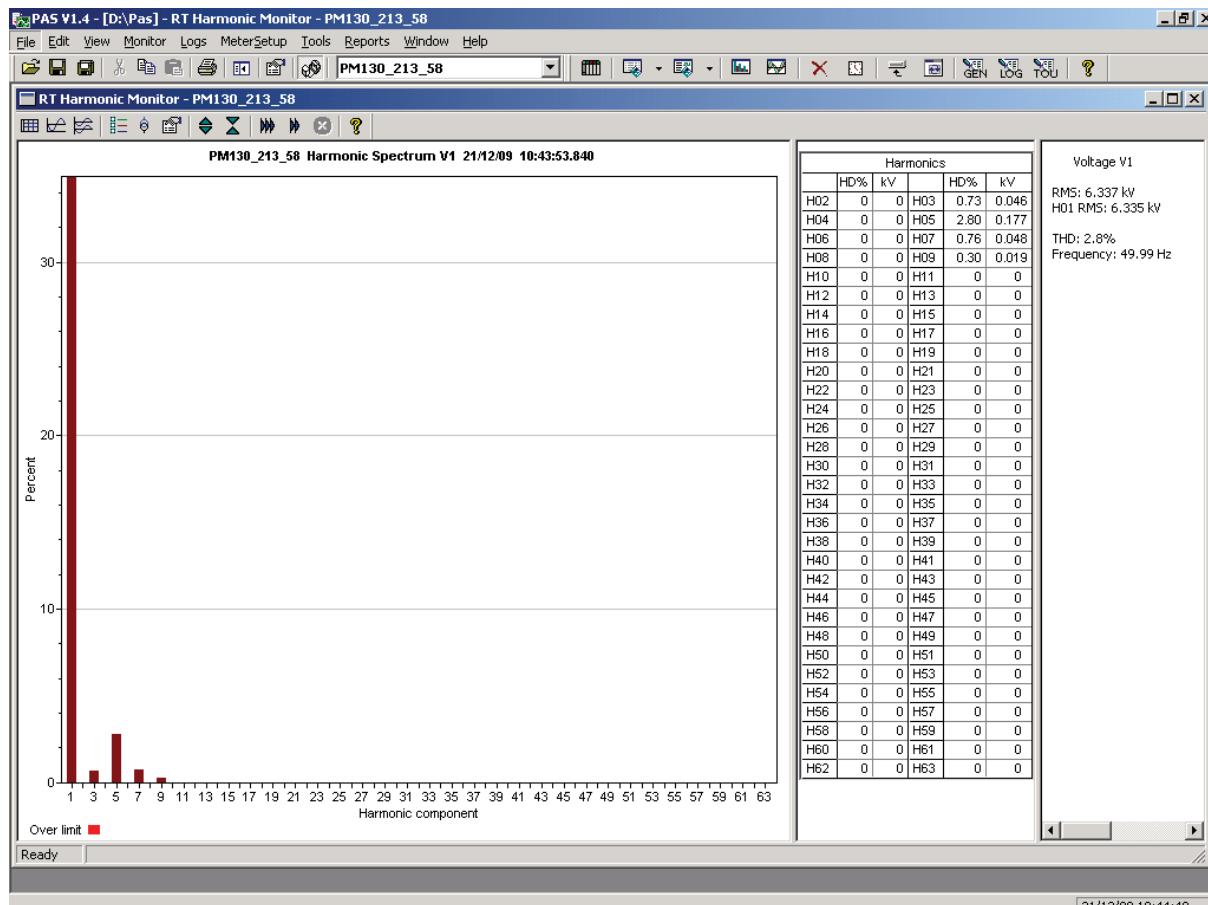


Figure 7-3: RT Harmonic Monitor – Spectrum Chart

PAS retrieves harmonic spectrum for V1-V3 and I1-I3 channels. Harmonics can be displayed as a spectrum chart for a selected channel or in a table. PAS can also synthesize waveforms based on the harmonic

spectrum to let you view a shape of the voltage and current waveforms in your network.

## Viewing a Spectrum Chart

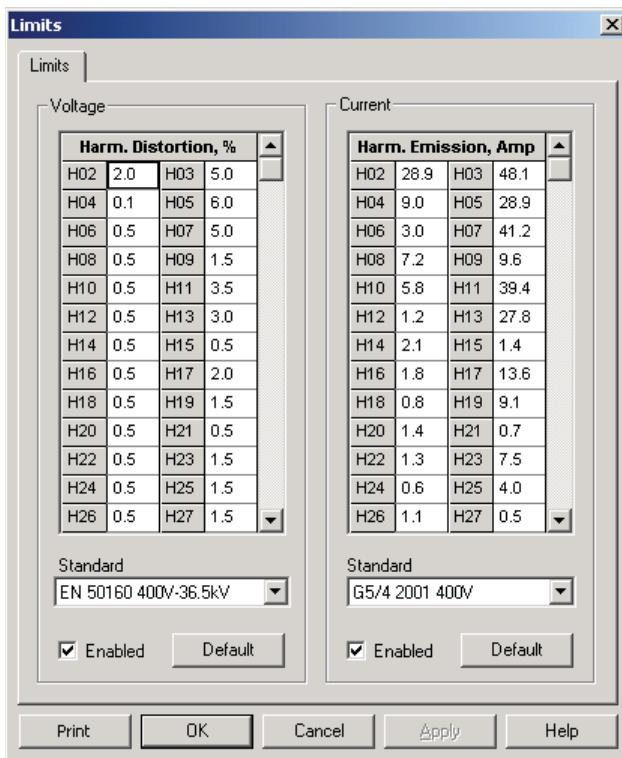
Click on the  button to view a spectrum chart for the selected channel. To change a channel, click on the window with the right mouse button, select **Channels...**, check the channel you want displayed, and then click **OK**. PAS provides voltage, current, active power and reactive power spectrum charts.

PAS can give you indication on whether harmonic levels in the sampled waveforms exceed compliance limits defined by the power quality standards or local regulations.

### To review or change harmonic limits:

1. Click on the spectrum window with the right mouse button and select **Limits....**
2. Select a known harmonics standard, or select **Custom** and specify your own harmonic limits.
3. Check the **Enabled** box to visualize harmonic faults on the spectrum graph and in harmonic tables.

Harmonics that exceed selected compliance levels are colored in red on the graph and in the tables.



The dialog box is titled 'Limits'. It contains two tables: 'Voltage' and 'Current'. Both tables have columns for Harm. Distortion, % and Harm. Emission, Amp. Each table lists harmonics from H02 to H27. Below each table are dropdown menus for 'Standard' and checkboxes for 'Enabled' and 'Default'.

Voltage				Current			
Harm. Distortion, %				Harm. Emission, Amp			
H02	2.0	H03	5.0	H02	28.9	H03	48.1
H04	0.1	H05	6.0	H04	9.0	H05	28.9
H06	0.5	H07	5.0	H06	3.0	H07	41.2
H08	0.5	H09	1.5	H08	7.2	H09	9.6
H10	0.5	H11	3.5	H10	5.8	H11	39.4
H12	0.5	H13	3.0	H12	1.2	H13	27.8
H14	0.5	H15	0.5	H14	2.1	H15	1.4
H16	0.5	H17	2.0	H16	1.8	H17	13.6
H18	0.5	H19	1.5	H18	0.8	H19	9.1
H20	0.5	H21	0.5	H20	1.4	H21	0.7
H22	0.5	H23	1.5	H22	1.3	H23	7.5
H24	0.5	H25	1.5	H24	0.6	H25	4.0
H26	0.5	H27	1.5	H26	1.1	H27	0.5

Figure 7-4: Harmonic Limits

## Viewing a Spectrum Table

Click on the  button on the local toolbar to display the harmonics spectrum in a tabular view for a selected phase or for all phases together.

The spectrum table shows voltage, current, active power and reactive power harmonic components both in percent of the fundamental and in natural units, and harmonic phase angles.

To change a phase, click on the window with the right mouse button, select **Options...**, check the phase you want displayed, and then click **OK**.

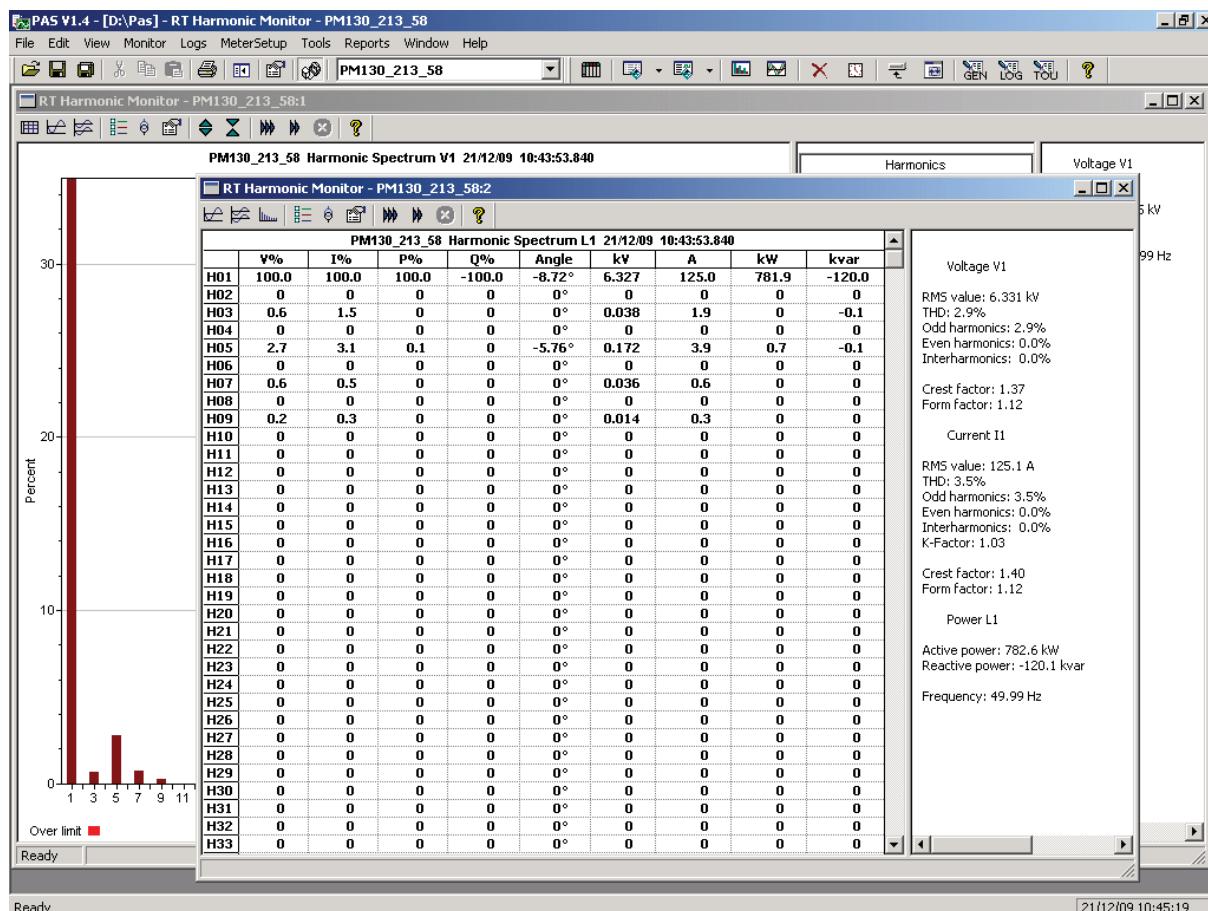


Figure 7-5: RT Harmonic Monitor – Spectrum Table

## Viewing Synthesized Waveforms

To view the synthesized waveforms based on the sampled harmonic spectrum, click on the button on the local toolbar to view non-overlapped voltage and current waveforms, or click on the button to view them overlapped.

PAS shows a pair of 4-cycle voltage and current synthesized AC waveforms for a single phase.

To select the channels you want to view, click with the right mouse button on the waveform window, select "Channels...", check the channels for the phase you want displayed, and then click OK.

## Chapter 7 Monitoring M E T E R S

### S P E C T R U M

### Viewing R E A L - T I M E H A R M O N I C S

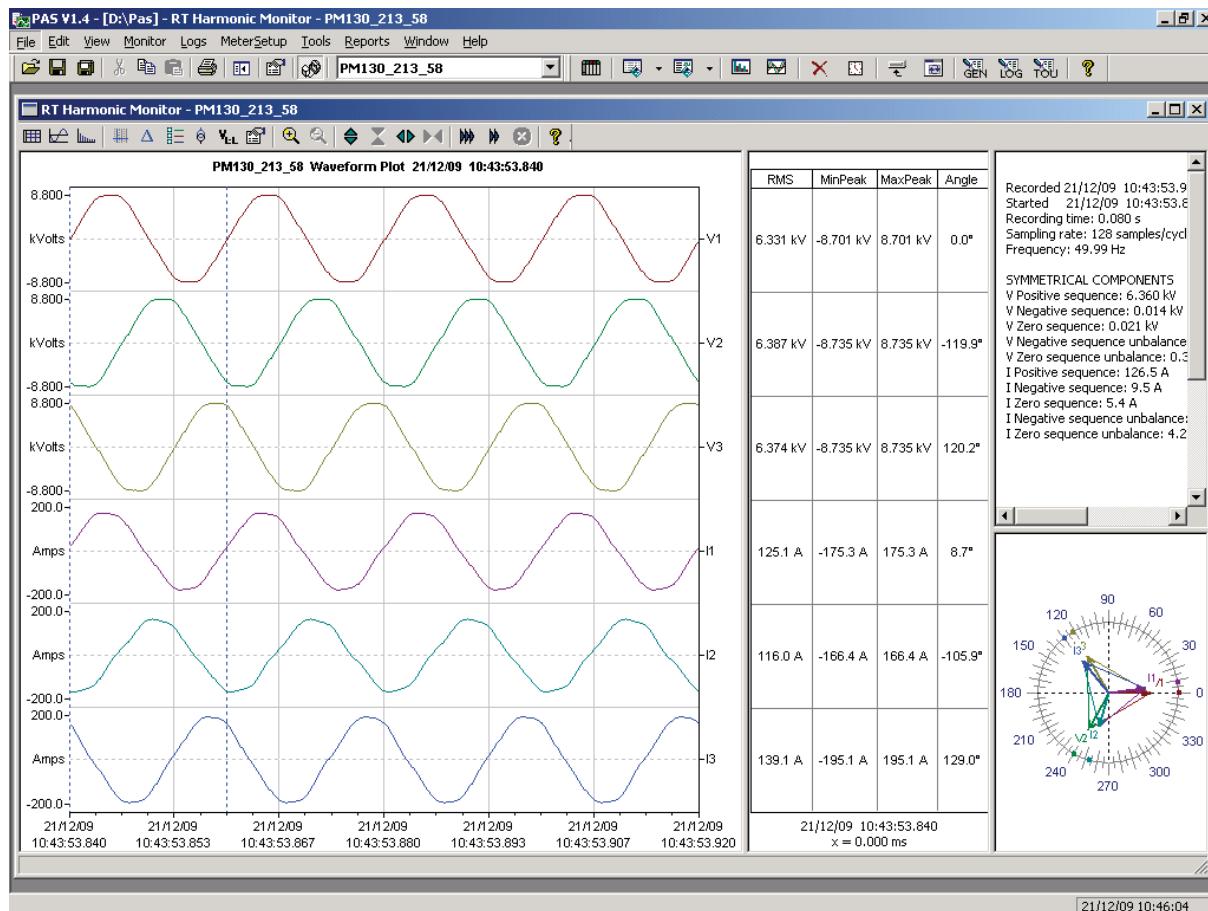


Figure 7-6: RT Harmonic Monitor – Synthesized Waveforms

# Chapter 8 Retrieving and Storing Files

PAS allows you to retrieve recorded events and data from your meters and to save them to files on your PC in the Microsoft Access database format.

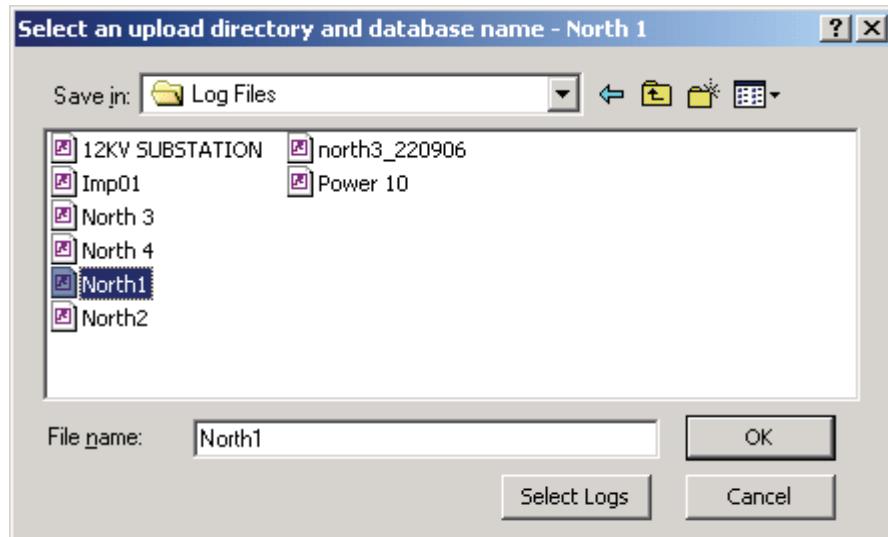
Historical data can be uploaded on demand any time you need it, or periodically through the Upload Scheduler that retrieves data automatically on a predefined schedule, for example, daily, weekly or monthly.

If you do not change the destination database location, new data is added to the same database so you can store long-term data profiles in one database regardless of the upload schedule you selected.

## 8.1 Uploading Files on Demand

To retrieve the log files from your meter:

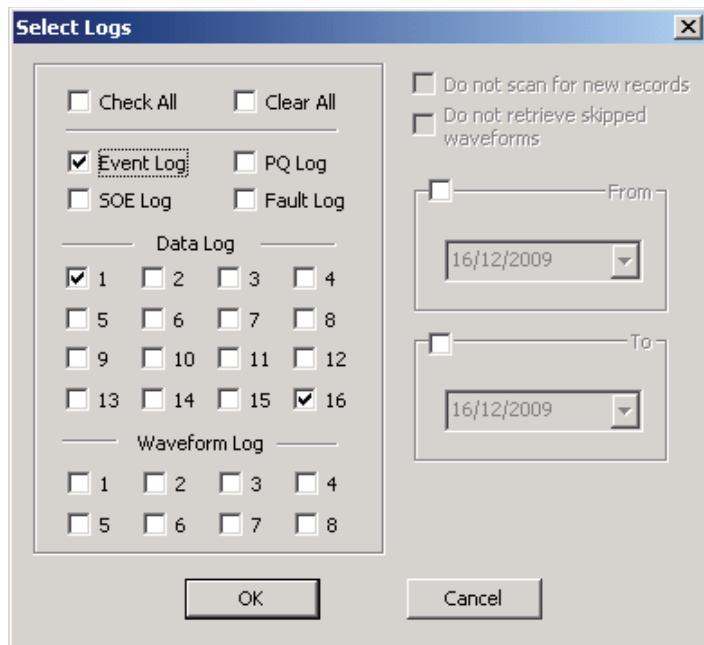
1. Ensure that the On-line button  on the PAS toolbar is checked.
2. Select a device site from the list box on the PAS toolbar.
3. Select **Upload Logs** from the **Logs** menu.



4. Select a database, or type the name for a new database, and select a directory where you want to save it.
5. Click on the **Select Logs** button and check boxes for logs you want to be retrieved from the meter.
6. If you wish to retrieve data starting with a known date, check the "From" box and select the start date for retrieving data.
7. If you wish to retrieve data recorded before a known date, check the "To" box and select the last date for retrieving data.
8. Click **OK**.

**Chapter 8 Retrieving A ND S TORING F ILES**  
**Using THE U PLOAD S CEDULER**

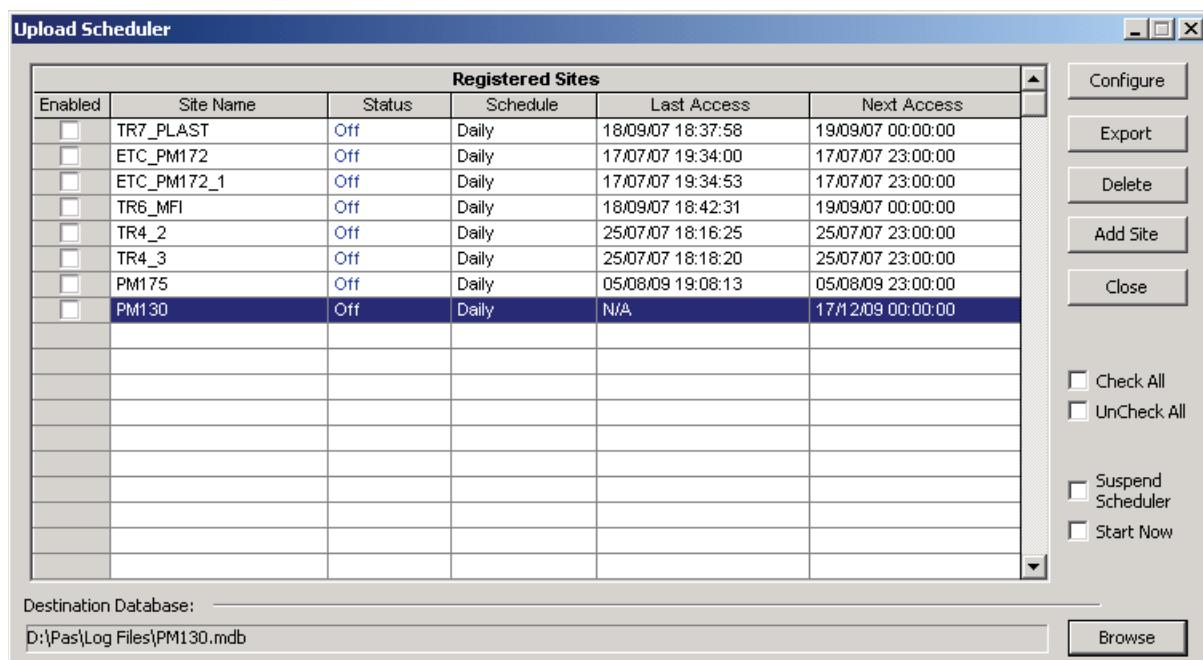
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## 8.2 Using the Upload Scheduler

To setup the Upload Scheduler:

1. Select **Upload Scheduler** from the **Logs** menu.



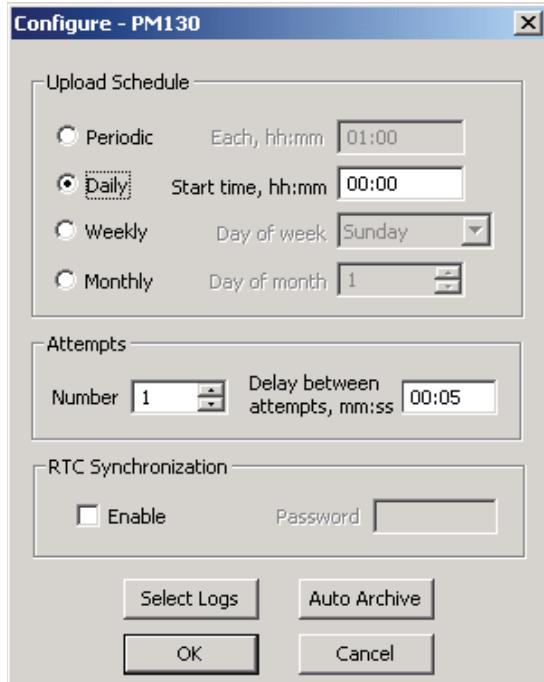
**Figure 8-1: Upload Scheduler Setup Dialog Box**

2. Click **Add Site**, point to the site database for which you want to organize the schedule, and then click **OK**.
3. Click **Browse** and select a database for storing retrieved data, or type the name for a new database, select a directory where you want to save it, and then click **OK**.
4. Click **Configure** or double click on the site row.

## Chapter 8 Retrieving A ND S TORING F ILES

### Using THE U PLOAD S CEDULER

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5. Select a daily, weekly or monthly schedule, and adjust the start time. If you wish to upload data periodically in predefined intervals, click on **Periodic** and define the time period in hours and minutes.
6. Select the number of attempts to upload data in the event of temporary communication problems or unavailability of your device, and the delay between attempts in minutes and seconds.
7. If you wish to use the schedule to synchronize the device clock with your PC, check the **RTC Synchronization Enable** box. If your device is password protected by a communications password, type in the password you set in the device to allow PAS to update the clock.
8. Click on the **Select Logs** button, check the boxes for logs you want to upload on a schedule, and then click **OK**.
9. Check the **Enabled** box at left to activate a schedule for the device.
10. Click **Close** to store your schedule.

To keep the Upload Scheduler running, the On-line button  on the PAS toolbar must be checked all the time. If you uncheck it, the scheduler stops operations. This does not cause loss of data, since the scheduler will resume operations when you check this button again.

### Suspending the Scheduler

To suspend the Upload Scheduler, check the **Suspend Scheduler** box at right. To activate the Upload Scheduler, leave this box unchecked.

### Running the Scheduler on Demand

You can run the scheduler at any time outside the schedule by checking the **Start Now** box at right. This is a one-time action. After uploading is completed, the Upload Scheduler un-checks this box automatically.

## Reviewing Upload Problems

When the Upload Scheduler fails to retrieve data from the device, or some data is missing, or another problem occurs, it puts an error message to the log file. To review this file, select **System Log** from the **View** menu.

## 8.3 Viewing Files On-line

Sometimes, it is useful to review a particular piece of historical data online at the time you expect new events to appear in the log. PAS allows you to retrieve historical data from a particular log without storing it to a file. The data appears only in the window on your screen. You can save it manually to the database.

To view the log data on-line, check the **On-line** button  on the PAS toolbar, select the log you want to retrieve in the **Logs** menu, and then click on the **Poll** button . Only new log records are retrieved from the device. If you want to review the entire log from the beginning, click on the **Restore log** button , and then click on the **Poll** button .

### NOTE

When reading multi-section profile data, only the first section is available for reading online.

See Chapter 9 [Viewing Files](#) for information on using different log views.

## 8.4 Exporting Files

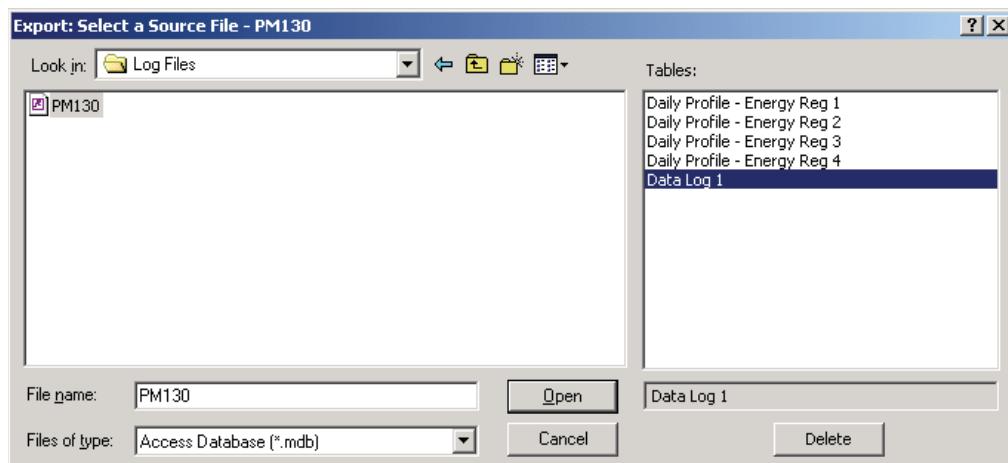
### Exporting Files in COMTRADE and PQDIF Formats

The COMTRADE and PQDIF file converters allow you to convert saved real-time waveforms into COMTRADE or PQDIF file format, and data log tables – into PQDIF format.

#### Manual Converting

To manually convert your waveforms or a data log into COMTRADE or PQDIF format:

1. Click on the Export  button on the PAS toolbar.

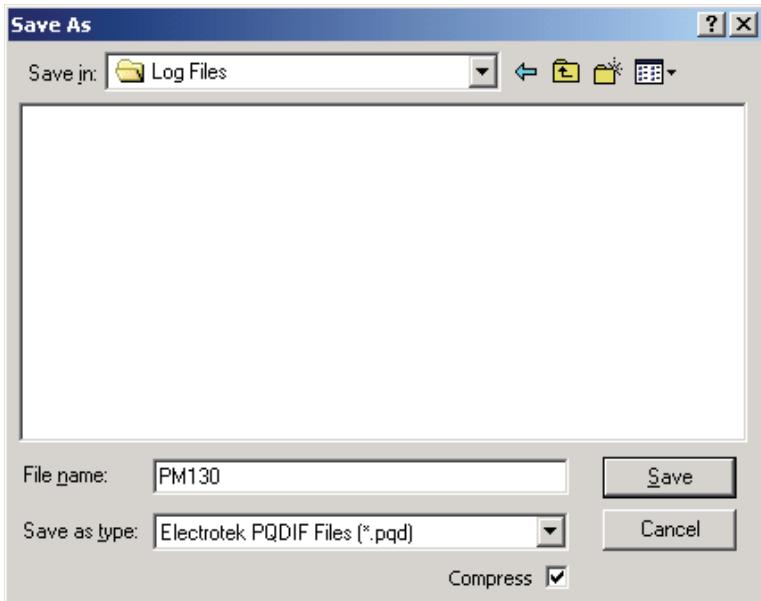


2. Select the database and a data log table you want to export, and then click Open.

## Chapter 8 Retrieving A ND S T O R I N G F I L E S

### Exporting F I L E S

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3. Select a folder where you want to store your exported files, type a file name that identifies your files, select a file output format, and then click on the **Save** button.
4. The PQDIF files are commonly recorded in compressed format. If you do not want your files to be compressed, uncheck the **Compress** box before saving the file.

In COMTRADE format, each waveform event is recorded into a separate file.

PQDIF file names are followed by a timestamp of the first event recorded to the file, and may look like follows:

12KVSUB\_20040928T133038.pqd.

### Automatic Converting

PAS allows you to automatically convert data logs into PQDIF format at the time you upload data from your devices via the Upload Scheduler.

To automatically convert your data log tables into PQDIF format:

1. Open the **Upload Scheduler**.
2. Highlight a desired device site with the left mouse button, and then click on the **Export** button.
3. Check the **Enabled** box for a data log or a waveform log table you want to automatically convert at the upload time.
4. Highlight the **Record to...** row for the selected table and click on the **Browse** button.
5. Select a folder where you want to store converted files, type in the converted file's name, select a desired output file format, and then click on **Save**.
6. Repeat the same for all tables you wish to be converted.
7. Click **OK**.

## Exporting Files in Excel Format

PAS allows you to convert data tables into the Microsoft Excel workbook format, either manually, or automatically while retrieving data from your meters via the Upload Scheduler.

To store files in Excel format, follow instructions in the previous section and select **Excel Workbook** as the output file format.

The first row of the Excel table lists data names (see Appendix D) and the second row provides data codes, which identify recorded data points (see Modbus communications guide for data codes) that may be useful for automated table processing.

Each table row is provided with the device identifier that you can define in the meter database (see [Creating a New Site for your Meter](#)).

## 8.5 Archiving Files

Microsoft Access databases tend to grow fast. Databases above 0.5 Gigabytes can drastically slow down file operations.

To avoid enormous growing files, you can either periodically change the target database, or use the Upload Scheduler's file archiver to automatically move older data to archives.

The Upload Scheduler archives files upon a weekly, monthly or yearly schedule. When archiving data, a new database is created to where older data from your present database with the expired archiving date is moved.

An archive file keeps the original database name to which the date of the oldest database record is added, so you can easily identify your archives and work with them as you work with a regular database.

To provide a schedule for archiving files:

1. When defining a schedule for uploading files from your meter, click on **Configure** or double click on the site row.
2. Click **Auto Archive**.



3. Check the **Enable** box and select a periodic schedule for archiving your files for this site.
4. Click **OK**.

To avoid archiving partially updated data, archiving is performed in a day after expiring a scheduled period and not before 2 hours a.m.

# Chapter 9 Viewing Files

## 9.1 Operations with Files

Files you read from the meters are stored in one or in a number of tables in the meter database. Sections of multi-section files like energy load profiles are stored in multiple tables – each file section in a separate database table.

### Opening a Database Table

To open a database table:

1. Click on the **Open** button  on the PAS toolbar, or select **Open...** from the File menu.
2. Select **Access Database (\*.mdb)** in the **Files of type** box; select a directory where your files are located, and point to the file you wish to open.
3. Select a desired table on the right pane, and then click **Open**, or double click on the table name.

Names of the last 16 files you opened are stored in the **File** menu, so you can select them directly from the menu.

### Saving Data to a File

To save data from the open database table to a file:

1. Click on the **Save** button , and select a directory where you want your file to be stored.
2. Select a database or type the name for a new database.
3. Click **Save**.

To avoid confusion, do not store data files into the **Sites** directory where site databases are located.

## 9.2 Viewing Options

### Customizing Views

#### Changing Date Order

To change the way PAS displays the date:

1. Select **Options** from the **Tools** menu and click on the **Preferences** tab.
2. Select the preferred date order.
3. Click **OK**.

#### Selecting Timestamp Format

The timestamp is normally recorded and displayed on the screen at a 1-ms resolution. If you have an application that does not support this format, you may instruct PAS to drop milliseconds.

To change the way PAS records and displays the timestamp:

1. Select **Options** from the **Tools** menu and click on the **Preferences** tab.

2. Select the preferred timestamp format.
3. Click **OK**.

## Working with Tables

### Selecting Font and Grid

To change the table font or a type of the grid lines:

1. Click with right mouse button on the table, select **Options** and click on the **Table** tab.
2. Select the font type and size and how you wish the table grid to be shown.
3. Click **OK**.

### Selecting Primary and Secondary Units

Voltages and currents can be displayed in primary or secondary units.

To change units, click on the table with the right mouse button, select **Options**, select the desired units for voltages and currents, and then click **OK**.

### Copying a Table

To copy the entire table, or its part, into the Clipboard or into another application such as Microsoft Excel or Word:

1. Click on the data window with the right mouse button and choose **Select All**, or click on the upper-left corner of the table (where the "No." label is commonly displayed).
2. Click with the right mouse button on the window again and choose **Copy**, or click on the **Copy** button  on the PAS toolbar.
3. Run the application to which you want to copy data, position the cursor at the correct place.
4. Click the **Paste** button  on the application's toolbar or select **Paste** from the **Edit** menu.

When copying, table columns are separated by a tab character.

### Printing a Table

To check how your document appears on a printed page, select **Print Preview** from the **File** menu.

To print a table to a printer, click on the print button  on the toolbar, select a printer and click **OK**.

## Working with Graphic Windows

### Selecting Channels

To select the channels you want to view on the screen, click on the graph window with the right mouse button, select **Channels...**, check the channels you want displayed, and then click **OK**.

Checkboxes for channels that are not available in the present view are dimmed.

## Selecting Primary and Secondary Units

Voltages and currents can be displayed in primary or secondary units.

To change units, click on the table with the right mouse button, select **Options**, select the desired units for voltages and currents, and then click **OK**.

## Selecting the Time Axis

In waveform views, the horizontal axis can be displayed either in absolute time with date and time stamps, or in milliseconds relatively to the beginning of a waveform.

To change the time units, click on the waveform window with the right mouse button, select **Options...**, click on the **Axes** tab, select the desired units, and then click **OK**.

## Selecting Line Styles and Colors

Channel waveforms can be displayed using different colors and line styles.

To change the colors or line styles, click on the graph window with the right mouse button, select **Options...**, click on the **Display** tab, adjust colors and styles, and then click **OK**.

## Selecting Grid and Frame Colors

Click on the graph window with the right mouse button, select **Options...**, and click on the **Display** tab

To change the color or style of the grid lines, click on the **Grid** line on the left pane, and then select the color and style for the grid. To disable the grid, uncheck the **Grid Visible** box.

To change the window frame color to white, check the **White Frame** box at right.

## Using Marker Lines

The waveform and trend windows have two blue dashed marker lines. The left marker indicates the starting position and the right marker indicates the end position for calculating the average and peak values.

The minimum distance between the two markers is exactly one cycle.

To change the marker position, click on the  button, or click on the window with the right mouse button and select **Set Marker**, and then click on the point where you want to put the marker.

You can also drag both markers with the mouse, or use the right and left arrow keys on your keyboard to change the marker position. Click on the graph pane to allow the keyboard to get your input before using the keyboard.

## Delta Measurements

To measure the distance between two waveform or trend points, click on the **Delta** button , then click on the first point, and then click on the second point.

The first reference point is still frozen until you uncheck and check the **Delta** button again, while the second point can be placed anywhere within the graph line by clicking on the graph to the left or right from the reference point.

To disable delta measurements, click on the **Delta** button once again.

## Using a Zoom

You can use a horizontal and, for waveforms, also a vertical, zoom to change size of your graph.

Use the buttons on your local toolbar to zoom in and zoom out. One click gives you a 100-percent horizontal or 50-percent vertical zoom. Two buttons representing magnifying glasses give you a proportional zoom in both directions.

## Copying a Graph

To copy a graph, or its part, into the Clipboard or into another application such as Microsoft Excel or Word:

1. Click on the graph window with the right mouse button and choose **Copy All**, or **Copy Waveform**. Some windows may have additional options.
2. Position the cursor at the place where you wish to copy the graph.
3. Click the **Paste** button on the application's toolbar or select Paste from the **Edit** menu.

## Printing a Graph

To check how the graph appears on a printed page, select **Print Preview** from the **File** menu.

To print a graph to a printer, click on the **Print** button on the PAS toolbar, select a printer and click **OK**.

## 9.3 Viewing the Event Log

The Event log contains time-tagged events related to configuration changes, resets and device diagnostics.

The Event log is displayed in a tabular view, one event per row. Use the scroll bar to view the entire log contents.

No.	Date/Time	Event	Cause	Point/Source	Value	Effect	Target
34	07/12/09 19:55:06.763	COMM	Billing/TOU setup			Setup change	
35	07/12/09 19:55:06.790	COMM	Billing/TOU setup			Setup change	
36	07/12/09 19:55:06.817	COMM	Billing/TOU setup			Setup change	
37	07/12/09 20:13:27.399	COMM	Billing/TOU setup			Setup change	
38	07/12/09 20:13:27.426	COMM	Billing/TOU setup			Setup change	
39	07/12/09 20:13:27.453	COMM	Billing/TOU setup			Setup change	
40	07/12/09 20:13:27.480	COMM	Billing/TOU setup			Setup change	
41	07/12/09 20:23:22.278	EXTERNAL	Power down				
42	07/12/09 20:23:23.000	SELF-CHECK	RTC		07/12/09 20:23:22	RTC set	
43	07/12/09 20:23:23.000	EXTERNAL	Power up				
44	08/12/09 02:35:42.780	EXTERNAL	Power down				
45	08/12/09 02:36:11.000	EXTERNAL	Power up				
46	08/12/09 05:16:18.012	FRONT PANEL	Comm. setup			Setup change	
47	08/12/09 05:37:08.666	EXTERNAL	Power down				
48	08/12/09 05:37:09.000	SELF-CHECK	RTC		08/12/09 05:37:08	RTC set	
49	08/12/09 05:37:09.000	EXTERNAL	Power up				
50	08/12/09 05:37:10.476	EXTERNAL	Power down				
51	08/12/09 05:37:11.000	SELF-CHECK	RTC		08/12/09 05:37:10	RTC set	
52	08/12/09 05:37:11.000	EXTERNAL	Power up				
53	08/12/09 05:39:05.141	COMM	Basic setup			Setup change	
54	08/12/09 05:39:30.241	COMM	Basic setup			Setup change	
55	08/12/09 05:40:04.471	COMM	Setpoints setup			Setpoint set	#2
56	08/12/09 05:40:22.107	COMM	Basic setup			Setup change	
57	08/12/09 05:41:53.015	COMM	Setpoints setup			Setpoint set	#2
58	08/12/09 05:41:53.107	COMM	Setpoints setup			Setpoint set	#3
59	08/12/09 05:41:53.196	COMM	Setpoints setup			Setpoint set	#4
60	08/12/09 05:41:53.286	COMM	Setpoints setup			Setpoint set	#5
61	08/12/09 12:35:16.258	COMM	Data memory			Cleared max dmd	ALL
62	16/12/09 18:10:38.262	COMM	RTC		08/12/09 12:35:30	RTC set	
63	16/12/09 20:55:55.363	EXTERNAL	Power down				
64	16/12/09 20:55:56.000	SELF-CHECK	RTC		16/12/09 20:55:55	RTC set	
65	16/12/09 20:55:56.000	EXTERNAL	Power up				
66	16/12/09 22:22:42.241	EXTERNAL	Power down				
67	16/12/09 22:22:54.000	EXTERNAL	Power up				
68	16/12/09 22:24:11.932	COMM	Net setup			Setup change	
69	16/12/09 22:25:59.945	COMM	Setpoints setup			Setpoint set	#6
70	17/12/09 01:17:32.278	COMM	Data memory			Cleared max dmd	POWER

Figure 9-1: Event Log Window

See [Working with Tables](#) for more information on viewing options.

### Filtering and Sorting Events

You can use filtering to find and work with a subset of events that meet the criteria you specify.

Click on the Filter button , or click on the report window with the right mouse button and select **Filter....** Check the causes of events you want to display, and then click **OK**. PAS temporary hides rows you do not want displayed.

To change the default sorting order based on the date and time, click on the **Sort** button , or click on the report window with the right mouse button and select **Sort...**, check the desired sort order, and then click **OK**.

## 9.4 Viewing the Data Log

Data log files can be displayed in a tabular view, one data record per row, or in a graphical view as a data trend graph.

## Chapter 9 Viewing FILES

## Viewing THE DATA LOG

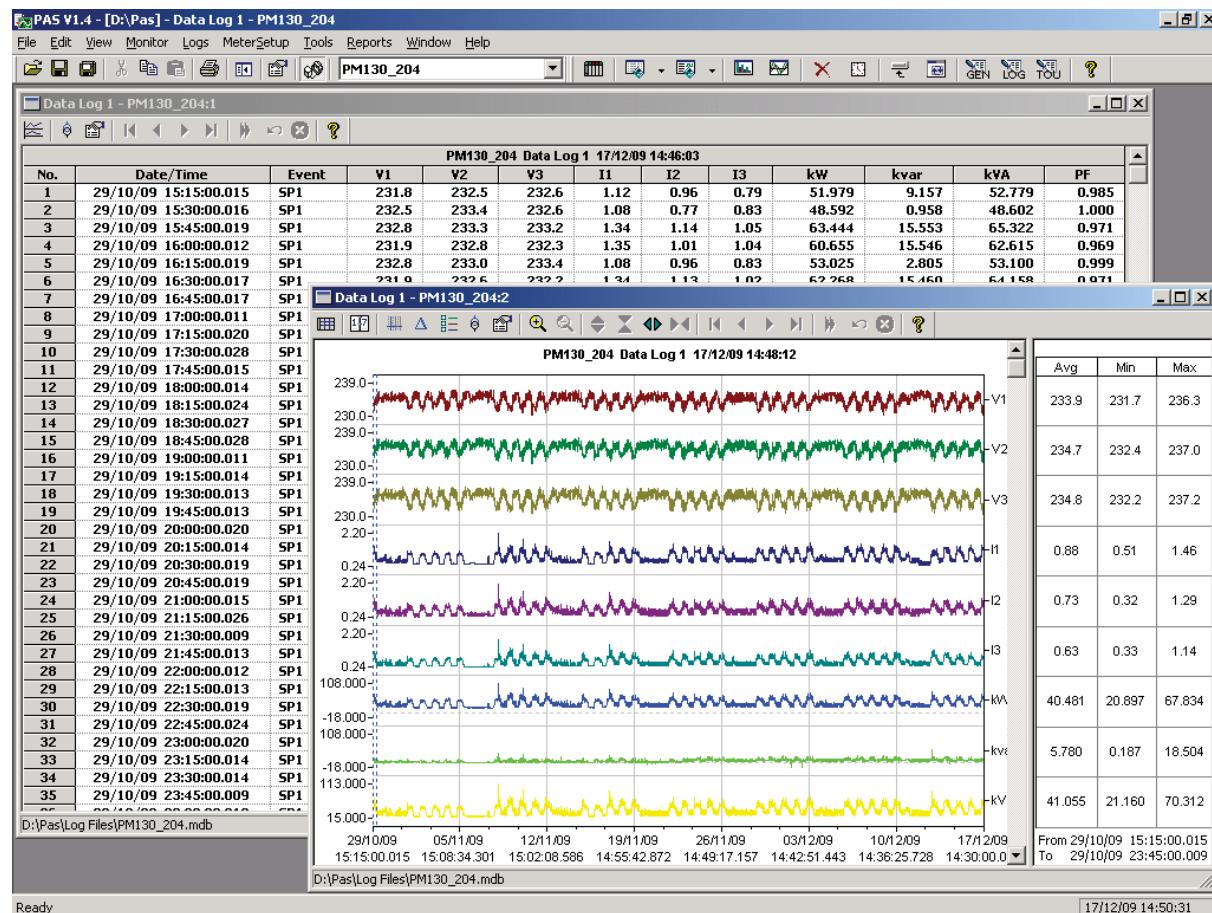


Figure 9-2: Data Log Window

## Viewing Data Trend

To view data in a graphical form, click on the **Data Trend** button on the local toolbar.

To change the time range for your graph, click on the **Time Range** button on the local toolbar, and then select the desired date and time range.

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## Appendix A Technical Specifications

# Appendix A Technical Specifications

### A.1 Environmental Conditions

Operating temperature: -30°C to 60°C (-22°F to 140°F)

Storage temperature: -40°C to 85°C (-40°F to 185°F)

Humidity: 0 to 95% non-condensing

### A.2 Construction

#### Dimensions see Figure 2-1

Weight: 0.70 kg (1.54 lb.)

#### Materials

Case enclosure: plastic PC/ABS blend

Front panel: plastic PC

PCB: FR4 (UL94-V0)

Terminals: PBT (UL94-V0)

Connectors-Plug-in type: Polyamide PA6.6 (UL94-V0)

Packaging case: Carton and Stratocell® (Polyethylene Foam) brackets

Labels: Polyester film (UL94-V0)

### A.3 Power Supply

#### 120/230 VAC-DC Option:

Rated input: 85-265VAC 50/60/400 Hz, 88-290VDC, Burden 9VA

Isolation:

Input to ground: 2500 VAC

#### 12 VDC Option:

Rated input: 9.5-18 VDC, Burden 4VA

Isolation: 1500VDC

#### 24/48 VDC Option:

Rated input: 18.5-58 VDC, Burden 4VA

Isolation: 1500VDC

Wire size: up to 12 AWG (up to 3.5 mm<sup>2</sup>)

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Appendix A Technical Specifications

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## A.4 Input Ratings

### **Voltage Inputs**

Operating range: 690VAC line-to-line, 400VAC line-to-neutral

Direct input and input via PT (up to 828VAC line-to-line, up to 480VAC line-to-neutral)

Input impedance: 1000 kΩ

Burden for 400V: < 0.4 VA

Burden for 120V: < 0.04 VA

Over-voltage withstands: 1000 VAC continuous, 2000 VAC for 1 second

Wire size: up to 12 AWG (up to 3.5mm<sup>2</sup>)

### **Current Inputs (via CT)**

Wire size: 12 AWG (up to 3.5 mm<sup>2</sup>)

Galvanic isolation: 3500 VAC

### **5A secondary (standard)**

Operating range: continuous 10A RMS

Burden: < 0.2 VA @ In=5A (with 12AWG wire and 1 m long)

Overload withstand:

15A RMS continuous, 300A RMS for 1 second (with 12AWG section wire)

### **1A secondary (option)**

Operating range: continuous 2A RMS

Burden: < 0.02 VA @ In=1A (with 12AWG wire and 1 m long)

Overload withstand:

3A RMS continuous, 80A RMS for 1 second (with 12AWG section wire)

### **Sampling Rate measurement**

128 samples/cycle

## A.5 Optional Relay Outputs

### **Electromechanical relay - DRY contact, option (DI/DO Optional module)**

2 relays rated at 5A/250 VAC; 5A/30 VDC, 1 contact (SPST Form A)

Galvanic isolation:

Between contacts and coil: 3000 VAC 1 min

Between open contacts: 750 VAC

Operate time: 10 ms max.

Release time: 5 ms max.

Update time: 1 cycle

Wire size: 14 AWG (up to 1.5 mm<sup>2</sup>)

### **Solid State relay option**

2 relays rated at 0.15A/250 V AC/DC, 1 contact (SPST Form A)

Galvanic isolation: 3750 VAC 1 min

Operate time: 1 ms max.

## Appendix A Technical Specifications

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Release time: 0.25 ms max.  
 Update time: 1 cycle  
 Connector type: removable, 4 pins.  
 Wire size: 14 AWG (up to 1.5 mm<sup>2</sup>)

### A.6 Optional Digital Inputs

4 Digital Inputs Dry Contacts, internally wetted @ 24VDC (DI/DO Optional module)  
 Sensitivity: Open @ input resistance >100 kΩ, Closed @ Input resistance < 100 Ω  
 Galvanic isolation: 3750 VAC 1 min  
 Internal power supply: 24VDC  
 Scan time: 1 ms  
 Connector type: removable, 5 pins.  
 Wire size: 14 AWG (up to 1.5 mm<sup>2</sup>)

### A.7 Optional Analog Outputs

4 Analog Outputs optically isolated (AO Optional module)  
 Ranges (upon order):  
 ±1 mA, maximum load 5 kΩ (100% overload)  
 0-20 mA, maximum load 510 Ω  
 4-20 mA, maximum load 510 Ω  
 0-1 mA, maximum load 5 kΩ (100% overload)  
 Isolation: 2500 VAC 1 min  
 Power supply: internal  
 Accuracy: 0.5% FS  
 Update time: 1 cycle  
 Connector type: removable, 5 pins.  
 Wire size: 14 AWG (up to 1.5 mm<sup>2</sup>)

### A.8 Communication Ports

#### **COM1**

RS-485 optically isolated port  
 Isolation: 3000 VAC 1 min  
 Baud rate: up to 115.2 kbps.  
 Supported protocols: Modbus RTU, DNP3, and SATEC ASCII.  
 Connector type: removable, 3 pins.  
 Wire size: up to 14 AWG (up to 1.5 mm<sup>2</sup>).

#### **COM2 (Optional module)**

#### **Ethernet Port**

Transformer-isolated 10/100BaseT Ethernet port.  
 Supported protocols: Modbus/TCP (Port 502), DNP3/TCP (Port 20000).

## Appendix A Technical Specifications

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Number of simultaneous connections: 4 (2 Modbus/TCP + 2 DNP3/TCP).

Connector type: RJ45 modular.

### **Profibus DP (IEC 61158)**

RS-485 optically isolated Profibus interface.

Connector type: removable, 5 pins.

Baud rate: 9600 bit/s – 12 Mbit/s (auto detection).

32 bytes input, 32 bytes output.

Supported protocols: PROFIBUS.

### **RS-232/422-485 Port**

RS-232 or RS-422/485 optically isolated port

Isolation: 3000 VAC 1 min

Baud rate: up to 115.2 kbps.

Supported protocols: Modbus RTU, DNP3, and SATEC ASCII.

Connector type: removable, 5 pins for RS-422/485 and DB9 for RS-232.

Wire size: up to 14 AWG (up to 1.5 mm<sup>2</sup>).

## A.9 Real-time Clock

### **Standard Meter Clock**

Non-backed clock

Accuracy: typical error 1 minute per month @ 25°C

Typical clock retention time: 30 seconds

### **TOU Module Meter Clock**

Battery-backed clock

Accuracy: typical error 7 seconds per month @ 25°C ( $\pm 2.5\text{ppm}$ )

Typical clock retention time: 36 months

## A.10 Display

High-brightness seven-segment digital LEDs, two 4-digit + one 5-digit windows

3 color led load bar graph (40-110%)

Keypad: 6 push buttons

## A.11 Standards Compliance

### **Accuracy:**

Complies IEC62053-22, class 0.5S

Meets ANSI C12.20 -1998, class 10 0.5%

### **Electromagnetic Immunity:**

Comply with IEC 61000-6-2:

IEC 61000-4-2 level 3: Electrostatic Discharge

IEC 61000-4-3 level 3: Radiated Electromagnetic RF Fields

IEC 61000-4-4 level 3: Electric Fast Transient

IEC 61000-4-5 level 3: Surge

## Appendix A Technical Specifications

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IEC 61000-4-6 level 3: Conducted Radio Frequency

IEC 61000-4-8: Power Frequency Magnetic Field

Meets ANSI/IEEE C37.90.1: Fast Transient SWC

### **Electromagnetic Emission:**

Comply with IEC 61000-6-4: Radiated/Conducted class A

Comply with IEC CISPR 22: Radiated/Conducted class A

### **Safety/Construction:**

UL File no. E236895

Meets IEC 61010-1: 2006

### **AC and Impulse Insulation:**

Comply with IEC 62052-11:

2500 VAC during 1 minute

6KV/500Ω @ 1.2/50 μs impulse

## Appendix A Technical Specifications

**A.12 Measurement Specifications****Table 33: Measurement Specifications Parameters**

Parameter	Full Scale @ Input Range	Accuracy			Range
		% Reading	% FS	Conditions	
Voltage	120VxPT @ 120V 400VxPT @ 690V	0.2	0.02	10% to 120% FS	0 to 1,150,000 V Starting voltage 1.5-5.0% FS (selectable)
Line current	CT	0.2	0.02	For In = 5A 1% to 200% FS For In = 1A 5% to 200% FS	0 to 50,000 A Starting current 0.1% FS
Active power	0.36×PT×CT @ 120V 1.2×PT×CT @ 690V	0.3	0.02	PF  ≥ 0.5 <sup>1</sup>	-10,000,000 kW to +10,000,000 kW
Reactive power	0.36×PT×CT @ 120V 1.2×PT×CT @ 690V	0.3	0.04	PF  ≤ 0.9 <sup>1</sup>	-10,000,000 kvar to +10,000,000 kvar
Apparent power	0.36×PT×CT @ 120V 1.2×PT×CT @ 690V	0.3	0.02	PF  ≥ 0.5 <sup>1</sup>	0 to 10,000,000 kVA
Power factor	1.000		0.2	PF  ≥ 0.5, I ≥ 2% FSI	-0.999 to +1.000
Frequency	50 Hz 60 Hz 25 Hz 400 Hz	0.02 0.04		V <sub>L-N</sub> > 25V	15 Hz to 70 Hz 15 Hz to 70 Hz 15 Hz to 70 Hz 320 Hz to 480 Hz
Total Harmonic Distortion, THD V (I), %Vf (%If)	999.9	1.5	0.2	THD ≥ 1%, V ≥ 10% FSV and V <sub>L-N</sub> > 25V, I ≥ 10% FSI	0 to 999.9
Total Demand Distortion, TDD, %	100		1.5	TDD ≥ 1%, I ≥ 10% FSI, V <sub>L-N</sub> > 25V	0 to 100
Active energy Import & Export				Class 0.5S under conditions as per IEC 62053-22:2003	0 to 999,999,999 kWh
Reactive energy Import & Export				Class 0.5S under conditions as per IEC 62053-22:2003,  PF  ≤ 0.9	0 to 999,999,999 kvarh
Apparent energy				Class 0.5S under conditions as per IEC 62053-22:2003	0 to 999,999,999 kVAh

PT - external potential transformer ratio

CT - primary current rating of the external current transformer

FSV - voltage full scale

FSI - current full scale

V<sub>f</sub> - fundamental voltageI<sub>f</sub> - fundamental current**NOTES**

1. Accuracy is expressed as ± (percentage of reading + percentage of full scale) ± 1 digit. This does not include inaccuracies introduced by the user's potential and current transformers. Accuracy calculated at 1second average.

<sup>1</sup> @ 80% to 120% of voltage FS, 1% to 200% of current FS and frequency 50/60 Hz

## Appendix A Technical Specifications

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2. Specifications assume: voltage and current waveforms with THD  $\leq$  5% for kvar, kVA and PF, and reference operating temperature 20°C - 26°C.
3. Measurement error is typically less than the maximum error indicated.

# Appendix B Analog Output Parameters

The following table lists parameters that can be provided on the meter's analog outputs.

**Table 34: Analog Output Parameters**

Display Code	Designation	Description
none	NONE	None (output disabled)
		<b>1-Cycle Phase Values</b>
rt.U1	V1/12 RT <sup>1</sup>	V1/V12 Voltage
rt.U2	V2/23 RT <sup>1</sup>	V2/V23 Voltage
rt.U3	V3/31 RT <sup>1</sup>	V3/V31 Voltage
rt.U12	V12 RT	V12 Voltage
rt.U23	V23 RT	V23 Voltage
rt.U31	V31 RT	V31 Voltage
rt.C1	I1 RT	I1 Current
rt.C2	I2 RT	I2 Current
rt.C3	I3 RT	I3 Current
		<b>1-Cycle Total Values</b>
rt.P	kW RT	Total kW
rt.q	kvar RT	Total kvar
rt.S	kVA RT	Total kVA
rt.PF	PF RT	Total PF
r.PF.LG	PF LAG RT	Total PF Lag
r.PF.Ld	PF LEAD RT	Total PF Lead
		<b>1-Cycle Auxiliary Values</b>
r.nEU.C	In RT	In Current
rt.Fr	FREQ RT	Frequency
		<b>1-Sec Phase Values</b>
Ar.U1	V1/12 AVR <sup>1</sup>	V1/V12 Voltage
Ar.U2	V2/23 AVR <sup>1</sup>	V2/V23 Voltage
Ar.U3	V3/31 AVR <sup>1</sup>	V3/V31 Voltage
Ar.U12	V12 AVR	V12 Voltage
Ar.U23	V23 AVR	V23 Voltage
Ar.U31	V31 AVR	V31 Voltage
Ar.C1	I1 AVR	I1 Current
Ar.C2	I2 AVR	I2 Current
Ar.C3	I3 AVR	I3 Current
		<b>1-Sec Total Values</b>
Ar.P	kW AVR	Total kW
Ar.q	kvar AVR	Total kvar
Ar.S	kVA AVR	Total kVA
Ar.PF	PF AVR	Total PF
A.PF.LG	PF LAG AVR	Total PF Lag
A.PF.Ld	PF LEAD AVR	Total PF Lead
		<b>1-Sec Auxiliary Values</b>
A.nEU.C	In AVR	In Current
Ar.Fr	FREQ AVR	Frequency
		<b>Demand E, EH</b>
Acd.P.i	kW IMP ACD	Accumulated kW import demand
Acd.P.E	kW EXP ACD	Accumulated kW export demand

Appendix B Analog Output P A R A M E T E R S

Display Code	Designation	Description
Acd.q.i	kvar IMP ACD	Accumulated kvar import demand
Acd.q.E	kvar EXP ACD	Accumulated kvar export demand
Acd.S	kVA ACD	Accumulated kVA demand

- <sup>1</sup> In 4LN3, 3LN3 and 3BLN3 wiring modes, the voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line voltages.

# Appendix C Setpoint Triggers and Actions

Table 35: Setpoint Triggers

Display Code	Designation	Description
nonE	NONE	None (condition is not active)
<b>Status Inputs</b>		
S1.On	STAT INP #1 ON	Status input #1 ON
S2.On	STAT INP #2 ON	Status input #2 ON
S3.On	STAT INP #3 ON	Status input #3 ON
S4.On	STAT INP #4 ON	Status input #4 ON
S1.OFF	STAT INP #1 OFF	Status input #1 OFF
S2.OFF	STAT INP #2 OFF	Status input #2 OFF
S3.OFF	STAT INP #3 OFF	Status input #3 OFF
S4.OFF	STAT INP #4 OFF	Status input #4 OFF
<b>Relays</b>		
r1.On	RELAY #1 ON	Relay #1 ON
r2.On	RELAY #2 ON	Relay #2 ON
r1.OFF	RELAY #1 OFF	Relay #1 OFF
r2.OFF	RELAY #2 OFF	Relay #2 OFF
<b>Phase Reversal</b>		
POS.P.r	POS PHASE REVERSAL	Positive phase rotation reversal
nEG.P.r	NEG PHASE REVERSAL	Negative phase rotation reversal
<b>Low/High 1-Cycle Values on any Phase</b>		
r.Hi. U	HI VOLT RT <sup>1</sup>	High voltage
r.Lo. U	LO VOLT RT <sup>1</sup>	Low voltage
r.Hi. C	HI AMPS RT	High current
r.Lo. C	LO AMPS RT	Low current
r.thd.U	HI V THD <sup>2</sup>	High voltage THD
r.thd.C	HI I THD <sup>2</sup>	High current THD
r.HFc.C	HI KF RT	High K-Factor
r.tdd.C	HI I TDD	High current TDD
<b>1-Cycle Auxiliary Values</b>		
r.Hi.Fr	HI FREQ RT	High frequency
r.Lo.Fr	LO FREQ RT	Low frequency
r.U.Unb	HI V UNB% RT <sup>1</sup>	High voltage unbalance
r.C.Unb	HI I UNB% RT	High current unbalance
<b>1-Sec Phase Values</b>		
A.Hi.C1	HI I1 AVR	High I1 current
A.Hi.C2	HI I2 AVR	High I2 current
A.Hi.C3	HI I3 AVR	High I3 current
A.Lo.C1	LO I1 AVR	Low I1 current
A.Lo.C2	LO I2 AVR	Low I2 current
A.Lo.C3	LO I3 AVR	Low I3 current
<b>1-Sec Values on any Phase</b>		
A.Hi. U	HI VOLT AVR <sup>1</sup>	High voltage
A.Lo. U	LO VOLT AVR <sup>1</sup>	Low voltage
A.Hi. C	HI AMPS AVR	High current
A.Lo. C	LO AMPS AVR	Low current

## Appendix C Setpoint Triggers A N D A C T I O N S

Display Code	Designation	Description
<b>1-Sec Total Values</b>		
A.Hi.P.i	HI kW IMP AVR	High total kW import
A.Hi.P.E	HI kW EXP AVR	High total kW export
A.Hi.q.i	HI kvar IMP AVR	High total kvar import
A.Hi.q.E	HI kvar EXP AVR	High total kvar export
A.Hi. S	HI kVA AVR	High total kVA
A.PF.LG	HI PF LAG AVR	Low total PF Lag
A.PF.Ld	HI PF LEAD AVR	Low total PF Lead
<b>1-Sec Auxiliary Values</b>		
A.nEU.C	HI In AVR	High neutral current
A.Hi.Fr	HI FREQ RT	High frequency
A.Lo.Fr	LO FREQ RT	Low frequency
<b>Demands</b>		
Hi.d.U1	HI V1/12 DMD <sup>1</sup>	High V1/V12 Volt demand
Hi.d.U2	HI V2/23 DMD <sup>1</sup>	High V2/V23 Volt demand
Hi.d.U3	HI V3/31 DMD <sup>1</sup>	High V3/V31 Volt demand
Hi.d.C1	HI I1 DMD	High I1 Ampere demand
Hi.d.C2	HI I2 DMD	High I2 Ampere demand
Hi.d.C3	HI I3 DMD	High I3 Ampere demand
Hi.d.P	HI kW IMP BD	High block kW import demand
Hi.d.q	HI kvar IMP BD	High block kvar import demand
Hi.d. S	HI kVA BD	High block kVA demand
Hi.Sd.P	HI kW IMP SD	High sliding window kW import demand
Hi.Sd.q	HI kvar IMP SD	High sliding window kvar import demand
Hi.Sd. S	HI kVA SD	High sliding window kVA demand
Hi.Ad.P	HI kW IMP ACD	High accumulated kW import demand
Hi.Ad.q	HI kvar IMP ACD	High accumulated kvar import demand
Hi.Ad. S	HI kVA ACD	High accumulated kVA demand
Hi.Pd.P	HI kW IMP PRD	High predicted kW import demand
Hi.Pd.q	HI kvar IMP PRD	High predicted kvar import demand
Hi.Pd. S	HI kVA PRD	High predicted kVA demand
<b>Time and Date Parameters</b>		
U.day	DAY OF WEEK	Day of week
YEAr	YEAR	Year
Mon	MONTH	Month
M.day	DAY OF MONTH	Day of month
hour	HOURS	Hours
Min	MINUTES	Minutes
SEC	SECONDS	Seconds
Intr	MINUTE INTERVAL	Minute interval: 1-5, 10, 15, 20, 30, 60 min

<sup>1</sup> In 4LN3, 3LN3 and 3BLN3 wiring modes, the voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line voltages.

**Table 36: Setpoint Actions**

Display Code	Designation	Description
none	NONE	None (no action)
r1 On	OPERATE RELAY #1	Operate relay R01
r2 On	OPERATE RELAY #2	Operate relay R02
r1 OFF	RELEASE RELAY #1	Release latched relay R01
r2 OFF	RELEASE RELAY #2	Release latched relay R02
In.Cn.1	INC CNT #1	Increment counter #1

Appendix C SETPOINT TRIGGERS AND ACTIONS

Display Code	Designation	Description
In.Cn.2	INC CNT #2	Increment counter #2
In.Cn.3	INC CNT #3	Increment counter #3
In.Cn.4	INC CNT #4	Increment counter #4
ti.Cn.1	TIME CNT #1	Count operation time using counter #1
ti.Cn.2	TIME CNT #2	Count operation time using counter #2
ti.Cn.3	TIME CNT #3	Count operation time using counter #3
ti.Cn.4	TIME CNT #4	Count operation time using counter #4
notiF	NOTIFICATION	Send a notification message
dLoG1	DATA LOG #1	Record data to Data Log #1

Appendix D Parameters for DATA MONITORING AND LOGGING

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# Appendix D Parameters for Data Monitoring and Logging

The following table lists parameters measured by the meter that are available for monitoring through communications and for recording to a data log file. The left column shows data abbreviations used in PAS. Parameter groups are highlighted in bold.

**Table 37: Data Monitoring and Logging Parameters**

Designation	Description
NONE	None (stub, read as zero)
<b>DIGITAL INPUTS</b>	<b>Digital Inputs</b>
DI1:16	Digital Inputs Status DI1:DI4
<b>RELAYS</b>	<b>Relays</b>
RO1:16	Relay Status RO1:RO2
<b>COUNTERS</b>	<b>Pulse Counters</b>
COUNTER 1	Counter #1
COUNTER 2	Counter #2
COUNTER 3	Counter #3
COUNTER 4	Counter #4
<b>RT PHASE</b>	<b>1-Cycle Phase Values</b>
V1	V1/V12 Voltage <sup>1</sup>
V2	V2/V23 Voltage <sup>1</sup>
V3	V3/V31 Voltage <sup>1</sup>
I1	I1 Current
I2	I2 Current
I3	I3 Current
kW L1	kW L1
kW L2	kW L2
kW L3	kW L3
kvar L1	kvar L1
kvar L2	kvar L2
kvar L3	kvar L3
kVA L1	kVA L1
kVA L2	kVA L2
kVA L3	kVA L3
PF L1	Power factor L1
PF L2	Power factor L2
PF L3	Power factor L3
V1 THD	V1/V12 Voltage THD <sup>1</sup>
V2 THD	V2/V23 Voltage THD <sup>1</sup>
V3 THD	V3/V31 Voltage THD <sup>1</sup>
I1 THD	I1 Current THD
I2 THD	I2 Current THD
I3 THD	I3 Current THD
I1 KF	I1 K-Factor
I2 KF	I2 K-Factor
I3 KF	I3 K-Factor
I1 TDD	I1 Current TDD
I2 TDD	I2 Current TDD

## Appendix D PARAMETERS FOR DATA MONITORING AND LOGGING

Designation	Description
I3 TDD	I3 Current TDD
V12	V12 Voltage
V23	V23 Voltage
V31	V31 Voltage
<b>RT TOTAL</b>	<b>1-Cycle Total Values</b>
kW	Total kW
kvar	Total kvar
kVA	Total kVA
PF	Total PF
PF LAG	Total PF lag
PF LEAD	Total PF lead
kW IMP	Total kW import
kW EXP	Total kW export
kvar IMP	Total kvar import
kvar EXP	Total kvar export
V AVG	3-phase average L-N/L-L voltage
V LL AVG	3-phase average L-L voltage
I AVG	3-phase average current
<b>RT AUX</b>	<b>1-Cycle Auxiliary Values</b>
In	In (neutral) Current
FREQ	Frequency
V UNB%	Voltage unbalance <sup>2</sup>
I UNB%	Current unbalance <sup>2</sup>
<b>AVR PHASE</b>	<b>1-Second Phase Values</b>
V1	V1/V12 Voltage
V2	V2/V23 Voltage
V3	V3/V31 Voltage
I1	I1 Current
I2	I2 Current
I3	I3 Current
kW L1	kW L1
kW L2	kW L2
kW L3	kW L3
kvar L1	kvar L1
kvar L2	kvar L2
kvar L3	kvar L3
kVA L1	kVA L1
kVA L2	kVA L2
kVA L3	kVA L3
PF L1	Power factor L1
PF L2	Power factor L2
PF L3	Power factor L3
V1 THD	V1/V12 Voltage THD <sup>1</sup>
V2 THD	V2/V23 Voltage THD <sup>1</sup>
V3 THD	V3/V31 Voltage THD <sup>1</sup>
I1 THD	I1 Current THD
I2 THD	I2 Current THD
I3 THD	I3 Current THD
I1 KF	I1 K-Factor
I2 KF	I2 K-Factor

## Appendix D Parameters for DATA MONITORING AND LOGGING

Designation	Description
I3 KF	I3 K-Factor
I1 TDD	I1 Current TDD
I2 TDD	I2 Current TDD
I3 TDD	I3 Current TDD
V12	V12 Voltage
V23	V23 Voltage
V31	V31 Voltage
<b>AVR TOTAL</b>	<b>1-Second Total Values</b>
kW	Total kW
kvar	Total kvar
kVA	Total kVA
PF	Total PF
PF LAG	Total PF lag
PF LEAD	Total PF lead
kW IMP	Total kW import
kW EXP	Total kW export
kvar IMP	Total kvar import
kvar EXP	Total kvar export
V AVG	3-phase average L-N/L-L voltage <sup>1</sup>
V LL AVG	3-phase average L-L voltage
I AVG	3-phase average current
<b>AVR AUX</b>	<b>1-Second Auxiliary Values</b>
In	In (neutral) Current
FREQ	Frequency
V UNB%	Voltage unbalance <sup>2</sup>
I UNB%	Current unbalance <sup>2</sup>
<b>PHASORS</b>	<b>Phasors</b>
V1 Mag	V1/V12 Voltage magnitude <sup>1</sup>
V2 Mag	V2/V23 Voltage magnitude <sup>1</sup>
V3 Mag	V3/V31 Voltage magnitude <sup>1</sup>
I1 Mag	I1 Current magnitude
I2 Mag	I2 Current magnitude
I3 Mag	I3 Current magnitude
V1 Ang	V1/V12 Voltage angle <sup>1</sup>
V2 Ang	V2/V23 Voltage angle <sup>1</sup>
V3 Ang	V3/V31 Voltage angle <sup>1</sup>
I1 Ang	I1 Current angle
I2 Ang	I2 Current angle
I3 Ang	I3 Current angle
<b>DEMANDS</b>	<b>Present Demands (Power Demands E, EH)</b>
V1 DMD	V1/V12 Volt demand <sup>1</sup>
V2 DMD	V2/V23 Volt demand <sup>1</sup>
V3 DMD	V3/V31 Volt demand <sup>1</sup>
I1 DMD	I1 Ampere demand
I2 DMD	I2 Ampere demand
I3 DMD	I3 Ampere demand
KW IMP BD	kW import block demand
kvar IMP BD	kvar import block demand
kVA BD	kVA block demand
kW IMP SD	kW import sliding window demand

## Appendix D PARAMETERS FOR DATA MONITORING AND LOGGING

Designation	Description
kvar IMP SD	kvar import sliding window demand
kVA SD	kVA sliding window demand
kW IMP ACD	kW import accumulated demand
kvar IMP ACD	kvar import accumulated demand
KVA ACD	kVA accumulated demand
KW IMP PRD	kW import predicted sliding window demand
kvar IMP PRD	kvar import predicted sliding window demand
KVA PRD	kVA predicted sliding window demand
PF IMP@kVA DMD	PF (import) at Maximum kVA sliding window demand
KW EXP BD	kW export block demand
kvar EXP BD	kvar export block demand
KW EXP SD	kW export sliding window demand
kvar EXP SD	kvar export sliding window demand
KW EXP ACD	kW export accumulated demand
kvar EXP ACD	kvar export accumulated demand
KW EXP PRD	kW export predicted sliding window demand
kvar EXP PRD	kvar export predicted sliding window demand
In DMD	In (neutral) current demand
<b>SUMM ACC DMD</b>	<b>Billing Summary (Total) Accumulated Demands E, EH</b>
REG1 ACD	Register #1 accumulated demand
REG2 ACD	Register #2 accumulated demand
REG3 ACD	Register #3 accumulated demand
REG4 ACD	Register #4 accumulated demand
<b>SUMM BLK DMD</b>	<b>Billing Summary (Total) Block Demands E, EH</b>
REG1 BD	Register #1 block demand
REG2 BD	Register #2 block demand
REG3 BD	Register #3 block demand
REG4 BD	Register #4 block demand
<b>SUMM SW DMD</b>	<b>Billing Summary (Total) Sliding Demands E, EH</b>
REG1 SD	Register #1 sliding demand
REG2 SD	Register #2 sliding demand
REG3 SD	Register #3 sliding demand
REG4 SD	Register #4 sliding demand
<b>ENERGY</b>	<b>Total Energy E, EH</b>
kWh IMPORT	kWh import
kWh EXPORT	kWh export
kvarh IMPORT	kvarh import
kvarh EXPORT	kvarh export
kVAh TOTAL	kVAh total
<b>SUMMARY REGS</b>	<b>Billing Summary (Total) Energy Registers E, EH</b>
SUM REG1	Summary energy register #1
SUM REG2	Summary energy register #2
SUM REG3	Summary energy register #3
SUM REG4	Summary energy register #4
<b>PHASE ENERGY</b>	<b>Phase Energy E, EH</b>
kWh IMP L1	kWh import L1
kWh IMP L2	kWh import L2
kWh IMP L3	kWh import L3
kvarh IMP L1	kvarh import L1
kvarh IMP L2	kvarh import L2
kvarh IMP L3	kvarh import L3

## Appendix D Parameters for DATA MONITORING AND LOGGING

Designation	Description
kVAh L1	kVAh total L1
kVAh L2	kVAh total L2
kVAh L3	kVAh total L3
<b>%HD V1</b>	<b>V1/V12 Harmonic Distortions EH 1</b>
V1 %HD01	H01 Harmonic distortion
V1 %HD02	H02 Harmonic distortion
...	...
V1 %HD40	H40 Harmonic distortion
<b>%HD V2</b>	<b>V2/V23 Harmonic Distortions EH 1</b>
V2 %HD01	H01 Harmonic distortion
V2 %HD02	H02 Harmonic distortion
...	...
V2 %HD40	H40 Harmonic distortion
<b>%HD V3</b>	<b>V3/V31 Harmonic Distortions EH 1</b>
V3 %HD01	H01 Harmonic distortion
V3 %HD02	H02 Harmonic distortion
...	...
V3 %HD40	H40 Harmonic distortion
<b>%HD I1</b>	<b>I1 Harmonic Distortions EH</b>
I1 %HD01	H01 Harmonic distortion
I1 %HD02	H02 Harmonic distortion
...	...
I1 %HD40	H40 Harmonic distortion
<b>%HD I2</b>	<b>I2 Harmonic Distortions EH</b>
I2 %HD01	H01 Harmonic distortion
I2 %HD02	H02 Harmonic distortion
...	...
I2 %HD40	H40 Harmonic distortion
<b>%HD I3</b>	<b>I3 Harmonic Distortions EH</b>
I3 %HD01	H01 Harmonic distortion
I3 %HD02	H02 Harmonic distortion
...	...
I3 %HD40	H40 Harmonic distortion
<b>ANG V1</b>	<b>V1/V12 Harmonic Angles EH 1</b>
V1 H01 ANG	H01 Harmonic angle
V1 H02 ANG	H02 Harmonic angle
...	...
V1 H40 ANG	H40 Harmonic angle
<b>ANG V2</b>	<b>V2/V23 Harmonic Angles EH 1</b>
V2 H01 ANG	H01 Harmonic angle
V2 H02 ANG	H02 Harmonic angle
...	...
V2 H40 ANG	H40 Harmonic angle
<b>ANG V3</b>	<b>V3/V31 Harmonic Angles EH 1</b>
V3 H01 ANG	H01 Harmonic angle
V3 H02 ANG	H02 Harmonic angle
...	...
V3 H40 ANG	H40 Harmonic angle
<b>ANG I1</b>	<b>I1 Harmonic Angles EH</b>
I1 H01 ANG	H01 Harmonic angle

## Appendix D PARAMETERS FOR DATA MONITORING AND LOGGING

Designation	Description
I1 H02 ANG	H02 Harmonic angle
...	...
I1 H40 ANG	H40 Harmonic angle
<b>ANG I2</b>	<b>I2 Harmonic Angles EH</b>
I2 H01 ANG	H01 Harmonic angle
I2 H02 ANG	H02 Harmonic angle
...	...
I2 H40 ANG	H40 Harmonic angle
<b>ANG I3</b>	<b>I3 Harmonic Angles EH</b>
I3 H01 ANG	H01 Harmonic angle
I3 H02 ANG	H02 Harmonic angle
...	...
I3 H40 ANG	H40 Harmonic angle
<b>H1 PHASE</b>	<b>Fundamental (H01) Phase Values</b>
V1 H01	V1/V12 Voltage <sup>1</sup>
V2 H01	V2/V23 Voltage <sup>1</sup>
V3 H01	V3/V31 Voltage <sup>1</sup>
I1 H01	I1 Current
I2 H01	I2 Current
I3 H01	I3 Current
kW L1 H01	kW L1
kW L2 H01	kW L2
kW L3 H01	kW L3
kvar L1 H01	kvar L1
kvar L2 H01	kvar L2
kvar L3 H01	kvar L3
kVA L1 H01	kVA L1
kVA L2 H01	kVA L2
kVA L3 H01	kVA L3
PF L1 H01	Power factor L1
PF L2 H01	Power factor L2
PF L3 H01	Power factor L3
<b>HRM TOT POW</b>	<b>Fundamental and Harmonic Total Power Values</b>
kW H01	Total fundamental kW
kvar H01	Total fundamental kvar
kVA H01	Total fundamental kVA
PF H01	Total fundamental PF
<b>MIN PHASE</b>	<b>Minimum 1-Cycle Phase Values</b>
V1 MIN	V1/V12 Voltage <sup>1</sup>
V2 MIN	V2/V23 Voltage <sup>1</sup>
V3 MIN	V3/V31 Voltage <sup>1</sup>
I1 MIN	I1 Current
I2 MIN	I2 Current
I3 MIN	I3 Current
<b>MIN TOTAL</b>	<b>Minimum 1-Cycle Total Values</b>
kW MIN	Total kW
kvar MIN	Total kvar
kVA MIN	Total kVA
PF MIN	Total PF

## Appendix D Parameters for DATA MONITORING AND LOGGING

Designation	Description
<b>MIN AUX</b>	<b>Minimum 1-Cycle Auxiliary Values</b>
In MIN	In Current
FREQ MIN	Frequency
MAX PHASE	Maximum 1-Cycle Phase Values
<b>V1 MAX</b>	<b>V1/V12 Voltage <sup>1</sup></b>
V2 MAX	V2/V23 Voltage <sup>1</sup>
V3 MAX	V3/V31 Voltage <sup>1</sup>
I1 MAX	I1 Current
I2 MAX	I2 Current
I3 MAX	I3 Current
<b>MAX TOTAL</b>	<b>Maximum 1-Cycle Total Values</b>
kW MAX	Total kW
kvar MAX	Total kvar
KVA MAX	Total kVA
PF MAX	Total PF
<b>MAX AUX</b>	<b>Maximum 1-Cycle Auxiliary Values</b>
In MAX	In Current
FREQ MAX	Frequency
<b>MAX DMD</b>	<b>Maximum Demands (Power Demands E, EH)</b>
V1 DMD MAX	V1/V12 Maximum volt demand <sup>1</sup>
V2 DMD MAX	V2/V23 Maximum volt demand <sup>1</sup>
V3 DMD MAX	V3/V31 Maximum volt demand <sup>1</sup>
I1 DMD MAX	I1 Maximum ampere demand
I2 DMD MAX	I2 Maximum ampere demand
I3 DMD MAX	I3 Maximum ampere demand
kW IMP SD MAX	Maximum kW import sliding window demand
kW EXP SD MAX	Maximum kvar import sliding window demand
kvar IMP SD MAX	Maximum kW export sliding window demand
kvar EXP SD MAX	Maximum kvar export sliding window demand
kVA SD MAX	Maximum kVA sliding window demand
In DMD MAX	In (neutral) current maximum demand
<b>MAX SUMMARY DMD</b>	<b>Billing Summary (Total) Maximum Demands E, EH</b>
REG1 MD	Summary register #1 maximum demand
REG2 MD	Summary register #2 maximum demand
REG3 MD	Summary register #3 maximum demand
REG4 MD	Summary register #4 maximum demand
<b>AO RAW</b>	<b>Raw Analog Outputs (A/D Units)</b>
AO1	Analog output AO1
AO2	Analog output AO2
AO3	Analog output AO3
AO4	Analog output AO4
<b>TOU PRMS</b>	<b>TOU Parameters E, EH</b>
ACTIVE TARIFF	Active TOU tariff
ACTIVE PROFILE	Active TOU profile
<b>TOU REG1</b>	<b>Billing TOU Energy Register #1 E, EH</b>
REG1 TRF1	Tariff #1 register
REG1 TRF2	Tariff #2 register
...	...
REG1 TRF8	Tariff #8 register

## Appendix D PARAMETERS FOR DATA MONITORING AND LOGGING

Designation	Description
<b>TOU REG2</b>	<b>Billing TOU Energy Register #2 E, EH</b>
REG2 TRF1	Tariff #1 register
REG2 TRF2	Tariff #2 register
...	...
REG2 TRF8	Tariff #8 register
<b>TOU REG3</b>	<b>Billing TOU Energy Register #3 E, EH</b>
REG3 TRF1	Tariff #1 register
REG3 TRF2	Tariff #2 register
...	...
REG3 TRF8	Tariff #8 register
<b>TOU REG4</b>	<b>Billing TOU Energy Register #4 E, EH</b>
REG4 TRF1	Tariff #1 register
REG4 TRF2	Tariff #2 register
...	...
REG4 TRF8	Tariff #8 register
<b>TOU MAX DMD REG1</b>	<b>Billing TOU Maximum Demand Register #1 E, EH</b>
REG1 TRF1 MD	Tariff #1 maximum demand
REG1 TRF2 MD	Tariff #2 maximum demand
...	...
REG1 TRF8 MD	Tariff #8 maximum demand
<b>TOU MAX DMD REG2</b>	<b>Billing TOU Maximum Demand Register #2 E, EH</b>
REG2 TRF1 MD	Tariff #1 maximum demand
REG2 TRF2 MD	Tariff #2 maximum demand
...	...
REG2 TRF8 MD	Tariff #8 maximum demand
<b>TOU MAX DMD REG3</b>	<b>Billing TOU Maximum Demand Register #3 E, EH</b>
REG3 TRF1 MD	Tariff #1 maximum demand
REG3 TRF2 MD	Tariff #2 maximum demand
...	...
REG3 TRF8 MD	Tariff #8 maximum demand
<b>TOU MAX DMD REG4</b>	<b>Billing TOU Maximum Demand Register #4 E, EH</b>
REG4 TRF1 MD	Tariff #1 maximum demand
REG4 TRF2 MD	Tariff #2 maximum demand
...	...
REG4 TRF8 MD	Tariff #8 maximum demand

<sup>1</sup> In 4LN3, 3LN3 and 3BLN3 wiring modes, the voltages will be line-to-neutral; for any other wiring mode, they will be line-to-line voltages.

<sup>2</sup> The value is calculated as a relation of the maximum deviation of phase values from a 3-phase average value to a 3-phase average.

**NOTE**

Designations of some engineering demands and billing energy and demand registers are shown using a short name notation available in PAS V1.4. By default, PAS uses long names compatible with older versions of PAS. You can select a desired notation from the Tools/Options/Preferences tab.

PAS does not allow to store data in files using different data names. If you have a file uploaded with a previous version of PAS using long data names, either continue using long data names, or store data in a new file.

See table below for a list of parameters with short and long names.

## Appendix D Parameters for DATA MONITORING AND LOGGING

<b>Short Data Name</b>	<b>Long Data Name</b>	<b>Description</b>
KW IMP ACD	kW IMP ACC DMD	Accumulated demand
KW IMP PRD	kW IMP PRD DMD	Predicted sliding window demand
PF IMP@kVA MD	PF IMP@kVA MXDMD	PF (import) at maximum kVA demand
REG1 ACD	SUM REG1 ACC DMD	Billing summary (total) register accumulated demand
REG1 BD	SUM REG1 BLK DMD	Billing summary (total) register block demand
REG1 SD	SUM REG1 SW DMD	Billing summary (total) register sliding demand
REG1	SUM REG1	Billing summary (total) energy register
REG1 MD	SUM REG1 DMD MAX	Billing summary (total) register maximum demand
REG1 TRF1	TOU REG1 TRF1	Billing tariff energy register
REG1 TRF1 MD	DMD1 TRF1 MAX	Billing tariff register maximum demand
TRF1	SEASON TRF1	Generic billing tariff energy register
TRF1 MD	SEASON TRF1	Generic billing tariff register maximum demand

## Appendix E Billing/TOU Profile Log File

The following table shows the record structure for the daily billing data profile log file.

The second column shows data abbreviations used in the PAS data log reports. Data log file sections are highlighted in bold.

**Table 38: Daily Billing/TOU Profile Data Log (Data Log #16)**

Field No.	Designation	Description
<b>Energy Register #1</b>		
1	REG1	Summary (total) energy reading
2	TRF1	Tariff #1 energy reading
3	TRF2	Tariff #2 energy reading
4	TRF3	Tariff #3 energy reading
5	TRF4	Tariff #4 energy reading
6	TRF5	Tariff #5 energy reading
7	TRF6	Tariff #6 energy reading
8	TRF7	Tariff #7 energy reading
9	TRF8	Tariff #8 energy reading
...		
<b>Energy Register #4</b>		
1	REG4	Summary (total) energy reading
2	TRF1	Tariff #1 energy reading
3	TRF2	Tariff #2 energy reading
4	TRF3	Tariff #3 energy reading
5	TRF4	Tariff #4 energy reading
6	TRF5	Tariff #5 energy reading
7	TRF6	Tariff #6 energy reading
8	TRF7	Tariff #7 energy reading
9	TRF8	Tariff #8 energy reading
<b>Daily Maximum Demand Register #1</b>		
1	REG1 MD	Summary (total) max. demand reading
2	TRF1 MD	Tariff #1 max. demand reading
3	TRF2 MD	Tariff #2 max. demand reading
4	TRF3 MD	Tariff #3 max. demand reading
5	TRF4 MD	Tariff #4 max. demand reading
6	TRF5 MD	Tariff #5 max. demand reading
7	TRF6 MD	Tariff #6 max. demand reading
8	TRF7 MD	Tariff #7 max. demand reading
9	TRF8 MD	Tariff #8 max. demand reading
...		
<b>Daily Maximum Demand Register #4</b>		
1	REG4 MD	Summary (total) max. demand reading
2	TRF1 MD	Tariff #1 max. demand reading
3	TRF2 MD	Tariff #2 max. demand reading
4	TRF3 MD	Tariff #3 max. demand reading
5	TRF4 MD	Tariff #4 max. demand reading
6	TRF5 MD	Tariff #5 max. demand reading
7	TRF6 MD	Tariff #6 max. demand reading
8	TRF7 MD	Tariff #7 max. demand reading
9	TRF8 MD	Tariff #8 max. demand reading

Appendix E Billing/TOU PROFILE LOG FILE

---

The number of parameters in each section is automatically configured depending on the number of actual tariffs you defined in the TOU Daily Profiles.

## Appendix F Data Scales

The maximum values for volts, amps and power in the PM130 PLUS setup and in communications are limited by the voltage and current scale settings. See [Device Options](#) in Chapter 4 on how to change the voltage and current scales in your meter.

The following table shows the meter data scales.

**Table 39: Data Scales Values**

Scale	Conditions	Range
Maximum voltage (V max)	All configurations	Voltage scale × PT Ratio, V <sup>1</sup>
Maximum current (I max)	All configurations	Current scale × CT Ratio, A <sup>2, 3</sup>
Maximum Power <sup>4</sup>	Wiring 4LN3, 3LN3, 3BLN3	V max × I max × 3, W
	Wiring 4LL3, 3LL3, 3BLL3, 3OP2, 3OP3, 3DIR2	V max × I max × 2, W
Maximum frequency	25, 50 or 60 Hz	100 Hz
	400Hz	500 Hz

<sup>1</sup> The default voltage scale is 144V. The recommended voltage scale is  $120V+20\% = 144V$  for using with external PT's, and  $690V+20\% = 828V$  for a direct connection to power line.

<sup>2</sup> CT Ratio = CT primary current/CT secondary current

<sup>3</sup> The default current scale is  $2 \times$  CT secondary (2.0A with 1A secondary and 10.0A with 5A secondary).

<sup>4</sup> Maximum power is rounded to whole kilowatts. With PT=1.0, it is limited to 9,999,000 W.

## Appendix G Device Diagnostic C O D E S

# Appendix G Device Diagnostic Codes

Table 40: Device Diagnostic Codes

Diagnostic Code	Diagnostic Message	Description	Reason
2	dAtA	Memory/Data fault	Hardware failure
3	rSt	Hardware watchdog reset	Hardware failure
5	CPU	CPU exception	Hardware failure
6	runt	Run-time software error	Hardware failure
7	tout	Software watchdog timeout	Hardware failure
8	PWr.UP	Power Down/Up	Normal power-up sequence
9	rStrt	Warm restart	External restart via communications or by firmware upgrade
10	ConF	Configuration reset	Corrupted setup data has been replaced with the default configuration
11	rtc	RTC fault	The clock time has been lost
13	Lo.bAt	Low battery (with a battery backup unit)	Battery replacement is required
15	EEPr	EEPROM fault	Hardware failure

See [Diagnostics Display](#) in Chapter 3 for more information on the PM130 PLUS built-in diagnostics.

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# TECHNICAL DATA SHEET

**Equipment Type:** HMI

**Location:** RTU Section

**Model Numbers:** G306A

**Manufacturer:** Red Lion

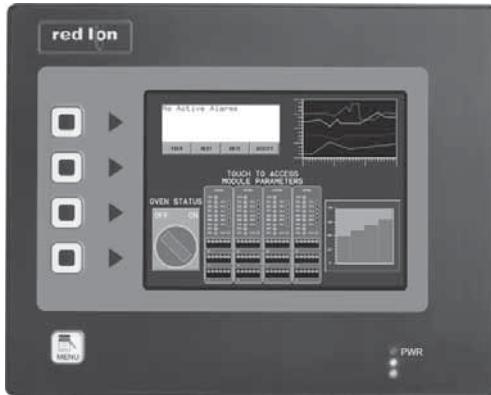
**Supplier:** Control Logic  
25 Lavarack Ave,  
Eagle Farm QLD 4009  
(07) 3623 1212



Tel +1 (717) 767-6511  
Fax +1 (717) 764-0839  
www.redlion.net

Bulletin No. G306A-G  
Drawing No. LP0666  
Released 02/13

## MODEL G306A - GRAPHIC COLOR LCD OPERATOR INTERFACE TERMINAL WITH TFT QVGA DISPLAY AND TOUCHSCREEN



FOR USE IN HAZARDOUS LOCATIONS:  
Class I, Division 2, Groups A, B, C, and D

PROCESS CONTROL EQUIPMENT

### GENERAL DESCRIPTION

The G306A Operator Interface Terminal combines unique capabilities normally expected from high-end units with a very affordable price. It is built around a high performance core with integrated functionality. This core allows the G306A to perform many of the normal features of the Paradigm range of Operator Interfaces while improving and adding new features.

The G306A is able to communicate with many different types of hardware using high-speed RS232/422/485 communications ports and Ethernet 10 Base T/100 Base-TX communications. In addition, the G306A features USB for fast downloads of configuration files and access to trending and data logging. A CompactFlash socket is provided so that Flash cards can be used to collect your trending and data logging information as well as to store larger configuration files.

In addition to accessing and controlling of external resources, the G306A allows a user to easily view and enter information. Users can enter data through the touchscreen and/or front panel 5-button keypad.

### SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use the controller to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the controller.



The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.



WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2



**CAUTION: Risk Of Danger.**  
Read complete instructions prior to installation and operation of the unit.



**CAUTION: Risk of electric shock.**

- CONFIGURED USING CRIMSON® SOFTWARE (BUILD 424 OR NEWER)
- UP TO 5 RS-232/422/485 COMMUNICATIONS PORTS (2 RS-232 AND 1 RS-422/485 ON BOARD, 1 RS-232 AND 1 RS422/485 ON OPTIONAL COMMUNICATIONS CARD)
- 10 BASE T/100 BASE-TX ETHERNET PORT TO NETWORK UNITS AND HOST WEB PAGES
- USB PORT TO DOWNLOAD THE UNIT'S CONFIGURATION FROM A PC OR FOR DATA TRANSFERS TO A PC
- UNIT'S CONFIGURATION IS STORED IN NON-VOLATILE MEMORY (8 MBYTE FLASH)
- COMPACTFLASH® SOCKET TO INCREASE MEMORY CAPACITY
- 5.7-INCH TFT ACTIVE MATRIX 256 COLOR QVGA 320 X 240 PIXEL LCD W/LED BACKLIGHT
- 5-BUTTON KEYPAD FOR ON-SCREEN MENUS
- THREE FRONT PANEL LED INDICATORS
- POWER UNIT FROM 24 VDC ±20% SUPPLY
- RESISTIVE ANALOG TOUCHSCREEN

### CONTENTS OF PACKAGE

- G306A Operator Interface.
- Panel gasket.
- Template for panel cutout.
- Hardware packet for mounting unit into panel.
- Terminal block for connecting power.

### ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
G306A	Operator Interface for indoor applications, textured finish with embossed keys	G306A000
G3CF	CompactFlash Card <sup>5</sup>	G3CFxxxx
G3RS	RS232/485 Optional Communication Card	G3RS0000
G3CN	CANopen Optional Communication Card	G3CN0000
G3DN	DeviceNet option card for G3 operator interfaces with isolated high speed communications ports	G3DN0000
G3PBDP	Profibus DP Optional Communication Card	G3PBDP00
SFCRM2	Crimson 2.0 <sup>2</sup>	SFCRM200
CBL	RS-232 Programming Cable	CBLPROG0
	USB Cable	CBLUSB00
	Communications Cables <sup>1</sup>	CBLxxxxx
DR	DIN Rail Mountable Adapter Products <sup>3</sup>	DRxxxxxx
	Replacement Battery <sup>4</sup>	BNL20000
G3FILM	Protective Films	G3FILM06

<sup>1</sup> Contact your Red Lion distributor or visit our website for complete selection.

<sup>2</sup> Use this part number to purchase the Crimson® software on CD with a printed manual, USB cable, and RS-232 cable. Otherwise, download for free from [www.redlion.net](http://www.redlion.net).

<sup>3</sup> Red Lion offers RJ modular jack adapters. Refer to the DR literature for complete details.

<sup>4</sup> Battery type is lithium coin type CR2025.

<sup>5</sup> Industrial grade two million write cycles.

# SPECIFICATIONS

## 1. POWER REQUIREMENTS:

Must use a Class 2 circuit according to National Electrical Code (NEC), NFPA-70 or Canadian Electrical Code (CEC), Part I, C22.1 or a Limited Power Supply (LPS) according to IEC 60950-1 or Limited-energy circuit according to IEC 61010-1.

Power connection via removable three position terminal block.

Supply Voltage: +24 VDC ±20%

Typical Power<sup>1</sup>: 8 W

Maximum Power<sup>2</sup>: 10 W

### Notes:

1. Typical power with +24 VDC, RS232/485 communications, Ethernet communications, CompactFlash card installed, and display at full brightness.
2. Maximum power indicates the most power that can be drawn from the G306A. Refer to "Power Supply Requirements" under "Installing and Powering the G306A."
3. The G306A's circuit common is not connected to the enclosure of the unit. See "Connecting to Earth Ground" in the section "Installing and Powering the G306A."
4. Read "Power Supply Requirements" in the section "Installing and Powering the G306A" for additional power supply information.

## 2. BATTERY:

Lithium coin cell. Typical lifetime of 10 years.

## 3. LCD DISPLAY:

SIZE	5.7-inch
TYPE	TFT
COLORS	256
PIXELS	320 X 240
BRIGHTNESS	380 cd/m <sup>2</sup>
BACKLIGHT*	50,000 HR TYP.

\*Lifetime at room temperature. Refer to "Display" in "Software/Unit Operation"

## 4. 5-KEY KEYPAD:

for on-screen menus.

## 5. TOUCHSCREEN:

Resistive analog

## 6. MEMORY:

On Board User Memory: 8 Mbyte of non-volatile Flash memory.

Memory Card: CompactFlash Type II slot for Type I and Type II CompactFlash cards.

## 7. COMMUNICATIONS:

USB Port: Adheres to USB specification 1.1. Device only using Type B connection.



**WARNING - DO NOT CONNECT OR DISCONNECT CABLES WHILE POWER IS APPLIED UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. USB PORT IS FOR SYSTEM SET-UP AND DIAGNOSTICS AND IS NOT INTENDED FOR PERMANENT CONNECTION.**

**Serial Ports:** Format and Baud Rates for each port are individually software programmable up to 115,200 baud.

PGM Port: RS232 port via RJ12.

COMMS Ports: RS422/485 port via RJ45, and RS232 port via RJ12.

DH485 TXEN: Transmit enable; open collector,  $V_{OH} = 15$  VDC,  $V_{OL} = 0.5$  V @ 25 mA max.

*Note: For additional information on the communications or signal common and connections to earth ground please see the "Connecting to Earth Ground" in the section "Installing and Powering the G306A."*

Ethernet Port: 10 BASE-T / 100 BASE-TX

RJ45 jack is wired as a NIC (Network Interface Card).

Isolation from Ethernet network to G3 operator interface: 1500 Vrms

## 8. ENVIRONMENTAL CONDITIONS:

**Operating Temperature Range:** 0 to 50°C

**Storage Temperature Range:** -20 to 70°C

**Operating and Storage Humidity:** 80% maximum relative humidity (non-condensing) from 0 to 50°C.

**Vibration according to IEC 68-2-6:** Operational 5 to 8 Hz, 0.8" (p-p), 8 to 500 Hz, in X, Y, Z direction, duration: 1 hour, 3 g.

**Shock according to IEC 68-2-27:** Operational 40 g, 9 msec in 3 directions.

**Altitude:** Up to 2000 meters.

## 9. CERTIFICATIONS AND COMPLIANCES:

### SAFETY

UL Listed, File #E245515, UL61010-1, ANSI/ISA 12.12.01-2007, CAN/CSA 22.2 No. 61010.1, CSA 22.2 No. 213-M1987 and File #E179259, UL61010-1, CAN/CSA 22.2 No.61010-1

LISTED by Und. Lab. Inc. to U.S. and Canadian safety standards

Type 4X Indoor Enclosure rating (Face only), UL50

IEC60068-2-29: Environmental Test Report #E179259-A1-CB-3

Issued by Underwriters Laboratories Inc.

IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.

IP66 Enclosure rating (Face only), IEC 529

### ELECTROMAGNETIC COMPATIBILITY

Emissions and Immunity to EN 61326: 2006: Electrical Equipment for Measurement, Control and Laboratory use.

#### Immunity to Industrial Locations:

Electrostatic discharge	EN61000-4-2	Criterion A 4kV contact discharge 8kV air discharge
-------------------------	-------------	---

Electromagnetic RF fields	EN61000-4-3	Criterion A 10V/m (80 MHz to 1 GHz) 3 V/m (1.4 GHz to 2 GHz) 1 V/m (2 GHz to 2.7 GHz)
---------------------------	-------------	--

Fast transients (burst)	EN61000-4-4	Criterion A 2kV power 1kV I/O signal
-------------------------	-------------	--

Surge	EN61000-4-5	Criterion A 1kV L to L 2kV L to G power 1 kV signal
-------	-------------	--

RF conducted interference	EN61000-4-6	Criterion A 3Vrms
---------------------------	-------------	----------------------

Power frequency magnetic fields	EN61000-4-8	Criterion A 30A/m
---------------------------------	-------------	----------------------

#### Emissions:

Emissions	EN55011	Class A
-----------	---------	---------

#### Note:

1. Criterion A: Normal operation within specified limits.

## 10. CONNECTIONS:

Compression cage-clamp terminal block.

Wire Gage: 12-30 AWG copper wire

Torque: 5-7 inch-pounds (56-79 N-cm)

## 11. CONSTRUCTION:

Steel rear metal enclosure with NEMA 4X/IP66 aluminum front plate for indoor use only when correctly fitted with the gasket provided. Installation Category II, Pollution Degree 2.

## 12. MOUNTING REQUIREMENTS:

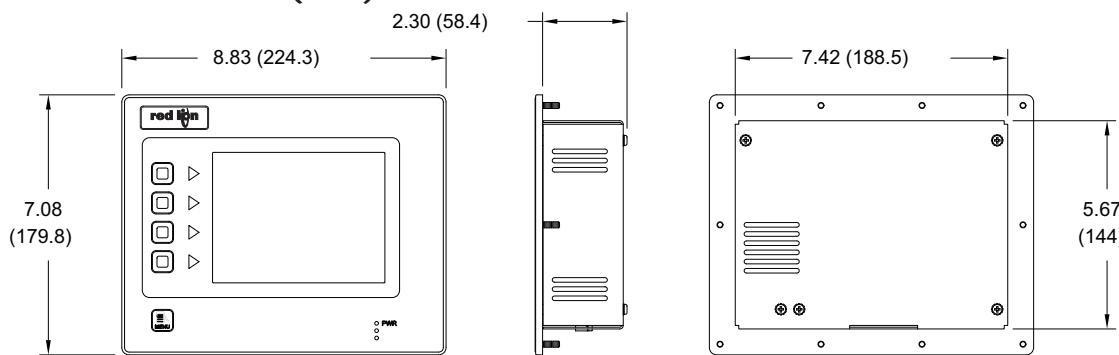
Maximum panel thickness is 0.25" (6.3 mm). For NEMA 4X/IP66 sealing, a steel panel with a minimum thickness of 0.125" (3.17 mm) is recommended.

Maximum Mounting Stud Torque: 17 inch-pounds (1.92 N-m)

## 13. WEIGHT:

3.0 lbs (1.36 Kg)

## DIMENSIONS In inches (mm)

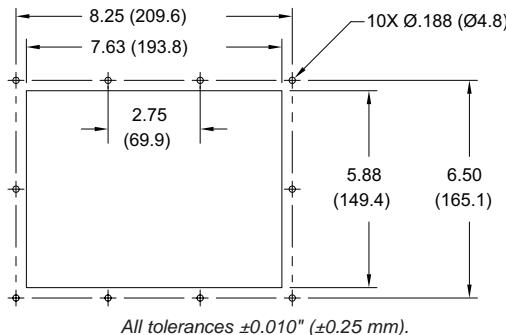


# INSTALLING AND POWERING THE G306A

## MOUNTING INSTRUCTIONS

This operator interface is designed for through-panel mounting. A panel cut-out diagram and a template are provided. Care should be taken to remove any loose material from the mounting cut-out to prevent that material from falling into the operator interface during installation. A gasket is provided to enable sealing to NEMA 4X/IP6 specification. Install the ten kep nuts provided and tighten evenly for uniform gasket compression.

*Note: Tightening the kep nuts beyond a maximum of 17 inch-pounds (1.92 N-m) may cause damage to the front panel.*



**ALL NONINCENDIVE CIRCUITS MUST BE WIRED USING DIVISION 2 WIRING METHODS AS SPECIFIED IN ARTICLE 501-4 (b), 502-4 (b), AND 503-3 (b) OF THE NATIONAL ELECTRICAL CODE, NFPA 70 FOR INSTALLATION WITHIN THE UNITED STATES, OR AS SPECIFIED IN SECTION 19-152 OF CANADIAN ELECTRICAL CODE FOR INSTALLATION IN CANADA.**

## CONNECTING TO EARTH GROUND



The protective conductor terminal is bonded to conductive parts of the equipment for safety purposes and must be connected to an external protective earthing system.

Each G306A has a chassis ground terminal on the back of the unit. Your unit should be connected to earth ground (protective earth).

The chassis ground is not connected to signal common of the unit. Maintaining isolation between earth ground and signal common is not required to operate your unit. But, other equipment connected to this unit may require isolation between signal common and earth ground. *To maintain isolation between signal common and earth ground care must be taken when connections are made to the unit.* For example, a power supply with isolation between its signal common and earth ground must be used. Also, plugging in a USB cable may connect signal common and earth ground.<sup>1</sup>

<sup>1</sup> USB's shield may be connected to earth ground at the host. USB's shield in turn may also be connected to signal common.

## POWER SUPPLY REQUIREMENTS

The G306A requires a 24 VDC power supply. Your unit may draw considerably less than the maximum rated power depending upon the options being used. As additional features are used your unit will draw increasing amounts of power. Items that could cause increases in current are additional communications, optional communications card, CompactFlash card, and other features programmed through Crimson.

In any case, it is very important that the power supply is mounted correctly if the unit is to operate reliably. Please take care to observe the following points:

- The power supply must be mounted close to the unit, with usually not more than 6 feet (1.8 m) of cable between the supply and the operator interface. Ideally, the shortest length possible should be used.
- The wire used to connect the operator interface's power supply should be at least 22-gage wire. If a longer cable run is used, a heavier gage wire should be used. The routing of the cable should be kept away from large contactors, inverters, and other devices which may generate significant electrical noise.
- A power supply with an NEC Class 2 or Limited Power Source (LPS) and SELV rating is to be used. This type of power supply provides isolation to accessible circuits from hazardous voltage levels generated by a mains power supply due to single faults. SELV is an acronym for "safety extra-low voltage." Safety extra-low voltage circuits shall exhibit voltages safe to touch both under normal operating conditions and after a single fault, such as a breakdown of a layer of basic insulation or after the failure of a single component has occurred.

# INSTALLING AN OPTION CARD



**WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN DISCONNECTED AND THE AREA IS KNOWN TO BE NON-HAZARDOUS.**

Each option card comes with a cable for communications and three screws for attaching the option card to the G306's rear cover. To install the option card, remove all power and I/O communications cables from the unit. Use the three screws provided to mount the option card to the rear cover of the G306 as shown in Figure 1.

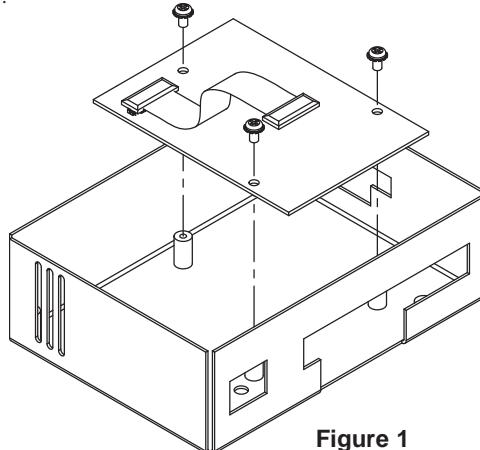


Figure 1

Connect the cable from the option card to CN11 on the main board of the G306 as shown in Figure 2. Be sure both ends of the cable are firmly seated into their appropriate connector housing. Carefully replace the rear cover by reversing the instructions for removing the rear cover.

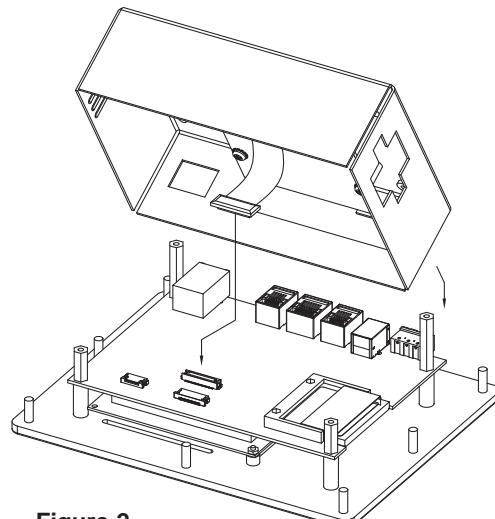


Figure 2

# COMMUNICATING WITH THE G306A

## CONFIGURING A G306A

The G306A is configured using Crimson® software. Crimson is available as a free download from Red Lion's website, or it can be purchased on CD. Updates to Crimson for new features and drivers are posted on the website as they become available. By configuring the G306A using the latest version of Crimson, you are assured that your unit has the most up to date feature set. Crimson® software can configure the G306A through the RS232 PGM port, USB port, or CompactFlash.

The USB port is connected using a standard USB cable with a Type B connector. The driver needed to use the USB port will be installed with Crimson.

The RS232 PGM port uses a programming cable made by Red Lion to connect to the DB9 COM port of your computer. If you choose to make your own cable, use the "G306A Port Pin Out Diagram" for wiring information.

The CompactFlash can be used to program a G3 by placing a configuration file and firmware on the CompactFlash card. The card is then inserted into the target G3 and powered. Refer to the Crimson literature for more information on the proper names and locations of the files.

## USB, DATA TRANSFERS FROM THE COMPACTFLASH CARD



**WARNING - DO NOT CONNECT OR DISCONNECT CABLES WHILE POWER IS APPLIED UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. USB PORT IS FOR SYSTEM SET-UP AND DIAGNOSTICS AND IS NOT INTENDED FOR PERMANENT CONNECTION.**

In order to transfer data from the CompactFlash card via the USB port, a driver must be installed on your computer. This driver is installed with Crimson and is located in the folder C:\Program Files\Red Lion Controls\Crimson 2.0\Device\ after Crimson is installed. This may have already been accomplished if your G306A was configured using the USB port.

Once the driver is installed, connect the G306A to your PC with a USB cable, and follow "Mounting the CompactFlash" instructions in the Crimson 2 user manual.

## CABLES AND DRIVERS

Red Lion has a wide range of cables and drivers for use with many different communication types. A list of these drivers and cables along with pin outs is available from Red Lion's website. New cables and drivers are added on a regular basis. If making your own cable, refer to the "G306A Port Pin Outs" for wiring information.

## ETHERNET COMMUNICATIONS

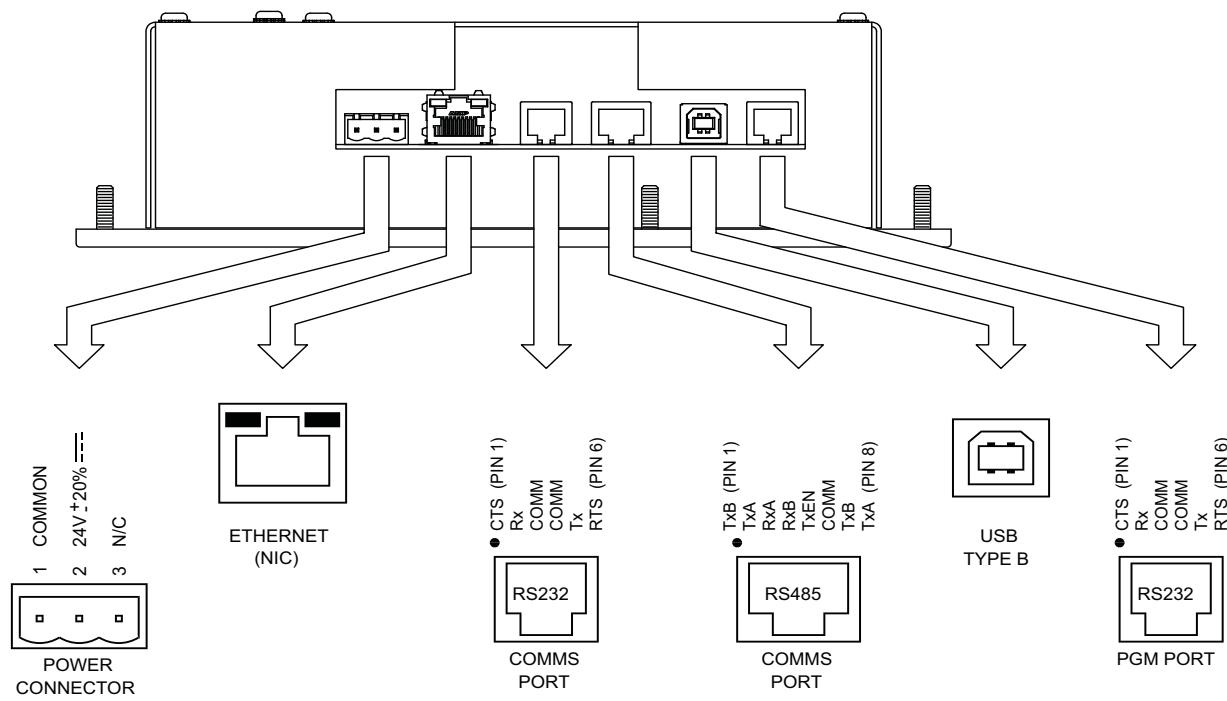
Ethernet communications can be established at either 10 BASE-T or 100 BASE-TX. The G306A unit's RJ45 jack is wired as a NIC (Network Interface Card). For example, when wiring to a hub or switch use a straight-through cable, but when connecting to another NIC use a crossover cable.

The Ethernet connector contains two LEDs. A yellow LED in the upper right, and a bi-color green/amber LED in the upper left. The LEDs represent the following statuses:

LED COLOR	DESCRIPTION
YELLOW solid	Link established.
YELLOW flashing	Data being transferred.
GREEN	10 BASE-T Communications
AMBER	100 BASE-TX Communications

On the rear of each unit is a unique 12-digit MAC address and a block for marking the unit with an IP address. Refer to the Crimson manual and Red Lion's website for additional information on Ethernet communications.

G306A PORT PIN OUTS



## RS232 PORTS

The G306A has two RS232 ports. There is the PGM port and the COMMS port. Although only one of these ports can be used for programming, both ports can be used for communications with a PLC.

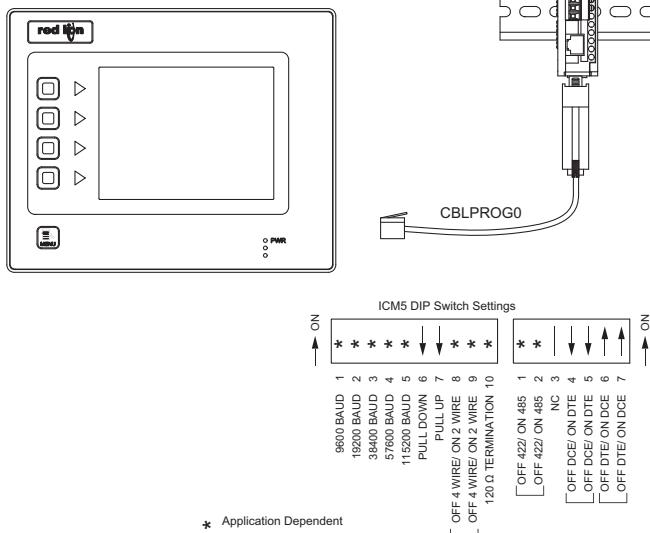
The RS232 ports can be used for either master or slave protocols with any G306A configuration.

Examples of RS232 communications could involve another Red Lion product or a PC. By using a cable with RJ12 ends on it, and a twist in the cable, RS232 communications with another G3 product or the Modular Controller can be established. Red Lion part numbers for cables with a twist in them are CBLPROGO<sup>1</sup>, CBLRLC01<sup>2</sup>, or CBLRC02<sup>3</sup>.

### G3 RS232 to a PC

Connections			
G3: RJ12	Name	PC: DB9	Name
4	COMM	1	DCD
5	Tx	2	Rx
2	Rx	3	Tx
	N/C	4	DTR
3	COM	5	GND
	N/C	6	DSR
1	CTS	7	RTS
6	RTS	8	CTS
	N/C	9	RI

CONNECTING A G306A OPERATOR INTERFACE TO AN ICM5



<sup>1</sup> CBLPROGO can also be used to communicate with either a PC or an ICM5.

<sup>2</sup> DB9 adapter not included, 1 foot long.

<sup>3</sup> DB9 adapter not included, 10 feet long.

## Examples of RS485 2-Wire Connections

### G3 to Red Lion RJ11 (CBLRLC00) DLC, IAMS, ITMS, PAXCDC4C

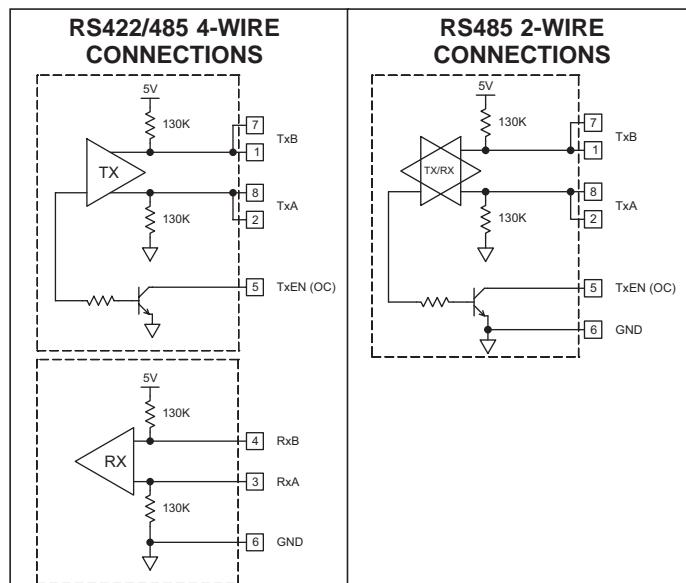
Connections			
G3: RJ45	Name	RLC: RJ11	Name
5	TxEN	2	TxEN
6	COM	3	COM
1	TxB	5	B-
2	TxA	4	A+

### G3 to Modular Controller (CBLRLC05)

Connections			
G3	Name	Modular Controller	Name
1,4	TxB	1,4	TxB
4,1	RxB	4,1	RxB
2,3	TxA	2,3	TxA
3,2	RxA	3,2	RxA
5	TxEN	5	TxEN
6	COM	6	COM
7	TxB	7	TxB
8	TxA	8	TxA

## RS422/485 COMMS PORT

The G306A has one RS422/485 port. This port can be configured to act as either RS422 or RS485.



Note: All Red Lion devices connect A to A and B to B, except for Paradigm devices. Refer to [www.redlion.net](http://www.redlion.net) for additional information.

## DH485 COMMUNICATIONS

The G306A's RS422/485 COMMS port can also be used for Allen Bradley DH485 communications.

**WARNING: DO NOT** use a standard DH485 cable to connect this port to Allen Bradley equipment. A cable and wiring diagram are available from Red Lion.

### G3 to AB SLC 500 (CBLAB003)

Connections			
RJ45: RLC	Name	RJ45: A-B	Name
1	TxB	1	A
2	TxA	2	B
3, 8	RxA	-	24V
4, 7	RxB	-	COMM
5	TxEN	5	TxEN
6	COMM	4	SHIELD
4, 7	TxB	-	COMM
3, 8	TxA	-	24V

# SOFTWARE/UNIT OPERATION

## CRIMSON® SOFTWARE

Crimson® software is available as a free download from Red Lion's website or it can be purchased on a CD, see "Ordering Information" for part number. The latest version of the software is always available from the website, and updating your copy is free.

## DISPLAY

This operator interface uses a liquid crystal display (LCD) for displaying text and graphics. The display utilizes an LED backlight for lighting the display. The backlight can be dimmed for low light conditions.

The LED backlight has a limited lifetime. Backlight lifetime is based upon the amount of time the display is turned on at full intensity. Turning the backlight off when the display is not in use can extend the lifetime of your backlight. This can be accomplished through the Crimson® software when configuring your unit.

## FRONT PANEL LEDs

There are three front panel LEDs. Shown below is the default status of the LEDs.

LED	INDICATION
<b>RED (TOP, LABELED "PWR")</b>	
FLASHING	Unit is in the boot loader, no valid configuration is loaded. <sup>1</sup>
STEADY	Unit is powered and running an application.
<b>YELLOW (MIDDLE)</b>	
OFF	No CompactFlash card is present.
STEADY	Valid CompactFlash card present.
FLASHING RAPIDLY	CompactFlash card being checked.
FLICKERING	Unit is writing to the CompactFlash, either because it is storing data, or because the PC connected via the USB port has locked the drive. <sup>2</sup>
FLASHING SLOWLY	Incorrectly formatted CompactFlash card present.
<b>GREEN (BOTTOM)</b>	
FLASHING	A tag is in an alarm state.
STEADY	Valid configuration is loaded and there are no alarms present.

<sup>1</sup> The operator interface is shipped without a configuration. After downloading a configuration, if the light remains in the flashing state continuously, try cycling power. If the LED still continues to flash, try downloading a configuration again.

<sup>2</sup> Do not turn off power to the unit while this light is flickering. The unit writes data in two minute intervals. Later Microsoft operating systems will not lock the drive unless they need to write data; Windows 98 may lock the drive any time it is mounted, thereby interfering with logging. Refer to "Mounting the CompactFlash" in the Crimson 2 User Manual.

## TOUCHSCREEN

This operator interface utilizes a resistive analog touchscreen for user input. The unit will only produce an audible tone (beep) when a touch on an active touchscreen cell is sensed. The touchscreen is fully functional as soon as the operator interface is initialized, and can be operated with gloved hands.

## KEYPAD

The G306A keypad consists of five keys that can be used for on-screen menus.

## TROUBLESHOOTING YOUR G306A

If for any reason you have trouble operating, connecting, or simply have questions concerning your new G306A, contact Red Lion's technical support. For contact information, refer to the back page of this bulletin for phone and fax numbers.

EMAIL: [techsupport@redlion.net](mailto:techsupport@redlion.net)  
Web Site: <http://www.redlion.net>

## BATTERY & TIME KEEPING



**WARNING - EXPLOSION HAZARD - THE AREA MUST BE KNOWN TO BE NON-HAZARDOUS BEFORE SERVICING/REPLACING THE UNIT AND BEFORE INSTALLING OR REMOVING I/O WIRING AND BATTERY.**



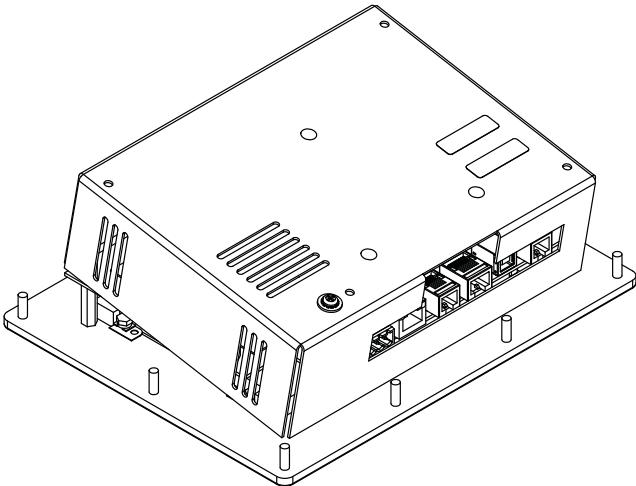
**WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN DISCONNECTED AND THE AREA IS KNOWN TO BE NON-HAZARDOUS.**

A battery is used to keep time when the unit is without power. Typical accuracy of the G306A time keeping is less than one minute per month drift. The battery of a G306A unit does not affect the unit's memory, all configurations and data is stored in non-volatile memory.



**CAUTION:** The circuit board contains static sensitive components. Before handling the operator interface without the rear cover attached, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the operator interface at a static controlled clean workstation. Also, do not touch the surface areas of the circuit board. Dirt, oil, or other contaminants may adversely affect circuit operation.

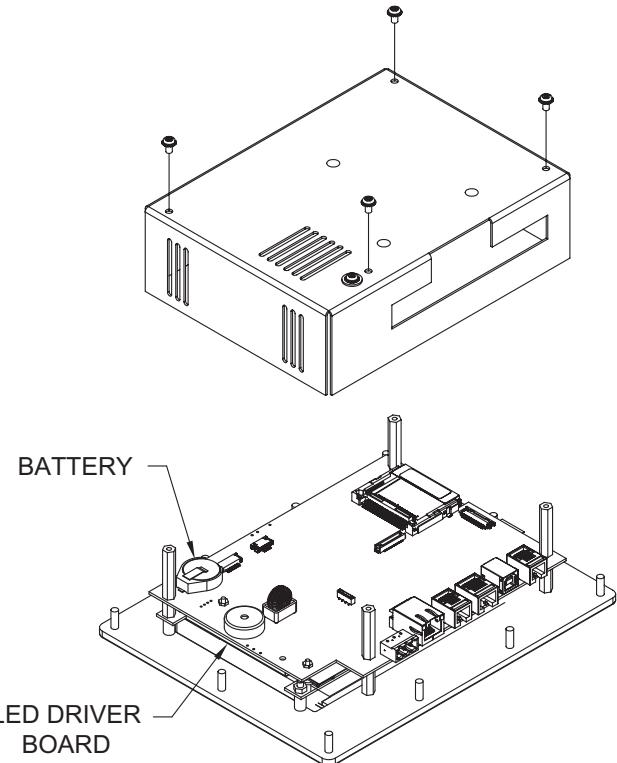
To change the battery of a G306A, remove power, cabling, and then the rear cover of the unit. To remove the cover, remove the four screws designated by the arrows on the rear of the unit. Then, by lifting the top side, hinge the cover, thus providing clearance for the connectors on the bottom side of the PCB as shown in the illustration below. Install in the reverse manner.



Remove the old battery\* from the holder and replace with the new battery. Replace the rear cover, cables, and re-apply power. Using Crimson or the unit's keypad, enter the correct time and date.

\* Please note that the old battery must be disposed of in a manner that complies with your local waste regulations. Also, the battery must not be disposed of in fire, or in a manner whereby it may be damaged and its contents come into contact with human skin.

The battery used by the G306A is a lithium type CR2025.



# OPTIONAL FEATURES AND ACCESSORIES

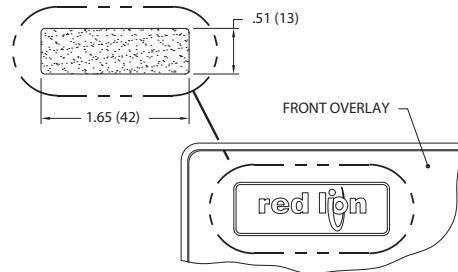
## OPTIONAL COMMUNICATION CARD

Red Lion offers optional communication cards for fieldbus communications. These communication cards will allow your G306A to communicate with many of the popular fieldbus protocols.

Red Lion is also offering a communications card for additional RS232 and RS422/485 communications. Visit Red Lion's website for information and availability of these cards.

## CUSTOM LOGO

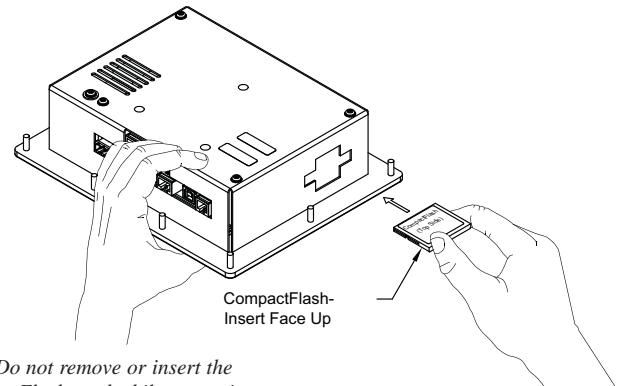
Each G3 operator interface has an embossed area containing the Red Lion logo. Red Lion can provide custom logos to apply to this area. Contact your distributor for additional information and pricing.



## COMPACTFLASH SOCKET

CompactFlash socket is a Type II socket that can accept either Type I or II cards. Use cards with a minimum of 4 Mbytes and formatted to a maximum of 2 Gbytes (See Note box below) with the G306A's CompactFlash socket. Cards are available at most computer and office supply retailers.

CompactFlash can be used for configuration transfers, larger configurations, data logging, and trending.



*Note: Do not remove or insert the CompactFlash card while power is applied. Refer to "Front Panel LEDs."*

Information stored on a CompactFlash card by a G306A can be read by a card reader attached to a PC. This information is stored in IBM (Windows®) PC compatible FAT16 file format.

## NOTE

For reliable operation of this and other Red Lion products, one of the following brands of CompactFlash card must be used...

SimpleTech	SMART® Modular
SanDisk®	Silicon Systems

*Not all of the above manufacturers offer CompactFlash cards recognized to UL standards, which may be required for your application.*

*Although RLC products limit use of CompactFlash card memory to 2 GB, cards with a larger capacity can be used. They MUST be formatted to 2 GB and use the FAT 16 file system. It is recommended to format the CF card using the format utility from within Crimson.*

## LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company's liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company's option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company's products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.

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Fax +86 21 6113 3683

### 3. Drawings

# Drawings – As Built



QUEENSLAND  
UrbanUtilities

# SP033 ADAM STREET SEWAGE PUMPING STATION SITE COVER SHEET

Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015  
Signed:

ELECTRICAL DRAWINGS INDEX					
DWG N°.	TITLE	SHEET	REVISIONS		
486/5/7-0471-000	SITE COVER SHEET	00	O	A	B
486/5/7-0471-001	POWER DISTRIBUTION SCHEMATIC DIAGRAM	01	O	A	B
486/5/7-0471-002a	PUMP 01 SCHEMATIC DIAGRAM	02a	O	A	B
486/5/7-0471-002b	PUMP 02 SCHEMATIC DIAGRAM	02b	O	A	B
486/5/7-0471-003a	PUMP 03 SCHEMATIC DIAGRAM	03a	O	A	B
486/5/7-0471-003b	PUMP 04 SCHEMATIC DIAGRAM	03b	O	A	B
486/5/7-0471-004a	ACTUATOR 01 SCHEMATIC DIAGRAM	04a	O	A	B
486/5/7-0471-004b	ACTUATOR 02 SCHEMATIC DIAGRAM	04b	O	A	B
486/5/7-0471-005	DRY WELL & EM. STORAGE DEWATERING PUMPS SCHEMATIC DIAGRAM	05	O	A	B
486/5/7-0471-006	MTS CONTROL WIRING DIAGRAM	06	O	A	B
486/5/7-0471-007	COMMON CONTROLS SCHEMATIC DIAGRAM	07	O	A	B C
486/5/7-0471-008	COMMON RTU I/O SCHEMATIC DIAGRAM	08	O	A	B
486/5/7-0471-009	RTU POWER DISTRIBUTION SCHEMATIC & NETWORK DIAGRAM	09	O	A	B
486/5/7-0471-010	RTU DIGITAL INPUTS TERMINATION DIAGRAM - SHEET 1 OF 3	10	O	A	B
486/5/7-0471-011	RTU DIGITAL INPUTS TERMINATION DIAGRAM - SHEET 2 OF 3	11	O	A	B
486/5/7-0471-012	RTU DIGITAL INPUTS TERMINATION DIAGRAM - SHEET 3 OF 3	12	O	A	B
486/5/7-0471-013	RTU DIGITAL OUTPUTS TERMINATION DIAGRAM - SHEET 1 OF 2	13	O	A	B
486/5/7-0471-014	RTU DIGITAL OUTPUTS TERMINATION DIAGRAM - SHEET 2 OF 2	14	O	A	B
486/5/7-0471-015	RTU ANALOG INPUTS TERMINATION DIAGRAM	15	O	A	B
486/5/7-0471-016	RTU ANALOG OUTPUTS TERMINATION DIAGRAM	16	O	A	B
486/5/7-0471-017	COMMON CONTROLS TERMINATION DIAGRAM	17	O	A	B
486/5/7-0471-018	EQUIPMENT LIST	18	O	A	B C
486/5/7-0471-019	CABLE SCHEDULE	19	O	A	B
486/5/7-0471-020	SWITCHBOARD LABEL SCHEDULE	20	O	A	B
486/5/7-0471-021	SWITCHBOARD CONSTRUCTION DETAILS - SHEET 1 of 3	21	O	A	B
486/5/7-0471-022	SWITCHBOARD CONSTRUCTION DETAILS - SHEET 2 of 3	22	O	A	B
486/5/7-0471-023	SWITCHBOARD CONSTRUCTION DETAILS - SHEET 3 of 3	23	O	A	B
486/5/7-0471-024	FIELD INSTRUMENTATION - INSTALLATION DETAILS	24	O	A	B
486/5/7-0471-025	RESERVED (CATHODIC PROTECTION UNIT)	25			
486/5/7-0471-026	RESERVED (GENERATOR CONTROL)	26			
486/5/7-0471-027	DRY WELL DISCONNECTION BOX GENERAL ARRANGEMENT	27	O	A	B
486/5/7-0471-028	WETWELL INSTRUMENTATION DISCONNECT BOX GENERAL ARRANGEMENT	28	O	A	B
486/5/7-0471-029	SWBD GENERAL ARRANGEMENT - SHEET 1 OF 4	29	O	A	B
486/5/7-0471-030	SWBD GENERAL ARRANGEMENT - SHEET 2 OF 4	30	O	A	B
486/5/7-0471-031	SWBD GENERAL ARRANGEMENT - SHEET 3 OF 4	31	O	A	B
486/5/7-0471-032	SWBD GENERAL ARRANGEMENT - SHEET 4 OF 4	32	O	A	B
486/5/7-0471-033	EXTERNAL GENERATOR CONNECTION CUBICLE	33	O	A	B
486/5/7-0471-034	DRY WELL MOTOR DISCONNECTION BOX INSTALLATION DETAILS	34	O	A	B
486/5/7-0471-040	SWITCHBOARD SLAB - LOCALITY AND SITE PLANS - SHEET 1 of 3	40	O	A	B
486/5/7-0471-041	SWITCHBOARD SLAB AND CONDUIT DETAILS - SHEET 2 of 3	41	O	A	B
486/5/7-0471-042	SWITCHBOARD AND ELECTRICAL CONDUIT LAYOUT - SHEET 3 of 3	42	O	A	B

STANDARD VARIABLES	
DESCRIPTION	VALUES
CT METERING ISOLATOR	630A SLB 630 3P
NORMAL SUPPLY MAIN SWITCH	10 (630A) S630CE/630
GENERATOR SUPPLY MAIN SWITCH	10 (630A) S630CE/630
PUMP1 CIRCUIT BREAKER	0.63 (252A) S400GJ/400
PUMP2 CIRCUIT BREAKER	0.63 (252A) S400GJ/400
PUMP3 CIRCUIT BREAKER	0.8 (128A) S160GJ/160
PUMP4 CIRCUIT BREAKER	0.8 (128A) S160GJ/160
DRY WELL SUMP PUMP CIRCUIT BREAKER	20A S125NJ/20
EM. STORAGE DEWATERING PUMP CCT BREAKER	NOT APPLICABLE
PUMP VSD STARTER SIZE	FC202N132 260A
PUMP RATINGS	132kW 252A 50kW 87A
PUMP LINE CONTACTOR	NOT APPLICABLE
DRY WELL SUMP PUMP RATING	2.2kW 4.8A
DRY WELL SUMP PUMP CONTACTOR & TOL	CA7-23 CT7N 23 B63
PUMP SOCKET OUTLET + INCLINE SLEEVE	NOT APPLICABLE
PUMP INLET PLUG + HANDLE	NOT APPLICABLE
WET WELL LEVEL TRANSMITTER	WL52XXA4AM01D01X 6m
EMERGENCY STORAGE WELL LEVEL TRANSMITTER	NOT APPLICABLE
EM. STORAGE DEWATERING PUMP RATING	NOT APPLICABLE
EM. STORAGE DEWATERING PUMP CONTR & TOL	NOT APPLICABLE
FLOWMETER RANGE	500l/s
WET WELL ULTRASONIC LEVEL SENSOR	NOT APPLICABLE
DELIVERY PRESSURE TRANSMITTER	BR52XXCA1EHPMAS L=20 25m
RADIO	DR900-06A02-D0
EMERGENCY PUMPING TIME	tbase
No of SINGLE POINT PROBES	6
INCOMING MAINS SUPPLY CABLE	2x185mm <sup>2</sup>
MAIN EARTHING CABLE	120mm <sup>2</sup>
INCOMING GENERATOR SUPPLY CABLE	NOT APPLICABLE
VSD STARTER 3 PHASE SUPPLY	132kW = 95mm <sup>2</sup> 50kW = 35mm <sup>2</sup>

STANDARD DESIGN OPTIONS		
OPTION	DESCRIPTION	FITTED
A	INDIVIDUAL PUMP MOISTURE IN OIL (MIO) SENSOR AND FAULT RELAY	YES <input checked="" type="checkbox"/>
B	INDIVIDUAL PUMP MOISTURE IN STATOR (MIS) SENSOR AND FAULT RELAY	YES <input checked="" type="checkbox"/>
C	INDIVIDUAL PUMP REFLUX VALVE PROXIMITY SWITCH	YES <input checked="" type="checkbox"/>
D	STATION MANHOLE SURCHARGE IMMINENT	<input checked="" type="checkbox"/>
E	STATION DRY WELL SUMP PUMP AND LEVEL INDICATION SENSORS AND RELAYS	YES <input checked="" type="checkbox"/>
F	PERMANENT GENERATOR INSTALLED	<input checked="" type="checkbox"/>
G	STATION EMERGENCY STORAGE LEVEL SENSOR, DEWATERING PUMP	<input checked="" type="checkbox"/>
H	STATION DELIVERY FLOWMETER - 240VAC ABB	YES <input checked="" type="checkbox"/>
I	BACKUP COMMUNICATION - GSM	YES <input checked="" type="checkbox"/>
J	PUMP CONNECTION (Via Dry Well J-Box)	YES <input checked="" type="checkbox"/>
K	CATHODIC PROTECTION	<input checked="" type="checkbox"/>
L	MOTOR THERMISTORS (Via Dry Well J-Box)	YES <input checked="" type="checkbox"/>
M	ODOUR CONTROL	<input checked="" type="checkbox"/>
N	CURRENT TRANSFORMER (CT) METERING	YES <input checked="" type="checkbox"/>
O	NO PUMP INTERLOCKING	<input checked="" type="checkbox"/>
P	WET WELL WASHER	<input checked="" type="checkbox"/>
Q	AUX PIT SUMP PUMP AND LEVEL PROBE	<input checked="" type="checkbox"/>
R	TELEMETRY RADIO	YES <input checked="" type="checkbox"/>
S	WET WELL SECONDARY LEVEL SENSOR	<input checked="" type="checkbox"/>
T	WET WELL PRIMARY LEVEL SENSOR (Via Field Instrument Box)	YES <input checked="" type="checkbox"/>
U	DELIVERY PRESSURE TRANSMITTER (Direct Connected)	YES <input checked="" type="checkbox"/>
V	CHEMICAL DOSING	<input checked="" type="checkbox"/>
W	PUMP START METHOD - VARIABLE SPEED DRIVE	YES <input checked="" type="checkbox"/>
X	3rd & 4th PUMP INSTALLED	YES <input checked="" type="checkbox"/>
Y	POWER METER	YES <input checked="" type="checkbox"/>

Sheet 00

FOR CONSTRUCTION

B 02.15	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14
A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN	R.P.E.Q. NO. DATE
O 03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_C	A.WITTHOFFT	8855 3-3-14
No. DATE	Q-Pulse ID: TMS1407	DRN.	APD.	B.C.C. FILE NO.		DESIGN CHECK	R.P.E.Q. NO. DATE

NAME: QUEENSLAND URBAN UTILITIES DELEGATE	DATE: 30/09/2015
QUEENSLAND Urban Utilities	AUTHORISED FOR 12 MONTHS FROM DATE OF SIGNATURE



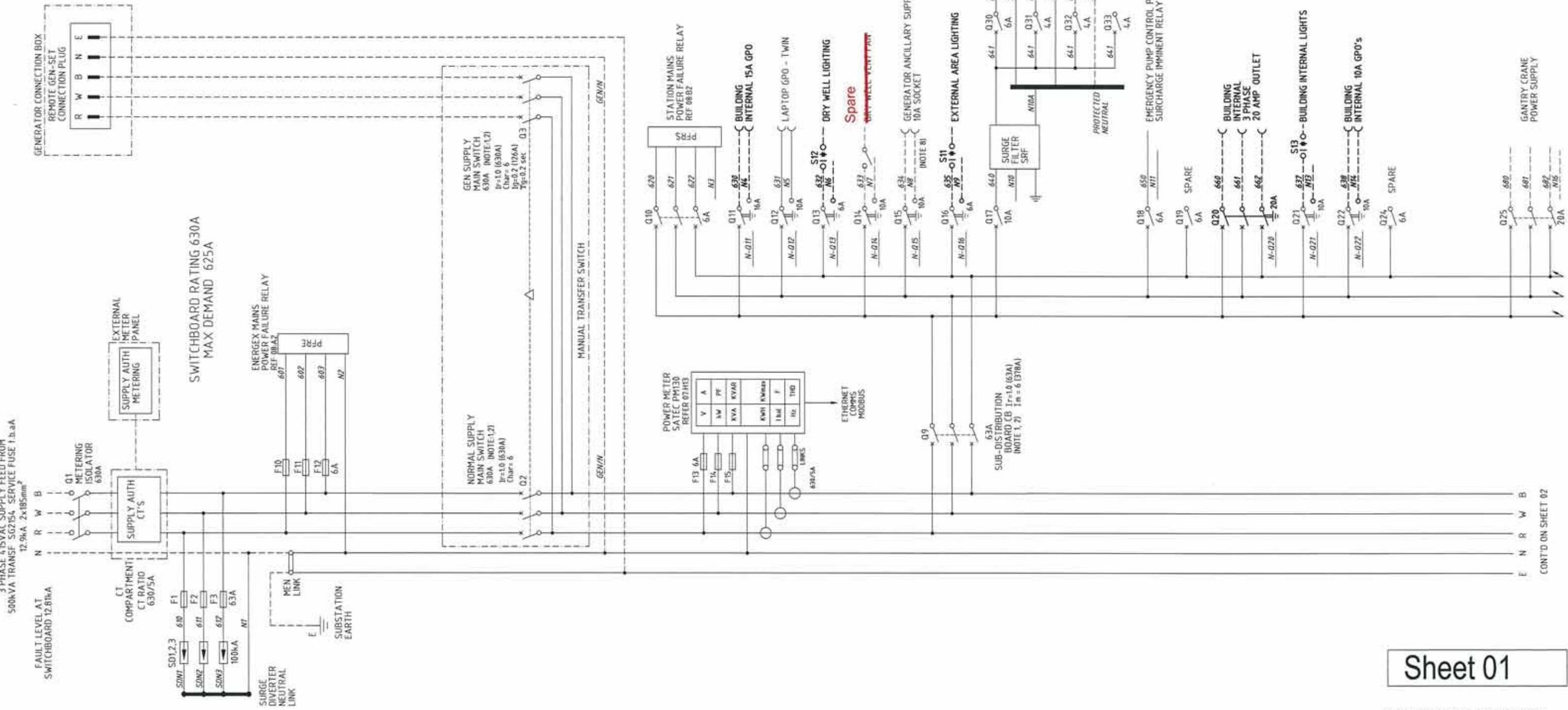
SITE SP033  
ADAM STREET  
SEWAGE PUMP STATION

TITLE SITE COVER SHEET

SHEET No. 0  
Queensland Urban Utilities DRAWING No.  
**486/5/7-0471-000** B  
Page 1487 of 1633

## NOTES

1. INCOMING MAIN GENSET, PUMP & DB CIRCUIT BREAKERS SHALL BE LINE SIDE SURROUNDED.
2. M.E.N. LINK TO BE PROVIDED AS PER AS3000.2007 SECTION 7.
3. SURGE PROTECTION DEVICE TO BE AS CLOSE TO THE INCOPER AS POSSIBLE.
4. ALL CIRCUIT BREAKERS TO BE PADLOCKABLE. LOCKING IS TO BE INDEPENDENT OF ESCUTCHEON
5. CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD TO OVERLOADS TO AS3947-4-1.
6. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SH2000 COMPATIBLE LABELING.
7. ALL LIGHT AND POWER CIRCUITS SHALL BE FITTED WITH RCD PROTECTION, SET AT 30mA.
8. MAXIMUM DEMAND CALCULATION AND ALL CIRCUIT BREAKER SETTINGS WITHIN THIS DRAWINGS SET HAVE BEEN DERIVED FROM THE SITE POWER SYSTEM ANALYSIS FILE.  
(Refer "SP033 ADAM STREET Power System Analysis and Protection Coordination.pdf")
9. CABLING TO GENERATOR CONNECTION BOX AND AUXILIARY SUPPLY SOCKET TO BE DOUBLE INSULATED CABLING.



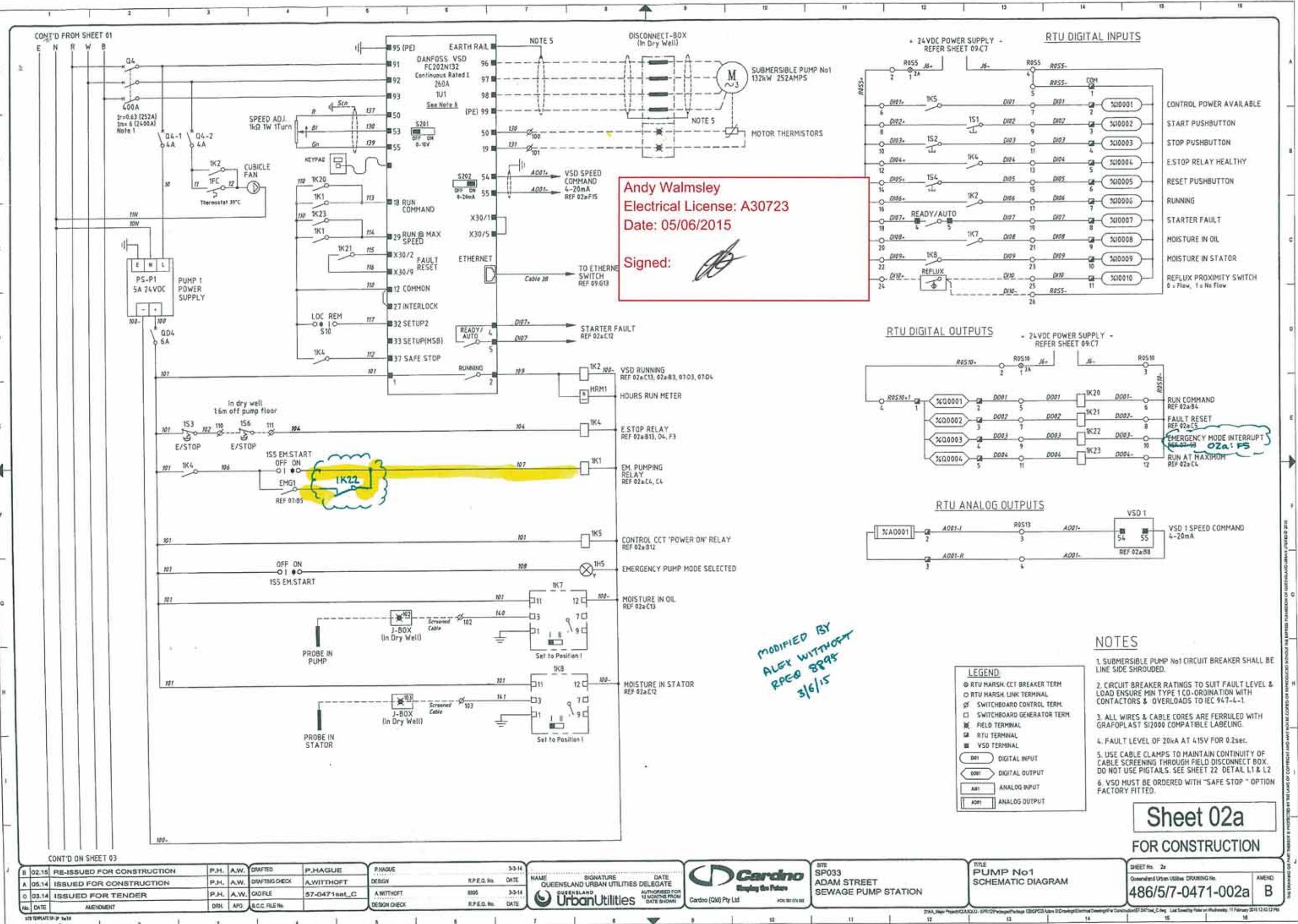
Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

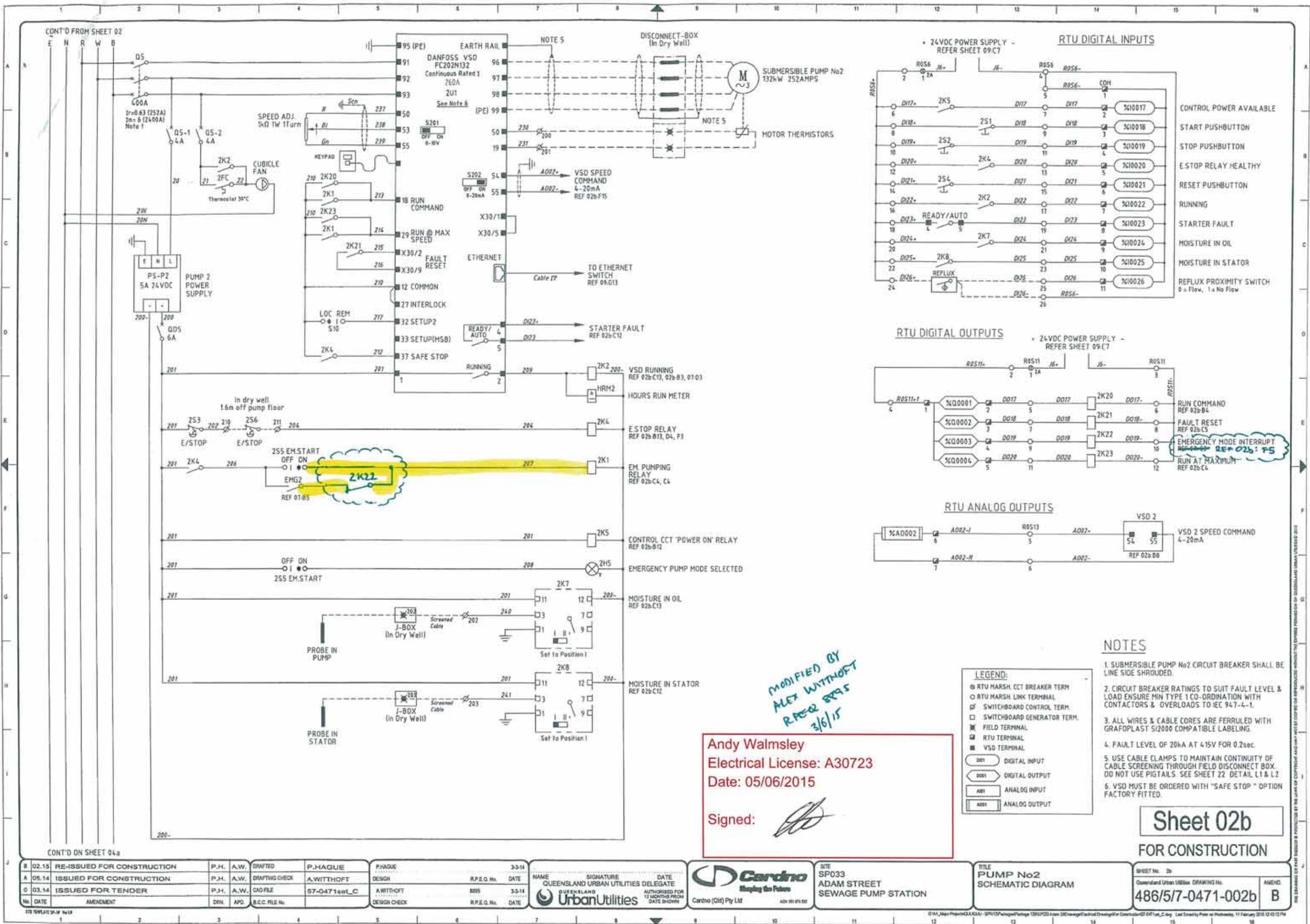
Signed:

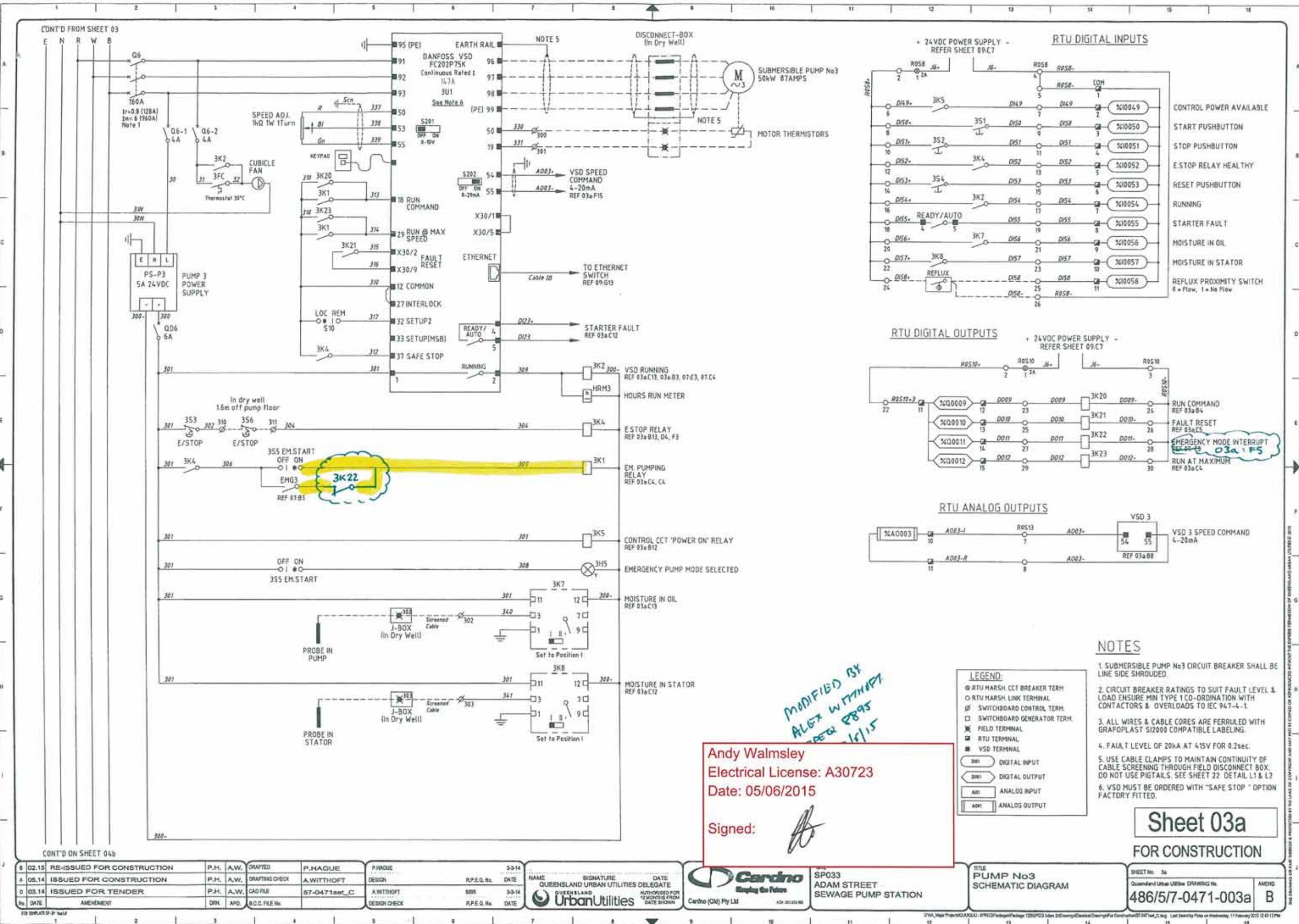
Sheet 01

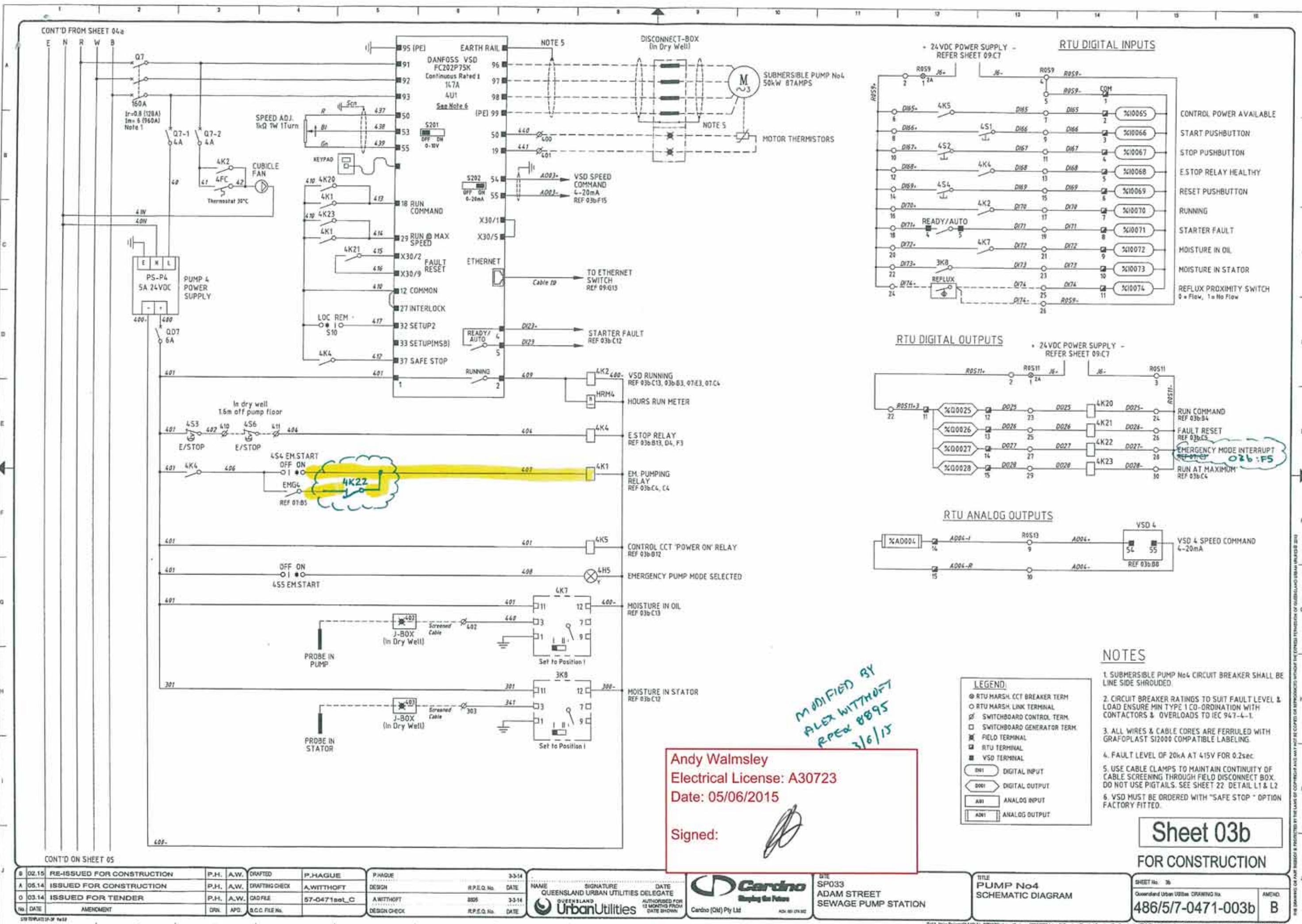
FOR CONSTRUCTION

B 02.15 RE-ISSUED FOR CONSTRUCTION	P.H. A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	NAME	SIGNATURE	DATE	SITE	TITLE	SHEET NO.
A 05.14 ISSUED FOR CONSTRUCTION	P.H. A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN	R.P.E.Q. No.	DATE	QUEENSLAND URBAN UTILITIES DELEGATE	DATE	AMITTHOFF	DESIGN	R.P.E.Q. No.	SP033	POWER DISTRIBUTION SCHEMATIC DIAGRAM	1
O 03.14 ISSUED FOR TENDER	P.H. A.W.	CAD FILE	57-0471set_C	APPROVED	8895	DATE	12 MONTHS FROM	DATE	Cardno	Supply the Future	DATE	ADAM STREET SEWAGE PUMP STATION	486/5/7-0471-001	Queensland Urban Utilities DRAWING No.
No. DATE	Q-Pulse ID: TMS1407	DRN. APD.	B.C.C. FILE No.	DESIGN CHECK	R.P.E.Q. No.	DATE	Active 30/09/2015	DATE	Cardno (Qld) Pty Ltd	Active 30/09/2015	DATE	FOR CONSTRUCTION	Page 1488 of 1633	AMEND. B



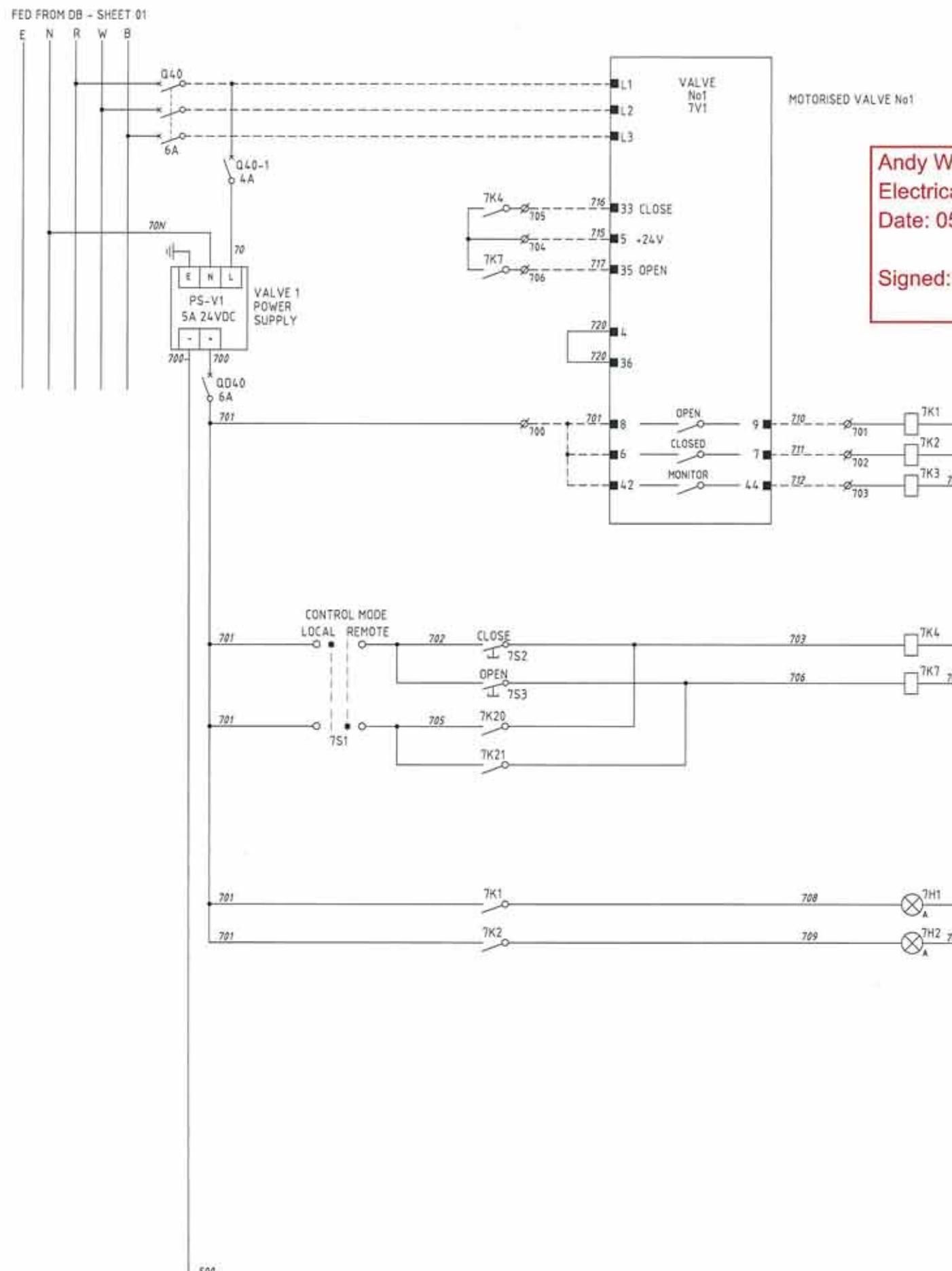


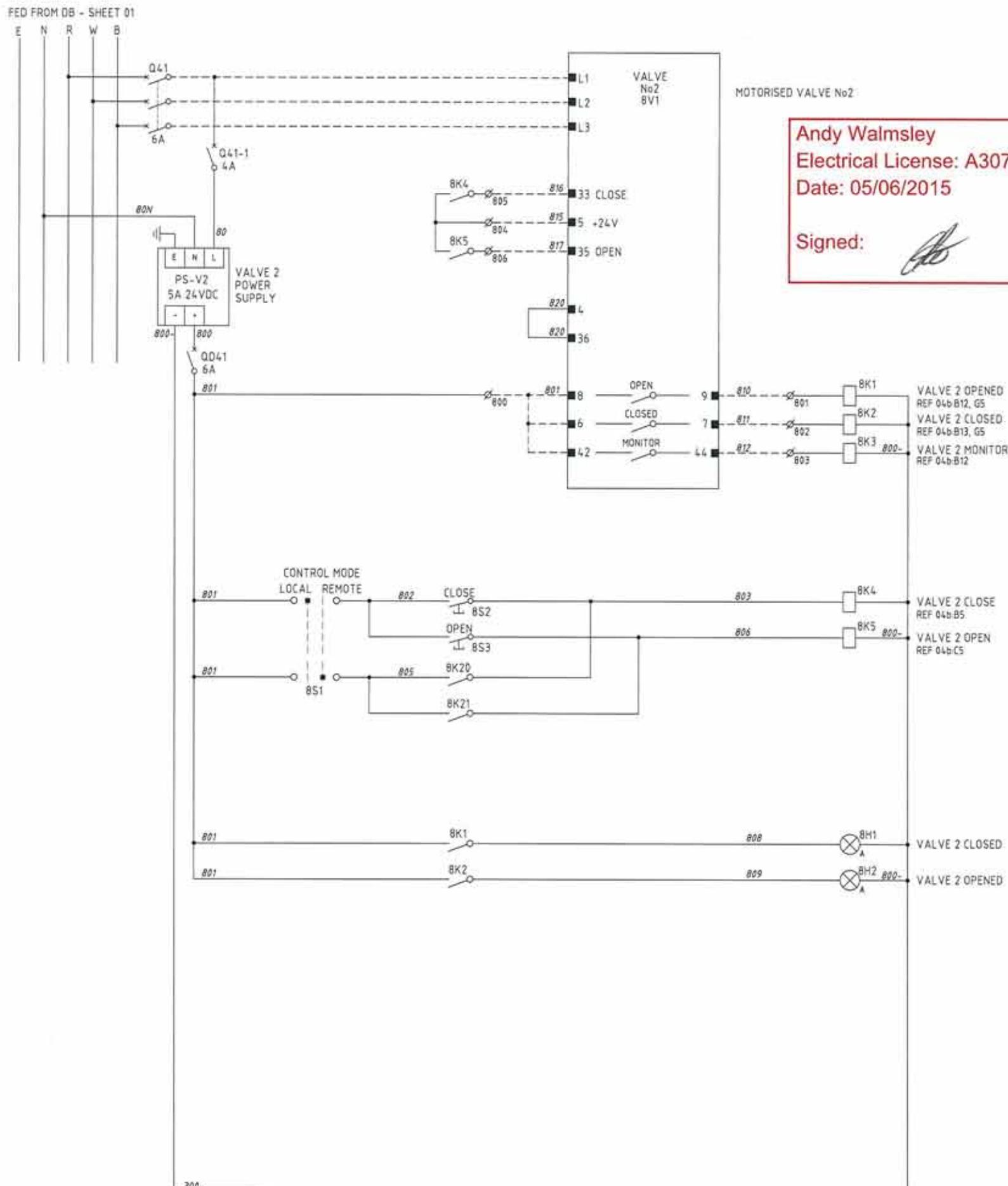




Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:

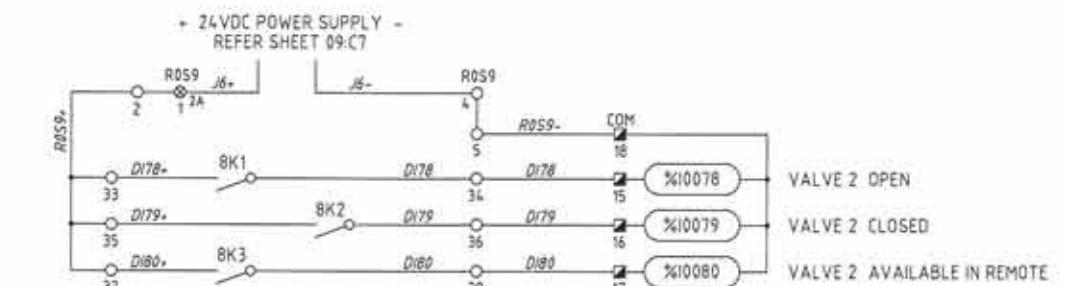




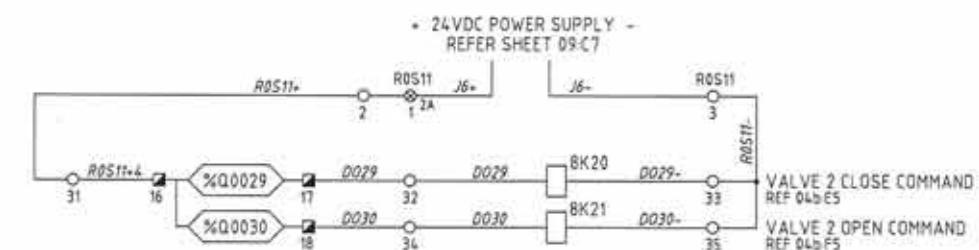
Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed

RTU DIGITAL INPUTS



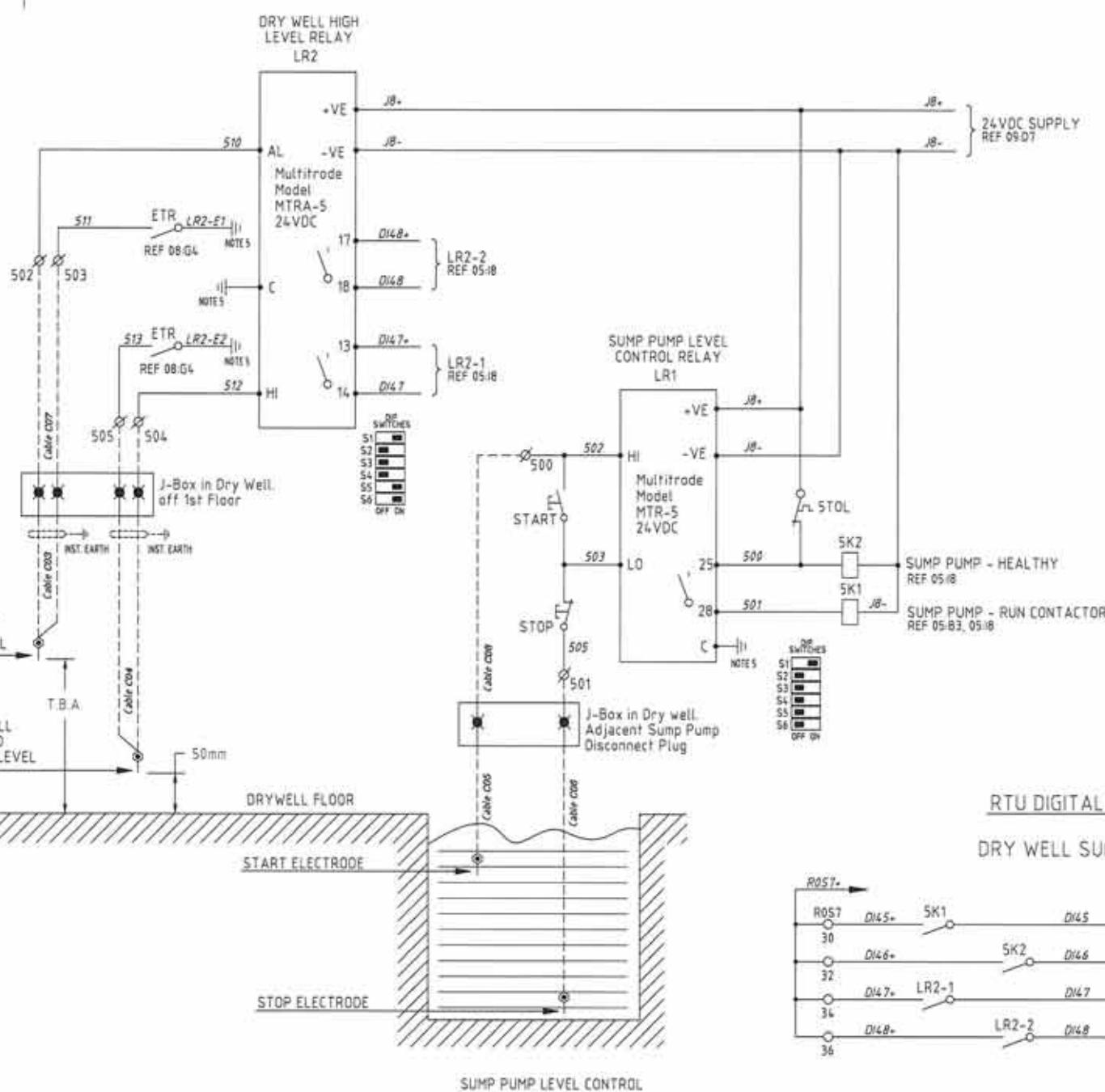
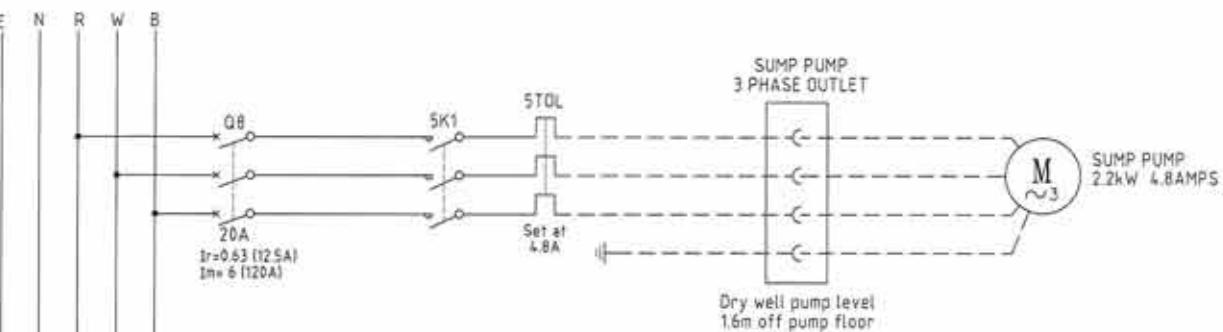
RTU DIGITAL OUTPUTS



Sheet 4b

## FOR CONSTRUCTION

CONT'D FROM SHEET 03b



# RESERVED EMERGENCY STORAGE DEWATERING PUMP

Andy Walsmley  
Electrical License: A30723  
Date: 05/06/2015

Signed:

**NOTES**

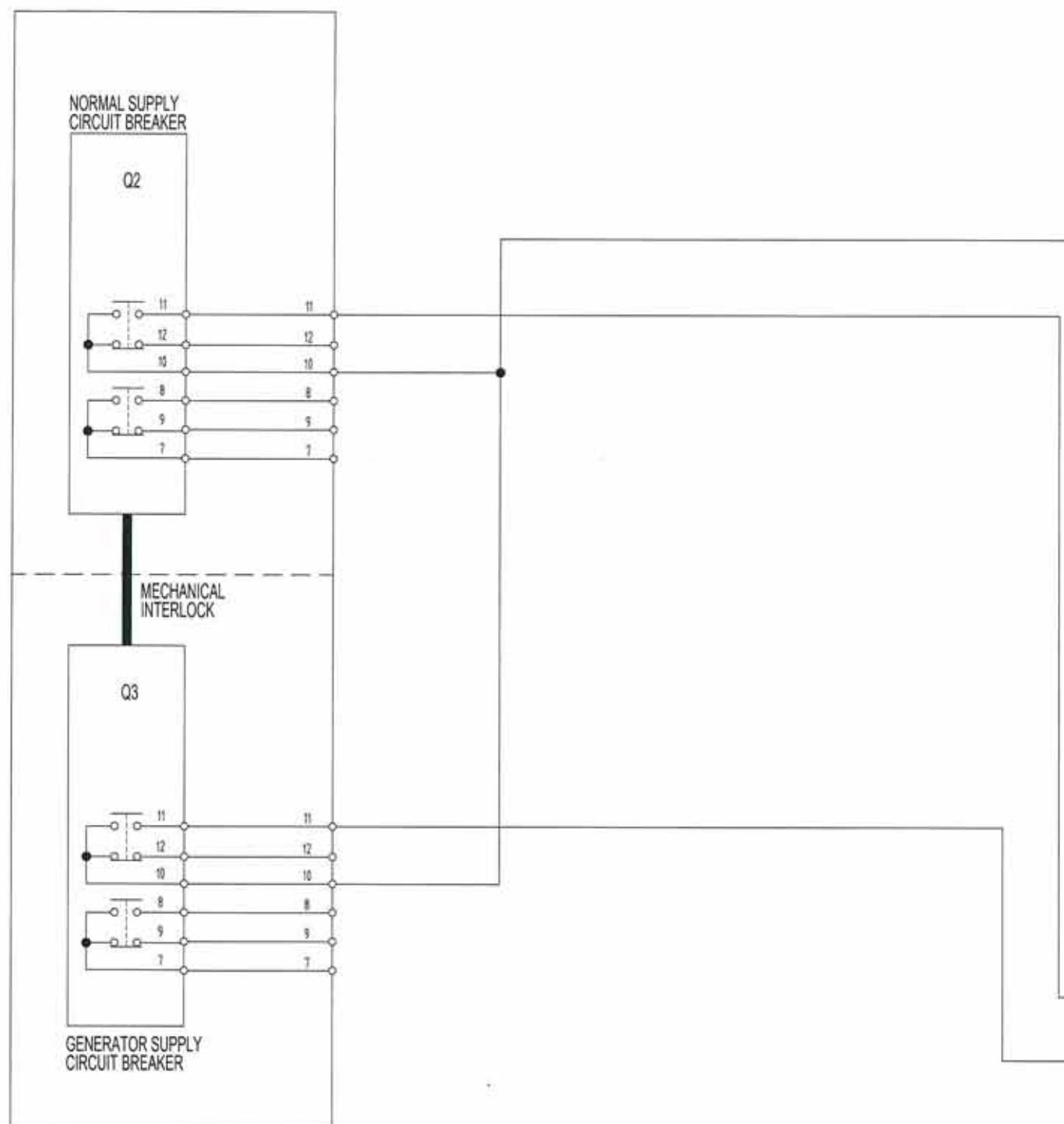
- SUMP PUMP & STORAGE TANK DEWATERING PUMP CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
- CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE MIN TYPE 1 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
- FAULT LEVEL OF 20KA AT 415V FOR 0.2sec.
- ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.
- RUN SEPARATE DEDICATED EARTH CONDUCTORS TO EARTH BAR.

**Sheet 05****FOR CONSTRUCTION**

B 02.15 RE-ISSUED FOR CONSTRUCTION	P.H. A.W.	DRAFTED	P.HAGUE	PHAQUE	3-14	NAME	SIGNATURE	DATE	SITE	TITLE	SHEET NO.
A 05.14 ISSUED FOR CONSTRUCTION	P.H. A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN	R.P.E.Q. No.	DATE	QUEENSLAND URBAN UTILITIES DELEGATE	DATE	SP033	SUMP PUMPS	5
O 03.14 ISSUED FOR TENDER	P.H. A.W.	CAD FILE	57-0471set_C	DESIGN CHECK	3-14	APPROVED FOR	12 MONTHS FROM	APPROVED FOR	ADAM STREET	SCHEMATIC DIAGRAM	Queensland Urban Utilities DRAWING NO.
No DATE	O-Pulse ID: TMS1407	DRW APO	B.C.C. FILE No.	DESIGN CHECK	R.P.E.Q. No.	DATE	APPROVED FOR	12 MONTHS FROM	SEWAGE PUMP STATION	DRY WELL SUMP PUMP	486/5/7-0471-005
							APPROVED FOR	12 MONTHS FROM		EM. STORAGE DEWATERING PUMP	Page 1495 of 1633

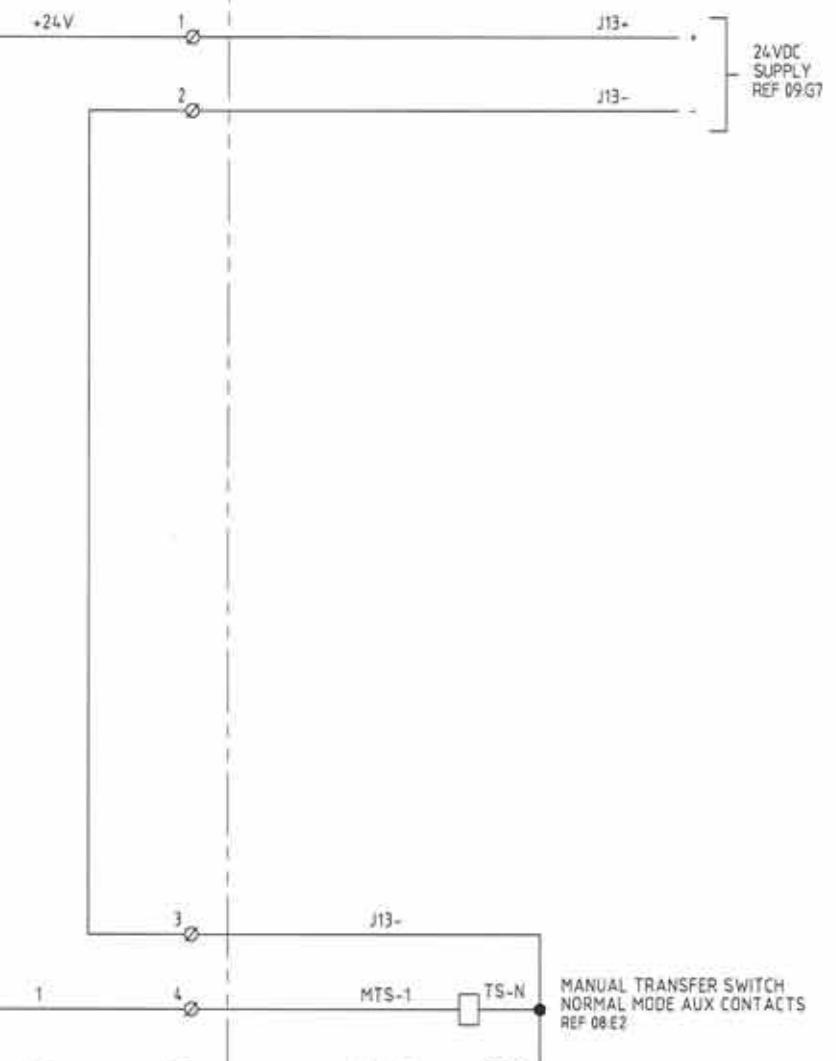
## MAIN SWITCH COMPARTMENT

## MANUAL TRANSFER SWITCH



Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:



- LEGEND:**
- ◎ RTU MARSH. CCT BREAKER TERM
  - RTU MARSH. LINK TERMINAL
  - ▢ SWITCHBOARD CONTROL LINK TERM.
  - MARSHALLING BOX CONTROL TERM.
  - MARSHALLING BOX POWER TERM.
  - SWITCHBOARD GENERATOR TERM.
  - FIELD TERMINAL
  - RTU TERMINAL
  - VSD TERMINAL

**Sheet 06**

FOR CONSTRUCTION

6/02/15	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	PHAGUE	3-3-14
A/05/14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN	R.P.E.Q. No. DATE
0/03/14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_C	A.WITTHOFFT	8885 3-3-14
No. DATE	AMENDMENT	O-Pulse ID:	TMS1407	DRN. APD.	B.C.C. FILE No.	DESIGN CHECK	R.P.E.Q. No. DATE



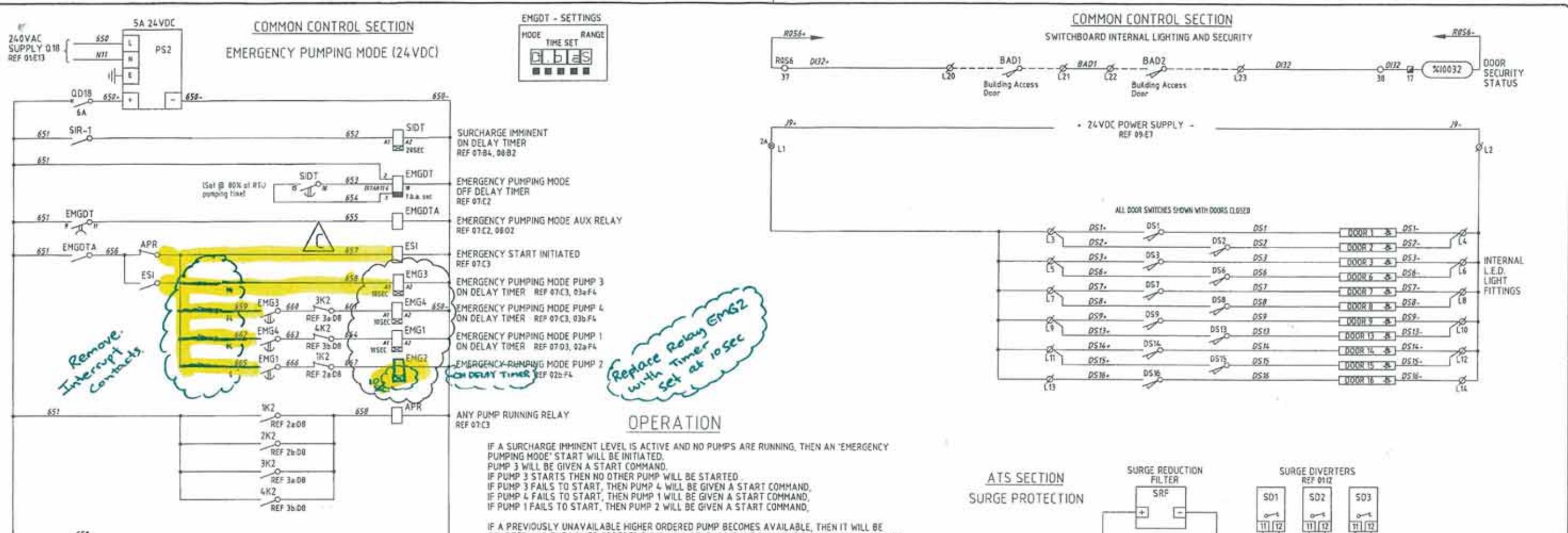
Active 30/09/2015



SITE SP033  
ADAM STREET  
SEWAGE PUMP STATION

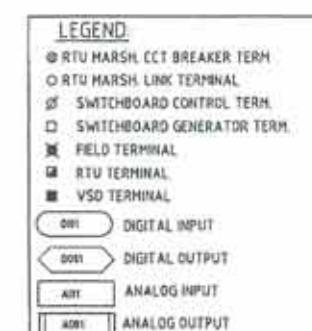
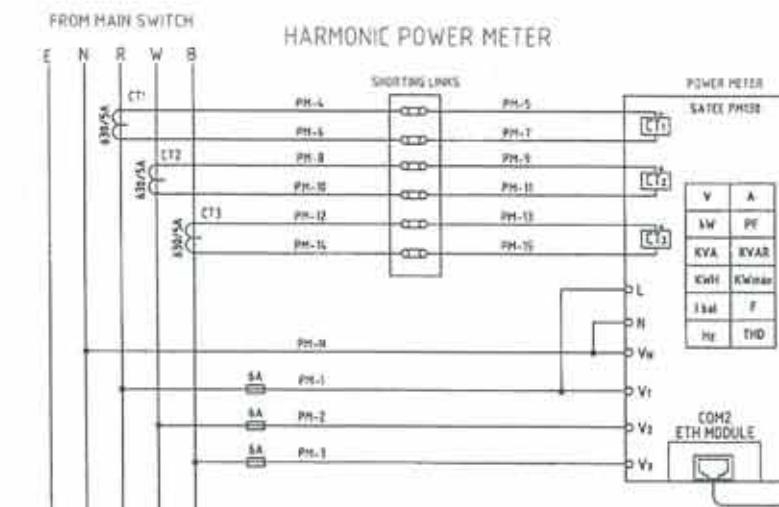
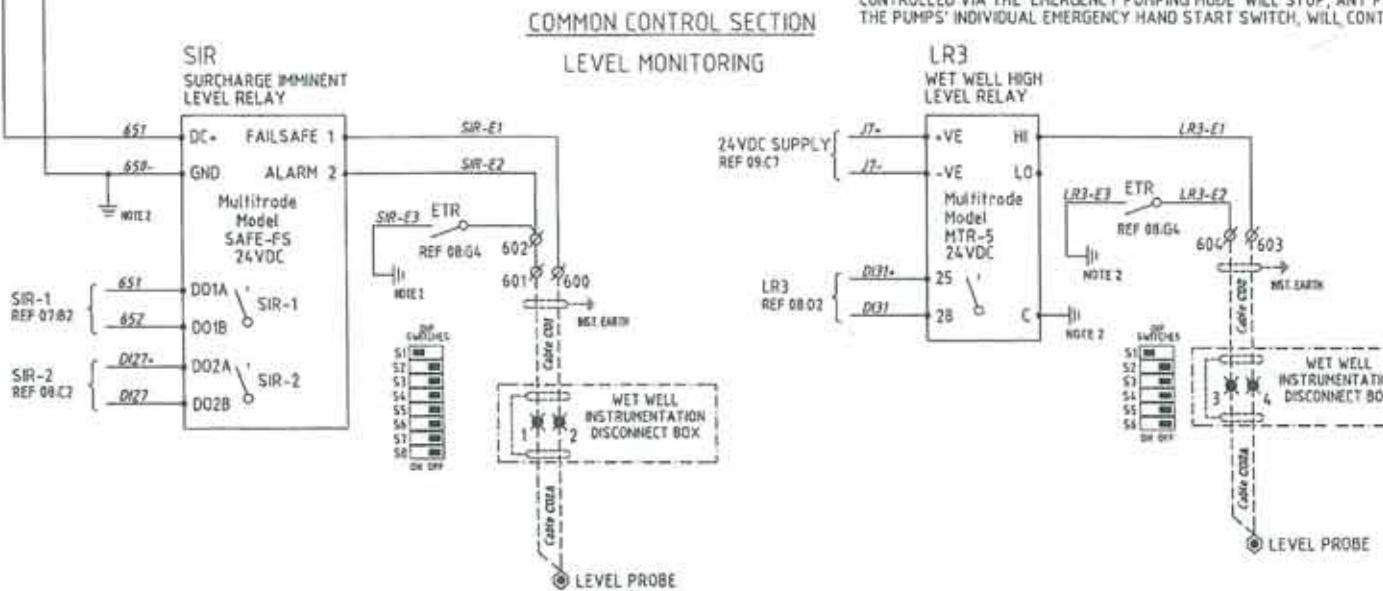
TITLE MTS CONTROL  
WIRING DIAGRAM

SHEET NO. 06  
Queensland Urban Utilities DRAWING NO.  
**486/5/7-0471-006** AMEND. B  
Page 1496 of 1633



Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:



Sheet 07

FOR CONSTRUCTION

B	02.15	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	PIQUE	3-3-14	NAME	SIGNATURE	0
A	05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFF	DESIGN	R.P.E.Q. No.	DATE	QUEENSLAND URBAN UTILITIES DELEGATED POWER	
C	02.15	EMERGENCY BACKUP CCT CHANGED	P.H.	A.W.	CAD FILE	57-0471set_C	A.WITTHOFF	8895	3-3-14	QUEENSLAND URBAN UTILITIES DELEGATED POWER	
D	DATE	AMENDMENT	DRL	APO	E.C.C. FILE NO.		DESIGN CHECK	R.P.E.Q. No.	DATE	QUEENSLAND URBAN UTILITIES DELEGATED POWER	
										Urban Utilities	AUTHORISATION 12 MONTHS FROM DATE

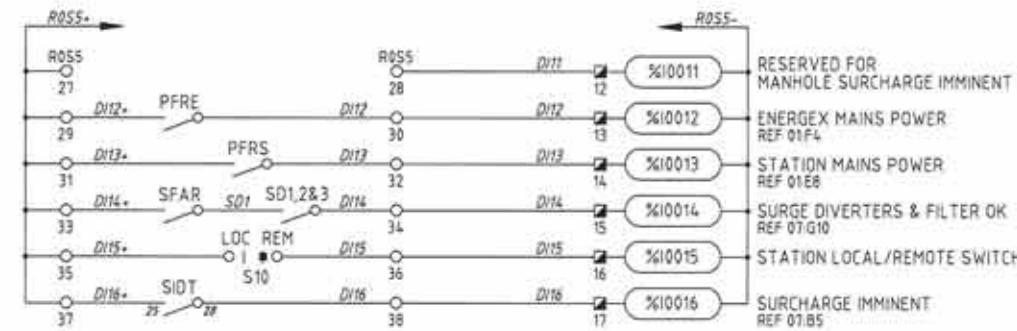


SITE  
SP033  
ADAM STREET  
SEWAGE PUMP STATION

TITLE  
COMMON CONTROLS  
SCHEMATIC DIAGRAM

SHEET No. 7  
Queensland Urban Utilities DRAWING No.  
**486/5/7-0471-007**

## RTU DIGITAL INPUTS

24VDC SUPPLY  
REF 09.C1

012+24V

R055+

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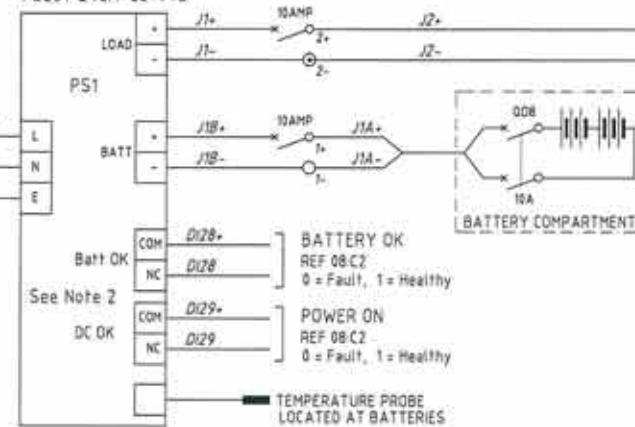
36

38

24VAC  
FILTERED  
SUPPLY Q30  
REF 01:C11

COMMON CONTROLS  
SECTION

POWERBOX  
PB251-24CM-CC-T-S



CONTROL SYSTEM  
POWER SUPPLY  
10A 24VDC

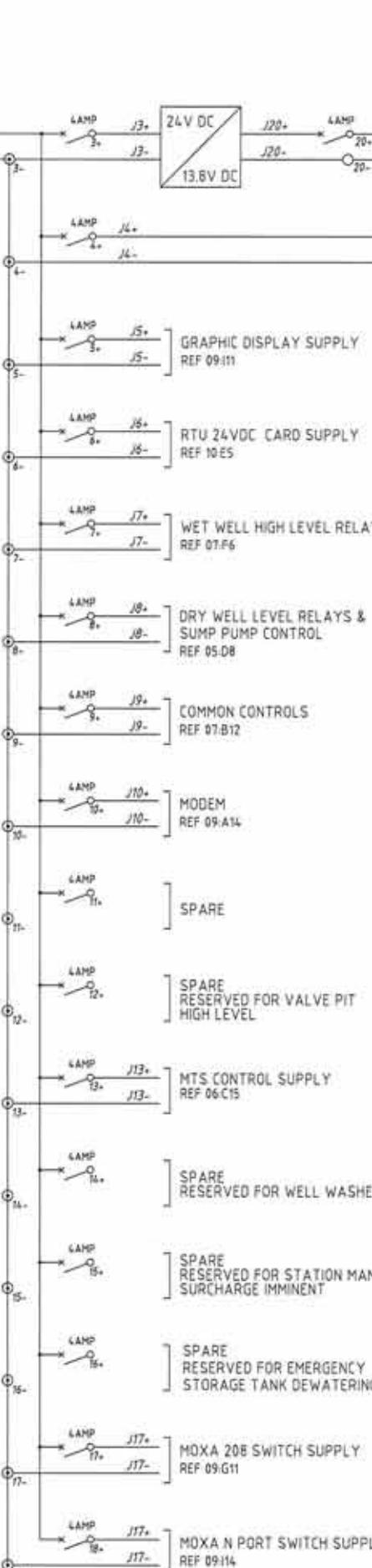
Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:

LEGEND:	
◎	RTU MARSH. CCT BREAKER TERM
○	RTU MARSH. LINK TERMINAL
☒	SWITCHBOARD CONTROL TERM.
□	SWITCHBOARD GENERATOR TERM.
■	FIELD TERMINAL
■	RTU TERMINAL
■	VSD TERMINAL
DIN	DIGITAL INPUT
DOUT	DIGITAL OUTPUT
AIN	ANALOG INPUT
AOUT	ANALOG OUTPUT

### NOTES

- ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.
- RELAY CONTACT LABELS INDICATE THE POWERED UPS HEALTHY STATE.  
IE: NORMALLY CLOSED WHEN THE UNIT IS ENERGISED. WHEN UNIT IS DE-ENERGISED, THE CONTACTS WILL CHANGE STATE TO NORMALLY OPEN.



Rx TBA  
Tx TBA  
SD

RADIO

24VDC  
SUPPLY  
REF 09:F1

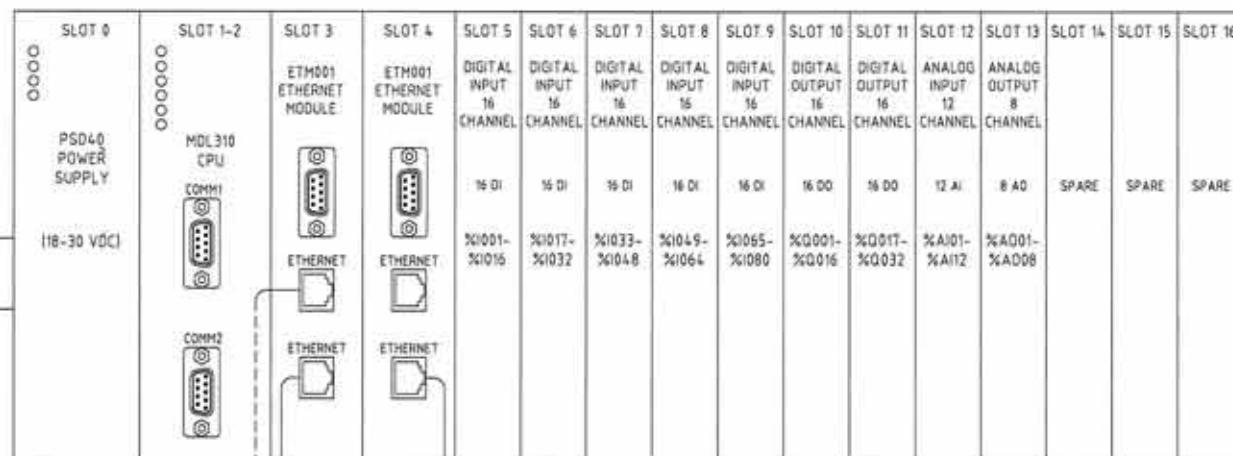
TERMINALS '21'  
MOUNTED ADJACENT  
TO GSM MODEM

GSM ANTENNA

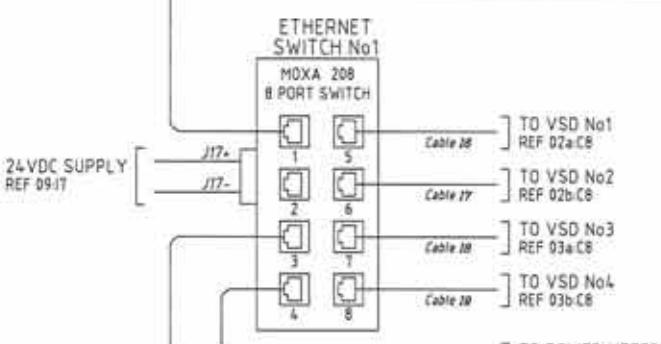
GSM  
MODEM

SUB HOUSING

PLC  
GEFanuc RX3i



LAPTOP  
CONNECTION



24VDC SUPPLY  
REF 09:J7

MOXA 208 8 PORT SWITCH  
REF 09:G11

MOXA N PORT IAS250a  
REF 09:J1

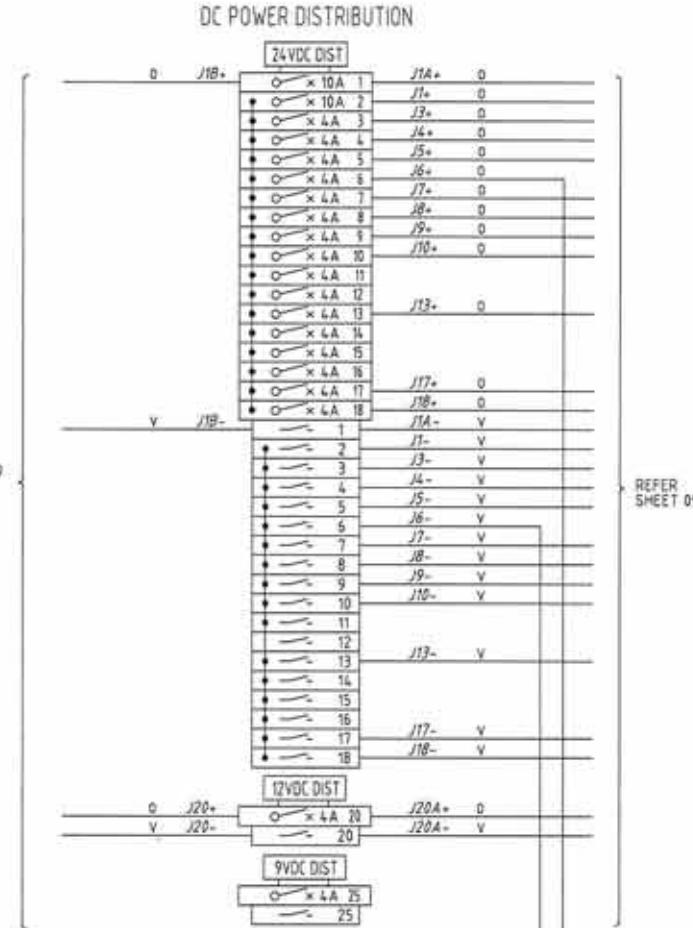
REDLION G306A000  
REF 09:J7

24VDC SUPPLY  
REF 09:J7

## RTU COMPARTMENT

RACK D SLOT 5  
GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

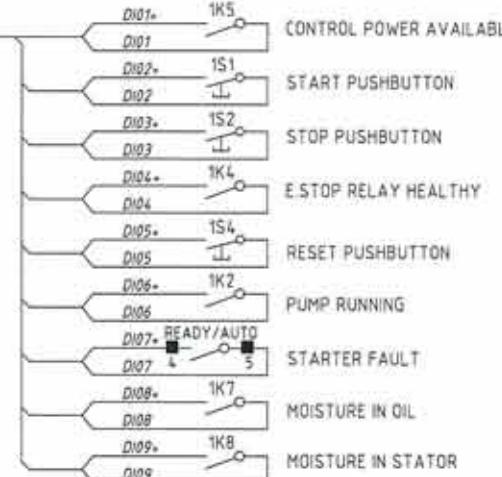
	1	ROSS-
%I0001	2	D101
%I0002	3	D102
%I0003	4	D103
%I0004	5	D104
%I0005	6	D105
%I0006	7	D106
%I0007	8	D107
%I0008	9	D108
%I0009	10	D109
%I0010	11	D110
%I0011	12	D111
%I0012	13	D112
%I0013	14	D113
%I0014	15	D114
%I0015	16	D115
%I0016	17	D116
NOT USED	18	
	19	
	20	



## SWITCHBOARD

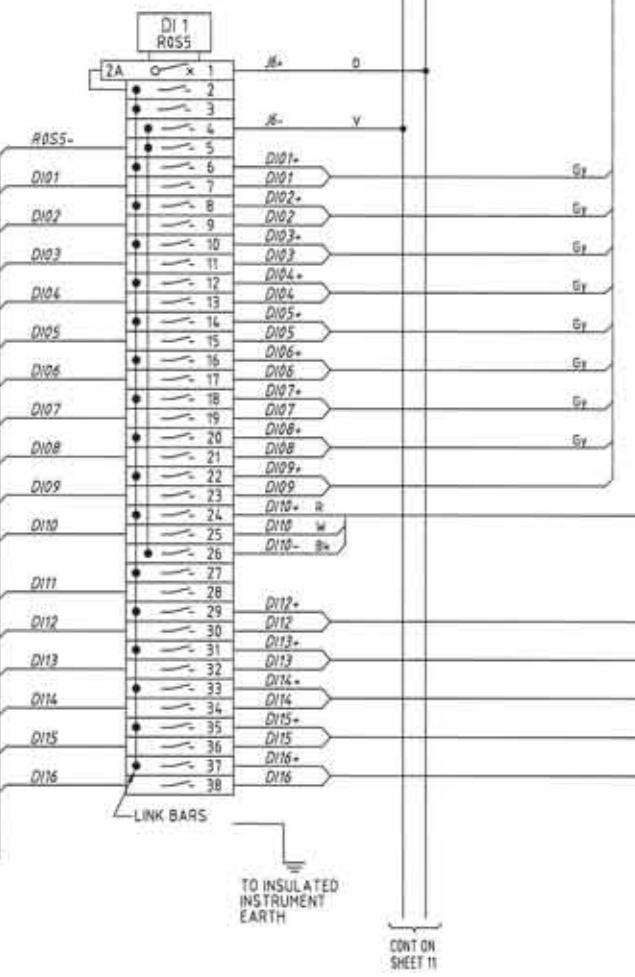
PUMP 1  
STARTER COMPARTMENT

REFER SHEET 02a



Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

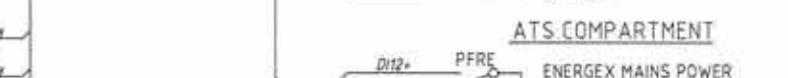
Signed:



## COMMON COMPARTMENT

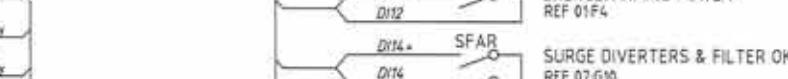
## STATION MAINS POWER

REF 01E8



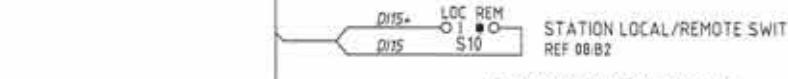
## ATS COMPARTMENT

REF 01F4



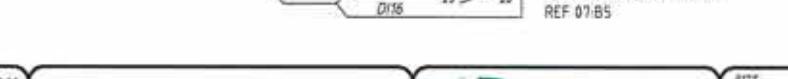
## STARTER COMPARTMENT

REF 07-G10



## COMMON COMPARTMENT

REF 07-B2



## STATION LOCAL/REMOTE SWITCH

REF 08-B2

## SURCHARGE IMMINENT

REF 07-B5

## LEGEND:

- C?? CABLE IDENTIFIER
- 2A o-x 1 RTU MINIATURE CCT BREAKER
- 1 DISCONNECT LINK TERMINAL
- 1 THROUGH TERMINAL

## NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.

Sheet 10

FOR CONSTRUCTION

B 02.15	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-14
A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN	R.F.E.Q. No. DATE
O 03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	S7-0471set_C	AWITTHOFFT	8886 3-14
No. DATE	O-Pulse ID: TMS1407	DRN.	APD.	B.C.C. FILE No.		DESIGN CHECK	R.F.E.Q. No. DATE



SITE SP033  
ADAM STREET  
SEWAGE PUMP STATION

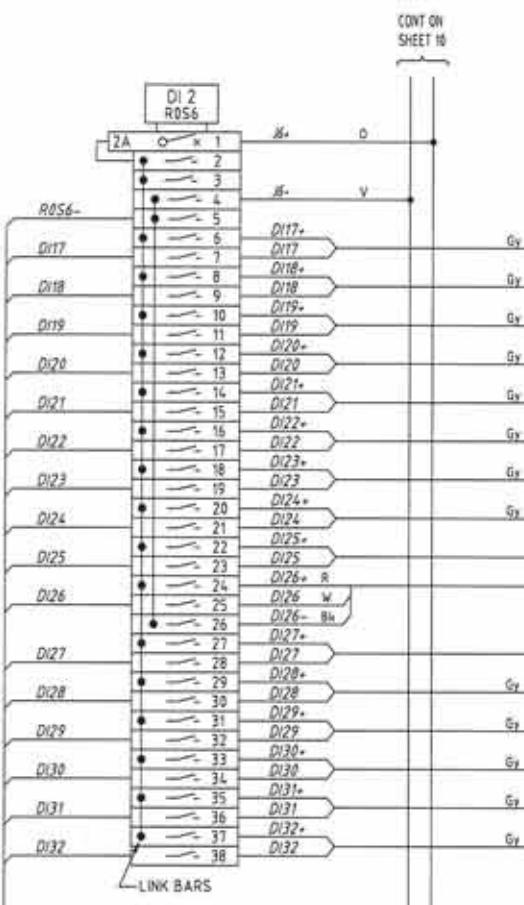
TITLE RTU DIGITAL INPUTS  
TERMINATION DIAGRAM  
SHEET 1 OF 3

SHEET NO. 10  
Queensland Urban Utilities DRAWING NO.  
486/5/7-0471-010  
Page 1500 of 1633  
AMEND: B

## RTU COMPARTMENT

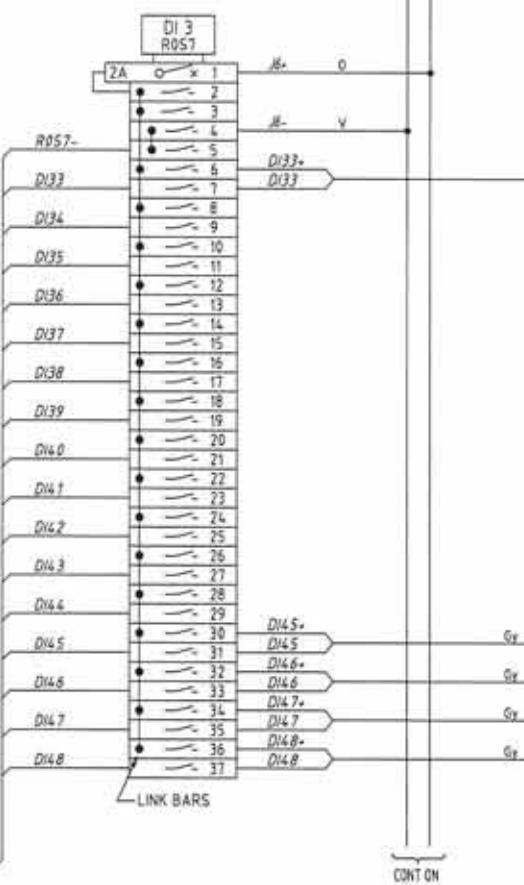
RACK 0 SLOT 6  
GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

COM	1	R056-
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%I0018	3	D118
%I0019	4	D119
%I0020	5	D120
%I0021	6	D121
%I0022	7	D122
%I0023	8	D123
%I0024	9	D124
%I0025	10	D125
%I0026	11	D126
%I0027	12	D127
%I0028	13	D128
%I0029	14	D129
%I0030	15	D130
%I0031	16	D131
%I0032	17	D132
NOT USED	18	
	19	
	20	



RACK 0 SLOT 7  
GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

COM	1	R057-
%I0033	2	D133
%I0034	3	D134
%I0035	4	D135
%I0036	5	D136
%I0037	6	D137
%I0038	7	D138
%I0039	8	D139
%I0040	9	D140
%I0041	10	D141
%I0042	11	D142
%I0043	12	D143
%I0044	13	D144
%I0045	14	D145
%I0046	15	D146
%I0047	16	D147
%I0048	17	D148
NOT USED	18	
	19	
	20	

PUMP 2  
STARTER COMPARTMENT  
REFER SHEET 02s

## COMMON COMPARTMENT

SIR-2  
SURCHARGE IMMINENT PROBE FAIL  
REF 07.G2

## RTU COMPARTMENT

D128+ Batt OK  
D128- DC OK  
D129+ D129- RTU CONTROL POWER  
REF 09.C4

## COMMON COMPARTMENT

D130+ EMGDTA  
D130- LR3  
D131+ D131- WET WELL HIGH LEVEL  
REF 07.G5  
D132+ L20  
D132- L23  
Building Access  
Doors (2 off in series)

Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:

PUMP 2  
REFLUX PROXIMITY SWITCH  
REF 02b.C12

D133+ TS-N  
D133- CB CLOSED  
REF 06.H14

## SUMP PUMP COMPARTMENT

D145+ SK1  
D145- D146+ SK2  
D146- D147+ LR2-1  
D147- D148+ LR2-2  
D148- D149+ DRY WELL SUMP PUMP RUNNING  
REF 05.I8  
DRY WELL SUMP PUMP HEALTHY  
REF 05.I8  
DRY WELL FLOODED ALARM  
REF 05.I8  
DRY WELL FLOODED TRIP  
REF 05.I8

## NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.

## LEGEND:

- C?? CABLE IDENTIFIER
- 2A O-x-1 RTU MINIATURE CCT BREAKER
- 1 DISCONNECT LINK TERMINAL
- 1 THROUGH TERMINAL

Sheet 11

FOR CONSTRUCTION

B	02.15	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14
A	05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN	R.F.E.Q. No.
O	03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_C	DATE	DATE
No.	DATE	AMENDMENT	DRN.	APD.	B.C.C. FILE No.	DESIGN CHECK	A.WITTHOFFT	R.F.E.Q. No.



Active: 30/09/2015



SITE  
SP033  
ADAM STREET  
SEWAGE PUMP STATION

TITLE  
RTU DIGITAL INPUTS  
TERMINATION DIAGRAM  
SHEET 2 OF 3

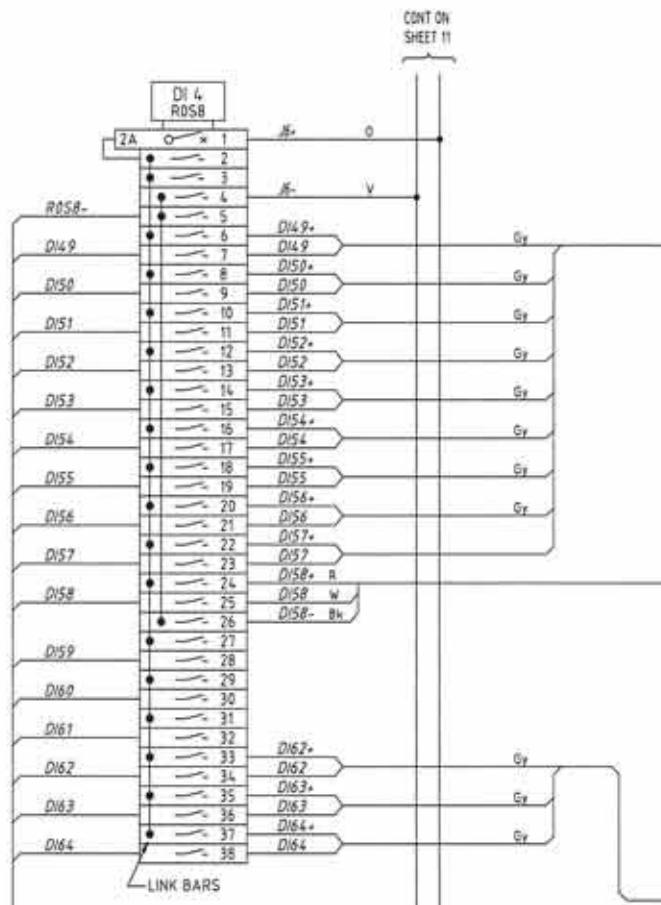
SHEET No. 11  
Queensland Urban Utilities DRAWING No.  
486/5/7-0471-011  
Page 1501 of 1633

B

## RTU COMPARTMENT

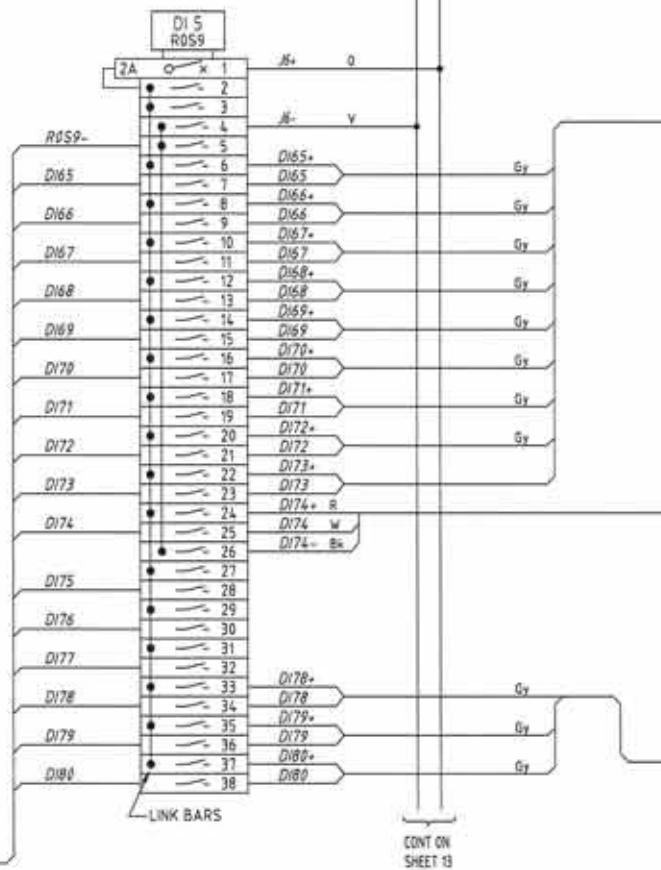
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GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

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	20	

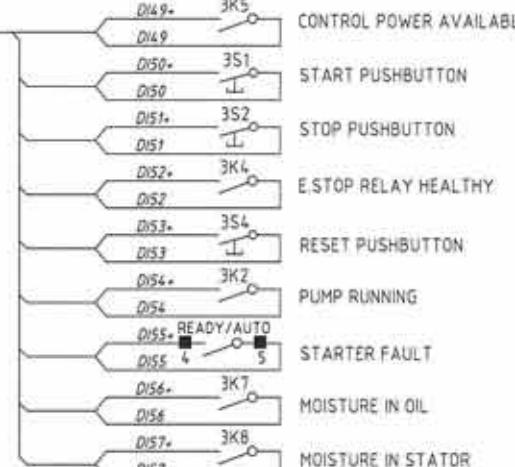


RACK 0 SLOT 9  
GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

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%I0069	6	D169
%I0070	7	D170
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%I0075	12	D175
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%I0078	15	D178
%I0079	16	D179
%I0080	17	D180
NOT USED	18	
	19	
	20	



PUMP 3  
STARTER COMPARTMENT  
REFER SHEET 03a



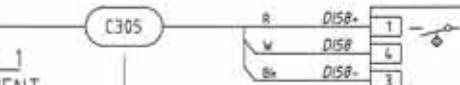
## SWITCHBOARD

## FIELD

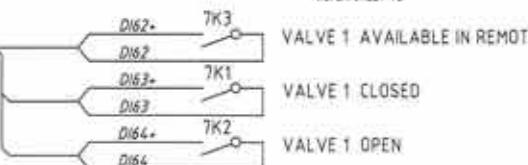
Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:

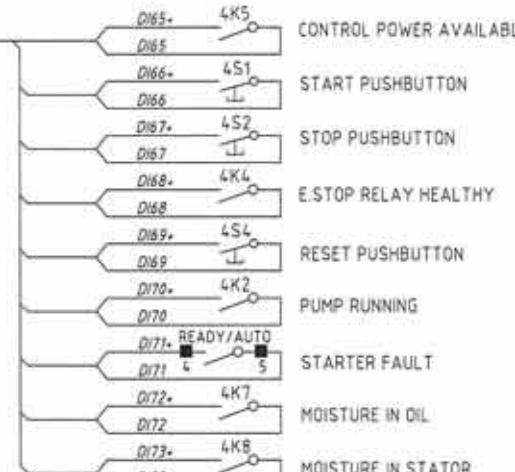
PUMP 3  
REFLUX PROXIMITY SWITCH  
REF 03bC12



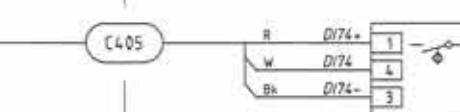
MOTORISED VALVE 1  
CONTROL COMPARTMENT  
REFER SHEET 4a



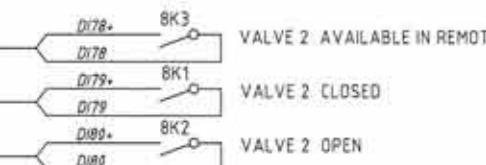
PUMP 4  
STARTER COMPARTMENT  
REFER SHEET 03b



PUMP 4  
REFLUX PROXIMITY SWITCH  
REF 03bC12



MOTORISED VALVE 2  
CONTROL COMPARTMENT  
REFER SHEET 4a



NOTES  
1. ALL WIRES & CABLE CORES ARE  
FERRULED WITH GRAFOPLAST SI2000  
COMPATIBLE LABELING.

## LEGEND:

C??	CABLE IDENTIFIER
2A o x 1	RTU MINITURE CCT BREAKER
— 1	DISCONNECT LINK TERMINAL
1	THROUGH TERMINAL

Sheet 12

FOR CONSTRUCTION

B 02.15 RE-ISSUED FOR CONSTRUCTION  
A 05.14 ISSUED FOR CONSTRUCTION  
O 03.14 ISSUED FOR TENDER  
No. DATE Q-Pulse Id: TMS1407

P.H. A.W. DRAFTED P.HAGUE  
P.H. A.W. DRAFTING CHECK A.WITTHOFFT  
P.H. A.W. CAD FILE 57-0471set\_C  
DRN. APD. B.C.C. FILE N/A

PHAGUE  
DESIGN  
A.WITTHOFFT  
A.WITTHOFFT  
DESIGN CHECK

3-3-14  
R.P.E.Q. No. DATE  
8895 3-3-14  
R.P.E.Q. No. DATE  
Active: 30/09/2015

NAME QUEENSLAND URBAN UTILITIES DELEGATE  
URBAN UTILITIES  
SIGNATURE DATE  
APPROVED FOR 12 MONTHS FROM  
Active: 30/09/2015

DATE  
R.P.E.Q. No. DATE  
Active: 30/09/2015

DATE  
R.P.E.Q. No. DATE  
Active: 30/09/2015

DATE  
R.P.E.Q. No. DATE  
Active: 30/09/2015

Cardno  
Shaping the Future  
Queensland Urban Utilities

SITE SP033  
ADAM STREET  
SEWAGE PUMP STATION

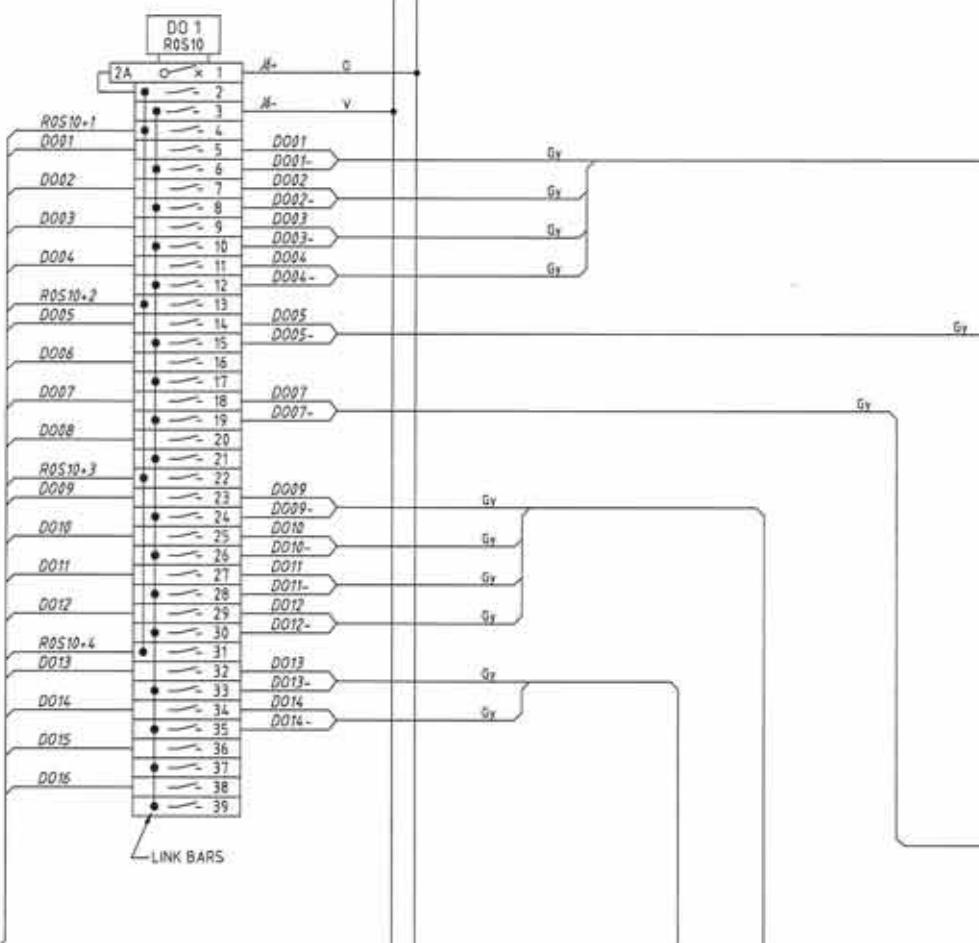
TITLE RTU DIGITAL INPUTS  
TERMINATION DIAGRAM  
SHEET 3 OF 3

SHEET No. 12  
Queensland Urban Utilities DRAWING No.: 486/5/7-0471-012  
AMEND. B  
Page 1502 of 1633

## RTU COMPARTMENT

RACK 0 SLOT 10  
GE FANUC 16 POINT  
DIGITAL OUTPUT MODULE  
IE694MDL940

	1	R0S10+7
%Q0001	2	D001
%Q0002	3	D002
%Q0003	4	D003
%Q0004	5	D004
COM2	6	R0S10+2
%Q0005	7	D005
%Q0006	8	D006
%Q0007	9	D007
%Q0008	10	D008
COM3	11	R0S10+3
%Q0009	12	D009
%Q0010	13	D010
%Q0011	14	D011
%Q0012	15	D012
COM4	16	R0S10+4
%Q0013	17	D013
%Q0014	18	D014
%Q0015	19	D015
%Q0016	20	D016

CONT ON  
SHEET 12CONT ON  
SHEET 16

## SWITCHBOARD

PUMP 1  
STARTER COMPARTMENT  
REFER SHEET 02a

- D001 → 1K20 PUMP 1 RUN COMMAND REFER 02a:E14
- D001- → 1K21 PUMP 1 FAULT RESET REFER 02a:E14
- D002 → 1K22 PUMP 1 EMERGENCY MODE INTERRUPT REFER 02a:E14
- D002- → 1K23 PUMP 1 RUN AT MAXIMUM REFER 02a:E14

## COMMON COMPARTMENT

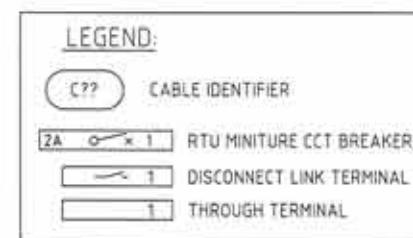
- D005 → ETR ELECTRODE TEST RELAY REFER 08:G4

PUMP 3  
STARTER COMPARTMENT  
REFER SHEET 03a

- D009 → 3K20 PUMP 3 RUN COMMAND REFER 03a:E14
- D009- → 3K21 PUMP 3 FAULT RESET REFER 03a:E14
- D010 → 3K22 PUMP 3 EMERGENCY MODE INTERRUPT REFER 03a:E14
- D010- → 3K23 PUMP 3 RUN AT MAXIMUM REFER 03a:E14

MOTORIZED VALVE 1  
CONTROL COMPARTMENT  
REFER SHEET 4a

- D013 → 7K20 VALVE 1 CLOSE REFER 04a:E14
- D013- → 7K21 VALVE 1 OPEN REFER 04a:E14



## FIELD

Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:

DRY WELL ALARM STROBE

## NOTES

- ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.

## Sheet 13

## FOR CONSTRUCTION

8 02.16	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-34
A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	DESIGN	R.P.E.Q. No. DATE
O 03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_C	A.WITTHOFT	R.P.E.Q. No. DATE
No. DATE	Q-Pulse Id: TMS1407	DRN.	APD.	B.C.C. FILE NO.		DESIGN CHECK	

NAME	SIGNATURE	DATE
QUEENSLAND URBAN UTILITIES DELEGATE		
Q.U.U. Urban Utilities	APPROVED FOR	43 MARCH 2015
	Qld (Qld) Pty Ltd	Active: 30/09/2015



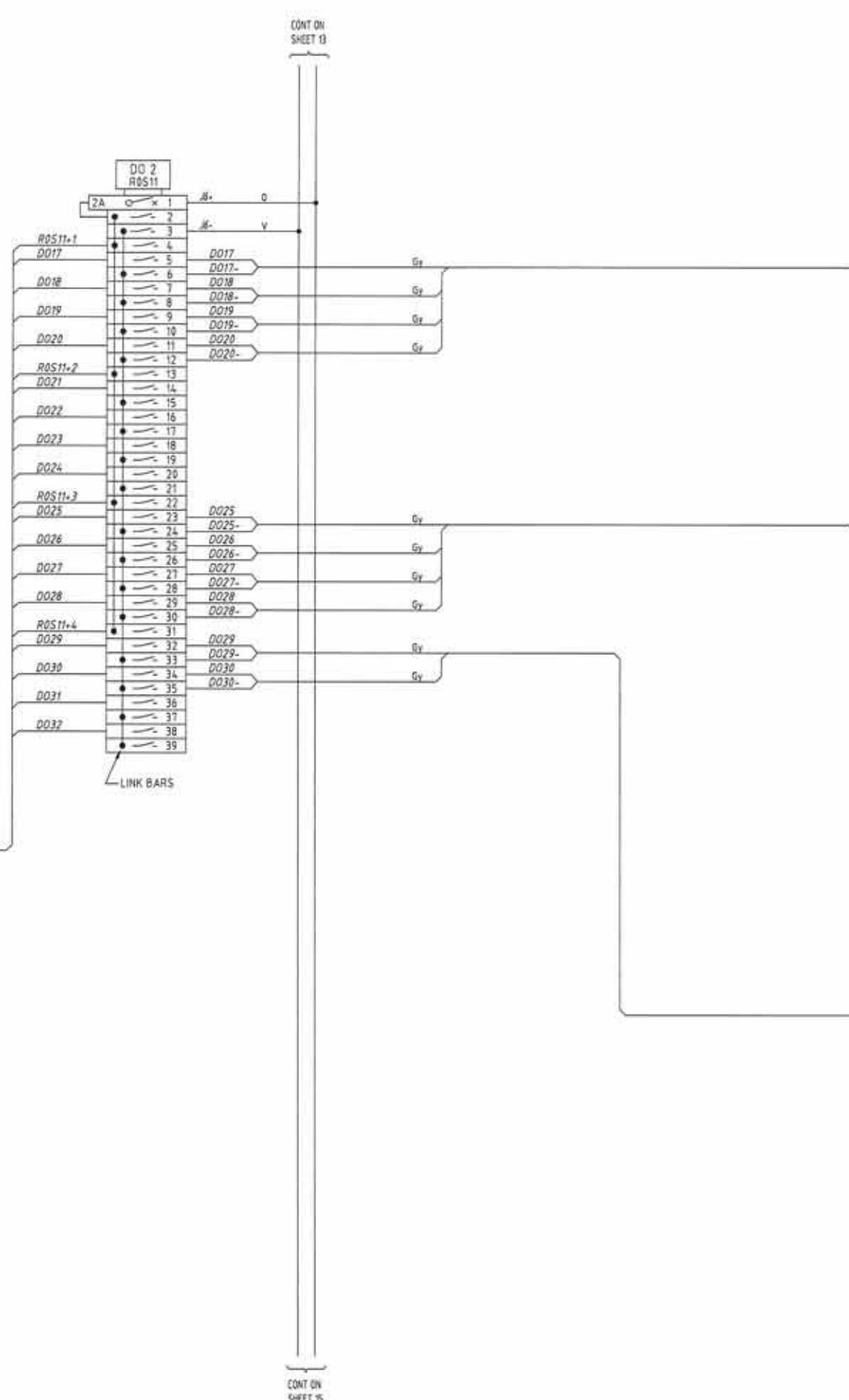
SITE SP033  
ADAM STREET  
SEWAGE PUMP STATION

TITLE RTU DIGITAL OUTPUTS  
TERMINATION DIAGRAM  
SHEET 1 OF 2

SHEET No. 13  
Queensland Urban Utilities DRAWING No. AMEND.  
486/5/7-0471-013 B  
Page 1503 of 1633

## RTU COMPARTMENT

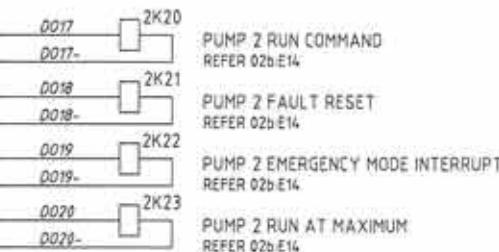
RACK 0 SLOT 11 GE FANUC 16 POINT DIGITAL OUTPUT MODULE IE694MDL940	
COM1	1 R0511+1
%Q0017	2 D017
%Q0018	3 D018
%Q0019	4 D019
%Q0020	5 D020
COM2	6 R0511+2
%Q0021	7 D021
%Q0022	8 D022
%Q0023	9 D023
%Q0024	10 D024
COM3	11 R0511+3
%Q0025	12 D025
%Q0026	13 D026
%Q0027	14 D027
%Q0028	15 D028
COM4	16 R0511+4
%Q0029	17 D029
%Q0030	18 D030
%Q0031	19 D031
%Q0032	20 D032



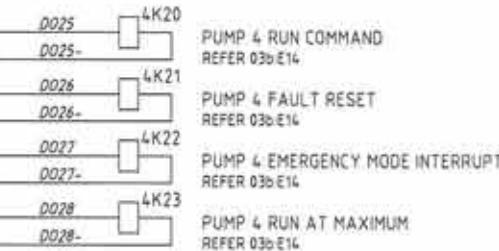
## SWITCHBOARD

PUMP 2  
STARTER COMPARTMENT

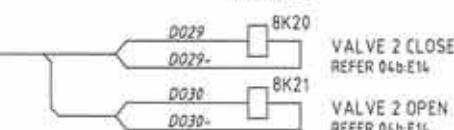
REFER SHEET 02b

PUMP 4  
STARTER COMPARTMENT

REFER SHEET 03b

MOTORISED VALVE 2  
CONTROL COMPARTMENT

REFER SHEET 4b



## FIELD

Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:

## NOTES

1. ALL WIRES & CABLE CORES ARE  
FERRULED WITH GRAFOPLAST SI2000  
COMPATIBLE LABELING.

## LEGEND:

C??	CABLE IDENTIFIER
2A o-x 1	RTU MINIATURE CCT BREAKER
— 1	DISCONNECT LINK TERMINAL
1	THROUGH TERMINAL

## Sheet 14

## FOR CONSTRUCTION

B	02.15	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-34
A	05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN	R.F.E.Q. No.
D	03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_C	R.F.E.Q. No.	DATE
No.	DATE	Q-Pulse Id: TMS1407	DRN.	APD.	B.C.C. FILE No.	DESIGN CHECK	A.WITTHOFFT	DATE



SITE SP033  
ADAM STREET  
SEWAGE PUMP STATION

TITLE RTU DIGITAL OUTPUTS  
TERMINATION DIAGRAM  
SHEET 2 OF 2

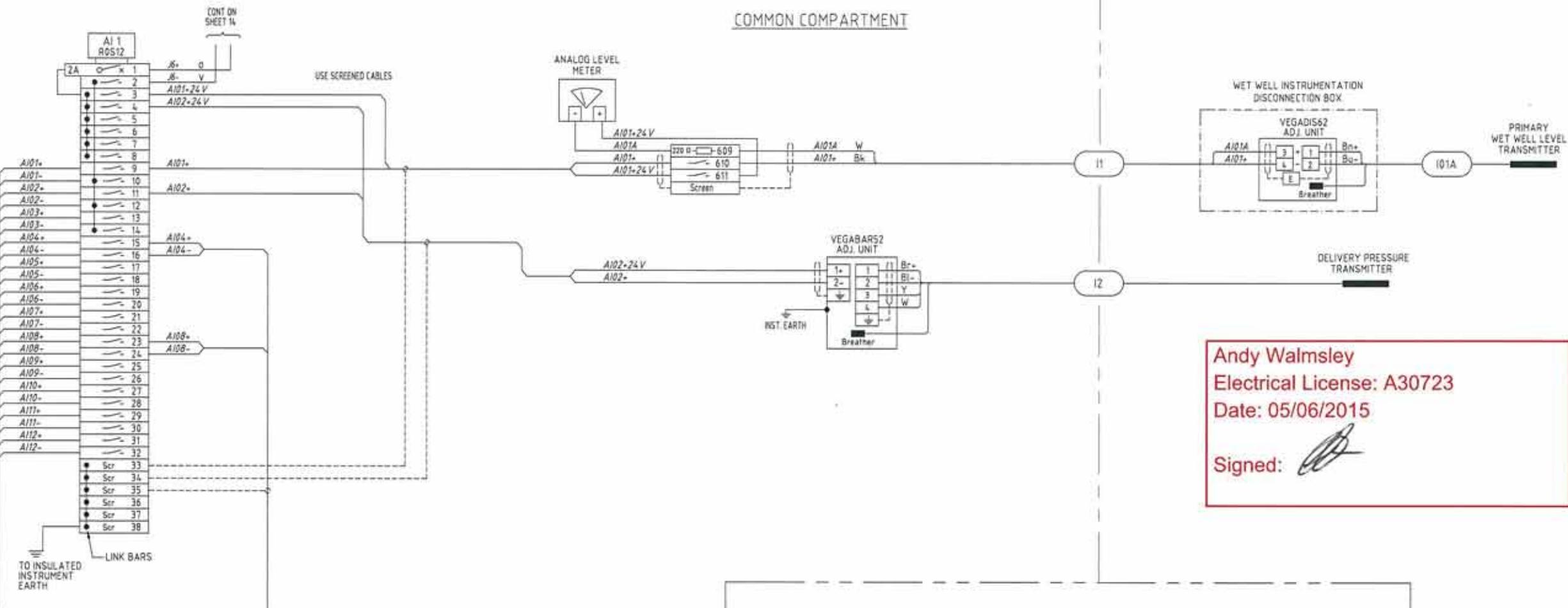
SHEET NO. 14  
Queensland Urban Utilities DRAWING NO.  
486/5/7-0471-014 AMEND. B  
Page 1504 of 1633

## RTU COMPARTMENT

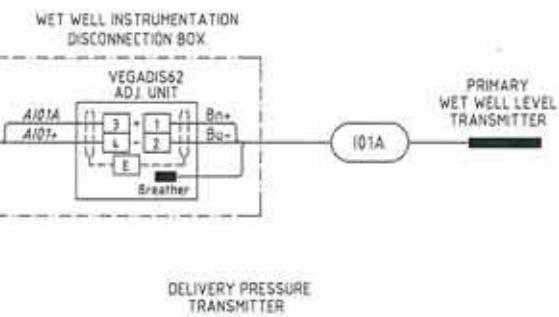
RACK 0 SLOT 12 GE FANUC 12 POINT ANALOG INPUT MODULE IC694ALG112	
CH1	In 1 A10+
Rtn 3	A10-
CH2	In 4 A10+
Rtn 6	A10-
CH3	In 7 A10+
Rtn 9	A10-
CH4	In 10 A10+
Rtn 12	A10-
CH5	In 13 A10+
Rtn 15	A10-
CH6	In 16 A10+
Rtn 18	A10-
CH7	In 19 A10+
Rtn 21	A10-
CH8	In 22 A10+
Rtn 24	A10-
CH9	In 25 A10+
Rtn 27	A10-
CH10	In 28 A10+
Rtn 30	A10-
CH11	In 31 A11+
Rtn 33	A11-
CH12	In 34 A11+
Rtn 36	A11-

## SWITCHBOARD

## COMMON COMPARTMENT

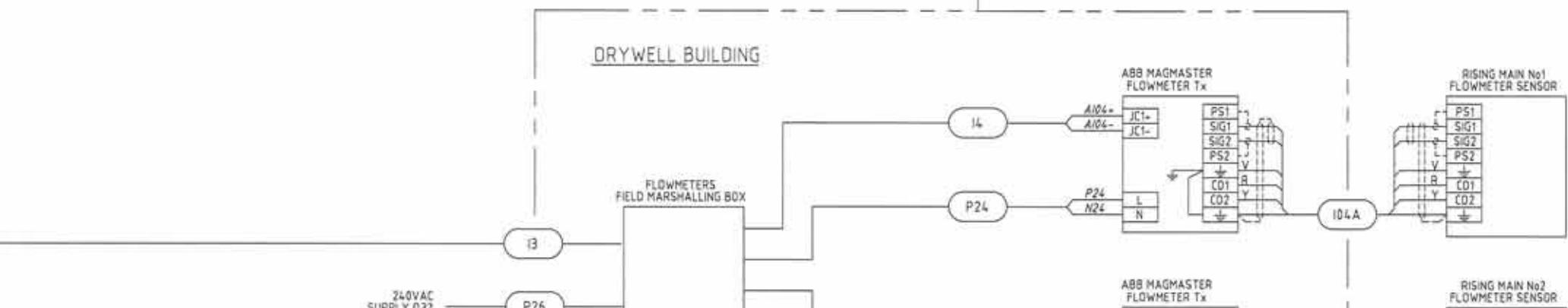


## FIELD



Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:



## DRYWELL BUILDING

## NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.

## LEGEND

- C?? CABLE IDENTIFIER
- ZA ○ x 1 RTU MINIATURE CCT BREAKER
- 1 DISCONNECT LINK TERMINAL
- THROUGH TERMINAL
- 220 D--- 1 COMPONENT TERMINAL

Sheet 15

## FOR CONSTRUCTION

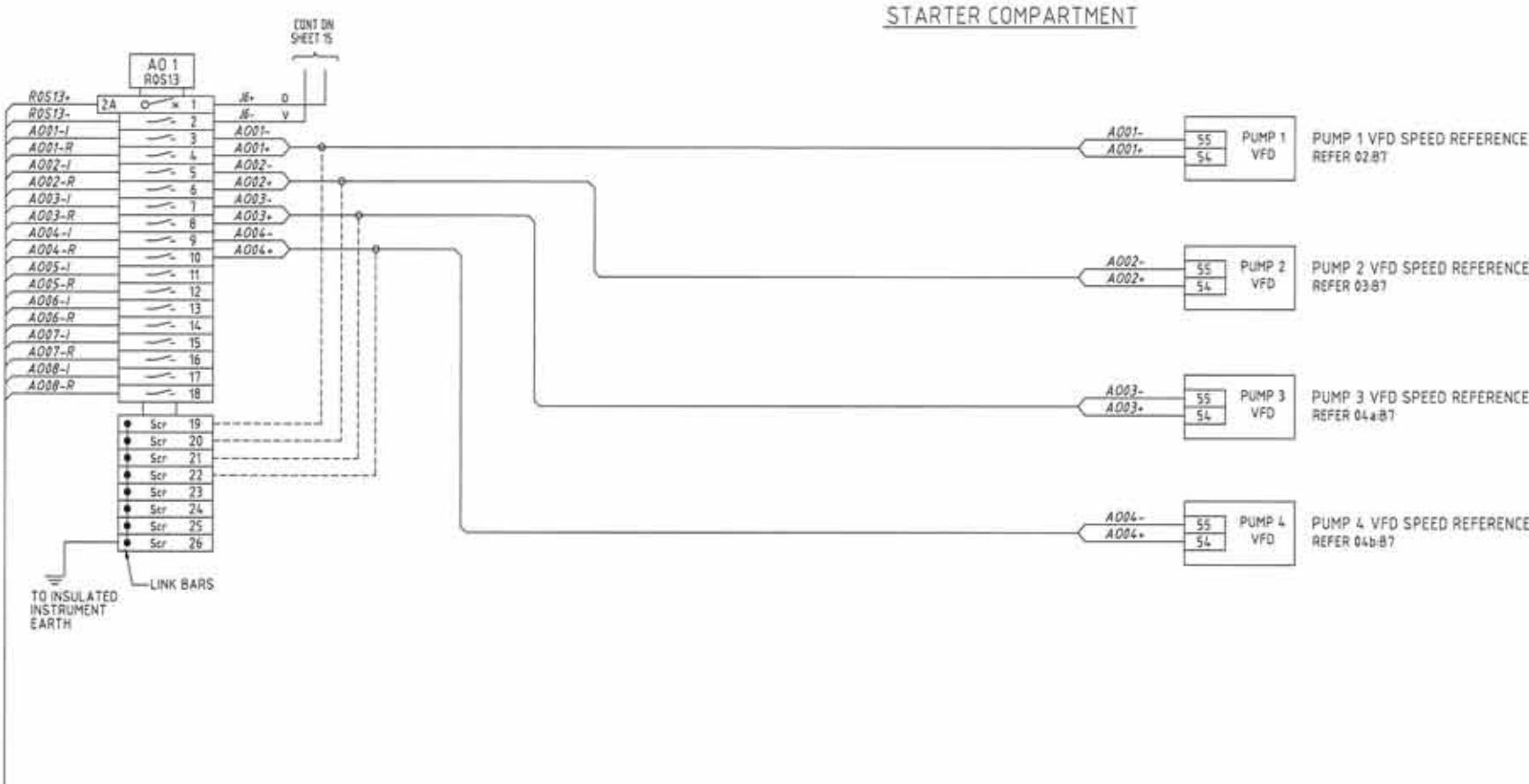
B 02.15	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	3-0-14
A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN
O 03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_C	R.P.E.Q. No. DATE
No DATE	Q-Pulse ID: TMS1407	DRN.	APO.	B.C.C. FILE No.	A.WITTHOFFT	DESIGN CHECK

## RTU COMPARTMENT

RACK 0 SLOT 13  
GE FANUC 8 POINT  
ANALOG OUTPUT MODULE  
IC694ALG8B

%A0001	CH1	Iout1	A001-I	A001-R	1
		Ret1			2
					3
					4
					5
%A0002	CH2	Iout2	A002-I	A002-R	6
		Ret2			7
					8
					9
%A0003	CH3	Iout3	A003-I	A003-R	10
		Ret3			11
					12
%A0004	CH4	Iout4	A004-I	A004-R	13
		Ret4			14
					15
					16
			R0513+		17
			R0513-		18
%A0005	CH5	Iout5	A005-I	A005-R	19
		Ret5			20
					21
					22
%A0006	CH6	Iout6	A006-I	A006-R	23
		Ret6			24
					25
					26
%A0007	CH7	Iout7	A007-I	A007-R	27
		Ret7			28
					29
					30
%A0008	CH8	Iout8	A008-I	A008-R	31
		Ret8			32
					33
					34
					35
					36

## SWITCHBOARD



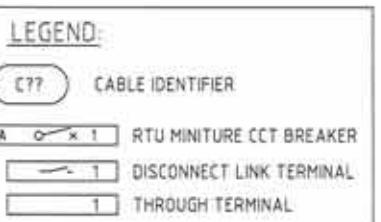
## FIELD

Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:

## NOTES

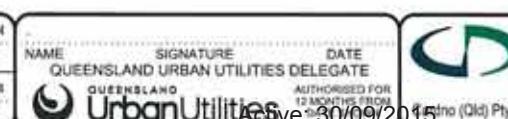
1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.



Sheet 16

## FOR CONSTRUCTION

B	02.15	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-14
A	05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN	R.P.E.Q. No.
D	03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_C	R.P.E.Q. No.	DATE
No.	DATE	Q-Pulse Id: TMS1407	DRN.	APD.	B.C.C. FILE No.		A.WITTHOFFT	3-14



SITE  
SP033  
ADAM STREET  
SEWAGE PUMP STATION

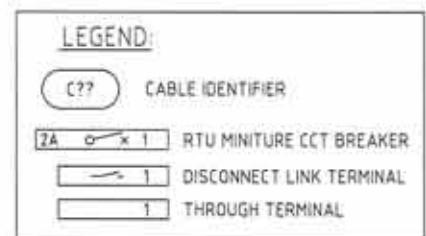
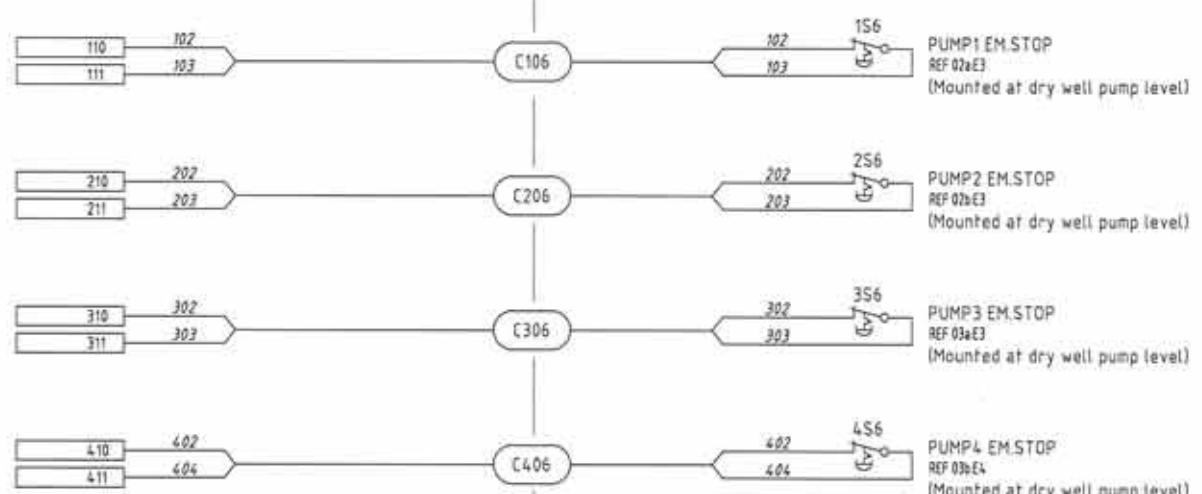
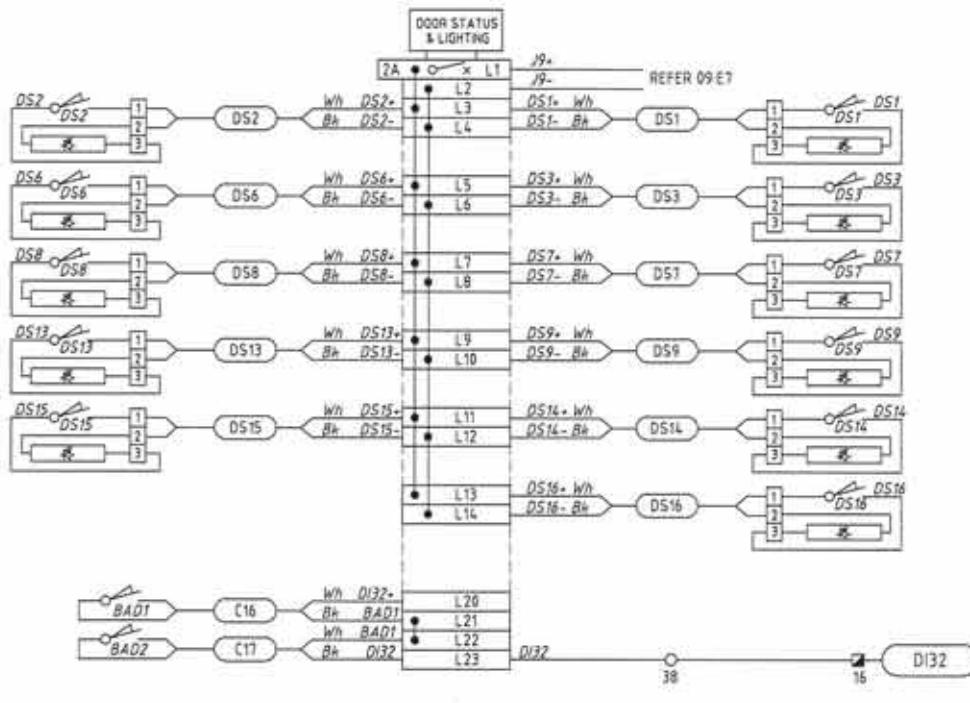
TITLE  
RTU ANALOG OUTPUTS  
TERMINATION DIAGRAM

SHEET No. 16  
Queensland Urban Utilities DRAWING No. AMEND.  
486/5/7-0471-016 B  
Page 1506 of 1633

Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:

## **SWITCHBOARD INTERNAL LIGHTING AND SECURITY**



## NOTES

1. ALL WIRES & CABLE CORES ARE  
FERRULED WITH GRAFOPLAST SI2000  
COMPATIBLE LABELING

Sheet 17

## FOR CONSTRUCTION

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No.	OPT	REMARKS	ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No.	OPT	REMARKS	ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No.	OPT	REMARKS
1	1	Q1 METERING ISOLATOR	SOCOME	SLB 630 3P	N		65	4	VSD RUNNING RELAY - K2	IDE	RH1B-ULD-DC24V	-	+ SH4B-05	129					G	
2	1	MANUAL TRANSFER SWITCH	TERASAKI	M1SS4CE63033	F	Set Ir=10 (630A) Char 6	66							131					S	
3	-	- TO SUIT Q2 & Q3 103 c/w Grid Fit Protection Unit	TERASAKI	Q3 - c/w AUX CONTACTS	F	Q3 - c/w AUX CONTACTS	67	4	PUMP EM STOP RELAY - K4	IDE	RH1B-ULD-DC24V	-	+ SH4B-05	132	2	FLOWMETER TRANSMITTERS - EXISTING	ABB	MAGMASTER	H	RANGE = 500L/s
4	1	Q4 PUMP1 CIRCUIT BREAKER + T2HS Handle	TERASAKI	S40GJ/400	-	Set Ir=0.63 (252A) Im=6 (2400A)	68	4	PUMP CONTROL CCT POWER ON RELAY - K5	IDE	RH1B-ULD-DC24V	-	+ SH4B-05	133	1	PRIMARY WET WELL LEVEL PROBE	VEGA - VEGAWELL52	WLS2XXKA1AM0D0IX	-	SET RANGE TO = 6m
5	1	Q5 PUMP2 CIRCUIT BREAKER + T2HS Handle	TERASAKI	S40GJ/400	-	Set Ir=0.63 (252A) Im=6 (2400A)	69	4						134	1	PRIMARY WET WELL LEVEL ADJUSTMENT UNIT	VEGA - VEGADIS62	DIS62XXXMASK	-	
6	1	Q6 PUMP3 CIRCUIT BREAKER + T2HS Handle	TERASAKI	S160GJ/160	-	Set Ir=0.8 (128A) Im=6 (960A)	70	4	PUMP MOISTURE IN OIL RELAY - K7	PEPPEL & FUCHS	KFDR-ER-16	A		135					G	
7	1	Q7 PUMP4 CIRCUIT BREAKER + T2HS Handle	TERASAKI	S160GJ/160	-	Set Ir=0.8 (128A) Im=6 (960A)	71	4	PUMP MOISTURE IN STATOR RELAY - K8	PEPPEL & FUCHS	KFDR-ER-16	B		136					-	
8	1	Q8 DRYWELL SUMP PUMP CIRCUIT BREAKER + T2HS Handle	TERASAKI	S125N/28	E	Set Ir=0.63 (125A) Im=6 (128A)	72							137	1	DELIVERY PRESSURE TRANSMITTER	VEGA - VEGABARS2	BR52XXCA1EHPMAS L=20	U	RANGE = 25m
9	1	Q9 SUB-DISTRIBUTION BOARD CIRCUIT BREAKER	TERASAKI	S125N/163	-	Set Ir=10 (63A) Im=6 (378A)	73	4	PUMP RUN COMMAND RELAY - K20	IDE	RH1B-ULD-DC24V	-	+ SH4B-05	138	1	TRICLOVE FITTING FOR VEGABARS2	VEGA	ADAPTOR 4	U	
10	1	Q10 STATION MAINS PHASE FAILURE CIRCUIT BREAKER	TERASAKI	DTCB6306C	-		74	4	PUMP FAULT RESET RELAY - K21	IDE	RH1B-ULD-DC24V	-	+ SH4B-05	139	1	CONTROL SYSTEM POWER SUPPLY 24VDC - PS1	POWERBOX	PB251A-24CM-CC-T-S	-	
11	1	Q11 15A GPO CIRCUIT BREAKER	TERASAKI	DSRCBH-10-30A	-		75	4	PUMP EMERGENCY MODE INTERRUPT RELAY - K22	IDE	RH1B-ULD-DC24V	-	+ SH4B-05	140	1	RADIO 24V/13.8VDC CONVERTER	POWERBOX	PBIH-2412-JC	R	
12	1	Q12 RTU LAPTOP GPO CIRCUIT BREAKER	TERASAKI	DSRCBH-10-30A	-		76	4	PUMP RUN AT MAXIMUM RELAY - K23	IDE	RH1B-ULD-DC24V	-	+ SH4B-05	141					I	
13	1	Q13 DRY WELL LIGHTING CIRCUIT BREAKER	TERASAKI	DSRCBH-6-30A	E		77	4	PUMP START PUSHBUTTON - S1	SPRECHER & SCHUH	DTP-F3-PX10	-		142	2	BATTERIES - INCLUDING SPILL TRAYS	YUASA	UXH50-12	-	
14	1	Q14 DRY WELL VENT FAN CIRCUIT BREAKER	TERASAKI	DSRCBH-10-30A	E		78	4	PUMP STOP PUSHBUTTON - S2	SPRECHER & SCHUH	DTP-F4-PX10	-		143	1	RADIO	TRIO	DR9100-06A02-D0	R	
15	1	Q15 GENERATOR AUXILIARY SUPPLY CIRCUIT BREAKER	TERASAKI	DSRCBH-10-30A	-		79	4	PUMP EM/STOP PUSHBUTTON - S3	SPRECHER & SCHUH	DTP-MT3L-PX01S	-	c/w D7-15YE12 + PX01S	144	1	RADIO ANTENNA	TRIO	YAGI ANT13AL	R	15 ELEMENT 13dB ALUM
16	1	Q16 EXTERNAL AREA LIGHTING CIRCUIT BREAKER	TERASAKI	DSRCBH-6-30A	-		80	4	PUMP RESET PUSHBUTTON - S4	SPRECHER & SCHUH	DTP-F6-PX10	-		145	1	RADIO COAX SURGE PROTECTION UNIT	POLYPHASER CORPORATION	IS-50NX-C2	R	Mounted on Din Rail
17	1	Q17 SURGE FILTER CIRCUIT BREAKER	TERASAKI	DTCB6106C	-		81	4	PUMP HOUR RUN METER - HRM	NHP	RQ4801080VDC	-	24VDC	146	1	TELEMETRY UNIT - REFER SHT 9 FOR PARTS LIST	MOTOROLA	ACE - 3600	-	REFER TABLE 1 - SHT 9
18	1	Q18 EM PUMP CNTRL & SURCHARGE IMMINENT CB	TERASAKI	DTCB6106C	-		82							147	1	GSM MODEM	WAVECOM	FASTRACK Supreme	I	c/w 1M Cable
19	1	Q19 SPARE CIRCUIT BREAKER	TERASAKI	DTCB6106C	-		83							148	1	GSM CELLULAR TRANSIT ANTENNA	RF INDUSTRIES	TLA2000	I	
20	1	Q20 3 PHASE OUTLET CIRCUIT BREAKER	TERASAKI	DTCB6320C		PLUS DSREM-32-38-BPN	84							149	1	ETHERNET SWITCH No1	MOXA	EDS-208		
21	1	Q21 BUILDING INTERNAL LIGHTING CIRCUIT BREAKER	TERASAKI	DSRCBH-10-30A			85							150	1	ETHERNET SWITCH No2	MOXA	IAS2500		
22	1	Q22 BUILDING 10A GPO's CIRCUIT BREAKER	TERASAKI	DSRCBH-10-30A			86	1	DRY WELL SUMP PUMP RUN CONTACTOR - K1	SPRECHER & SCHUH	CAT-23	E	24VDC COIL	151					R	
23	1	Q24 SPARE	TERASAKI				87	1	DRY WELL SUMP PUMP THERMAL OVERLOAD RELAY	SPRECHER & SCHUH	C7N 23 B63	E		152						
24	2	Q40/Q41 ACTUATOR VALVE N1/2+N2 CIRCUIT BREAKER	TERASAKI	DTCB6306C			88	1	DRY WELL SUMP PUMP HEALTHY RELAY - K2	IDE	RH1B-ULD-DC24V	-	+ SH4B-05	153	1	ETHERNET SWITCH No2	MOXA	IAS2500		
25	1	Q26 GANTRY CRANE SUPPLY CIRCUIT BREAKER	TERASAKI	DTCB6320C	E		89	1	DRY WELL SUMP PUMP START PUSHBUTTON	SPRECHER & SCHUH	DTP-F3-PX10	-		154						
26A	1	Q30 RTU POWER SUPPLY CIRCUIT BREAKER	TERASAKI	DTCB6106C	-		90	1	DRY WELL SUMP PUMP STOP PUSHBUTTON	SPRECHER & SCHUH	DTP-F4-PX01	-		155						
26B	1	Q31 SURGE FILTER ALARM RELAY CIRCUIT BREAKER	TERASAKI	DTCB6104C	-		91	1	LRI - DRY WELL SUMP PUMP LEVEL RELAY	MULTITRODE	MTR-5	E	24VDC	156						
26C	1	Q32 FLOWMETER CIRCUIT BREAKER	TERASAKI	DTCB6104C	H		92	1	LRI2 - DRY WELL LEVEL RELAY	MULTITRODE	MTR-5	E	24VDC	157	1	INTERNAL COAX CABLE (Radio to Lightning Arrestor)	TRIO	TRD - SMAM/NM/L23	R	Cable No X01
26D	1	Q33 SPARE	TERASAKI	DTCB6104C	-		93	1	LRI3 - WET WELL HIGH LEVEL RELAY	MULTITRODE	MTR-5	-	24VDC	158	1	EXTERNAL COAX CABLE (Lightning Arrestor to Aerial)	R.F. INDUSTRIES	ANDREW - CNT400	R	Cable No X02
27	1	POWER METER	SATEC	PM130EH-PLUS-S-50Hz-ACDC		c/w ETHERNET MODULE - ETH	94							159	2	COAX PLUG (For CNT400 cable)	PULSE	N-203HS	R	Straight cable plug crimp
28	3	POWER METER - POTENTIAL FUSES F13-15	NHP	6A HRC		FUSES & HOLDERS	95							160	1	U CLAMPS	R.F. INDUSTRIES	UNV	R	
29	6	POWER METER- SHORTING LINKS	PHOENIX CONTACT				96	1	SR - SURCHARGE IMMINENT LEVEL RELAY	MULTITRODE	SAFE-FS	-	24VDC	161	1	MINIATURE THERMAL CIRCUIT BREAKER	PHOENIX CONTACT	TCP-YA + UK6FSI/C	-	'Y' = AMP Rating
30	1	24VDC BATTERY CIRCUIT BREAKER	TERASAKI	DTCB6210C	-	QDB	97	1	EMERGENCY PUMPING MODE RELAY PUMP2 - EMG2	IDE	RH1B-ULD-DC24V	-	+ SH4B-05	162	1	THROUGH TERMINALS (Grey & Blue as Required)	PHOENIX CONTACT	PT 25		PT 25-BU Ifer - vel
31	8	PUMP 24VAC CONTROL CIRCUIT BREAKER	TERASAKI	DTCB6104C	-	Q4-1/2, 05-1/2, 06-1/2, Q7-1/2	98	1	SURCHARGE IMMINENT DELAY TIMER - S1DT	SPRECHER & SCHUH	RZ1-FSA 4U U23	-	ON DELAY / INSTANTANEOUS	163	1	DISCONNECT TERMINALS (Grey & Blue as Required)	PHOENIX CONTACT	PT 25-MT	-	PT 25-MT-BU Ifer - vel
32	5	24VDC CONTROL CIRCUIT BREAKER	TERASAKI	DTCB6106C	-	QD4, QD5, QD6, QD18	99	1	EMERGENCY PUMPING MODE TIMER - EMG1/3/4	OMRON	H3CA-A... I+P2CF-11	-	I+ Y92A-48B   OFF DELAY	164	1	GROUP MARKER CARRIER / PLUG-IN BRIDGE	PHOENIX CONTACT	UBE / FBS	-	
33	2	VALVE 24VAC CONTROL CIRCUIT BREAKERS	TERASAKI	DTCB6104C	-	Q43-1, Q44-1	100	3	EMERG. PUMPING MODE SWITCH & LIGHT - S57/H5	SPRECHER & SCHUH	RZ1-FSA 4E U23	-	ON DELAY / INSTANTANEOUS	165	1	COMPONENT CONNECTOR c/w 220 Ohm RESISTOR	PHOENIX CONTACT	P-00	-	+ Disconnect Terminal Block
34	7	24VAC-24VDC PUMP/VALVE CONTROL POWER SUPPLY	WEIDMULLER	8951340000	-	12W 5A/24VDC	101	4	EMERGENCY PUMPING MODE AUX RELAY - EMG1A	IDE	RH1B-ULD-DC24V	-	+ SH4B-05	166	2	TEST PLUG	PHOENIX CONTACT	PS-5		
35	2	VALVE 24VDC CONTROL CIRCUIT BREAKERS	TERASAKI	DTCB6106C		QD40, QD41	102	2	MITS AUX RELAYS - TS-N & TS-G	IDE	RH1B-ULD-DC24V	F	+ SH4B-05	167						
36	1	DISTRIBUTION BOARD CHASSIS	TERASAKI	CD-2-36/18-3U	-		103	2	VALVE LOCAL/REMOTE SWITCH - S1	KRAUS & NAIMER	CAD11-A728		ENGRAVE 'LOCAL REMOTE'	168						
37	3	F1-3 - SURGE DIVERTER CIRCUIT FUSES	NHP	6																

CABLE No.	STATUS	SIZE	CORES	TYPE	L ENGTH [m]	Note 1	FROM		TO		CABLE FUNCTION
							ENSBEX Supply 500VAC TRANGE SEC154	Switchboard Metering Isolator	Incoming Main Supply	Incoming Main Supply	
P01	NEW	2x10mm <sup>2</sup>	4c	XLPF	Note2						Refer Note2 for Earth Protection
E01	NEW	17mm <sup>2</sup>	1c	Building Wire			Earth grid - Transformer compound				Main Earth
P42	NEW	24mm <sup>2</sup> Notes 4c-E	XLPE				External Generator Isolation Panel				Isolating Generator Supply
P24	NEW	7.5mm <sup>2</sup>	2c-E	PVC/U/PVC			External Generator Isolation Panel				240VAC Supply to Generator
P25	NEW	12mm <sup>2</sup>	3c-E	Screened VSD			Pump No1 Disconnect Box in Dry Well				Pump 1 Motor Feed
P05A/B	NEW	2x50mm <sup>2</sup>	3c-E	Flexible San (Submer)			Pump No2 Disconnect Box in Dry Well				Pump 1 Motor Feed
P06	NEW	120mm <sup>2</sup>	3c-E	Screened VSD			Pump No3 Disconnect Box in Dry Well				Pump 2 Motor Feed
P06A/B	NEW	2x50mm <sup>2</sup>	3c-E	Flexible San (Submer)			Pump No4 Disconnect Box in Dry Well				Pump 2 Motor Feed
P07	NEW	35mm <sup>2</sup>	3c-E	Screened VSD			Pump No5 Disconnect Box in Dry Well				Pump 3 Motor Feed
P07A/B	NEW	2x80mm <sup>2</sup>	3c-E	Flexible San (Submer)			Pump No6 Disconnect Box in Dry Well				Pump 3 Motor Feed
P08	NEW	35mm <sup>2</sup>	3c-E	Screened VSD			Pump No7 Disconnect Box in Dry Well				Pump 4 Motor Feed
P08A/B	NEW	2x100mm <sup>2</sup>	3c-E	Flexible San (Submer)			Pump No8 Disconnect Box in Dry Well				Pump 4 Motor Feed
P11	NEW	25mm <sup>2</sup>	3c-E	PVC/CU/PVC			Switchboard				Dry Well Pump Pump Motor
P11A	NEW	25mm <sup>2</sup>	3c-E	PVC/CU/PVC			Dry Well Pump Pump Motor				Dry Well Pump Pump Motor
P12	NEW	15mm <sup>2</sup>	2c-E	PVC/CU/PVC			Switchboard				Dry Well Lighting
P14	NEW	2.5mm <sup>2</sup>	2c-E	PVC/CU/PVC			Switchboard				Dry Well Vent Fan Isolator
P14A	NEW	2.5mm <sup>2</sup>	2c-E	PVC/CU/PVC			Dry Well Vent Fan Isolator				Vent Fan
P16	NEW	2.5mm <sup>2</sup>	2c-E	PVC/CU/PVC			Switchboard				Switchroom 1 Phase 15A GPO
P19	NEW	4mm <sup>2</sup>	2c-E	PVC/CU/PVC			Switchboard				Switchroom 3 Phase 20A Outlet
P21	NEW	25mm <sup>2</sup>	2c-E	PVC/CU/PVC			Switchboard				Switchroom 1 Phase 10A GPO's
P22	NEW	15mm <sup>2</sup>	2c-E	PVC/CU/PVC			Switchboard				Internal Lighting
P23	NEW	15mm <sup>2</sup>	2c-E	PVC/CU/PVC			External Lights				External Area Lighting
P24	EXISTING	2.5mm <sup>2</sup>	2c-E	Vendor			Flameater Field Marshalling Box				Rising Main 1 Delivery Flameater TX
P25	EXISTING	2.5mm <sup>2</sup>	2c-E	Vendor			Flameater Field Marshalling Box				Rising Main 2 Delivery Flameater TX
P26	NEW	2.5mm <sup>2</sup>	2c-E	PVC/CU/PVC			Switchboard				Flameater Field Marshalling Box
P27	NEW	2.5mm <sup>2</sup>	2c-E	PVC/CU/PVC			Switchboard				Actuator Valve No1
P28	NEW	2.5mm <sup>2</sup>	2c-E	PVC/CU/PVC			Switchboard				Actuator Power Supply
C100	NEW	15mm <sup>2</sup>	4c	Flexible San (Submer)			Pump 1 Aux Terminals in Dry Well				Actuator Power Supply
C101	NEW	15mm <sup>2</sup>	4c	Flexible San (Submer)			Pump 1 Aux Terminals in Dry Well				Pump 1 Motor Thermistors + Aux Protection
C102	NEW	15mm <sup>2</sup>	4c	Flexible San (Submer)			Pump 1 Aux Terminals in Dry Well				Pump 1 Motor Thermistors + Aux Protection
C103	NEW	15mm <sup>2</sup>	4c	Flexible San (Submer)			Pump 2 Aux Terminals in Dry Well				Pump 2 Motor Thermistors + Aux Protection
C104	NEW	15mm <sup>2</sup>	4c	Flexible San (Submer)			Pump 2 Aux Terminals in Dry Well				Pump 2 Motor Thermistors + Aux Protection
C105	NEW	15mm <sup>2</sup>	4c	Flexible San (Submer)			Pump 3 Aux Terminals in Dry Well				Pump 3 Motor Thermistors + Aux Protection
C106	NEW	15mm <sup>2</sup>	4c	Flexible San (Submer)			Pump 3 Aux Terminals in Dry Well				Pump 3 Motor Thermistors + Aux Protection
C200	NEW	15mm <sup>2</sup>	3P+NC	PVC/Screened			Pump 4 Aux Terminals in Dry Well				Pump 4 Motor Thermistors + Aux Protection
C201	NEW	15mm <sup>2</sup>	4c	Flexible San (Submer)			Pump 4 Aux Terminals in Dry Well				Pump 4 Motor Thermistors + Aux Protection
C205	NEW	15mm <sup>2</sup>	2P+E	Instrument			Switchboard				Pump 5 Relais Valve
C206	NEW	15mm <sup>2</sup>	2c	PVC/CU/PVC			Switchboard				Pump 5 Field Emergency Stop Button
C300	NEW	1.0mm <sup>2</sup>	8c	PVC/CU/PVC			Switchboard				Actuator Valve No1
C301	NEW	1.5mm <sup>2</sup>	7c	PVC/CU/PVC			Switchboard				Actuator Valve No2
C305	NEW	1.5mm <sup>2</sup>	7c	PVC/CU/PVC			Switchboard				Actuator Cables
C306	NEW	15mm <sup>2</sup>	7c	PVC/CU/PVC			Switchboard				Surcharge Imminent Probe
C400	NEW	1.5mm <sup>2</sup>	7c	PVC/CU/PVC			Switchboard				Surge/Well Level Sensor
C501	NEW	1.5mm <sup>2</sup>	7c	PVC/CU/PVC			Switchboard				Well Well High Level Signal [R3]
C505	NEW	1.5mm <sup>2</sup>	7c	PVC/CU/PVC			Switchboard				Well Well Trip Level Signal [R2]
C506	NEW	1.5mm <sup>2</sup>	7c	PVC/CU/PVC			Switchboard				Well Well Alarm Level Signal [R2]
C507	NEW	1.5mm <sup>2</sup>	7c	PVC/CU/PVC			Switchboard				Well Well Pump Level Control [R1]
C508	NEW	1.5mm <sup>2</sup>	7c	PVC/CU/PVC			Switchboard				Well Well Pump Level Control [R1]
C509	NEW	1.0mm <sup>2</sup>	8c	PVC/CU/PVC			Switchboard				Primary Well Level
C601	NEW	1.5mm <sup>2</sup>	7c	Vendor-S20101SP-Shield			Switchboard				Primary Well Level
C602	NEW	1.5mm <sup>2</sup>	7c	Vendor-S20101SP-Shield			Switchboard				Delivery Pressure Transmitter
C603	NEW	1.5mm <sup>2</sup>	7c	Vendor-S20101SP-Shield			Switchboard				Delivery Pressure Transmitter
C604	NEW	1.5mm <sup>2</sup>	7c	Vendor-S20101SP-Shield			Switchboard				Delivery Flameater
C605	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C606	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C607	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C608	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C609	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C610	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C611	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C612	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C613	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C614	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C615	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C616	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C617	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C618	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C619	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C620	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C621	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C622	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C623	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C624	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C625	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C626	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C627	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C628	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C629	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C630	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C631	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switchboard				Delivery Flameater
C632	NEW	1.5mm <sup>2</sup>	7c	Vendor			Switch				

ITEM #	OPT.	DESCRIPTION - INTERNAL LABEL	LABEL 1 & 2 (IF NECESSARY)	LABEL 3 & 4 (IF NECESSARY)	TEXT HEIGHT	MATERIAL / COLOUR
41	N	METERING ISOLATOR	CT METERING ISOLATOR ONLY 630A		4mm	ABS PLASTIC W/B
42		ENERGEKX SUPPLY	NORMAL SUPPLY MAIN SWITCH 630A		4mm	ABS PLASTIC W/B
43		GENERATOR SUPPLY	GENERATOR SUPPLY MAIN SWITCH 630A		4mm	ABS PLASTIC W/B
44-47		PUMP CIRCUIT BREAKER	PUMP No1 400A PUMP No2 400A PUMP No3 160A PUMP No4 160A		4mm	ABS PLASTIC W/B
48	E	DRY WELL SUMP PUMP CIRCUIT BREAKER	DRY WELL SUMP PUMP 20A		4mm	ABS PLASTIC W/B
49		SUB-DISTRIBUTION BOARD CB	SUB-DISTRIBUTION BOARD 63A		4mm	ABS PLASTIC W/B
50		PHASE FAILURE CIRCUIT BREAKER	STATION PHASE FAILURE RELAY Q18		4mm	ABS PLASTIC W/B
51	1	1 PHASE OUTLET CIRCUIT BREAKER	M-BIA GPO Q11		4mm	ABS PLASTIC W/B
52		RTU LAPTOP CIRCUIT BREAKER	RTU LAPTOP GPO Q12		4mm	ABS PLASTIC W/B
53	E	DRY WELL LIGHTING CIRCUIT BREAKER	DRY WELL LIGHTING Q13		4mm	ABS PLASTIC W/B
54	E	DRY WELL VENT FAN CIRCUIT BREAKER	DRY WELL VENT FAN Q14		4mm	ABS PLASTIC W/B
55		GENERATOR AUXILIARY SUPPLY CB	GENERATOR AUXILIARY SUPPLY Q15		4mm	ABS PLASTIC W/B
56		EXT. AREA LIGHTING CIRCUIT BREAKER	AREA LIGHTING Q16		4mm	ABS PLASTIC W/B
57		SURGE FILTER CIRCUIT BREAKER	SURGE FILTER Q17	Mounted On DB Enclosure	4mm	ABS PLASTIC W/B
58		EM PUMP CONTROL & SIR CIRCUIT BREAKER	EM PUMPING CT & SR Q18		4mm	ABS PLASTIC W/B
59		SPARE CIRCUIT BREAKER	SPARE Q19		4mm	ABS PLASTIC W/B
60		3 PHASE OUTLET CIRCUIT BREAKER	3F 20A OUTLET Q20		4mm	ABS PLASTIC W/B
61	E	BUILDING INTERNAL LIGHTING CIRCUIT BREAKER	BUILDING INT LIGHTING Q21		4mm	ABS PLASTIC W/B
62	E	BUILDING MA GPO'S CIRCUIT BREAKER	BUILDING MA GPO'S Q22		4mm	ABS PLASTIC W/B
63		SPARE CIRCUIT BREAKER	SPARE Q24		4mm	ABS PLASTIC W/B
64		ACTUATOR VALVE NO1/NO2 CIRCUIT BREAKER	ACTUATOR VALVE NO1 Q24	ACTUATOR VALVE NO1 Q24	4mm	ABS PLASTIC W/B
65	E	GANTRY CRANE SUPPLY CIRCUIT BREAKER	GANTRY CRANE Q25		4mm	ABS PLASTIC W/B
66		RTU POWER SUPPLY CIRCUIT BREAKER	RTU POWER SUPPLY Q26		4mm	ABS PLASTIC W/B
67		SURGE FILTER ALARM RELAY CIRCUIT BREAKER	SURGE FILTER ALARM RELAY Q27		4mm	ABS PLASTIC W/B
68	H	FLOWMETER CIRCUIT BREAKER	FLOWMETER Q28		4mm	TRAFFOLITE W/B
69		SPARE CIRCUIT BREAKER	SPARE Q29		4mm	ABS PLASTIC W/B
70		POWER METER FUSES	POWER METER POTENTIAL FUSES P13-15		4mm	ABS PLASTIC W/B
71		POWER METER LINKS	POWER METER SHORTING LINKS		4mm	ABS PLASTIC W/B
72		BATTERY 24VDC CONTROL CCT BREAKER	BATTERY Q28		4mm	ABS PLASTIC W/B
73		PUMP 24VAC CONTROL CIRCUIT BREAKER	PUMP NO1 PUMP NO2 Q1-1 Q1-2 Q3-1 Q5-2	PUMP NO3 PUMP NO4 Q6-1 Q6-2 Q7-1 Q7-2	4mm	ABS PLASTIC W/B
74		24VDC CONTROL CIRCUIT BREAKER	PUMP NO1 PUMP NO2 PUMP NO3 Q04 Q05 Q06	PUMP NO4 EM PUMPING BATTERY Q07 Q08 Q09	4mm	ABS PLASTIC W/B
75		VALVE 24VAC CONTROL CCT BREAKER	VALVE NO1 VALVE NO2 Q48-1 Q48-2	VALVE NO3 Q48-1	4mm	ABS PLASTIC W/B
76		24VAC-24VDC POWER SUPPLY	PS-P1 PS-P2 PS-P3 PS-P4	PS-V1 PS-VT PS2	4mm	ABS PLASTIC W/B
77		VALVE 24VDC CONTROL CCT BREAKER	VALVE NO1 VALVE NO2 Q041	VALVE NO3 Q041	4mm	ABS PLASTIC W/B
78		SURGE DIVERTER FUSES	SURGE DIVERTER FUSES P1-P3 63A	FED FROM LINE SIDE OF MAIN SWITCH	4mm	ABS PLASTIC W/B - R/W
79		SURGE DIVERTERS	SURGE DIVERTERS	FED FROM LINE SIDE OF MAIN SWITCH	4mm	ABS PLASTIC W/B - R/W
80		SURGE FILTER ALARM RELAY	SPAR		4mm	ABS PLASTIC W/B
81		SURGE REDUCTION FILTER	REDUCTION FILTER		4mm	ABS PLASTIC W/B
82		PHASE FAILURE RELAY	ENERGEKX MAINS POWER FAIL - FIRE	FED FROM LINE SIDE OF MAIN SWITCH	4mm	ABS PLASTIC W/B
83		PHASE FAILURE RELAY	STATION MAINS POWER FAIL - PFRS	FED FROM LINE SIDE OF MAIN SWITCH	4mm	ABS PLASTIC W/B
84		ENERGEKX PHASE FAILURE FAULT LIMIT FUSES	F10-12 6A	FED FROM LINE SIDE OF MAIN SWITCH	4mm	ABS PLASTIC W/B - R/W
85		POWER METER CT's	POWER METER CT's		4mm	ABS PLASTIC W/B
86-88		MAIN NEUTRAL & EARTH LINKS	MAIN NEUTRAL	MAIN EARTH	4mm	ABS PLASTIC W/B
89		SUB-BOARD NEUTRAL & EARTH LINKS	NEUTRAL	EARTH	4mm	ABS PLASTIC W/B
90		SURGE DIVERTER NEUTRAL LINK	SURGE DIVERTER NEUTRAL		4mm	ABS PLASTIC W/B
91		INSTRUMENT EARTH LINK	INSTRUMENT EARTH		4mm	ABS PLASTIC W/B
92		FILTERED SUPPLY NEUTRAL LINK	FILTERED SUPPLY NEUTRAL		4mm	ABS PLASTIC W/B
93		LAPTOP GPO	LAPTOP SPD ONLY		4mm	ABS PLASTIC W/B
94	SF	GENERATOR 24VAC CONNECTION SOCKET	GENERATOR ACCULARY SUPPLY	I Mounted in External Generator Connection Box	4mm	ABS PLASTIC W/B
95	SF	GENERATOR POWER CONNECTION SOCKET	GENERATOR CONNECTION	I Mounted in External Generator Connection Box	4mm	ABS PLASTIC W/B
96		PUMP VARIABLE SPEED DRIVE	PUMP NO1 J01	PUMP NO2 PUMP NO3 J01 J01	4mm	ABS PLASTIC W/B
97		PUMP VSD KEY PAD	PUMP NO1	PUMP NO2 PUMP NO3	8mm	ABS PLASTIC W/B
98		PUMP MANUAL SPEED CONTROL	PUMP 1 SPEED PUMP 2 SPEED	PUMP 3 SPEED PUMP 4 SPEED	4mm	ABS PLASTIC W/B
99		EMERGENCY PUMPING RELAY	9K1 2K1	3K1 4K1	4mm	ABS PLASTIC W/B
100		VSD RUNNING RELAY	9K2 2K2	3K2 4K2	4mm	ABS PLASTIC W/B
101		EH STOP RELAY	9K3 2K3	3K3 4K3	4mm	ABS PLASTIC W/B
102		PUMP POWER ON RELAY	9K5 2K5	3K5 4K5	4mm	ABS PLASTIC W/B
103	A	PUMP MOISTURE IN OIL	9K7 2K7	3K7 4K7	4mm	ABS PLASTIC W/B
104	B	PUMP MOISTURE IN STATOR	9K8 2K8	3K8 4K8	4mm	ABS PLASTIC W/B

ITEM #	OPT.	DESCRIPTION - INTERNAL LABEL	LABEL 1 & 2 (IF NECESSARY)	LABEL 3 & 4 (IF NECESSARY)	TEXT HEIGHT	MATERIAL / COLOUR
73		PUMP RUN COMMAND RELAY	9K20 2K20	3K20 4K20	4mm	ABS PLASTIC W/B
74		PUMP FAULT RESET RELAY	9K21 2K21	3K21 4K21	4mm	ABS PLASTIC W/B
75		PUMP EMERGENCY MODE INTERRUPT RELAY	1K22 2K22	3K22 4K22	4mm	ABS PLASTIC W/B
76		PUMP RUN AT MAXIMUM RELAY	1K23 2K23	3K23 4K23	4mm	ABS PLASTIC W/B
77		PUMP START PUSHBUTTON	START	START	4mm	ABS PLASTIC W/B
78		PUMP STOP PUSHBUTTON	STOP	STOP	4mm	ABS PLASTIC W/B
79		PUMP EMSTOP PUSHBUTTON	(use label supplied with P/Button)	(use label supplied with P/Button)	4mm	
80		PUMP FAULT RESET PUSHBUTTON	FAULT RESET	FAULT RESET	4mm	ABS PLASTIC W/B
81		PUMP HOURS RUN METER	HOURS RUN	HOURS RUN	4mm	ABS PLASTIC W/B
82	E	DRY WELL SUMP PUMP RUN CONTACTOR	SK1		5mm	ABS PLASTIC W/B
83	E	DRY WELL SUMP PUMP TOL	STOL		5mm	ABS PLASTIC W/B
84	E	DRY WELL SUMP PUMP HEALTHY RELAY	SK2		5mm	ABS PLASTIC W/B
85	E	DRY WELL SUMP PUMP START PUSHBUTTON	START		4mm	ABS PLASTIC W/B
86	E	DRY WELL SUMP PUMP STOP PUSHBUTTON	STOP		4mm	ABS PLASTIC W/B
87	E	DRY WELL S/PUMP STOP/START LEVEL RELAY	DRY WELL SUMP PUMP CTL-L-LS1		4mm	ABS PLASTIC W/B
88	E	DRY WELL LEVEL RELAY	DRY WELL HIGH LEVEL - LS2		4mm	ABS PLASTIC W/B
89		WET WELL HIGH LEVEL RELAY	WET WELL HIGH LEVEL - LS3		4mm	ABS PLASTIC W/B
90		SURGE IMMINENT LEVEL RELAY	WET WELL SURCHARGE IMMINENT - SR		4mm	ABS PLASTIC W/B
91		EMERGENCY PUMPING MODE PUMP TRELAY	EMG1		4mm	ABS PLASTIC W/B
92		SURGE IMMINENT ON DELAY TIMER	SOT		4mm	ABS PLASTIC W/B
93		EMERGENCY PUMPING MODE OFF DELAY TIMER	EMGDT		4mm	ABS PLASTIC W/B
94		EMERGENCY PUMPING MODE PUMPS 2,3&4 TIMER	EMG2	EMG3 EMG4	4mm	ABS PLASTIC W/B
95		EMERGENCY PUMPING MODE START SWITCH	EMERGENCY PUMPING MODE	EMERGENCY PUMPING MODE	4mm	ABS PLASTIC W/B
96		EMERG PUMPING MODE OFF DELAY AUX RELAY	EMGOTA		4mm	ABS PLASTIC W/B
97	F	HYS. AUX RELAYS	TS-H	TS-G	4mm	ABS PLASTIC W/B
98		VALVE LOCAL/REMOTE SELECTOR SWITCH	VALVE 1 CONTROL MODE	VALVE 2 CONTROL MODE	4mm	ABS PLASTIC W/B
99		VALVE CLOSE PUSHBUTTON	CLOSE	CLOSE	4mm	ABS PLASTIC W/B
100		VALVE OPEN PUSHBUTTON	OPEN	OPEN	4mm	ABS PLASTIC W/B
101		VALVE CLOSE INDICATOR	CLOSED	CLOSED	4mm	ABS PLASTIC W/B
102		VALVE OPEN INDICATOR	OPEN	OPEN	4mm	ABS PLASTIC W/B
103		VALVE CLOSED RELAY	TK1	SK1	4mm	ABS PLASTIC W/B
104		VALVE OPENED RELAY	TK2	SK2	4mm	ABS PLASTIC W/B
105		VALVE MONITOR RELAY	TK3	SK3	4mm	ABS PLASTIC W/B
106		VALVE CLOSE CONTROL RELAY	TK4	SK4	4mm	ABS PLASTIC W/B
107		VALVE OPEN CONTROL RELAY	TK5	SK5	4mm	ABS PLASTIC W/B
108		VALVE CLOSE COMMAND RELAY	TK20	SK20	4mm	ABS PLASTIC W/B
109		VALVE OPEN COMMAND RELAY	TK21	SK21	4mm	ABS PLASTIC W/B
110		STATION LOCAL/REMOTE SELECTOR SWITCH	STATION CONTROL MODE	[Label = Red with White Lettering]	6mm	ABS PLASTIC R/W
111		ELECTRODES TEST RELAY	ETR		6mm	ABS PLASTIC W/B
112		WET WELL LEVEL INDICATOR	WET WELL LEVEL		6mm	ABS PLASTIC W/B
113						
114						
115						
116						

CONSTRUCTION - INTERNAL SWITCHBOARD

Cubicle construction 3mm Marine grade Aluminium (5251).  
 Plinth construction 80x40 channel 6061 T6 Grade Aluminium.  
 Folded, "Pulse MIG" & "TIG welded with all visible seams and joints fully welded, free from splatter and ground smooth where needed.  
 External doors and covers fitted with adhesive neoprene rubber seals.  
 Chrome plated "D" Handles fitted where indicated on the drawings.  
 M6 Earth studs fixed to the interior of all doors and hinged escutcheons and on adjacent cubicle interior surfaces. Fit dedicated earth stud adjacent main earth bar for switchboard earth.  
 Door stiffeners, door stays, cable straps, and document holders etc fitted where shown on the drawings.  
 Door stay arms to be S/Steel and of sufficient strength to prevent being deformed when subjected to reasonable loads. Minimum 3mm S/Steel.  
 Lift-off covers and mounting panels fixed with M8 studs & chrome plated dome nuts.  
 Gland plates manufactured from 3mm aluminium, unless otherwise shown.  
 Inspection/Access plates manufactured from 3mm aluminium.  
 Gland/Inspect/Access plate openings fitted with M6x10 flat head closed end rivet nuts. (Detail F)  
 Cable glands to be fitted with compression side installed within cubicle. (Detail G)  
 Gland/Inspection/Access plates to be fitted with seals attached to cubicle.  
 Gland/Inspection/Access plate fixings at 100mm.  
 Gland/Inspection/Access plates to maintain a 50mm clearance from section dividers.  
 Gland/Inspection/Access plates are NOT to be split.  
 All gland plates to be earthed.  
 Inspection/Access plates are NOT to be earthed.  
 Provide Shrouding to all live parts to IP20 where required.  
 Hinges (external) Selectrix HB650. Chrome plated.  
 S/Steel star washers fitted under all hinge screws.  
 Hinged escutcheons fixed with Emka 1/4 turn 1000-U142  
 All equipment to be removable via front access.  
 All escutcheons to open a minimum of 90°.  
 All switchboard LED lights to be mounted on the horizontal plane.

Locks Doors 1 - 16  
 LOCK FOCUS - 'T' Handle 1/THAN. Chrome Plated  
 90° Rotation

5 Pin brass cylinder  
 Spindle Type Q & 3 point locking cams c/w locking rods  
 Key Codes RC496A, RC496AB, RC496ABC refer to each door for clarification.

External Meter Panel  
 SELECTRIX - Swing Handle 110755504N Padlockable - 316  
 SELECTRIX - 3 point lock rod set - 1000-1587  
 ENERGENEX padlock, S/Steel Shackle, 45mm brass pin tumbler.  
 Energex Key No325. c/w 2 keys

OPERATING PARAMETERS  
 Standard AS 3439.1  
 Current & Frequency AC 50Hz  
 Rated Operational Voltage Ue 415 VAC  
 Rated Insulation Voltage UI 660 V  
 Rated Auxiliary Voltage 240 VAC / 24 VDC  
 Rated Current (Main Bus) 630A AMPS  
 Short Circuit Current Isc 20 kA  
 Duration of Isc .2 sec  
 Degree of Protection IP 54 to AS 1939  
 Measure of Protection by barriers and enclosures  
 Service Conditions Indoors  
 Mass Not exceeding 2000kg  
 Forms of Segregation Form 3, DB Section Form 1

WIRING

All wiring to be PVC V90 HT 0.6/1kV Grade with tinned conductor.  
 Control and instrumentation wiring has flexible copper conductors, and is colour coded as detailed below, each individual wire shall be numbered each end, and terminated by the use of appropriate pre-insulated crimp lugs or pins.  
 Separate lugs or pins shall be used for each conductor. A proprietary double pin lug may be used to terminate two conductors.  
 Use proprietary bridging links when required to common up terminals.  
 Not more than two wires shall be connected to any terminal.  
 Not more than one wire shall be connected on one side of any tunnel type terminal. Where multiple connections are required on tunnel terminals, proprietary terminal link bars shall be used.  
 Power wiring to be minimum 2.5sqmm stranded copper conductors, phase colour coded as detailed below.  
 Control wiring to be minimum 1.0sqmm flexible copper conductors, colour coded as detailed below.  
 Low level control signals to be minimum 0.5sqmm flexible copper conductors, colour coded as detailed below.  
 Wiring between RTU terminals & RTU marshalling terminals to be multicore cable with 0.5sqmm flexible copper conductors.  
 4-20mA analog signals (internal & external) wired in shielded pair minimum size 0.5sqmm, and earthed at one end only. (Switchboard end for external signals)  
 All 240VAC wiring in the RTU section and cable zones shall be double insulated and all terminals shall be shodged and labelled- 'Danger 240VAC' or 'Danger 415VAC'  
 10 & 30 Outlets on escutcheon to be wired in double insulated cable.  
 Provide shrouding with warning label over all 240VAC door/escutcheon mounted equipment.  
 All equipment shrouding within switchboard to be minimum IP20.  
 Earth cables minimum 2.5sqmm flexible.  
 Doors, gland plates and hinged escutcheons bonded with flexible copper B/wire.  
 Disconnection zone door to be bonded with flexible copper B/Wire. Heat shrink at lugs.  
 Switchboard to have dedicated earthing cable bonding directly to main earth bar.  
 Ensure minimum clearance of 100mm is maintained between cable ducting & gland plates.  
 Wire numbering will be equal to Grafoplast SI2000 system.  
 Terminal strips to be mounted 30mm off equipment panel to aid termination.  
 Wire numbers are readable left to right, bottom to top as shown.

COLOUR CODE

Phase wiring (A,B & C)	Red, White, Blue	2.5sqmm (min)
Potential Metering (240/415 VAC)	Red, White, Blue, Black	1.5sqmm
Current Metering (Secondary)	Red, White, Blue, Grey	2.5sqmm
240 VAC Control Active	Red	1.0sqmm
240 VAC Neutral	Black	1.0sqmm
Extra Low VDC Positive supplies	Orange	1.0sqmm
Extra Low VDC Negative supplies	Violet	1.0sqmm
General Extra Low VDC Wiring	Grey	1.0sqmm
RTU & PLC Wiring	Grey	0.5sqmm
Electrode Wiring	Salmon	1.0sqmm
Intrinsically safe wiring	Light Blue	1.5sqmm
Earth	Green/Yellow	2.5sqmm (min)
Door & Escutcheon Earth Bonds	Green/Yellow	6 sqmm Flexible
Instrument Shield Earth	Green/Yellow	1.5sqmm (min)

PAINTING

Aluminum Surface Preparation.  
 Finish smooth all exposed welds, clean, descale, and degrease all surfaces.  
 Surfaces pretreatment in accordance with AS 1580 & AS 3715 using Novox LF acid etch cleaner, Novacoat 12 conversion coating, & clean water rinses.  
 Apply DULUX ALPHATECH 3000 powder coat to manufacturer's recommendations.  
 CUBICLE & EXTERNAL COMPONENTS - X15 Electrical Orange gloss finish.  
 INTERIOR ITEMS (mounting panels, escutcheons, etc.) - DULUX Bright White (32166)  
 Minimum Dry Film Thickness all surfaces 50 microns.

LABELS

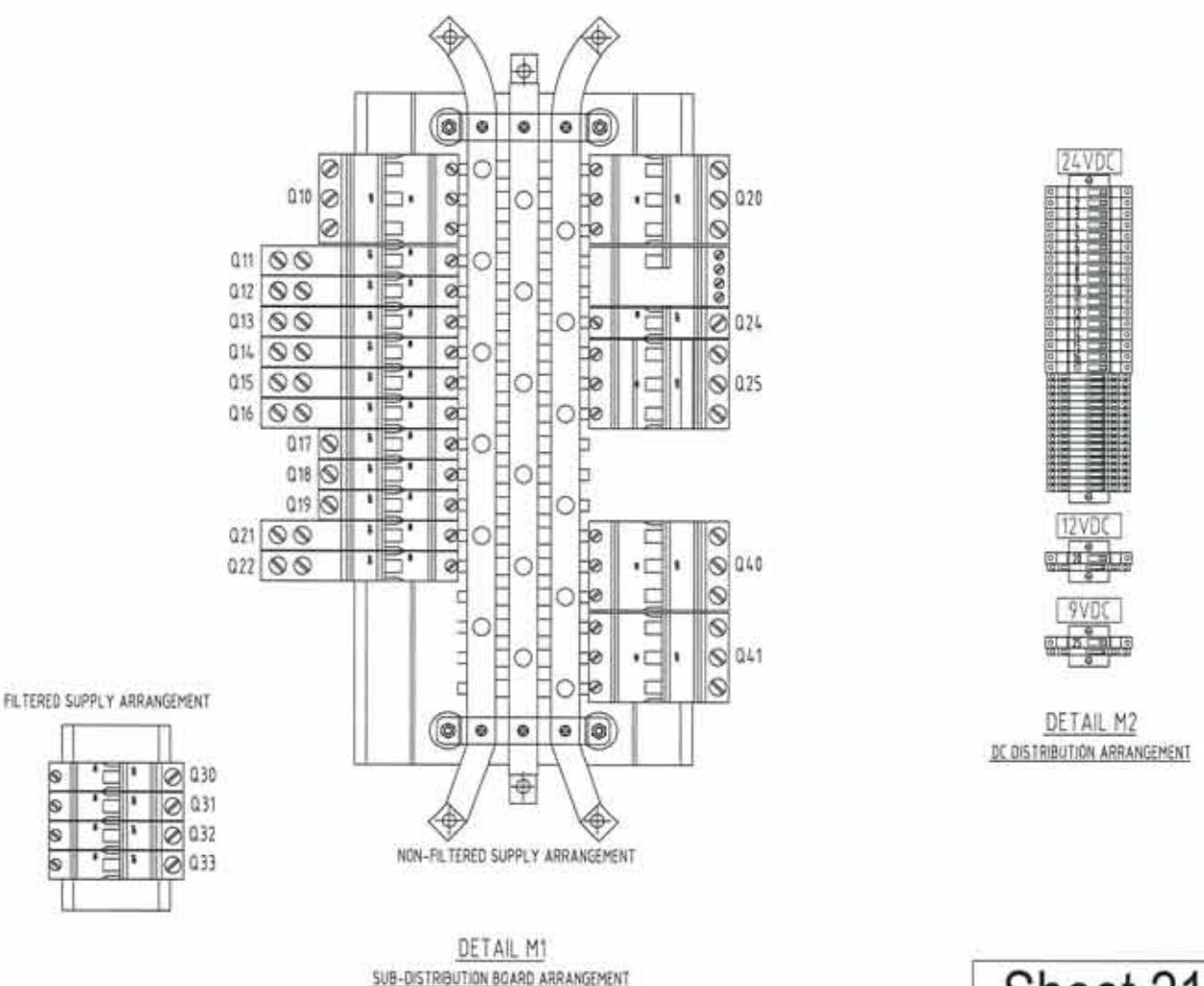
Internal labels W/B engraved ABS PLASTIC to label schedule.  
 Warning labels R/W engraved ABS PLASTIC to label schedule.  
 E/Stop labels Y/B engraved ABS PLASTIC to label schedule.  
 First letter = Background colour. Second letter = Lettering colour.

Main switch label.	MAIN SWITCH 400A	10mm 4mm	Material ABS PLASTIC Colour B/W
Pump CB labels	PUMP No1 250A	6mm 4mm	Material ABS PLASTIC Colour W/B
Compartment labels	RTU	10mm	Material Stainless Steel
E/Stop labels	EMERGENCY STOP	4mm	Material ABS PLASTIC Colour Y/B
Warning labels	DANGER 415V ISOLATE ELSE WHERE	7mm 5mm	Material ABS PLASTIC Colour R/W

Internal labels secured by M3 chrome plated metal threads.  
 CB's to be identified with individual labels as per label schedule.  
 Labels obstructed by switchboard wiring are relocated to adjacent duct lid and secured by M3 nylon threads. Lid to be secured by a single cable tie at one corner.  
 External switchboard labels to be ABS plastic secured by M3 chrome metal threads.  
 All internal and external labels are to have bevelled edges.

Andy Walmsley  
 Electrical License: A30723  
 Date: 05/06/2015

Signed:



Sheet 21

FOR CONSTRUCTION

B 02.15	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE
A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT
D 03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_C
No. DATE	Q-Pulse Id: TMS1407	DRN.	APD.	B.C.C. FILE No.	

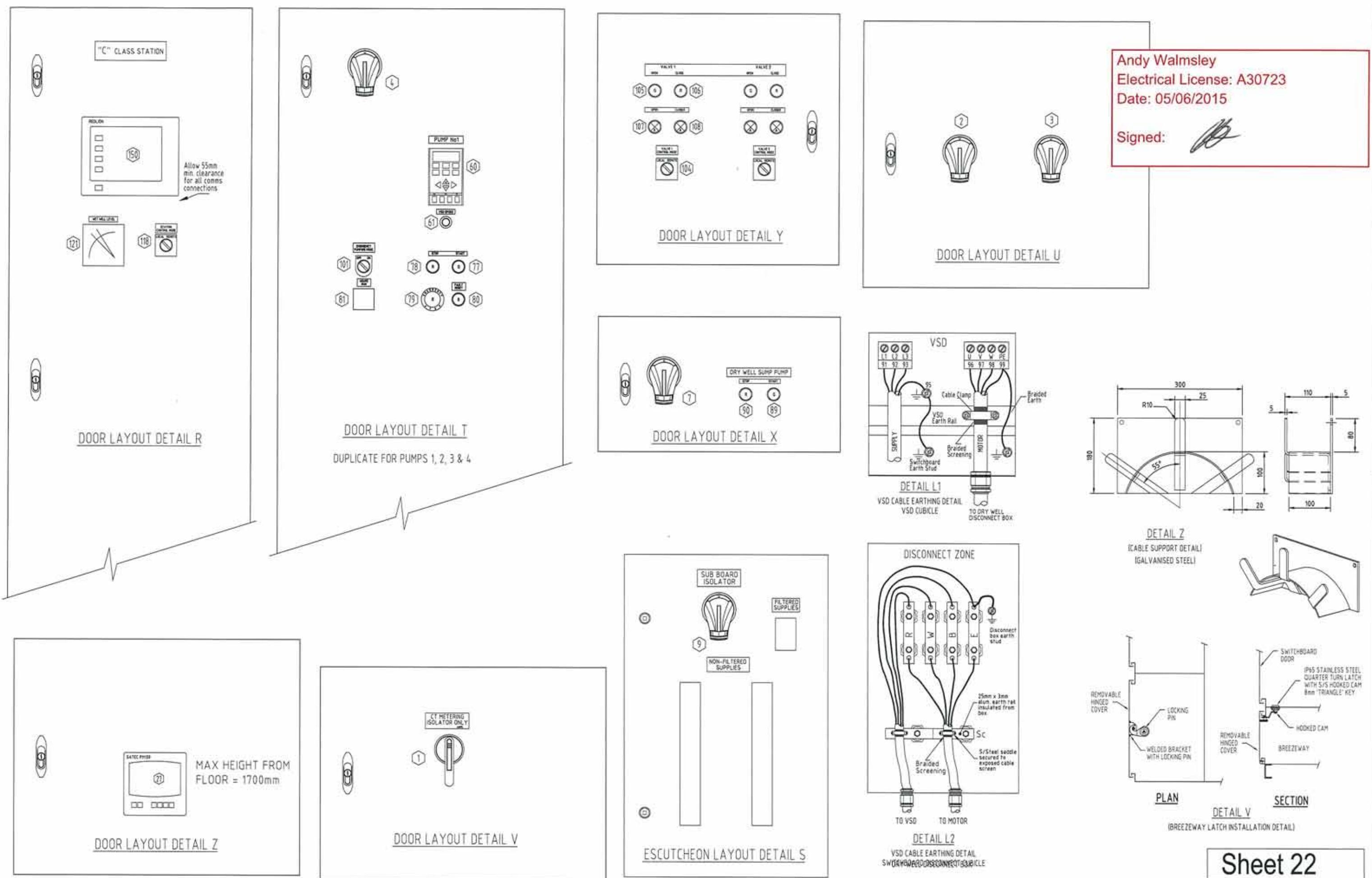
PHAQUE	3-14	DESIGN	R.P.E.Q. No.	DATE	NAME	SIGNATURE	DATE
		A.WITTHOFT	8895	3-14	QUEENSLAND URBAN UTILITIES DELEGATE	For the Queensland Urban Utilities Group	30/09/2015



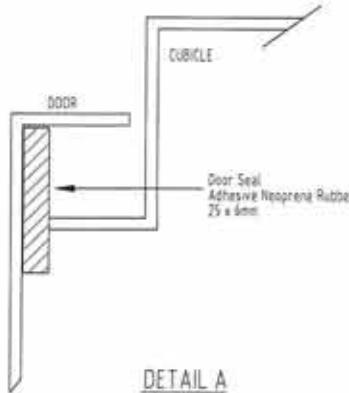
SITE  
 SP033  
 ADAM STREET  
 SEWAGE PUMP STATION

TITLE  
 SWITCHBOARD  
 CONSTRUCTION DETAILS  
 SHEET 1 OF 3

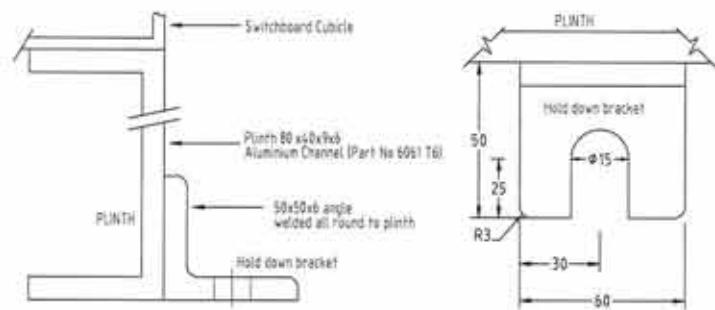
SHEET No. 21  
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 AMEND. B  
 Page T511 of 1633



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O 03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_C	DESIGN CHECK	8893	3-3-14	WITTHOFT	APPROVED FOR	13 MARCH 2015	
No. DATE	Q-Pulse Id: TMS1407	DRN.	APD.	B.C.C. FILE No.		R.P.E.Q. No.			Urban Utilities	Active: 30/09/2015	Cardno	B

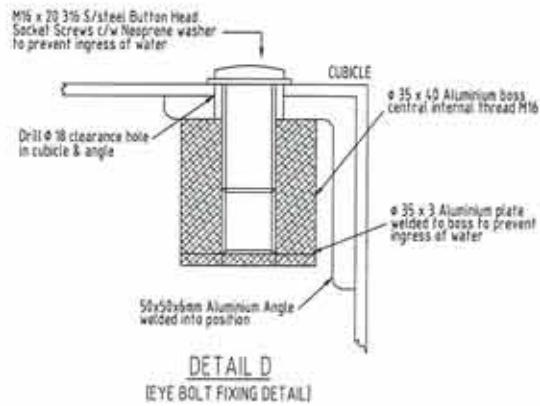


**DETAIL A**  
DOOR SEAL  
INTERNAL SWITCHBOARD



**DETAIL E1**  
(BOLTING DOWN FACILITIES DETAIL)  
(EXTERNAL BRACKET)

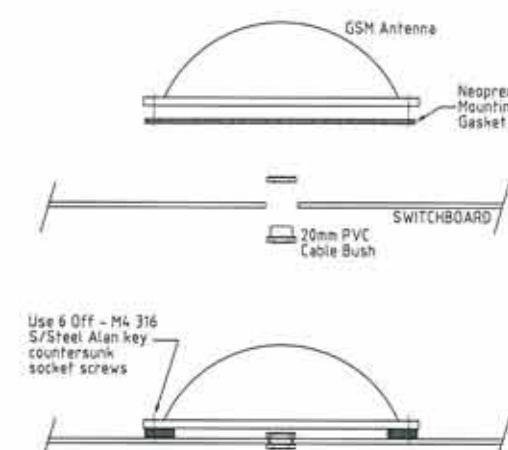
SET UP CUBICLE TO BE LEVEL & PLUMB BEFORE BOLTING TO CONCRETE PLINTH USING M12 S/STEEL CHEMICAL ANCHORS. MINIMUM ANCHORAGE 110mm. USE 40x40x3mm WASHERS. FILL WITH NON-SHRINK GROUT WHERE REQUIRED.



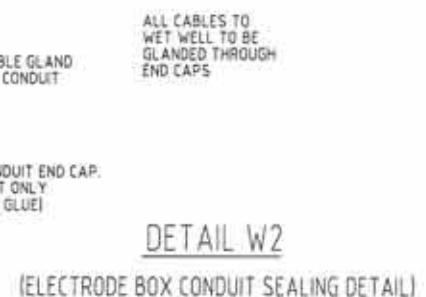
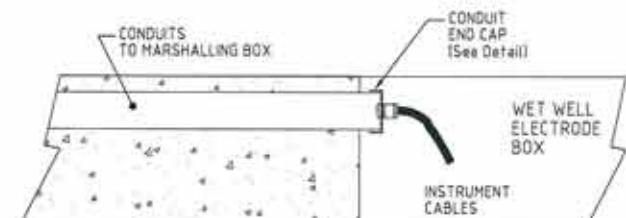
**DETAIL D**  
(EYE BOLT FIXING DETAIL)

Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:

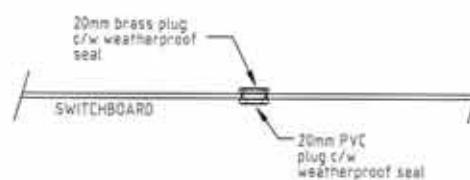


**DETAIL X1**  
(GSM ANTENNA MOUNTING DETAIL)



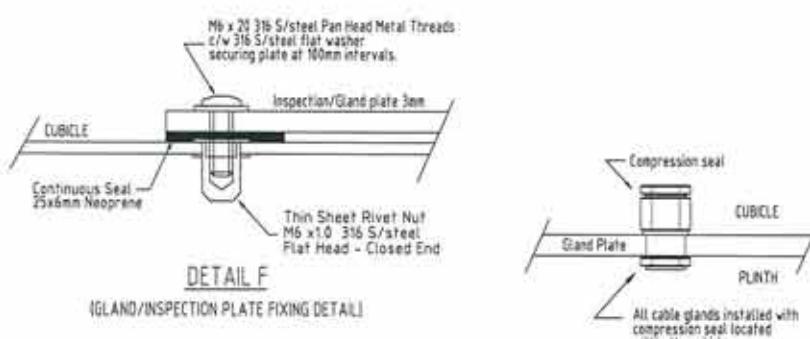
**DETAIL W2**

(ELECTRODE BOX CONDUIT SEALING DETAIL)



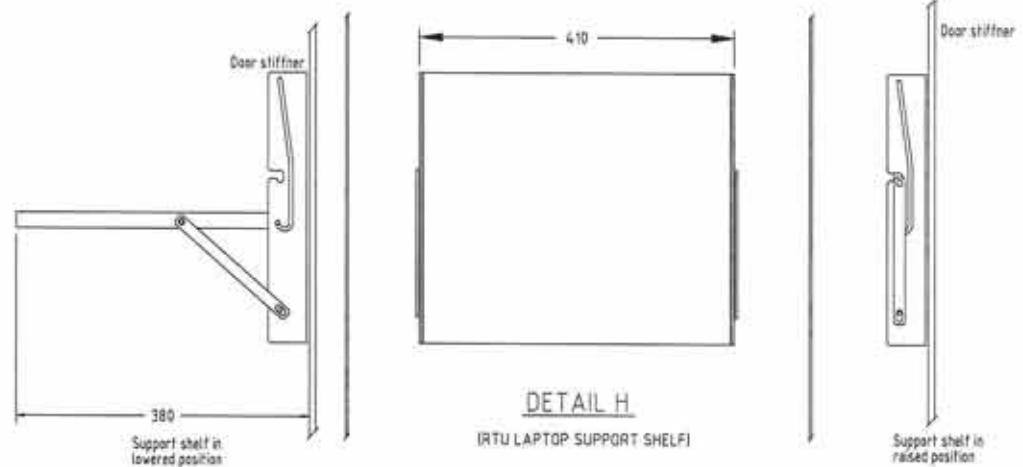
**DETAIL X2**

(SMART METERING ANTENNA PLUG DETAIL)



**DETAIL F**  
GLAND/INSPECTION PLATE FIXING DETAIL

**DETAIL G**  
(CABLE GLAND INSTALLATION DETAIL)

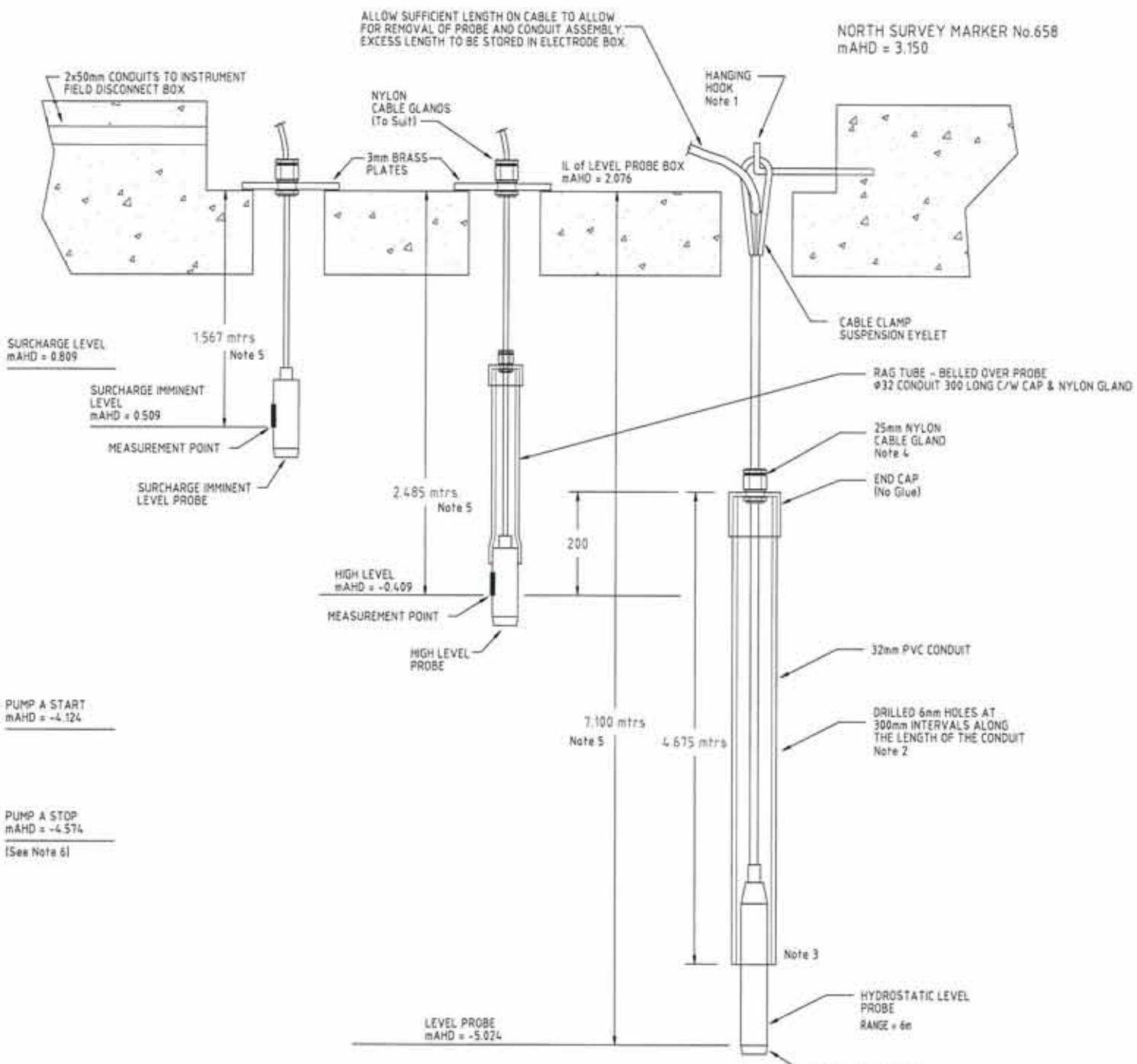


**DETAIL H**

(RTU LAPTOP SUPPORT SHELF)

**Sheet 23**

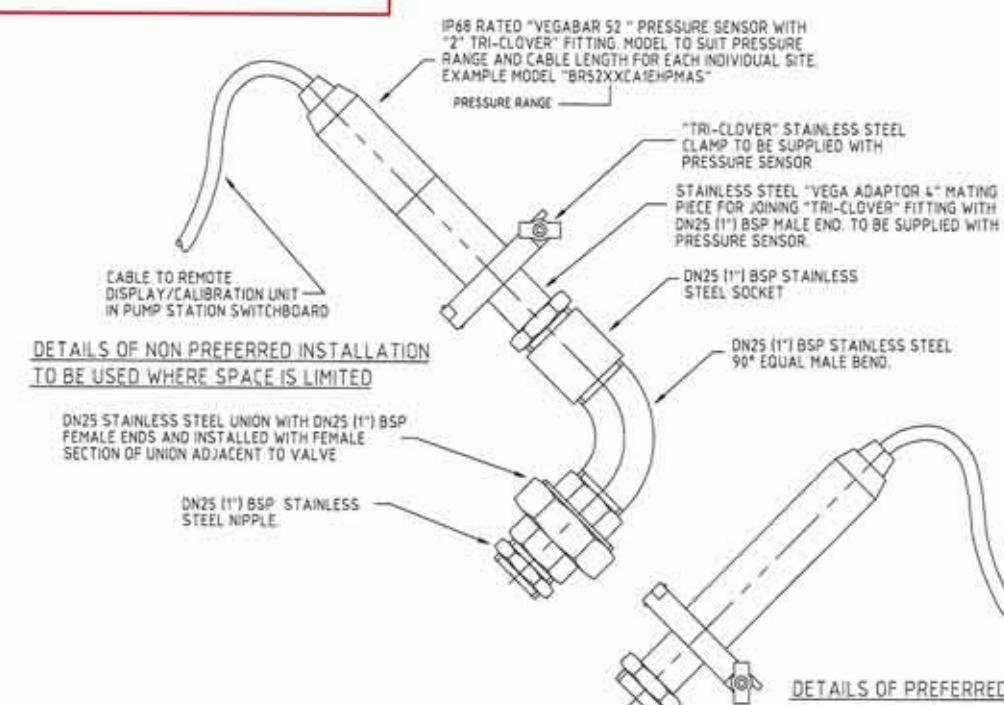
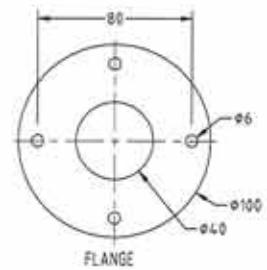
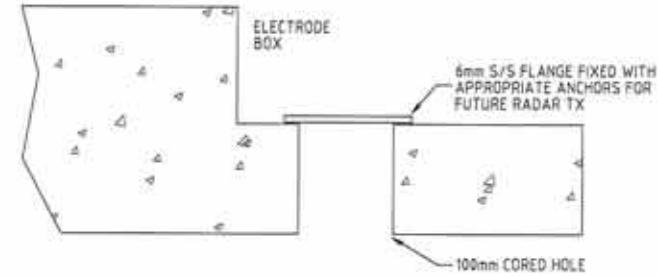
FOR CONSTRUCTION



**Andy Walmesley**  
Electrical License: A30723  
Date: 05/06/2015

Signed:

SECONDARY LEVEL TRANSMITTER MOUNTING BRACKET INSTALLATION DETAILS

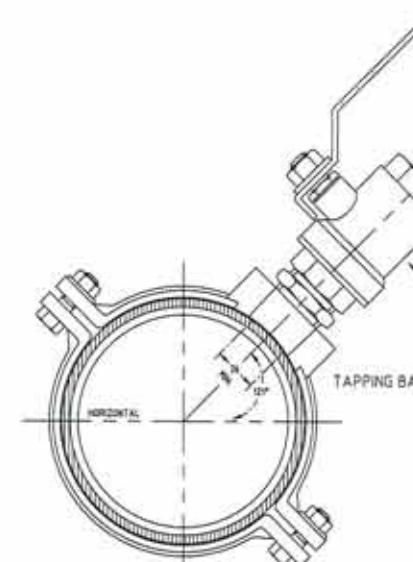


DETAILS OF NON PREFERRED INSTALLATION TO BE USED WHERE SPACE IS LIMITED

DN25 STAINLESS STEEL UNION WITH DN25 (1") BSP FEMALE ENDS AND INSTALLED WITH FEMALE SECTION OF UNION ADJACENT TO VALVE

DN25 (1") BSP STAINLESS STEEL NIPPLE

DETAILS OF PREFERRED INSTALLATION



PRESSURE TRANSMITTER INSTALLATION NOTES

1. Install stainless steel hanging hook for the suspension of the hydrostatic probe.
2. Drill 4 x 6mm holes; 150mm from each end and every 300mm of the cut length, prior to installation.
3. Install so that the conduit covers approximately 1/2 the probe. Do not glue the conduit to the end cap.
4. Install a 25mm nylon cable gland. Apply no compression to cable.
5. Measurements are to be taken from bottom of the Level Probe box to 'measurement points' on probes.
6. Pump stop level may need to be adjusted to allow for pump ramp down time. This may be required to prevent possible air locking of the pumps.

MATERIALS LIST	
1	LENGTH OF HEAVY DUTY ORANGE PVC CONDUIT 40mm.
2	CONDUIT END CAP
3	25mm NYLON CABLE GLAND
4	CABLE CLAMP SUSPENSION EYELET

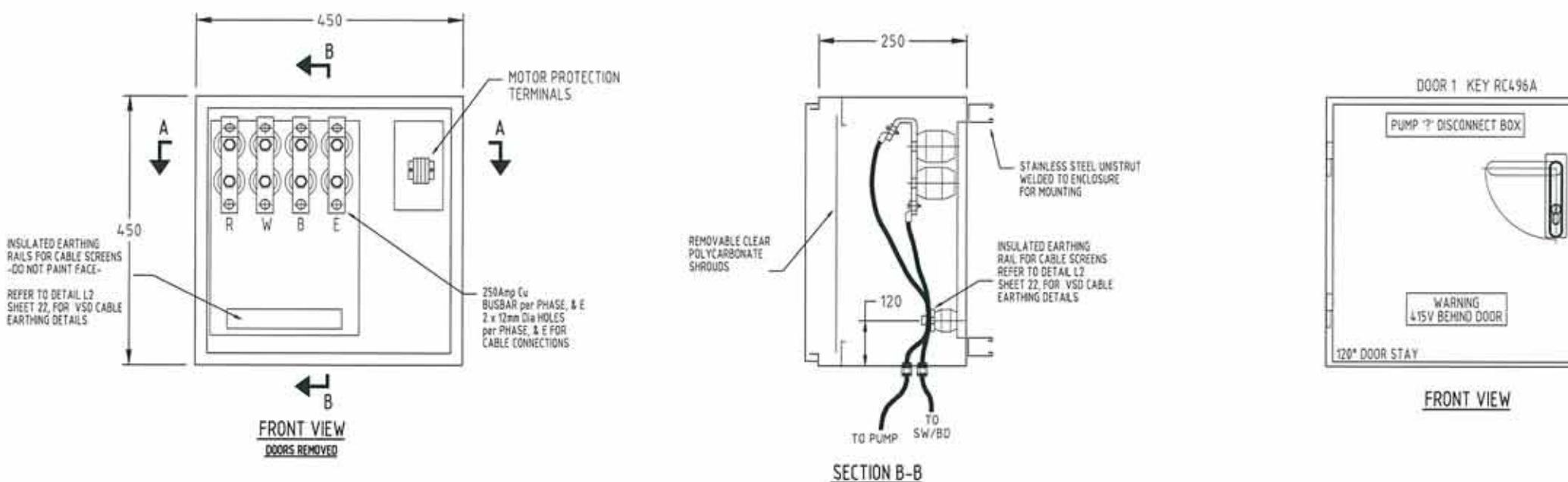
**Sheet 24**

**FOR CONSTRUCTION**

B 02-15 RE-ISSUED FOR CONSTRUCTION	P.H. A.W. DRAFTED	P.H. A.W. DRAFTING CHECK	P.H. HAGUE	3-3-14	NAME SIGNATURE DATE	DATE	NAME SIGNATURE DATE	DATE	FIELD INSTRUMENTATION INSTALLATION DETAILS	SHEET No. 24
A 05-14 ISSUED FOR CONSTRUCTION	P.H. A.W. CAD FILE	P.H. A.W. DRAFTING CHECK	A.WITTHOFFT	57-0471set_C	DESIGN R.P.E.Q. No. DATE	QUEENSLAND URBAN UTILITIES DELEGATE AUTHORIZED FOR 12 MONTHS FROM	QUEENSLAND URBAN UTILITIES	Active: 30/09/2015	Cardno	Queensland Urban Utilities DRAWING No. 486/5/7-0471-024
O 03-14 ISSUED FOR TENDER	P.H. A.W. B.C.C. FILE NO.	P.H. A.W. CAD FILE	A.WITTHOFFT	DESIGN CHECK	R.P.E.Q. No. DATE	APPROVED FOR 12 MONTHS FROM	Cardno (Old) Pty Ltd	AMEND. B		
No. DATE	Q-Pulse ID: TMS1407	DRN. APD.	B.C.C. FILE NO.	DESIGN CHECK	R.P.E.Q. No. DATE	APPROVED FOR 12 MONTHS FROM	Cardno (Old) Pty Ltd	Page 1514 of 1633		

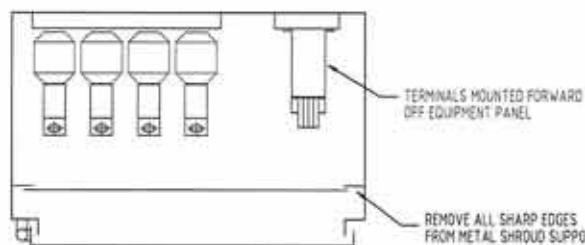
Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed: 



#### FOUR DISCONNECTION BOXES REQUIRED - PUMP1, 2, 3 & PUMP4

LOCATED IN DRY WELL



**CONSTRUCTION**  
Cubicle construction 2mm Stainless Steel.  
Folded, "Pulse MIG" & "TIG welded" with all visible seams and joints fully welded, free from splatter and ground smooth where needed.  
External doors and covers fitted with Emka 1011-207 self grip seal.  
M6 Earth studs fixed to the interior of all doors and hinged escutcheons and on adjacent cubicle interior surfaces.  
Door stiffeners to be of sufficient strength to prevent being deformed when subjected to reasonable loads.  
Provide Shrouding as shown on drawing to all busbars to IP20.  
Hinges external Selectrix HB650ss-316. Stainless Steel  
Star washers fitted under all hinge screws.

**OPERATING PARAMETERS**  
Standard AS 3439.1  
Current & Frequency AC 50Hz  
Rated Operational Voltage Ue 415 VAC  
Rated Insulation Voltage UI 660 V  
Rated Auxiliary Voltage 240 VAC / 24 VDC  
Rated Current (Busbars) 200 AMPS  
Short Circuit Current Isc 20 kA  
Duration of Isc 2 sec  
Degree of Protection IP 56 to AS 1939  
Service Conditions Outdoors

#### JUNCTION BOX LABEL LIST

TEXT	TEXT HEIGHT	MATERIAL / COLOUR	SIZE	QTY
PUMP No? DISCONNECT BOX (EXTERNAL)	20mm	S/STEEL - Black Text	300x35	1
WARNING 415V BEHIND DOOR	10mm	S/STEEL - Red Text	160x40	1
EXTERNAL LABELS 1mm THICK, 316 GRADE STAINLESS STEEL. FIXED WITH M3 316 STAINLESS STEEL METAL THREADS.				

**Locks Door 1**  
DORE ELECTRICS - Swing Handle SHKSS Universal Locking - 92268  
Lockwood Barrel Lock  
Key Code RC496A

Sheet 27

FOR CONSTRUCTION

0 02.15 RE-ISSUED FOR CONSTRUCTION  
4 05.14 ISSUED FOR CONSTRUCTION  
0 03.14 ISSUED FOR TENDER  
No DATE Q-Pulse Id: TMS1407

P.H. A.W. DRAFTED P.HAGUE  
P.H. A.W. DRAFTING CHECK A.WITTHOFFT  
P.H. A.W. CAD FILE 57-0471set\_C

P.HAGUE 3-14  
DESIGN R.P.E.Q. No. DATE  
A.WITTHOFFT 8895 3-14  
DESIGN CHECK R.P.E.Q. No. DATE

NAME SIGNATURE DATE  
QUEENSLAND URBAN UTILITIES DELEGATE  
QUEENSLAND Urban Utilities AUTHORIZED FOR  
Active: 30/09/2015 no (Qld) Pty Ltd

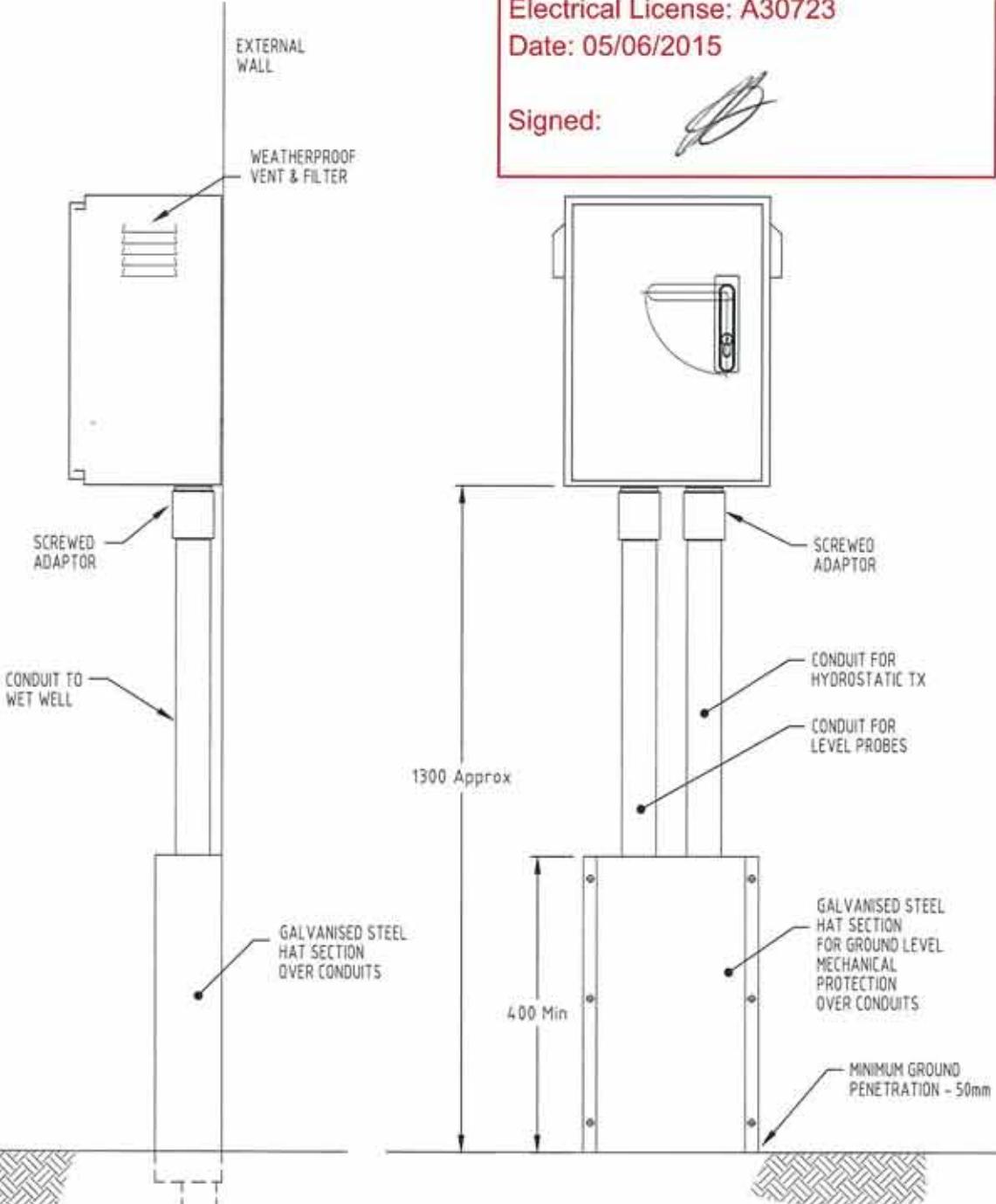
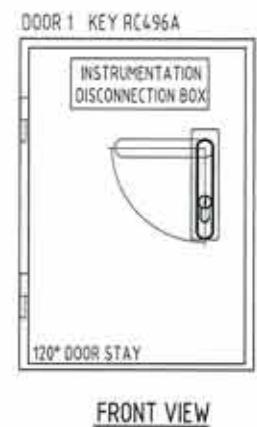
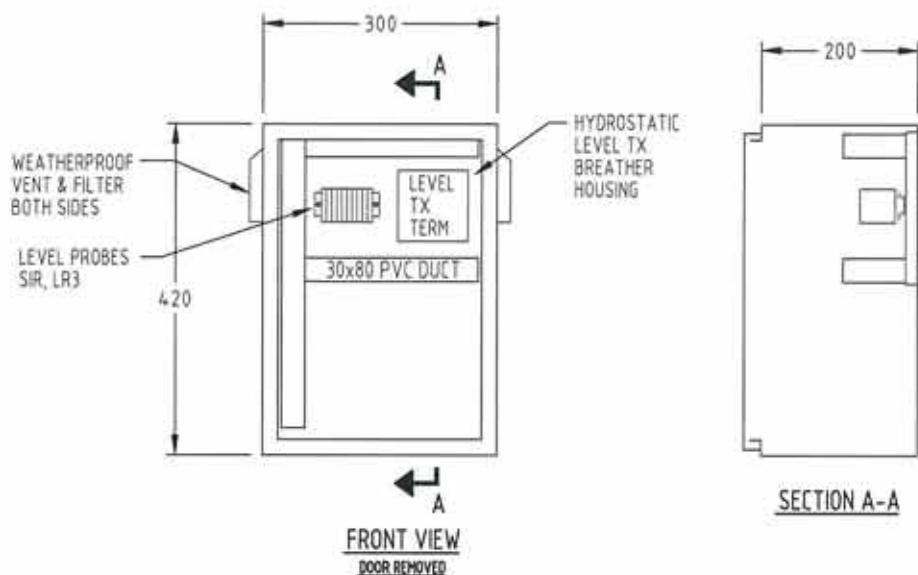
 **Cardno**  
Shaping the Future  
ADV-00117480

SITE SP033  
ADAM STREET  
SEWAGE PUMP STATION

TITLE FIELD DISCONNECTION BOX  
GENERAL ARRANGEMENT  
DRY WELL DISCONNECTION BOX  
FIELD DISCONNECTION BOX

SHEET NO. 27  
Queensland Urban Utilities DRAWING NO. 486/5/7-0471-027  
AMEND. B  
Page 15 of 1633

Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015  
Signed: 



CONSTRUCTION  
Cubicle construction 2mm 316 Stainless Steel.  
Folded, "Pulse MIG" & "TIG welded" with all visible seams and joints fully welded, free from splatter and ground smooth where needed.  
External doors and covers fitted with Emka 1011-207 self grip seal.  
M6 Earth studs fixed to the interior of all doors and hinged escutcheons and on adjacent cubicle interior surfaces.  
Door stiffeners to be of sufficient strength to prevent being deformed when subjected to reasonable loads.  
Hinges (external) Selectrix HIB650ss-316.  
Stainless Steel Star washers fitted under all hinge screws.  
Provide hat section for mechanical protection for cable entry. Hat section is to be readily removable to allow for probe replacement.

Locks/Door 1  
SELECTRIX - Swing Handle 1107SSSU3-45  
Lockwood Barrel Lock  
Key Codes RC496A

Labels  
Provide labels as shown. External labels 1mm thick, 316 grade stainless steel, fixed with m3 316 stainless steel metal threads.

Finish  
Stainless Steel 2b Finish.

OPERATING PARAMETERS

Standard	AS 3439.1
Current & Frequency	AC 50Hz
Rated Operational Voltage	24 VDC
Degree of Protection	IP 56 to AS 1939
Service Conditions	Outdoors

#### LABEL LIST

TEXT	TEXT HEIGHT	MATERIAL / COLOUR	QTY
INSTRUMENTATION MARSHALLING BOX (EXTERNAL)	20mm	S/STEEL - Black Text	1
EXTERNAL LABELS 1mm THICK, 316 GRADE STAINLESS STEEL, FIXED WITH M3 316 STAINLESS STEEL METAL THREADS.			

- CONDUIT FOR HYDROSTATIC TX 1 x 20mm
- CONDUIT FOR LEVEL PROBES 2 x 16mm

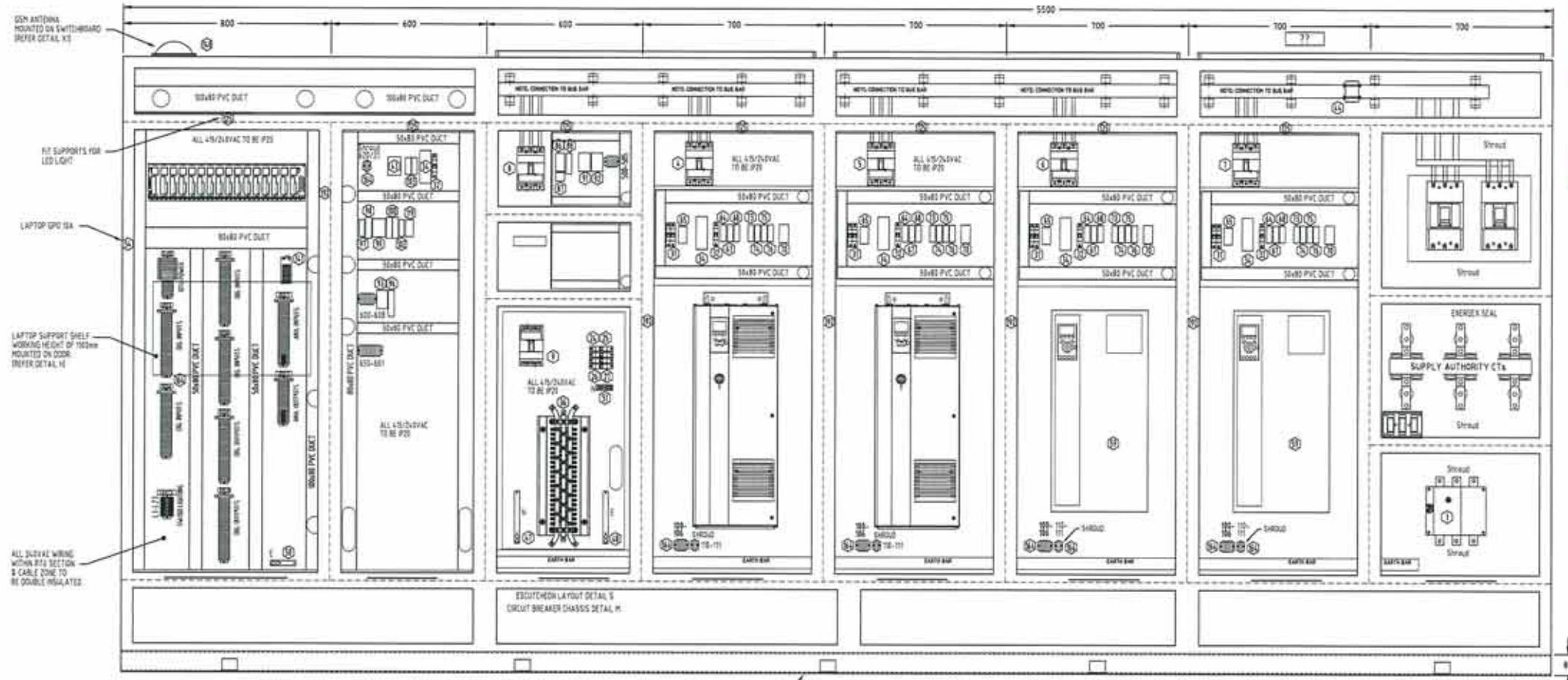
MARSHALLING BOX INSTALLATION DETAIL  
CONDUITS WITH END CAPS TO PROVIDE GAS SEALING

Sheet 28

FOR CONSTRUCTION

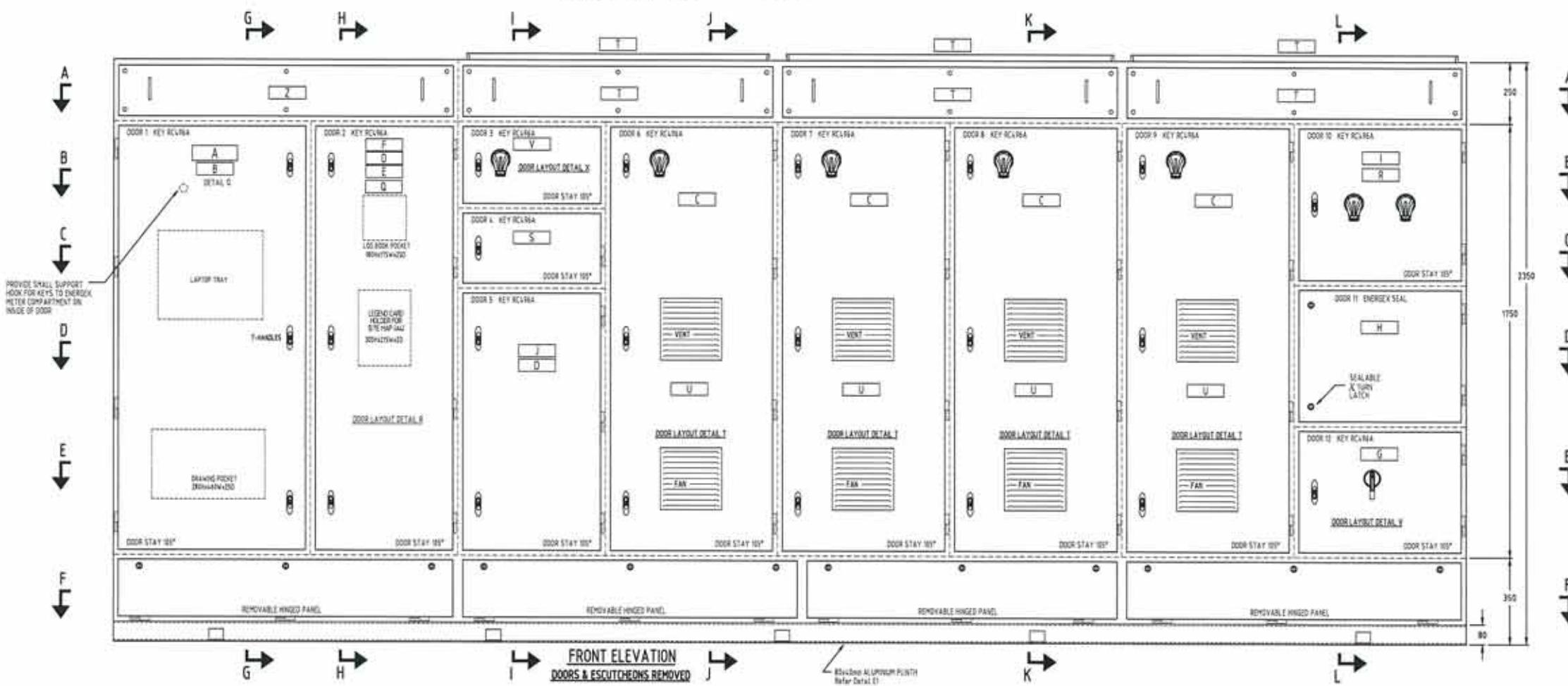
B 02.15 RE-ISSUED FOR CONSTRUCTION	P.H. A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-14	NAME QUEENSLAND URBAN UTILITIES DELEGATE	SIGNATURE DATE	DATE AUTHORISED FOR	CARDNO	SITE SP033 ADAM STREET SEWAGE PUMP STATION	TITLE WET WELL INSTRUMENTATION DISCONNECTION BOX GENERAL ARRANGEMENT	SHEET No. 28
A 05.14 ISSUED FOR CONSTRUCTION	P.H. A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN	R.P.E.Q. No.	DATE	QUEENSLAND URBAN UTILITIES DELEGATE	DATE	Queensland Urban Utilities (Qld) Pty Ltd	486/5/7-0471-028	Queensland Urban Utilities DRAWING No. 486/5/7-0471-028	AMEND. B
D 03.14 ISSUED FOR TENDER	P.H. A.W.	CAD FILE	57-0471set_C	DESIGN CHECK	A.WITTHOFFT	8895	3-14	13 MAY 2015	ACU033117188	Page 1516 of 1653		
No. DATE	Q-Pulse Id: TMS1407	DRN. APO.	B.C.C. FILE No.	DESIGN CHECK	R.P.E.Q. No.	DATE	Queensland Urban Utilities (Qld) Pty Ltd	DATE	ACU033117188			

Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015



FRONT ELEVATION  
DOORS & ESCUTCHEONS REMOVED

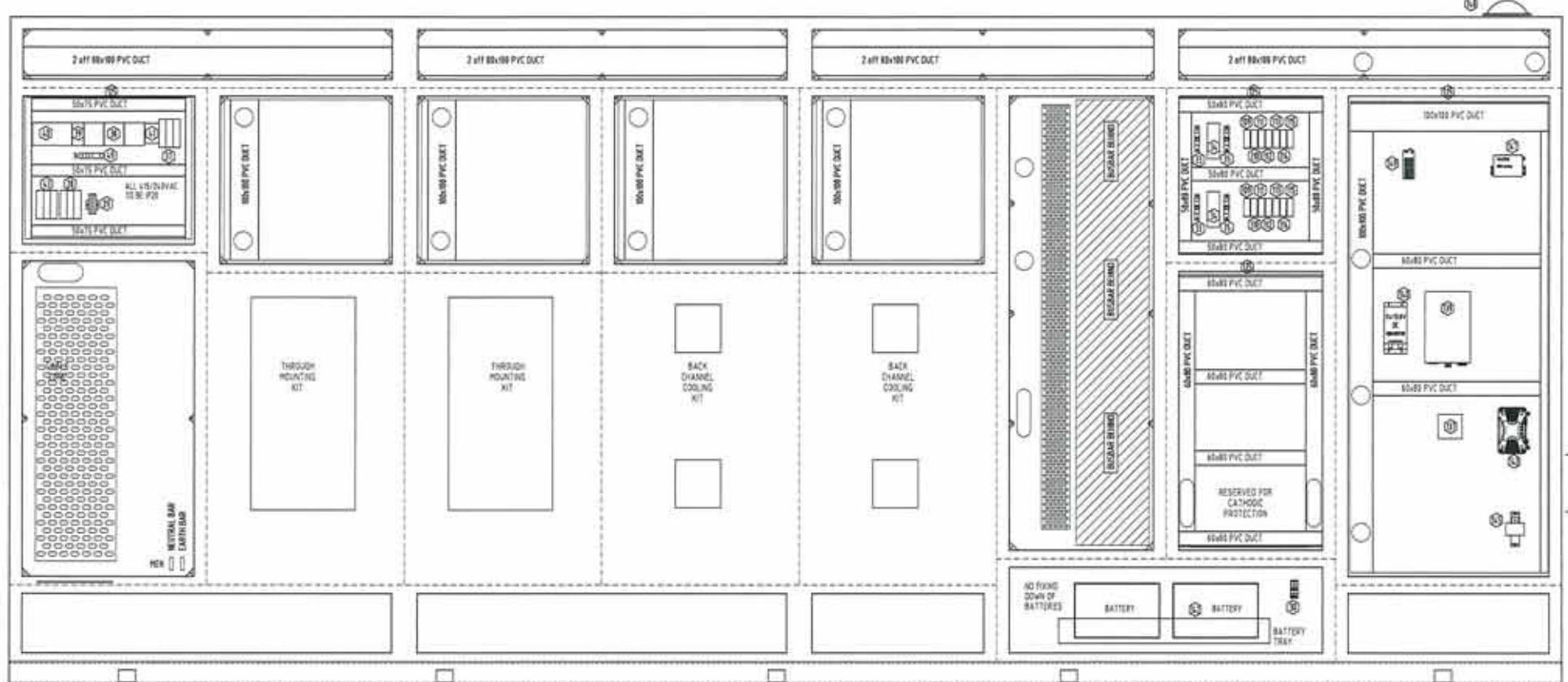
**Stainless ALUMINUM PLATE**



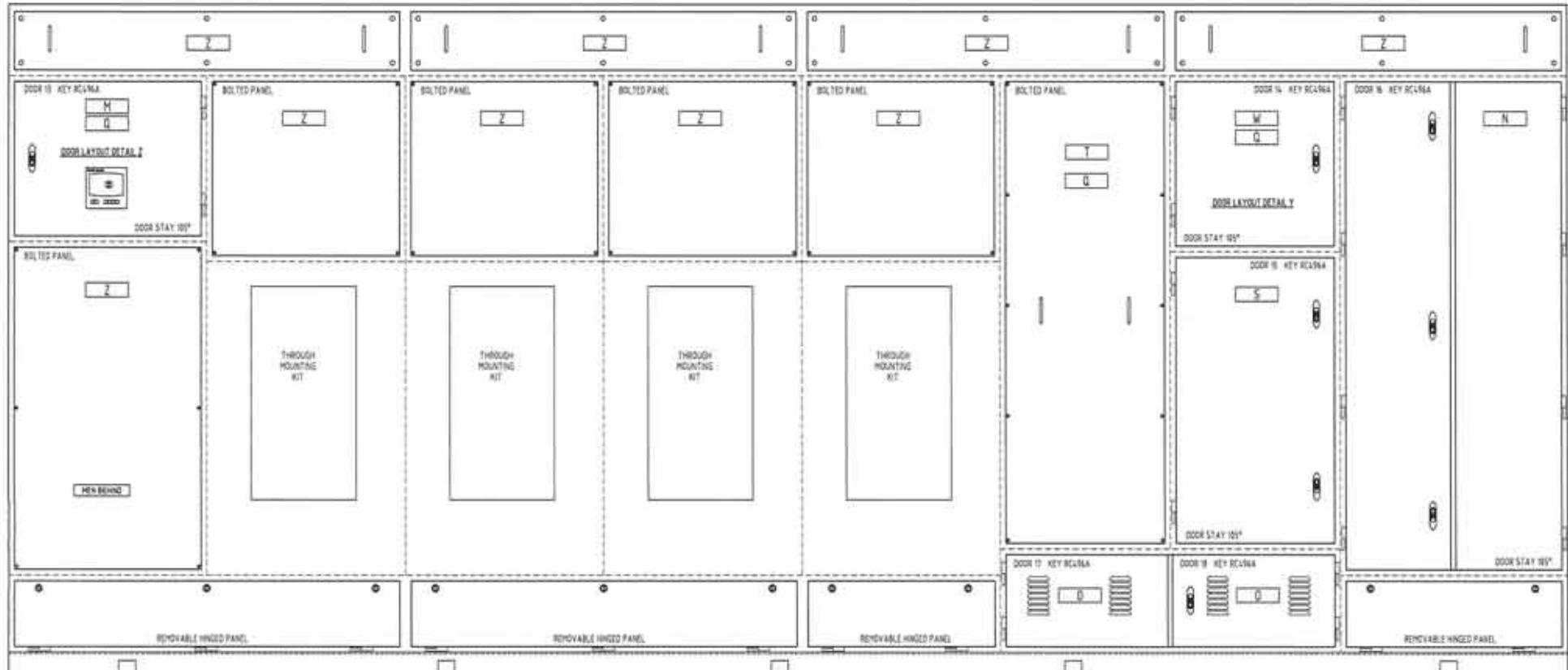
FRONT ELEVATION  
DOORS & ESCUTCHEONS REMOVED

[View All Payment Referrals](#)

Sheet 29  
FOR CONSTRUCT



**REAR ELEVATION**  
DOORS & ESCUTCHEONS REMOVED



**REAR ELEVATION**  
DOORS & ESCUTCHEONS REMOVED

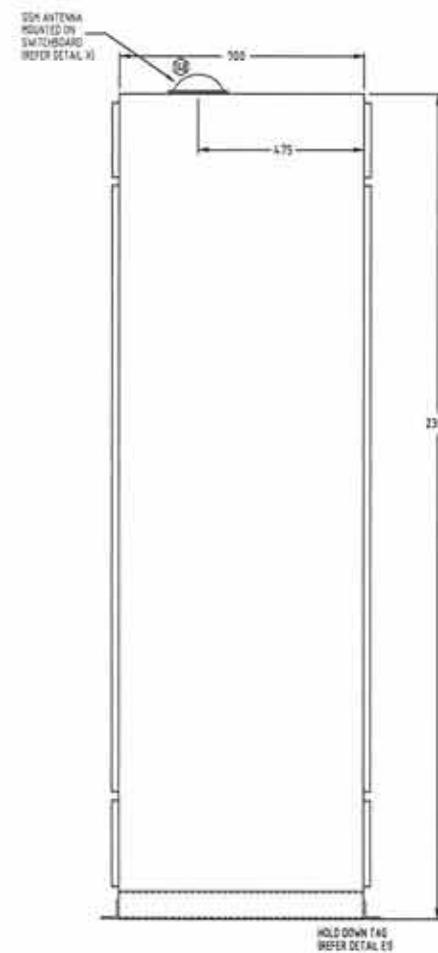
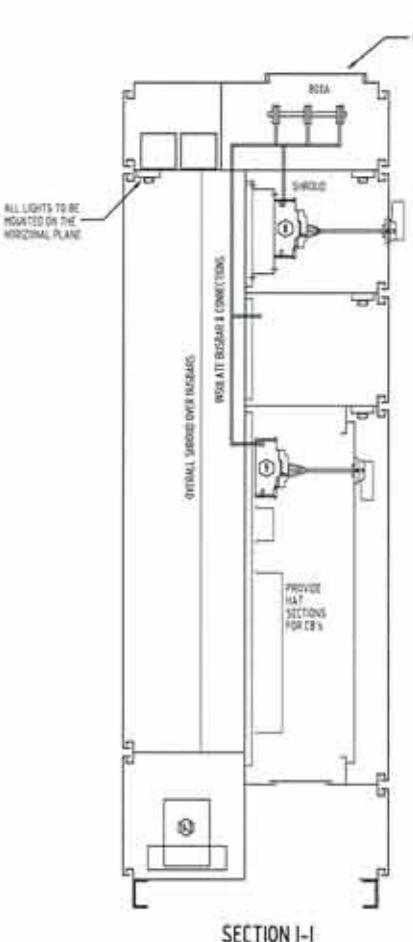
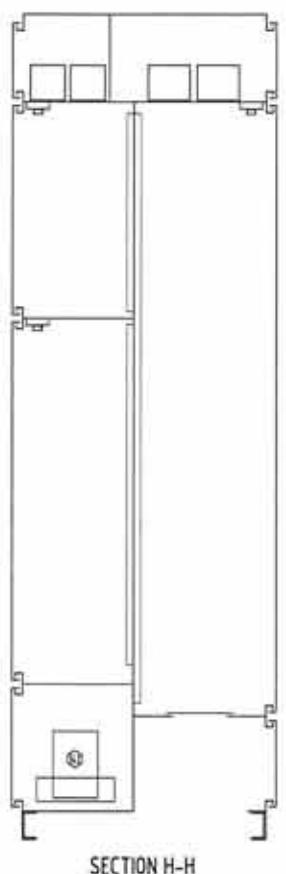
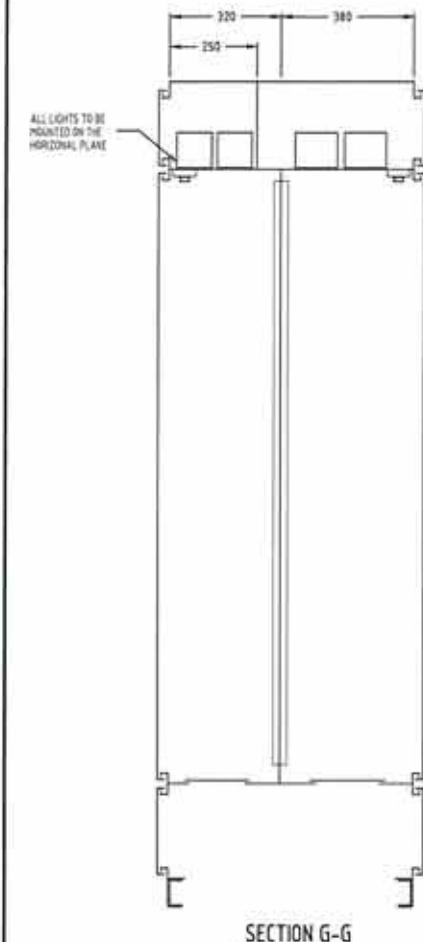
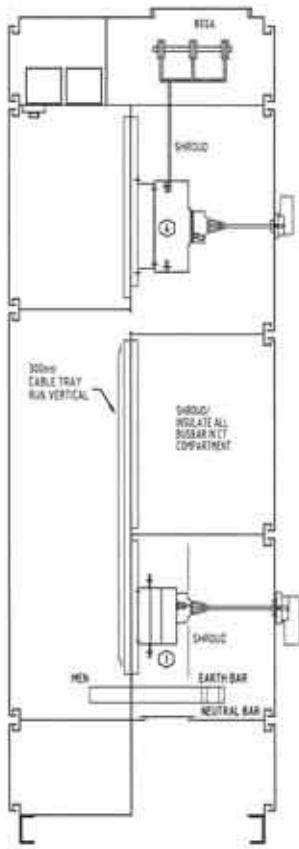
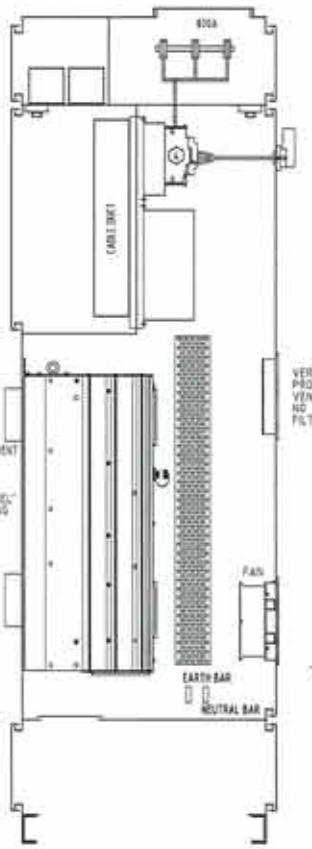
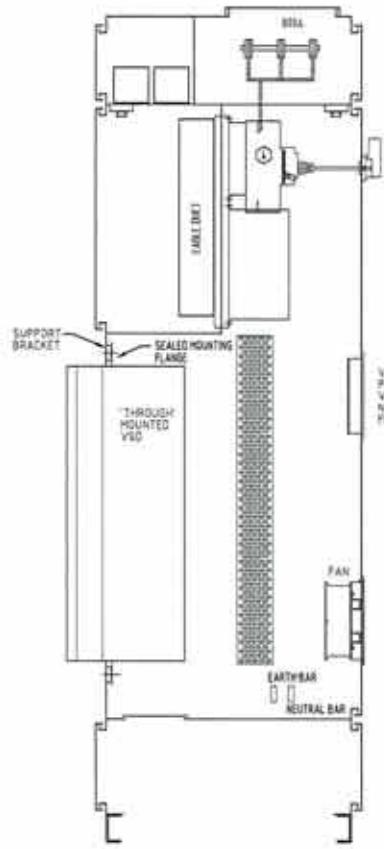
Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:

**Sheet 30**

FOR CONSTRUCTION

B 02.15	RE-ISSUED FOR CONSTRUCTION	P.H. A.W.	DRAFTED	P.HAGUE	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	SHEET NO. 30
A 05.14	ISSUED FOR CONSTRUCTION	P.H. A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN	R.P.E.Q. No.	DATE	QUEENSLAND URBAN UTILITIES DELEGATE		DATE SHOWN	Queensland Urban Utilities DRAWING No.
O 03.14	ISSUED FOR TENDER	P.H. A.W.	CAD FILE	57-0471set_C	A.WITTHOFFT	9865	3-3-14	Queensland Urban Utilities (Q.U.U.) Pty Ltd		DATE SHOWN	AMEND. B
No. DATE	Q-Pulse Id: TMS1407	AMENDMENT	B.C.C. FILE NO.	DRN. APO.	DESIGN CHECK	R.P.E.Q. No.	DATE	Gardno	Supplying the Future	ACN 071 016 881	486/5/7 Page 0418 b/f 1630

SECTION G-GSECTION H-HSECTION I-ILETT HAND ELEVATIONSECTION J-JSECTION K-KSECTION L-L

Sheet 31

FOR CONSTRUCTION

B	02.15	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	
A	05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	
D	03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471sel_C	
No.	DATE	Q-Pulse Id: TMS1407 AMENDMENT	DRN.	APD.	B.C.C. FILE NO.		

P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-14	
DESIGN	R.P.E.Q. No.	DATE	NAME	SIGNATURE	DATE	
A.WITTHOFT	8895	3-14	QUEENSLAND URBAN UTILITIES DELEGATE			

DESIGN CHECK	R.P.E.Q. No.	DATE
A.WITTHOFT		

DESIGN	R.P.E.Q. No.	DATE
A.WITTHOFT	8895	3-14

DESIGN CHECK	R.P.E.Q. No.	DATE



Active: 30/09/2015

DATE SHOWN

DATE

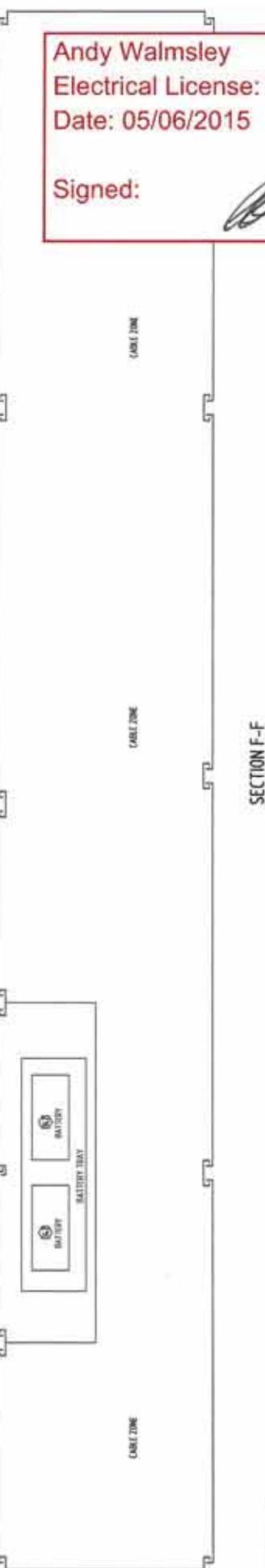
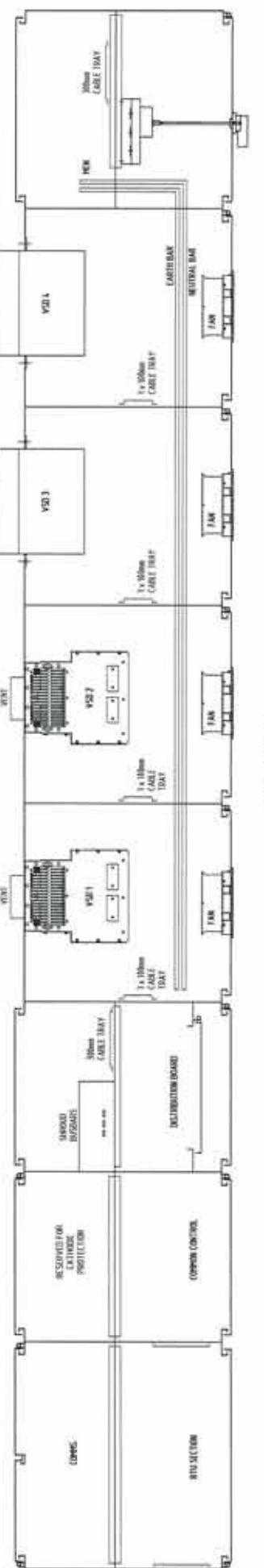
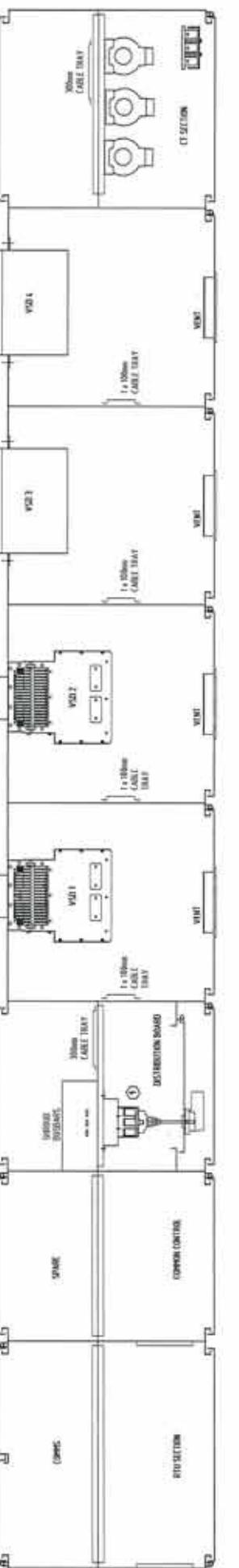
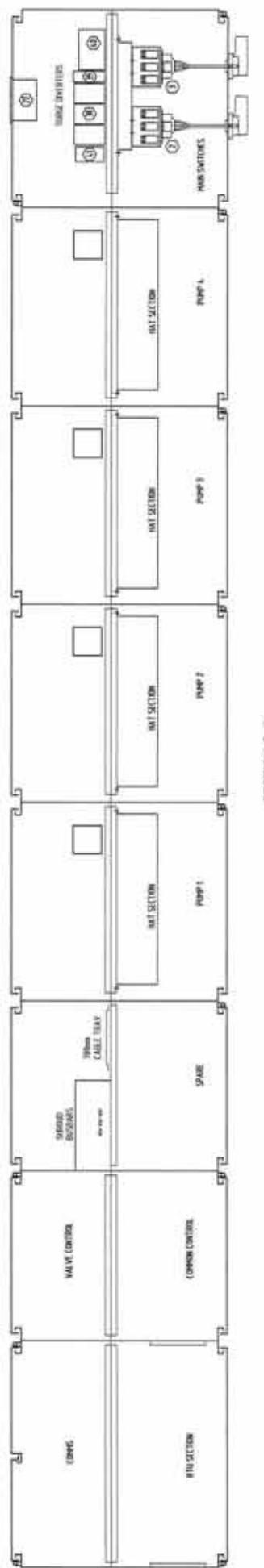
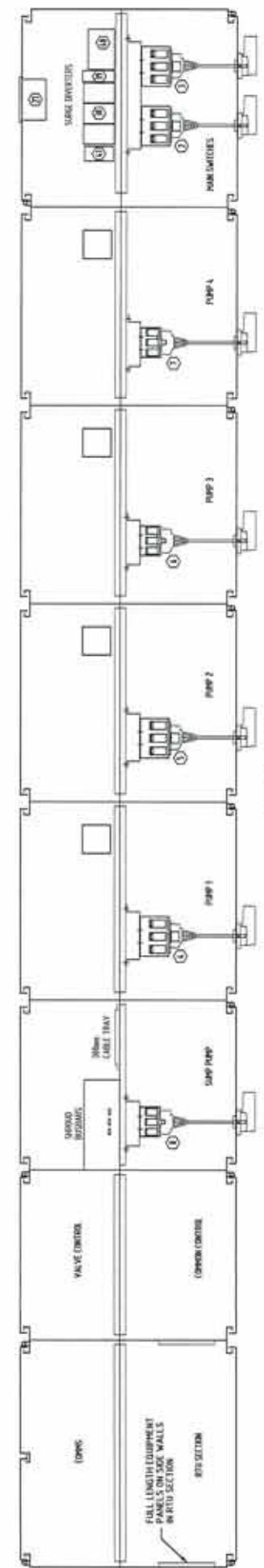
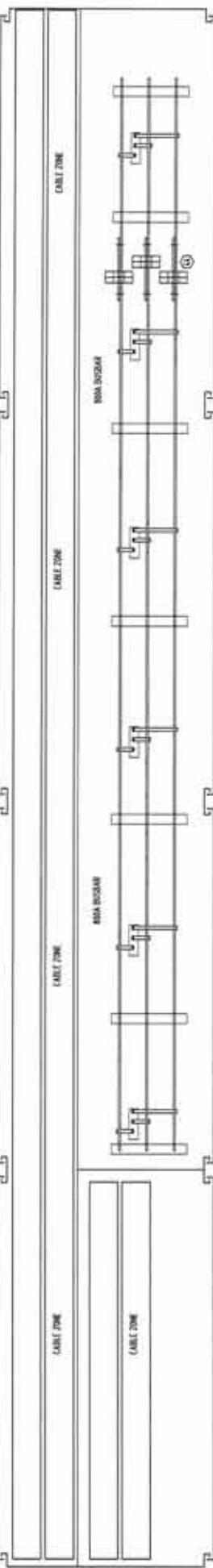
SITE SP033  
ADAM STREET  
SEWAGE PUMP STATION

TITLE GENERATOR CONNECTION CUBICLE  
GENERAL ARRANGEMENT  
SHEET 3 OF 4

SHEET No. 31  
Queensland Urban Utilities DRAWING No.  
486/57-0471-19 of 1631  
AMEND. B

Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:

Sheet 32

FOR CONSTRUCTION

8	02.15	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	
A	05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	
O	03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_C	
No	DATE	AMENDMENT	DRN.	APD.	B.C.C. FILE NO.	DESIGN CHECK	R.P.E.Q. No. DATE

Q-Pulse Id: TMS1407

						3-3-14	
						NAME	SIGNATURE
						QUEENSLAND URBAN UTILITIES DELEGATE	DATE

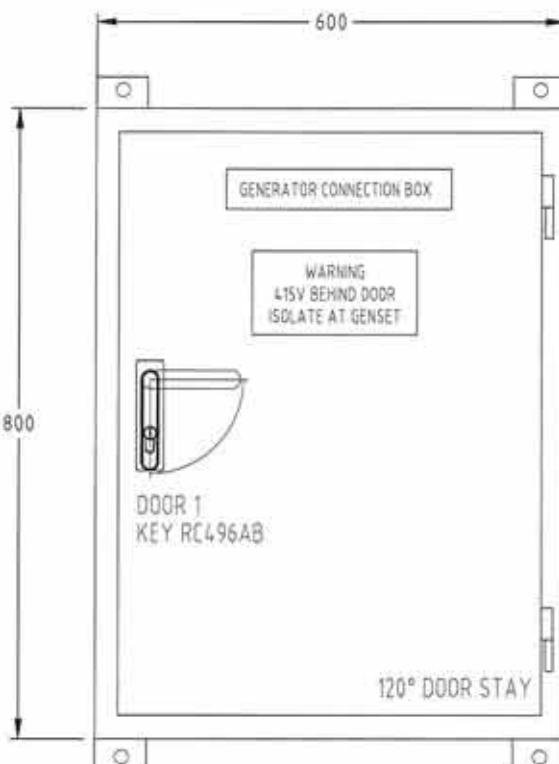


SITE  
SP033  
ADAM STREET  
SEWAGE PUMP STATION

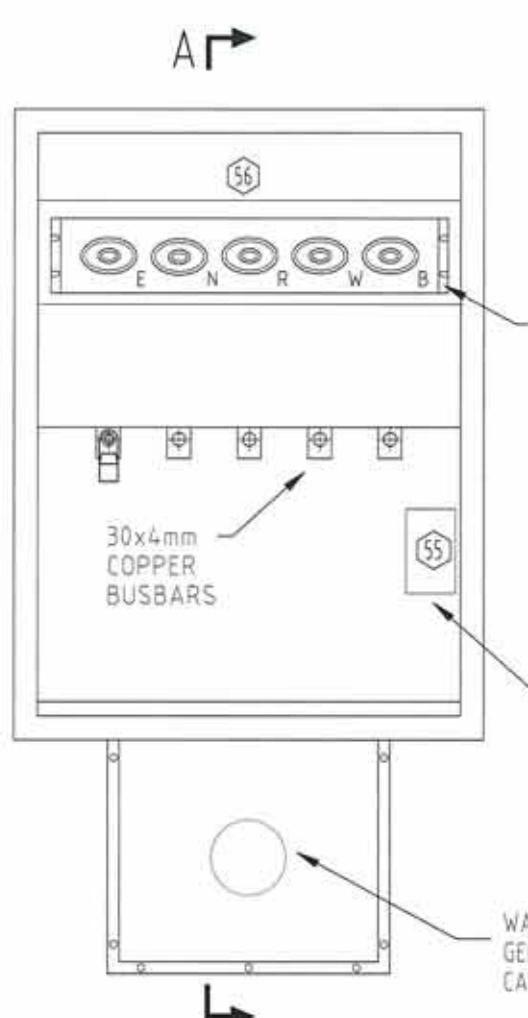
TITLE  
GENERATOR CONNECTION CUBICLE  
GENERAL ARRANGEMENT  
SHEET 4 OF 4

SHEET NO. 32  
Queensland Urban Utilities DRAWING NO.  
486/57-0471of1632  
AMEND. B

Active: 30/09/2015  
Cardno (Qld) Pty Ltd  
ACN 031 071 832

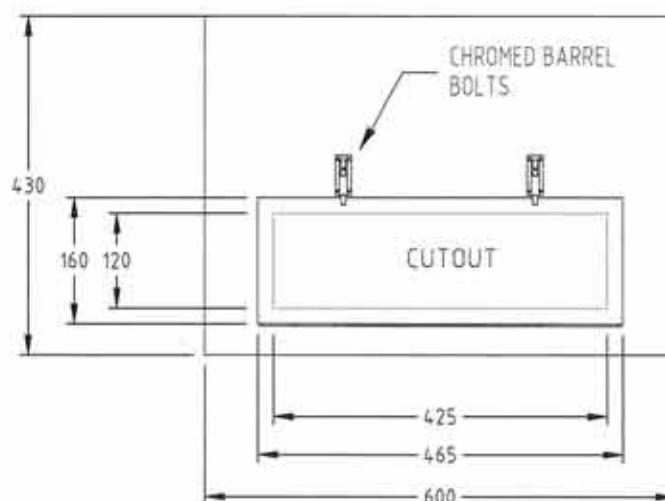


FRONT VIEW



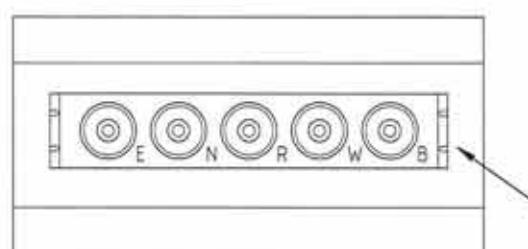
FRONT ELEVATION

DOOR AND COVER REMOVED



DETAIL 1

CABLE ENTRYS

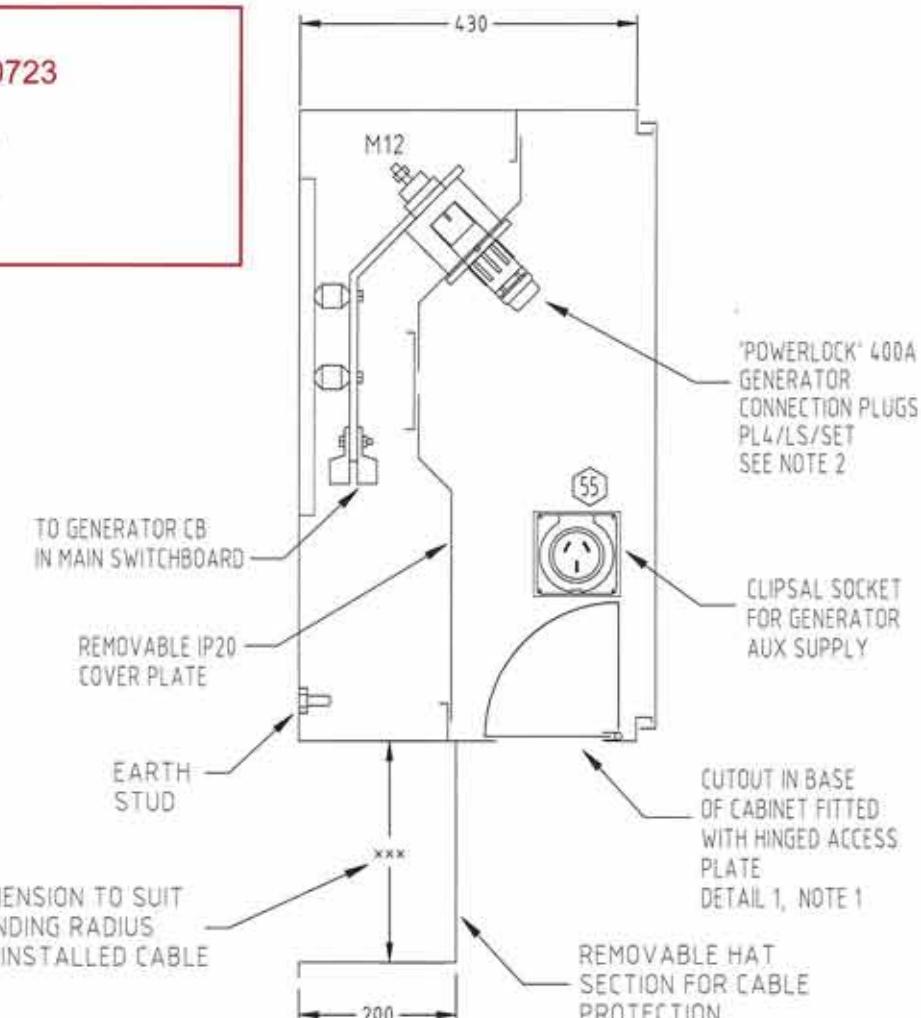
DETAIL 2  
(For mounting of powerlock connection box)

## NOTES:

- 1 STAINLESS STEEL FLAP WITH FULL LENGTH S/S PIANO HINGE WEATHERPROOF & CLOSED WITH 2 S/S SLIDE BOLTS FROM INSIDE.
- 2 SUPPLY LOOSE - 1 SET OF 'POWERLOCK' PLUGS TO SUIT CONNECTION TO POWERLOCK CONNECTION BOX

Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:



SECTION A-A

## CONSTRUCTION

Cubicle construction 16mm Stainless Steel.  
Folded, "Pulse MIG" & "TIG welded with all visible seams and joints fully welded, free from splatter and ground smooth where needed.  
External doors and covers fitted with Emka 1011-207 self grip seal.  
M6 Cubicle Earth stud welded to cubicle behind metal escutcheon.  
M6 earth studs welded to the interior door and on adjacent cubicle interior surface.  
Provide metal escutcheon as shown on drawing to shroud all cabling.  
Hinges (external) Selectrix HIB650ss-316 Stainless Steel.  
Star washers fitted under all hinge screws.

## Locks Door 1

SELECTRIX - Swing Handle 1107SSSU3-45  
SELECTRIX - 3 point lock rod set 1000-1587-SS  
Lockwood Barrel Lock,  
Key Code RC496AB

## Finish

Stainless Steel 2b Finish.

## Labels

Provide labels as shown. External labels 1mm thick  
316 grade stainless steel.  
Fixed with m3 316 stainless steel metal threads.

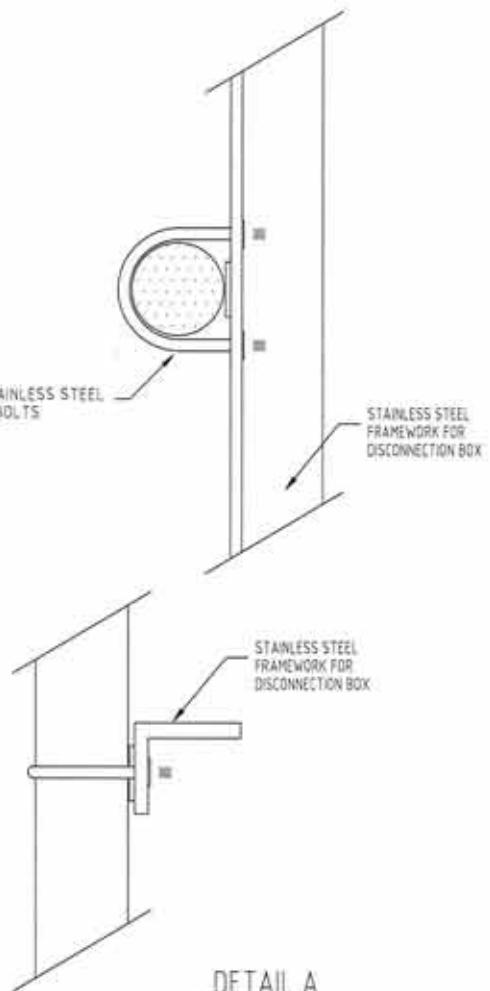
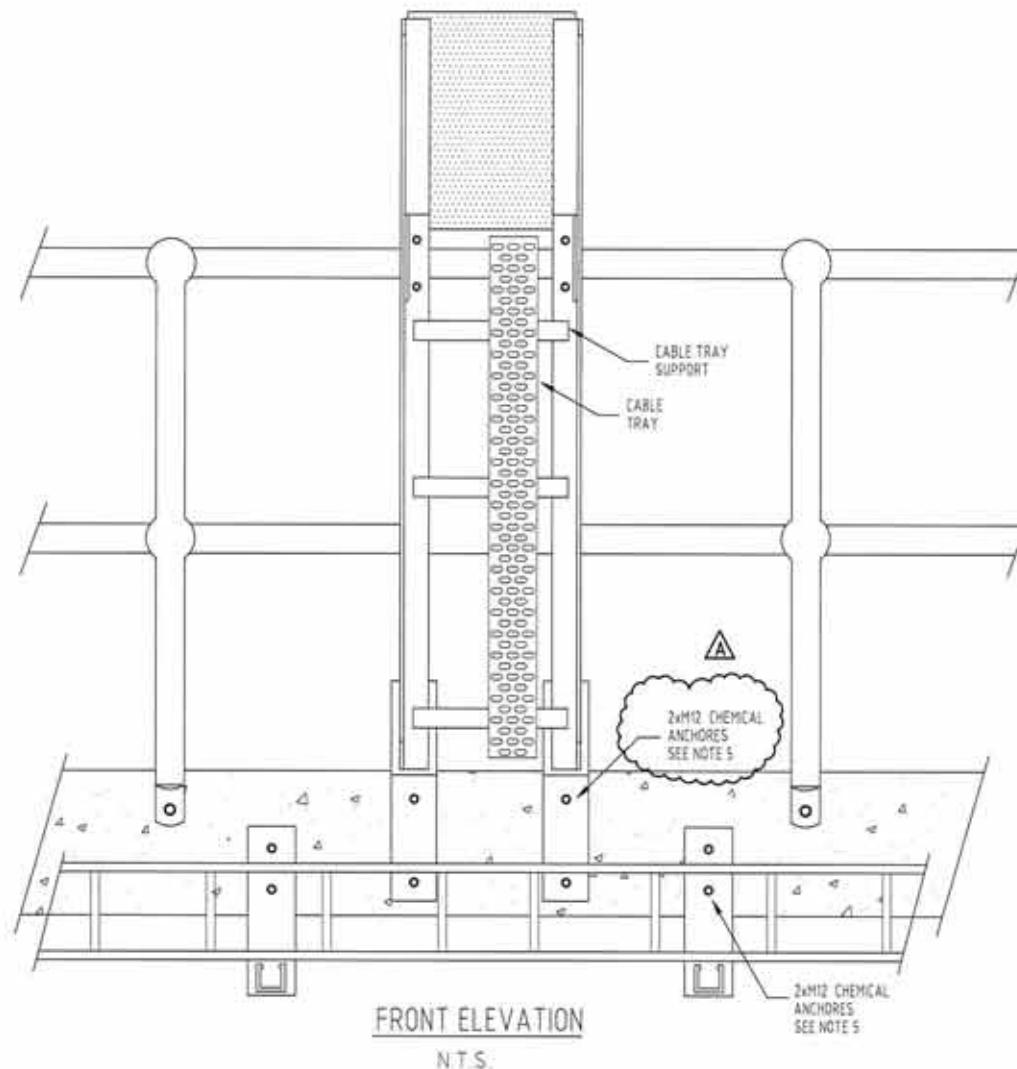
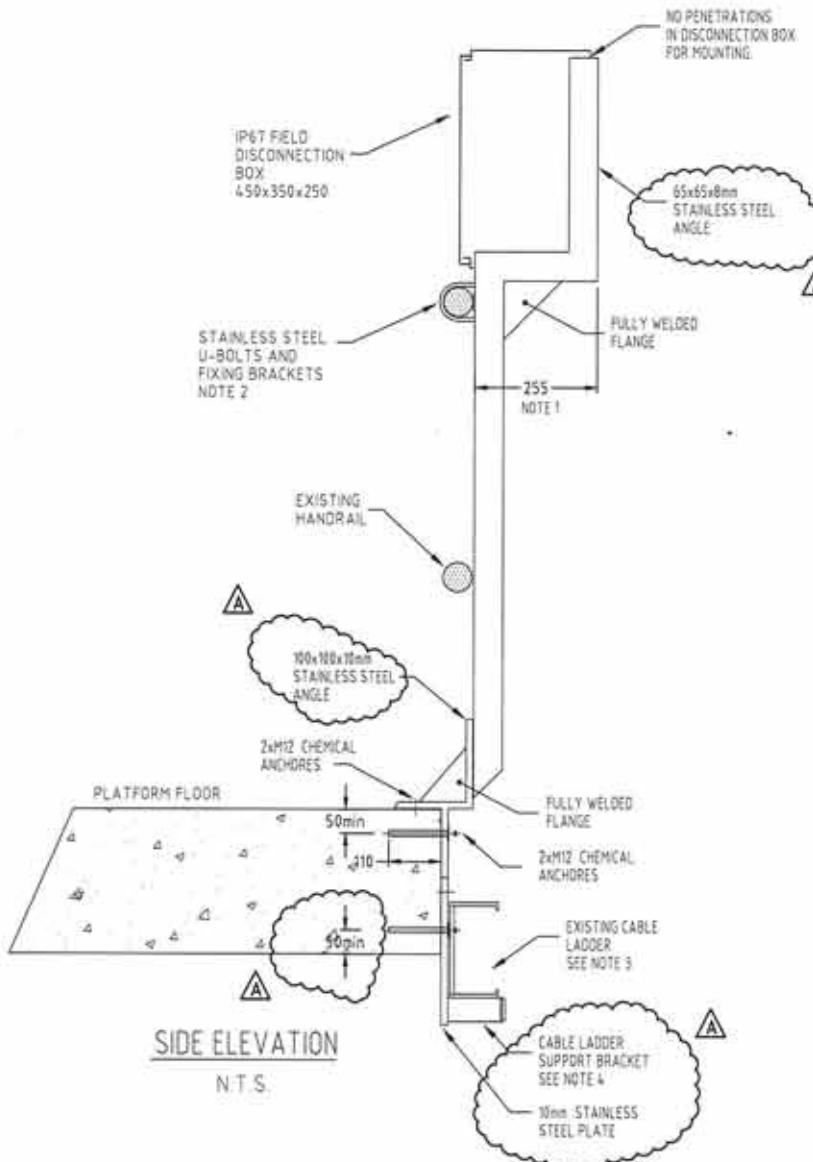
Sheet 33

FOR CONSTRUCTION

FIELD DISCONNECTION BOXES  
(4 OFF) FOR PUMPS 1,2,3 AND 4

Andy Walmsley  
Electrical License: A30723  
Date: 05/06/2015

Signed:



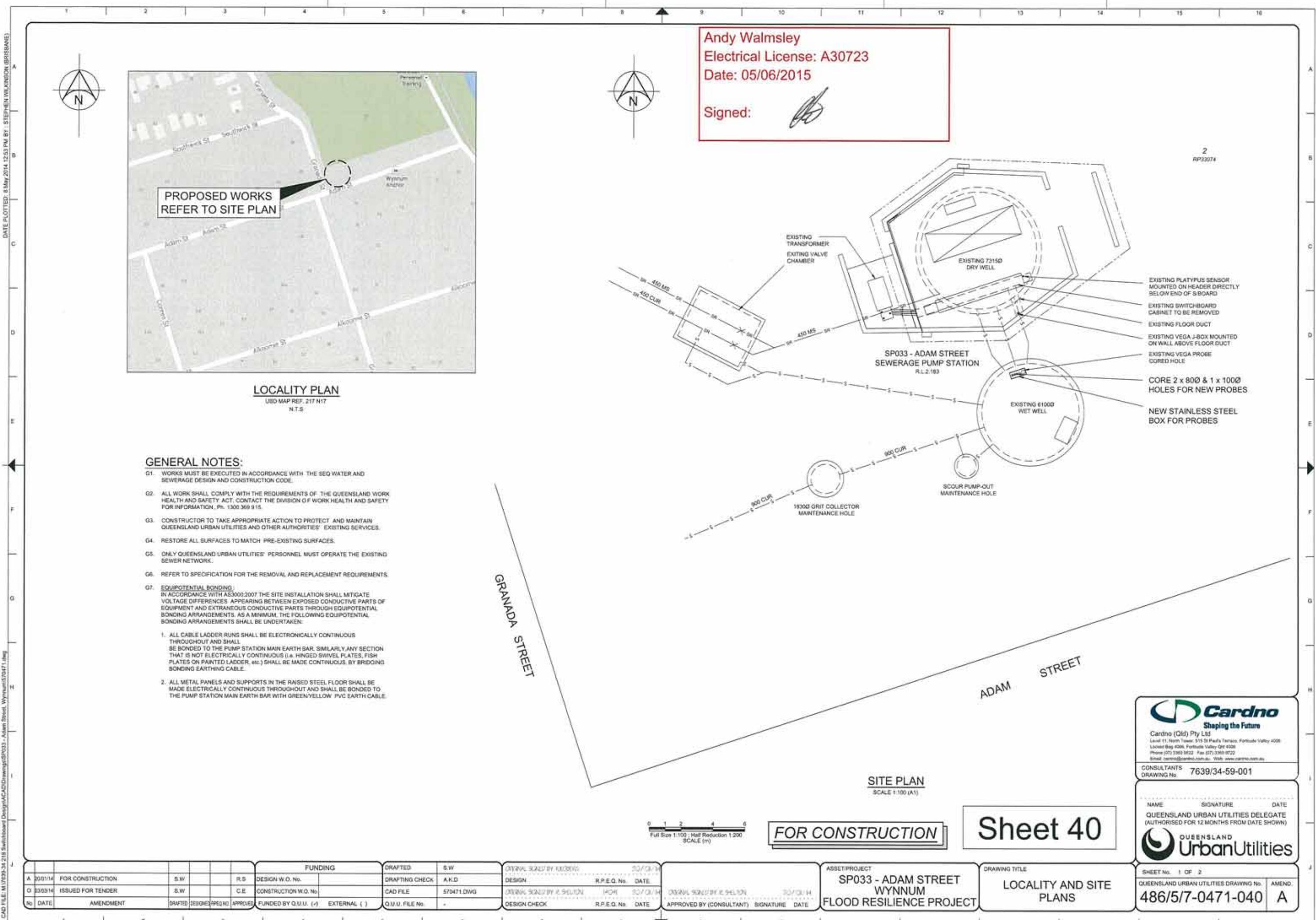
## NOTES

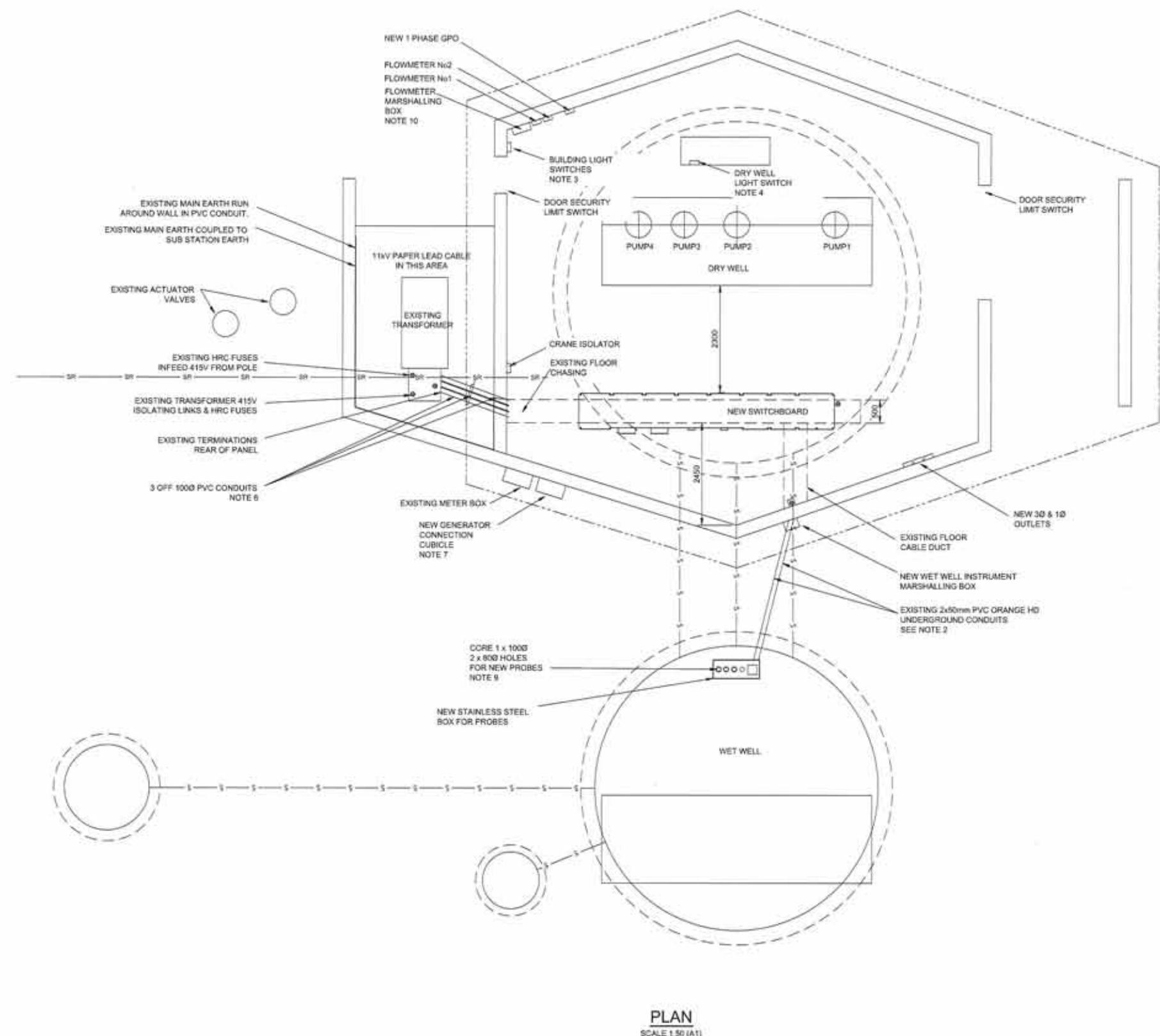
- 1- ACTUAL DIMENSION DETERMINED BY DEPTH OF DISCONNECT BOX.
  - 2- PROVIDE PROVISION FOR SEPARATION OF DISSIMILAR METALS
  - 3- EXISTING CABLE LADDER TO BE UTILISED FOR NEW MOTOR CABLES.
  - 4- NOMINAL 40x40 STAINLESS STEEL UNISTRUT (OR EQUIVALENT) WITH END CAPS
  - 5- CHEMSET REO 502 STAINLESS STEEL OR EQUIVALENT MINIMUM DEPTH = 110mm

THIS INSTALLATION DETAIL MAY BE ALTERED  
TO SUIT SITE SPECIFIC APPLICATION WITH PRIOR  
APPROVAL FROM QUU & CARDNO.

Sheet 34

FOR CONSTRUCTION





FOR CONSTRUCTION

Sheet 41

				FUNDING	DRAFTED	S.W.	ORIGINAL SIGNATURE REQUESTS	30/03/14	ASSET/PROJECT	DRAWING TITLE	
A	03/01/14	FOR CONSTRUCTION	SW	R.S DESIGN W.O. No.	DRAFTING CHECK	A.K.D	DESIGN R.P.E.Q. No. DATE		SP033 - ADAM STREET	SWITCHBOARD	
O	03/03/14	ISSUED FOR TENDER	SW	C.E CONSTRUCTION W.O. No.	CAD FILE	570471.DWG	ORIGINAL SIGNED BY E.SHELTON HOD 20/3/14 APPROVED BY (CONSULTANT) SIGNATURE DATE	30/03/14	WYNNUM	AND CONDUIT DETAILS	
N	DATE	AMENDMENT	DRAFTED	DESIGNED	REQ'D	APPROVED	FUNDED BY Q.U.U. (✓) EXTERNAL ( ) Q.U.U. FILE No.	-	FLOOD RESILIENCE PROJECT		



Cardno (Qld) Pty Ltd  
Level 11, North Tower, 515 St Paul's Terrace, Fortitude Valley 4006  
Locked Bag 4006, Fortitude Valley Qld 4006  
Phone (07) 3269 0732 Fax (07) 3269 0732  
Email: cardno@cardno.com.au Web: www.cardno.com.au

CONSULTANTS DRAWING NO. 7639/34-59-001

NAME SIGNATURE DATE  
QUEENSLAND URBAN UTILITIES DELEGATE  
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

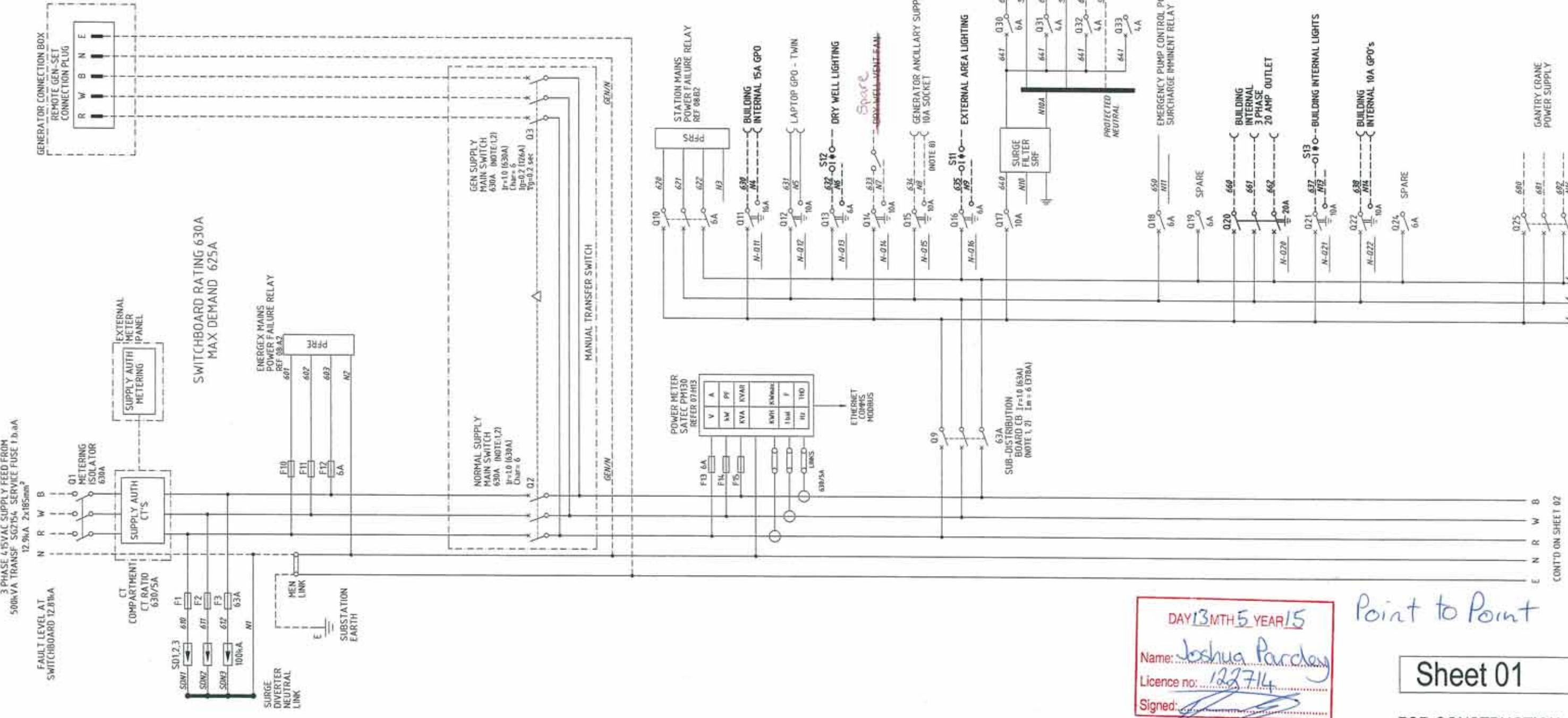


SHEET NO. 2 OF 2  
QUEENSLAND URBAN UTILITIES DRAWING NO. 486/5/7-0471-041 AMEND. A

# Drawings – Functional

## NOTES

1. INCOMING MAIN, GENSET, PUMP & DB CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
  2. M.E.N. LINK TO BE PROVIDED AS PER AS:3000.2007 SECTION 7.
  3. SURGE PROTECTION DEVICE TO BE AS CLOSE TO THE INCOMER AS POSSIBLE.
  4. ALL CIRCUIT BREAKERS TO BE PADLOCKABLE. LOCKING IS TO BE INDEPENDENT OF ESCUTCHEON.
  5. CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD TO ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS AND OVERLOADS TO AS:3947-4-1
  6. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAS SI2000 COMPATIBLE LABELING.
  7. ALL LIGHT AND POWER CIRCUITS SHALL BE FITTED WITH RCD PROTECTION, SET AT 30mA.  
ALL 10W & 30W POWER OUTLETS MOUNTED ON ESCUTCHEONS TO BE WIRED IN DOUBLE INSULATED CABLES.
  8. MAXIMUM DEMAND CALCULATION AND ALL CIRCUIT BREAKER SETTINGS WITHIN THIS DRAWINGS SET HAVE BEEN DERIVED FROM THE SITE POWER SYSTEM ANALYSIS FILE.  
Refer 'SP033 ADAM STREET Power System Analysis and Protection Coordination.pdf'
  9. CABLING TO GENERATOR CONNECTION BOX AND AUXILIARY



DAY 13 MTH 5 YEAR 15  
ame: Joshua Parcher  
cence no: 122714  
gned: J.P.

## Point to Point

Sheet 01

## FOR CONSTRUCTION

FOR CONSTRUCTION  
SHEET No. 1  
Queensland Urban Utilities DRAWING No.  
**486/5/7-0471-001**

S	02-15	RE-ISSUED FOR S
A	05-14	ISSUED FOR CO
O	03-14	ISSUED FOR T
No	DATE	AMENDMENT

STD TEMPLATE ST-20 Rev13



The logo for Cardco (Old) Pty Ltd, featuring a stylized 'C' and 'O' intertwined.

**Cardno**  
Shaping the Future  
ASX: CDO 074 000

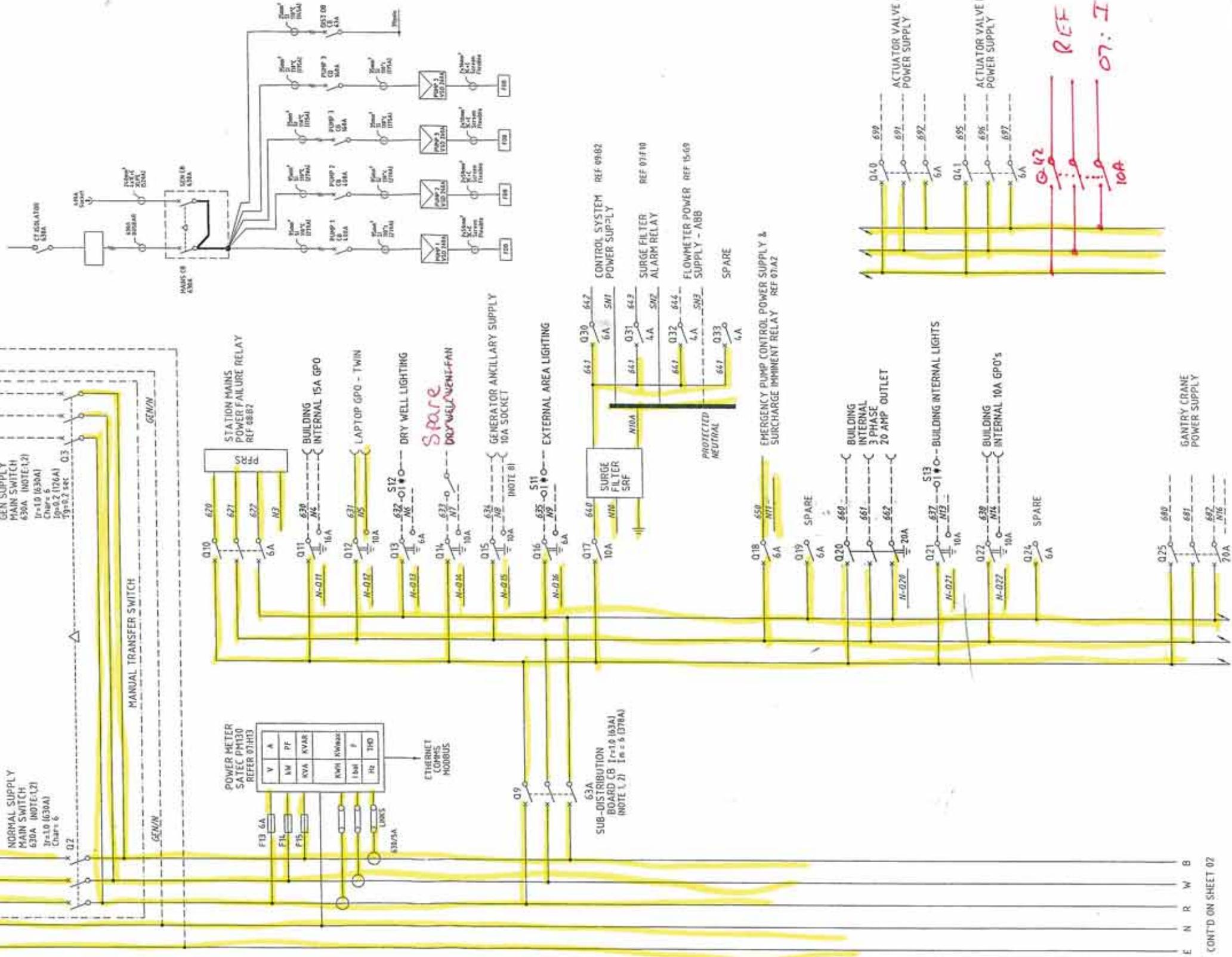
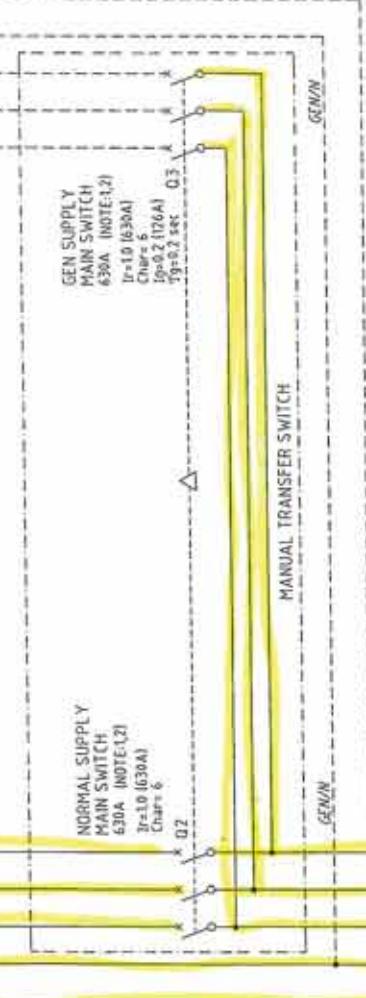
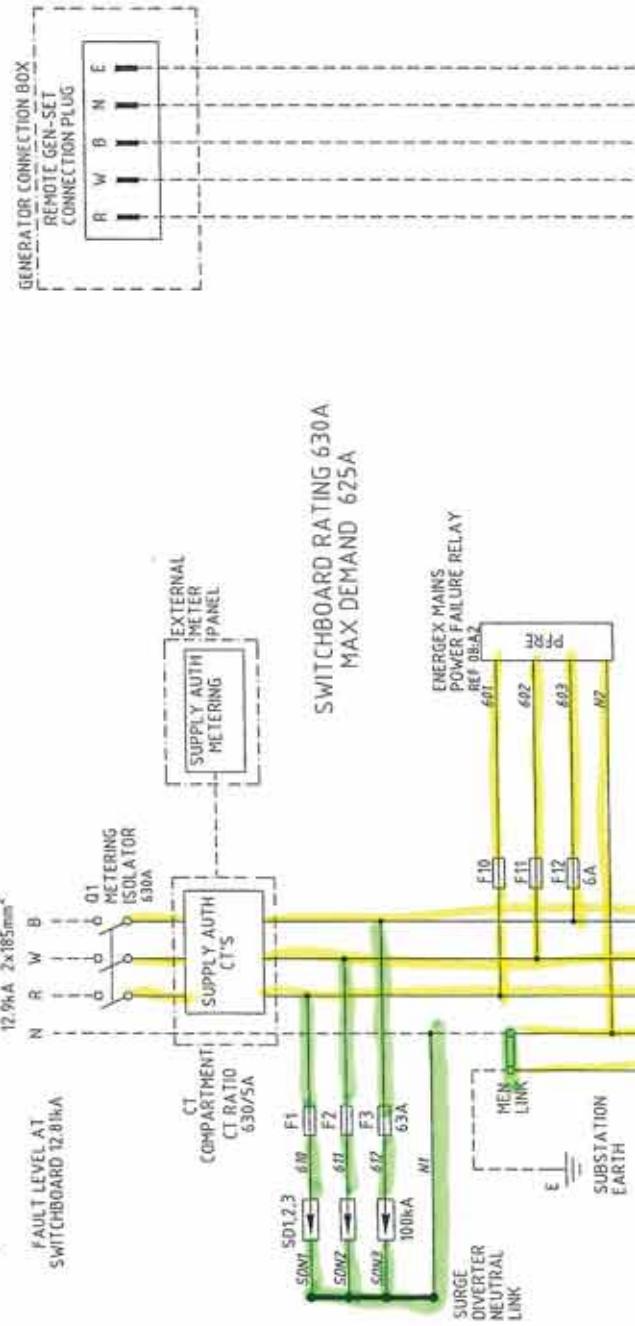
ITE  
SP033  
ADAM STREET  
SEWAGE PUMP STATION

POWER DISTRIBUTION SCHEMATIC DIAGRAM

SHEET No. 1	
Queensland Urban Utilities DRAWING No.	
<b>486/5/7-0471-001</b>	
AMEND	B

## NOTES

1. INCOMING MAIN, GENSET, PUMP & DB CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
  2. MEN LINK TO BE PROVIDED AS PER AS:3000.2007 SECTION 7.
  3. SURGE PROTECTION DEVICE TO BE AS CLOSE TO THE INCOMING CONDUCTORS SHALL BE A MINIMUM 6m<sup>2</sup> AT A MAXIMUM LENGTH OF 600mm, TO BE USED OVER THE SHORTEST AND MOST DIRECT PATH WITH NO LOOPS CONNECTED TO NEUTRAL.
  4. ALL CIRCUIT BREAKERS TO BE PADLOCKABLE. LOCKING IS TO BE INDEPENDENT OF ESCUTCHEON.
  5. CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD TO ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS AND OVERLOADS. TO AS3437.4-1.
  6. ALL WIRES & CABLE CORES ARE TERRULED WITH GRAFOPLAST 571000 COMPATIBLE LABELING.
  7. ALL LIGHT AND POWER CIRCUITS SHALL BE FITTED WITH RCD PROTECTION, SET AT 30mA.  
ALL 10 & 30A POWER OUTLETS MOUNTED ON ESLUTCHEDNS TO BE WIRED IN DOUBLE INSULATED CABLES.
  8. MAXIMUM DEMAND CALCULATION AND ALL CIRCUIT BREAKER SETTINGS WITHIN THIS DRAWINGS SET HAVE BEEN DERIVED FROM THE SITE POWER SYSTEM ANALYSIS FILE.  
Refer 'SP333 ADAM STREET Power System Analysis and Protection Coordination.pdf'
  9. CABLING TO GENERATOR CONNECTION BOX AND AUXILIARY STUDIONY SOCKET TO RE DOUBLE INSULATED CABLING.

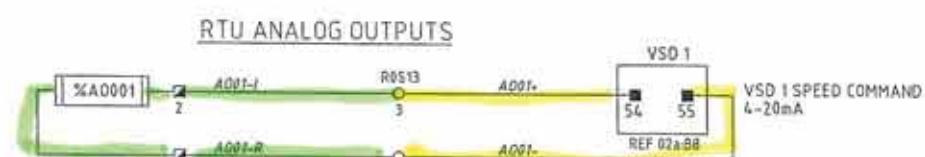
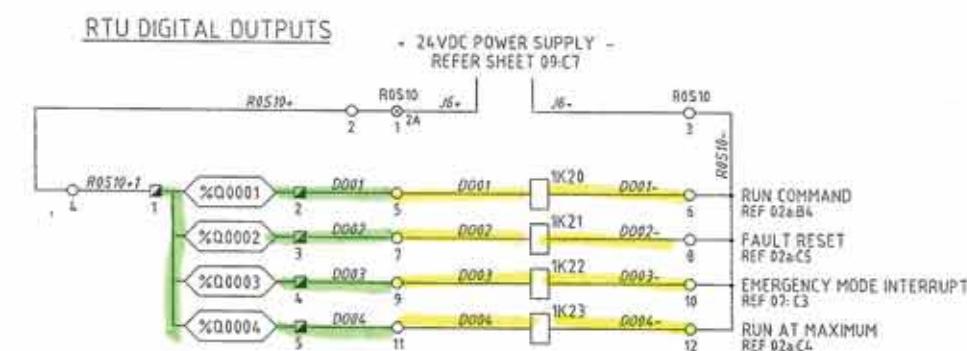
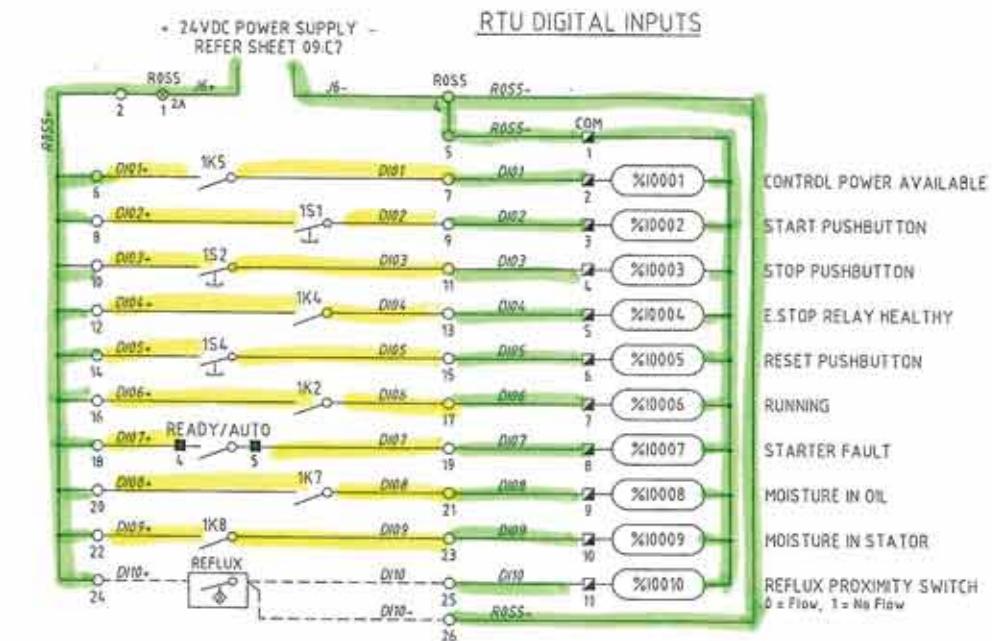
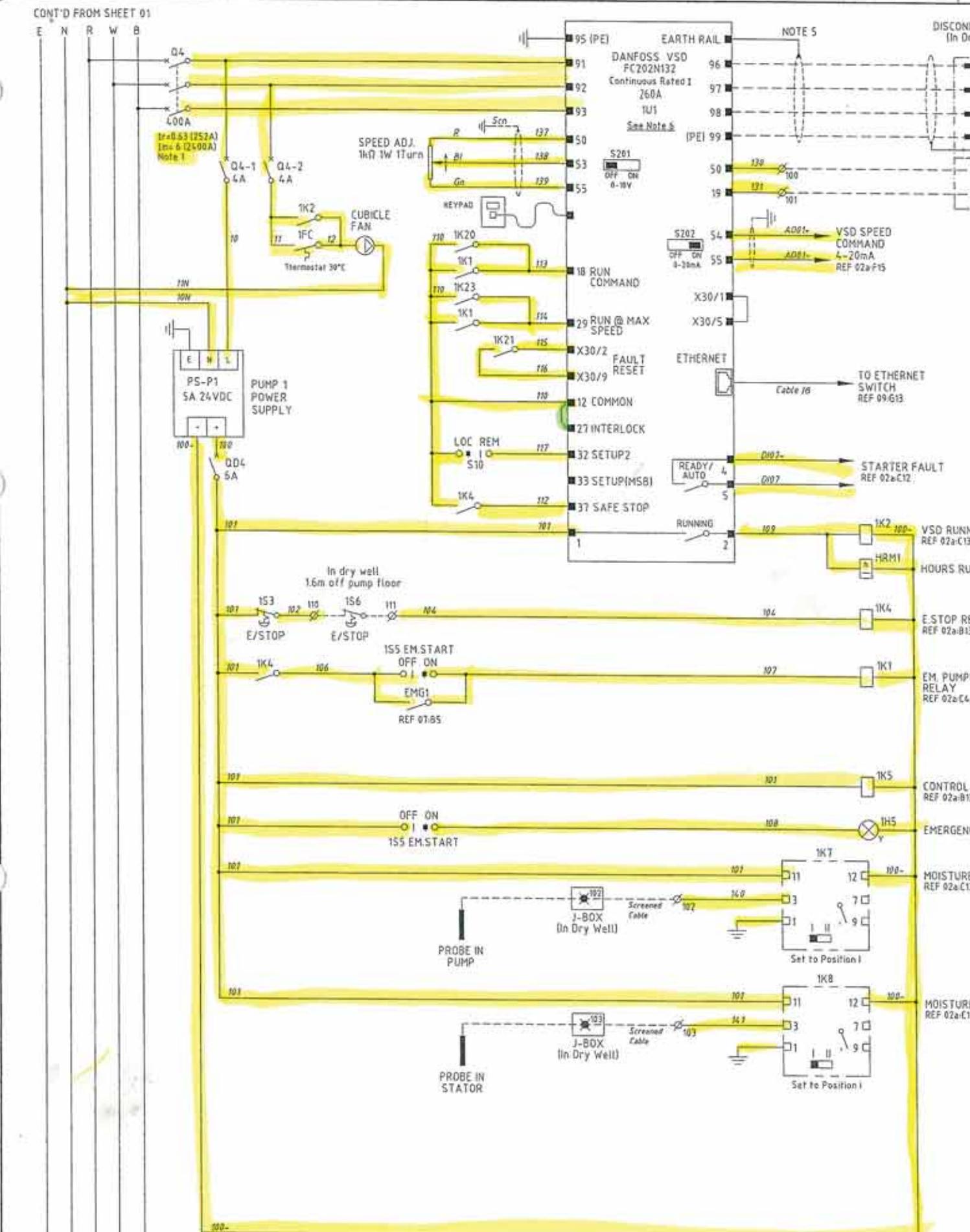


POINT TO POINT
DAY <u>19</u> MTH <u>9</u> YEAR <u>14</u>
Name: <u>Joshua Parley</u>
Licence no: _____
Signed: 

Sheet 01

## FOR CONSTRUCTION

		DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	SITE	TITLE	SHEET No.
A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHÖFT	DESIGN	R.P.E.Q. No.	DATE	SP033	POWER DISTRIBUTION	1
0 03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	67-0471set_A	A.WITTHÖFT	8885	3-3-14	ADAM STREET	SCHEMATIC DIAGRAM	Queensland Urban Utilities DRAWING No.
No.	DATE	AMENDMENT	DRN:	B.C.C. FILE No.	DESIGN CHECK	R.P.E.Q. No.	DATE	URBAN UTILITIES DELEGATE AUTHORISED FOR 12 MONTHS FROM DATE SHOWN	SEWAGE PUMP STATION		AMEND:
Cardno Shaping the Future Cardno (Qld) Pty Ltd											
©MA_SitePrinted 2014-09-01 - SPNS\jpk\Package\Package 12862\Q33.Adam\DWG\Site\Electrical Drawing\For Construction\Q33.Adam\DWG.dwg											

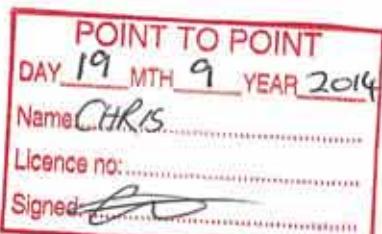
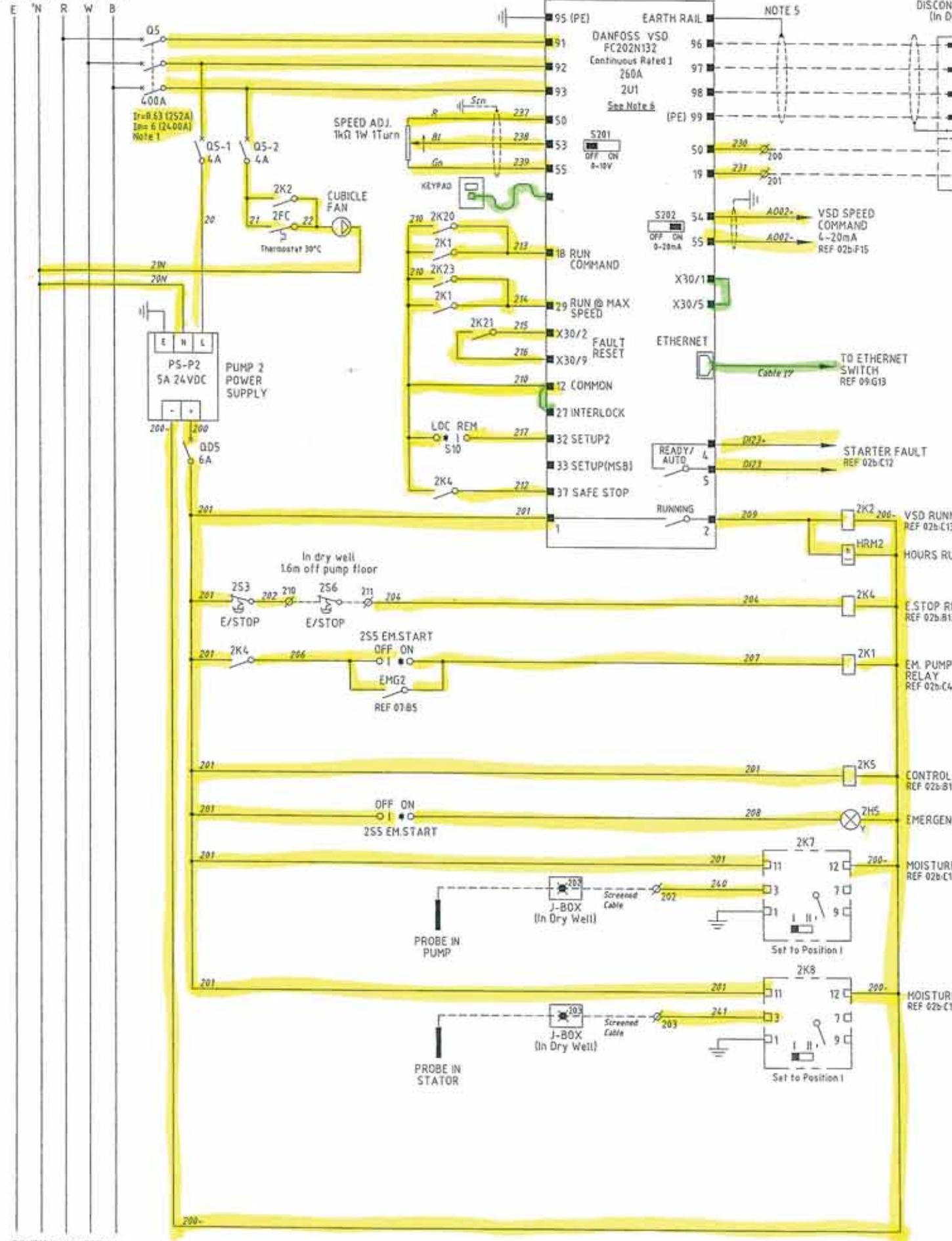
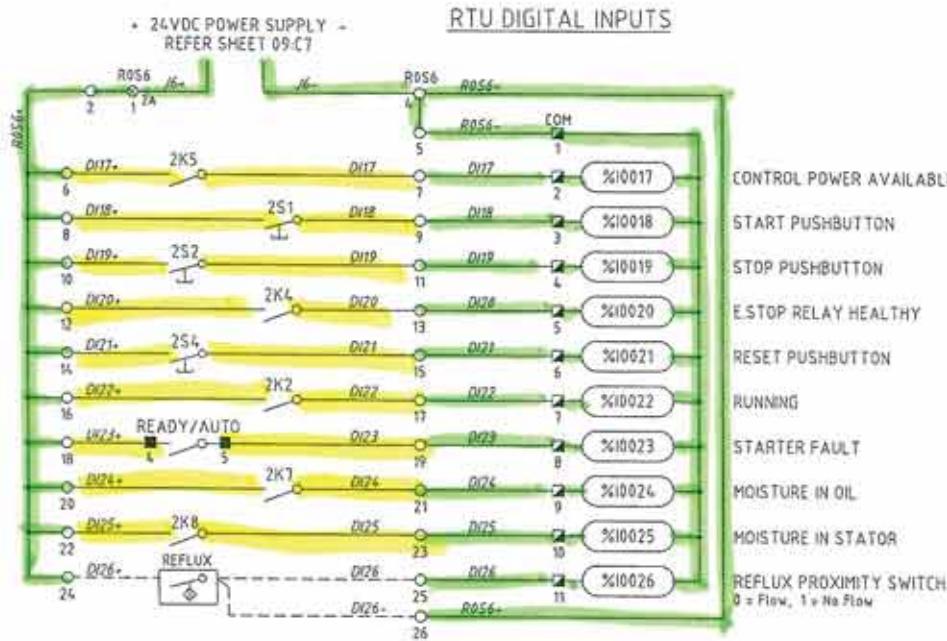
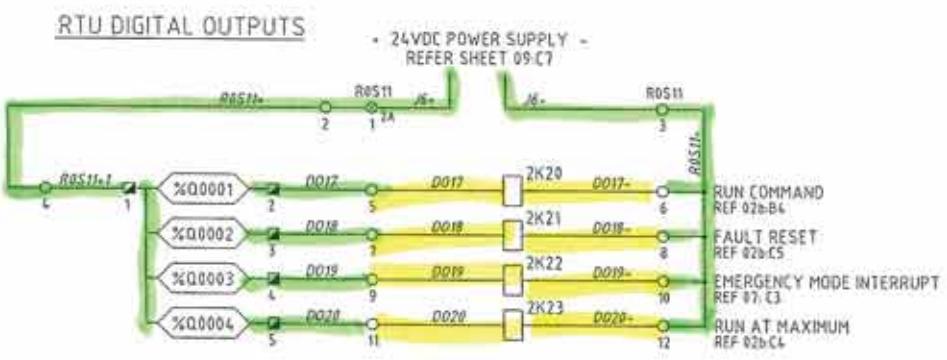
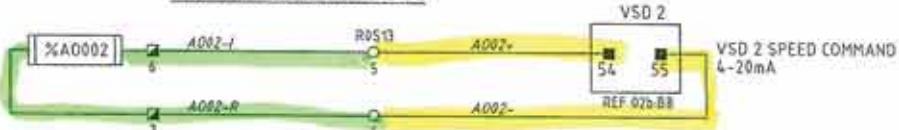
**NOTES**

- SUBMERSIBLE PUMP No1 CIRCUIT BREAKER SHALL BE LINE SIDE SHROUDED.
- CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE MIN TYPE 1 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
- ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.
- FAULT LEVEL OF 20kA AT 415V FOR 0.2sec.
- USE CABLE CLAMPS TO MAINTAIN CONTINUITY OF CABLE SCREENING THROUGH FIELD DISCONNECT BDX. DO NOT USE PIERTAILS. SEE SHEET 22 DETAIL L1 & L2
- VSD MUST BE ORDERED WITH "SAFE STOP" OPTION FACTORY FITTED.

**Sheet 02a****FOR CONSTRUCTION**

A 05.14 ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	DATE	NAME	SITE	TITLE	SHEET No.
0 03.14 ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOPT	A.WITTHOPT	3-3-14	QUEENSLAND URBAN UTILITIES	Queensland Urban Utilities	57-D471set_A	57-D471set_A	AMENDMENT	SP033 ADAM STREET SEWAGE PUMP STATION	PUMP No1 SCHEMATIC DIAGRAM	2a
No. DATE	AMENDMENT	DRN.	APD.	B.C.C. FILE No.	DESIGN CHECK	R.P.E.Q. No.	DATE	DESIGN	R.P.E.Q. No.	DATE	AMENDMENT	Queensland Urban Utilities DRAWING No.	486/5/7-0471-002a	A

CONT'D FROM SHEET 02

RTU DIGITAL INPUTSRTU DIGITAL OUTPUTSRTU ANALOG OUTPUTSNOTES

1. SUBMERSIBLE PUMP NO2 CIRCUIT BREAKER SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE MIN TYPE 1 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.
4. FAULT LEVEL OF 20kA AT 415V FOR 0.2sec.
5. USE CABLE CLAMPS TO MAINTAIN CONTINUITY OF CABLE SCREENING THROUGH FIELD DISCONNECT BOX. DO NOT USE PIGTAILS. SEE SHEET 22 DETAIL L1 & L2
6. VSD MUST BE ORDERED WITH "SAFE STOP" OPTION FACTORY FITTED.

LEGEND:

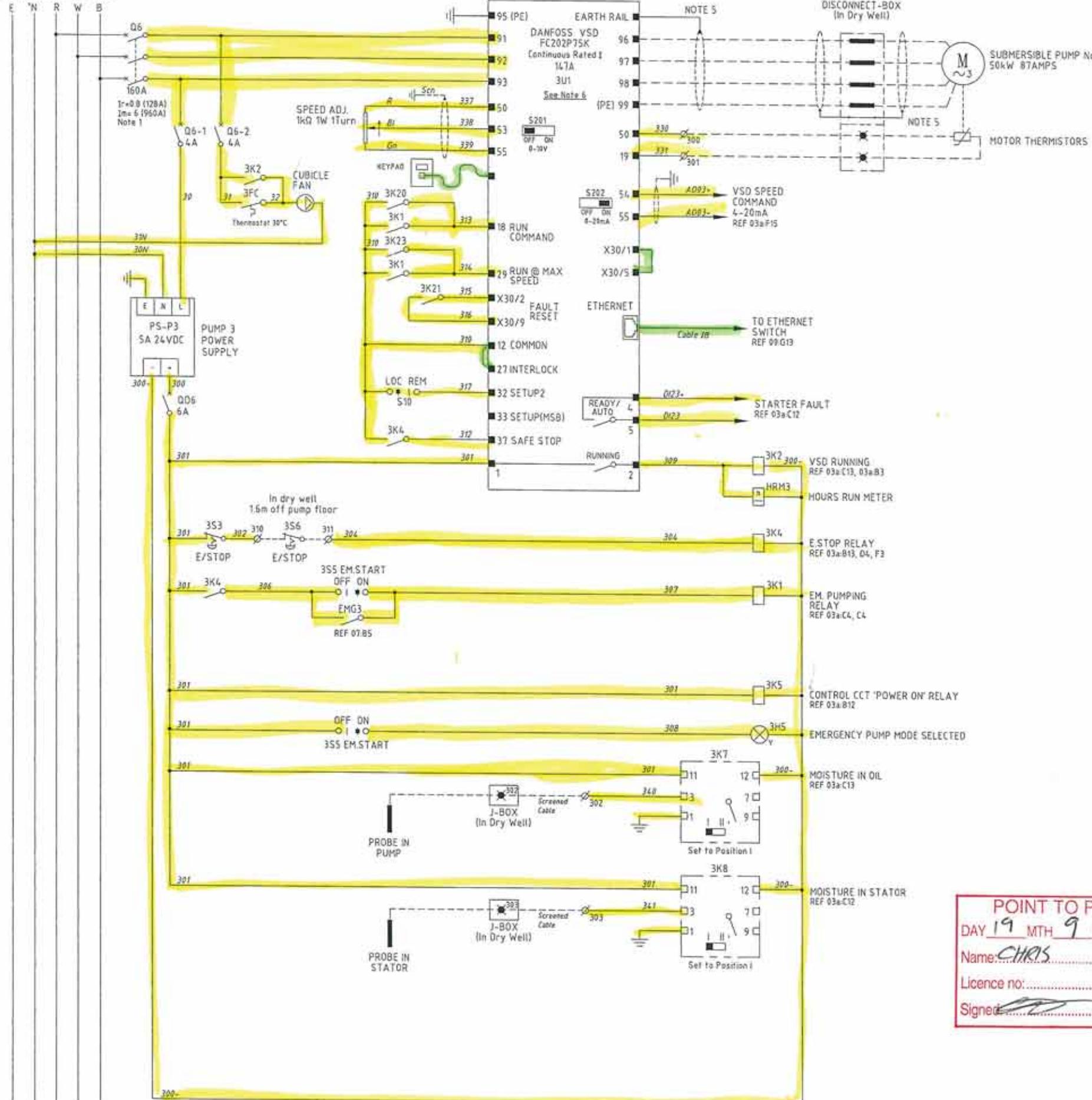
- ◎ RTU MARSH. CCT BREAKER TERM
- RTU MARSH. LINK TERMINAL
- ▢ SWITCHBOARD CONTROL TERM
- SWITCHBOARD GENERATOR TERM
- FIELD TERMINAL
- RTU TERMINAL
- VSD TERMINAL
- DIN DIGITAL INPUT
- DOUT DIGITAL OUTPUT
- AIN ANALOG INPUT
- AOUT ANALOG OUTPUT

**Sheet 02b**

FOR CONSTRUCTION

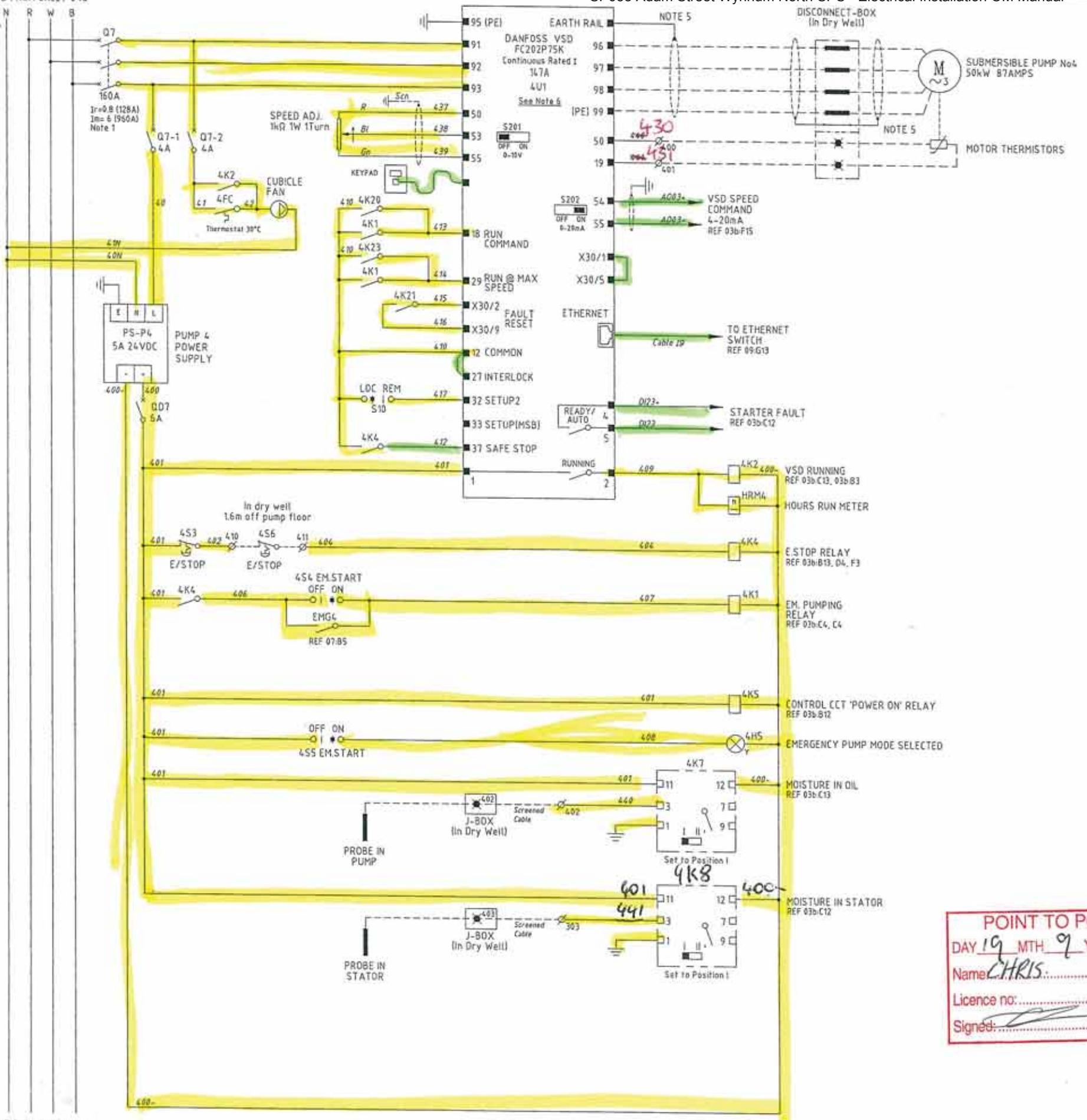
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03.14 ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	57-0471set_A	DESIGN	R.P.E.Q. No.	DATE	Shaping the Future	SP033	PUMP NO2 SCHEMATIC DIAGRAM	2b
N/A DATE	AMENDMENT	DRA.	APD.	B.C.C. FILE No.		DESIGN CHECK	A.WITTHOFFT	3-3-14	Queensland Urban Utilities	ADAM STREET SEWAGE PUMP STATION	Queensland Urban Utilities DRAWING No.	486/5/7-0471-002b
STO TEMPLATE SP-IP Ver3a	1	2	3	4	5	6	7	8	9	10	11	12

CONT'D FROM SHEET 03



A 05.14 ISSUED FOR CONSTRUCTION	P.H. A.W.	DRAFTED	P.HAGUE	PHAGUE	3-3-14	NAME	SIGNATURE	DATE	DATE	SITE	TITLE	SHEET No.
O 03.14 ISSUED FOR TENDER	P.H. A.W.	DRAFTING CHECK	A.WITHOFT	A.WITHOFT	3-3-14	QUEENSLAND URBAN UTILITIES DELEGATE				SP033	PUMP No3 SCHEMATIC DIAGRAM	3a
NO. DATE	AMENDMENT	DRN APD.	B.C.C. FILE NO.	DESIGN CHECK	R.P.E.Q. NO.	DATE	URBAN UTILITIES	DESIGN CHECK	R.P.E.Q. NO.	DATE	ADVISORY	Queensland Urban Utilities DRAWING No.

CONT'D FROM SHEET 04a



CONT'D ON SHEET 05

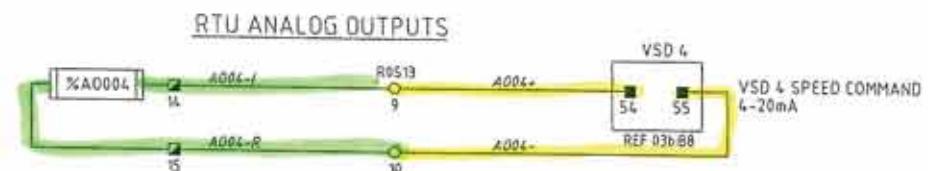
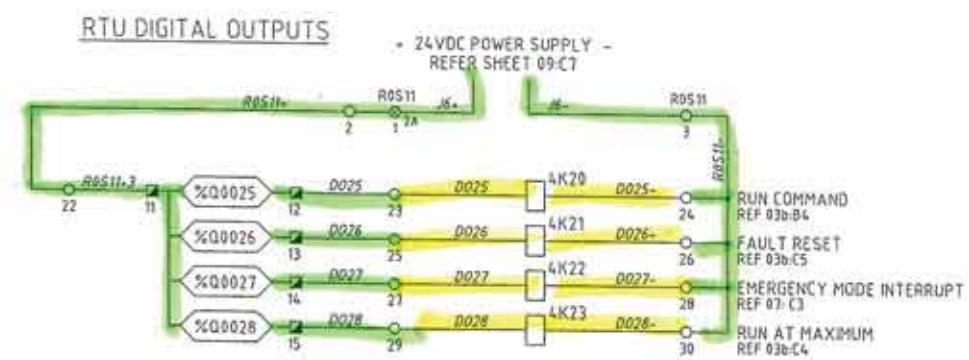
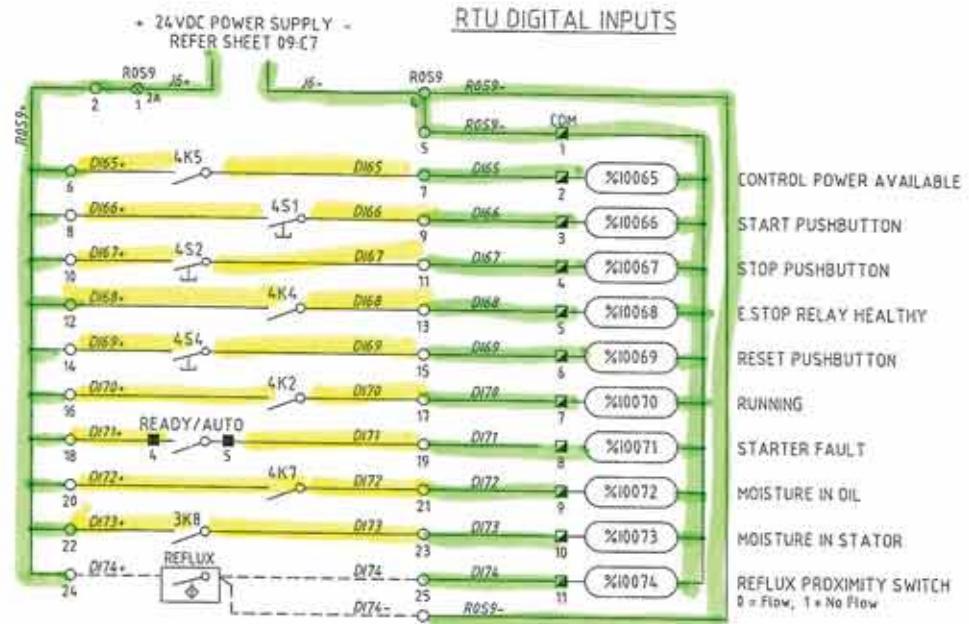
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0	03.14	ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	A.WITTHOFFT				QUEENSLAND URBAN UTILITIES				
No.	Date	AMENDMENT	DRN.	APD.	CADFILE	57-0471set_A	DESIGN CHECK	A.WITTHOFFT	8885	3-3-14	DESIGNER	DATE	DELEGATE	APPROVED FOR 12 MONTHS FROM DATE SHOWN	
									R.P.E.Q. No.						

Cardno (Qld) Pty Ltd  
Queensland Urban Utilities  
Shaping the Future  
JCH 011/11/14

SP033  
ADAM STREET  
SEWAGE PUMP STATION

TITLE  
PUMP No4  
SCHEMATIC DIAGRAM

SHEET No. 3a  
Queensland Urban Utilities DRAWING No.  
486/5/7-0471-003b A



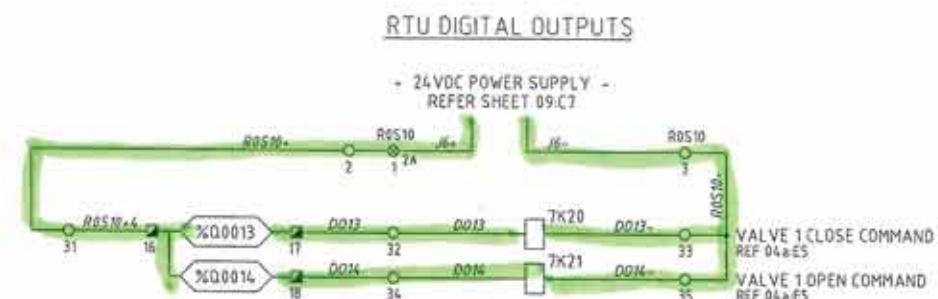
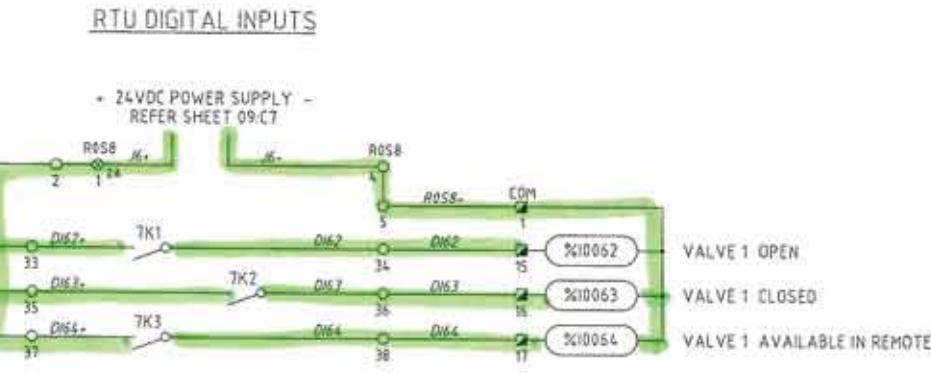
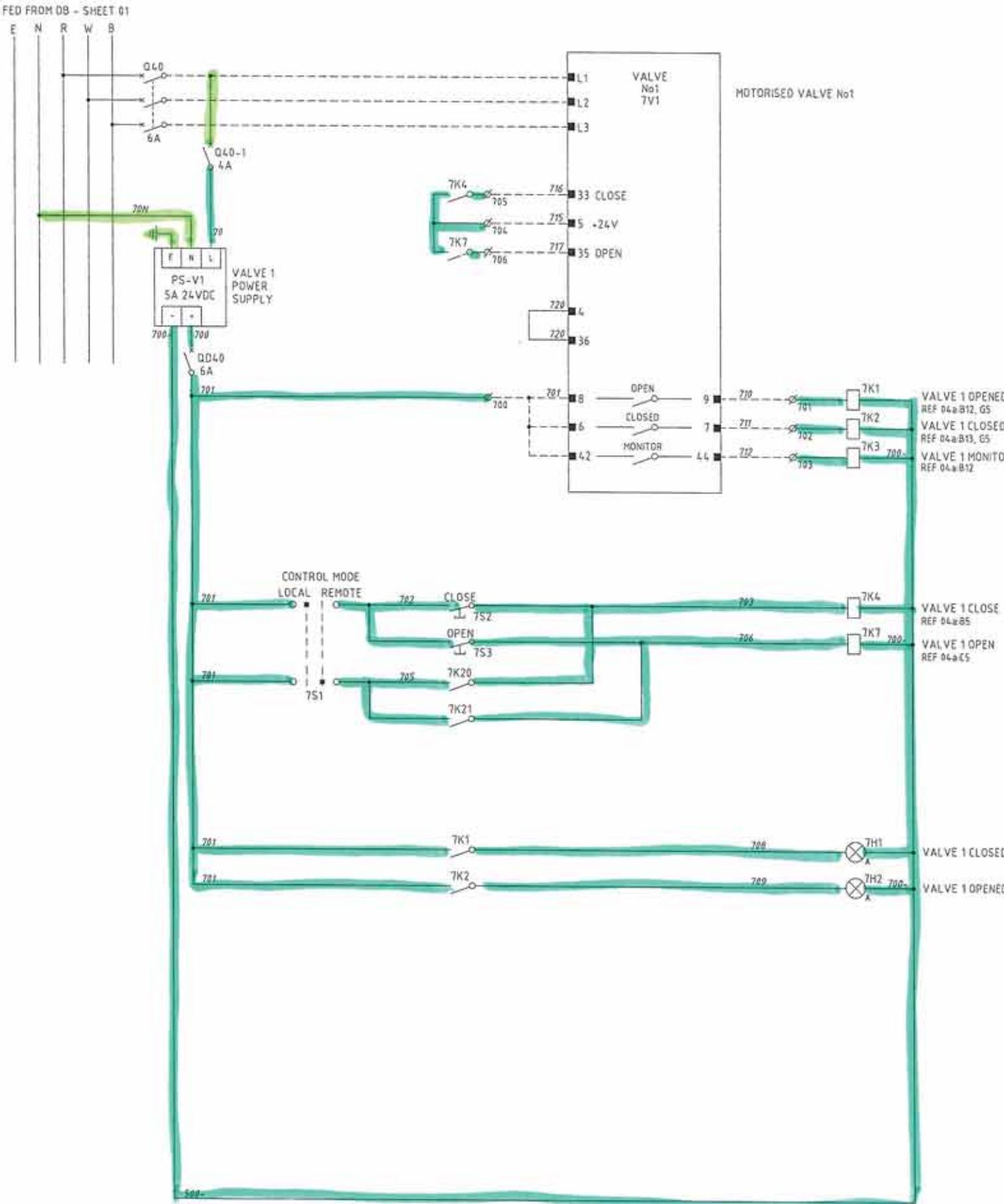
POINT TO POINT  
DAY 19 MTH 9 YEAR 14  
Name: CHRIS.  
Licence no.:  
Signed:

LEGEND:	
◎	RTU MARSH. CCT BREAKER TERM
○	RTU MARSH. LINK TERMINAL
□	SWITCHBOARD CONTROL TERM.
□	SWITCHBOARD GENERATOR TERM.
■	FIELD TERMINAL
■	RTU TERMINAL
■	VSD TERMINAL
■	DIGITAL INPUT
■	DIGITAL OUTPUT
■	ANALOG INPUT
■	ANALOG OUTPUT

1. SUBMERSIBLE PUMP No4 CIRCUIT BREAKER SHALL BE LINE SIDE SHROUDED.
2. CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD. ENSURE MIN TYPE 1 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFPLAST SI2000 COMPATIBLE LABELING.
4. FAULT LEVEL OF 20KA AT 415V FOR 0.2sec.
5. USE CABLE CLAMPS TO MAINTAIN CONTINUITY OF CABLE SCREENING THROUGH FIELD DISCONNECT BOX. DO NOT USE PIGTAILS. SEE SHEET 22 DETAIL L1 & L2.
6. VSD MUST BE ORDERED WITH "SAFE STOP" OPTION FACTORY FITTED.

Sheet 03b

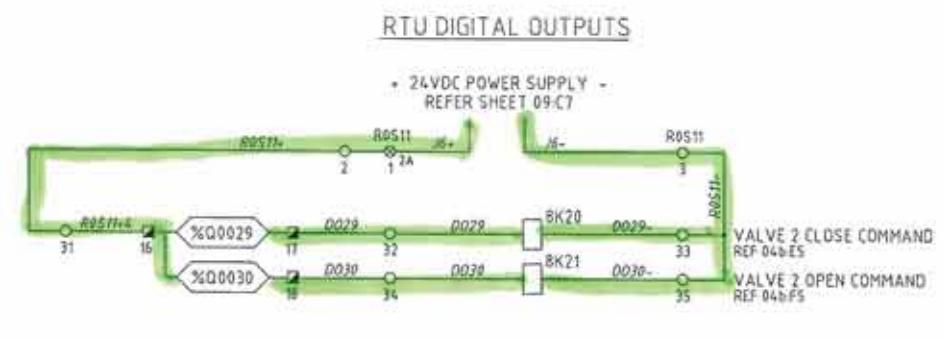
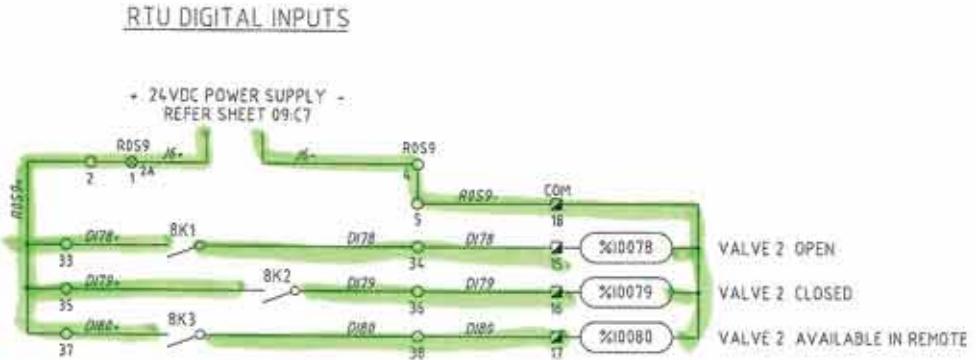
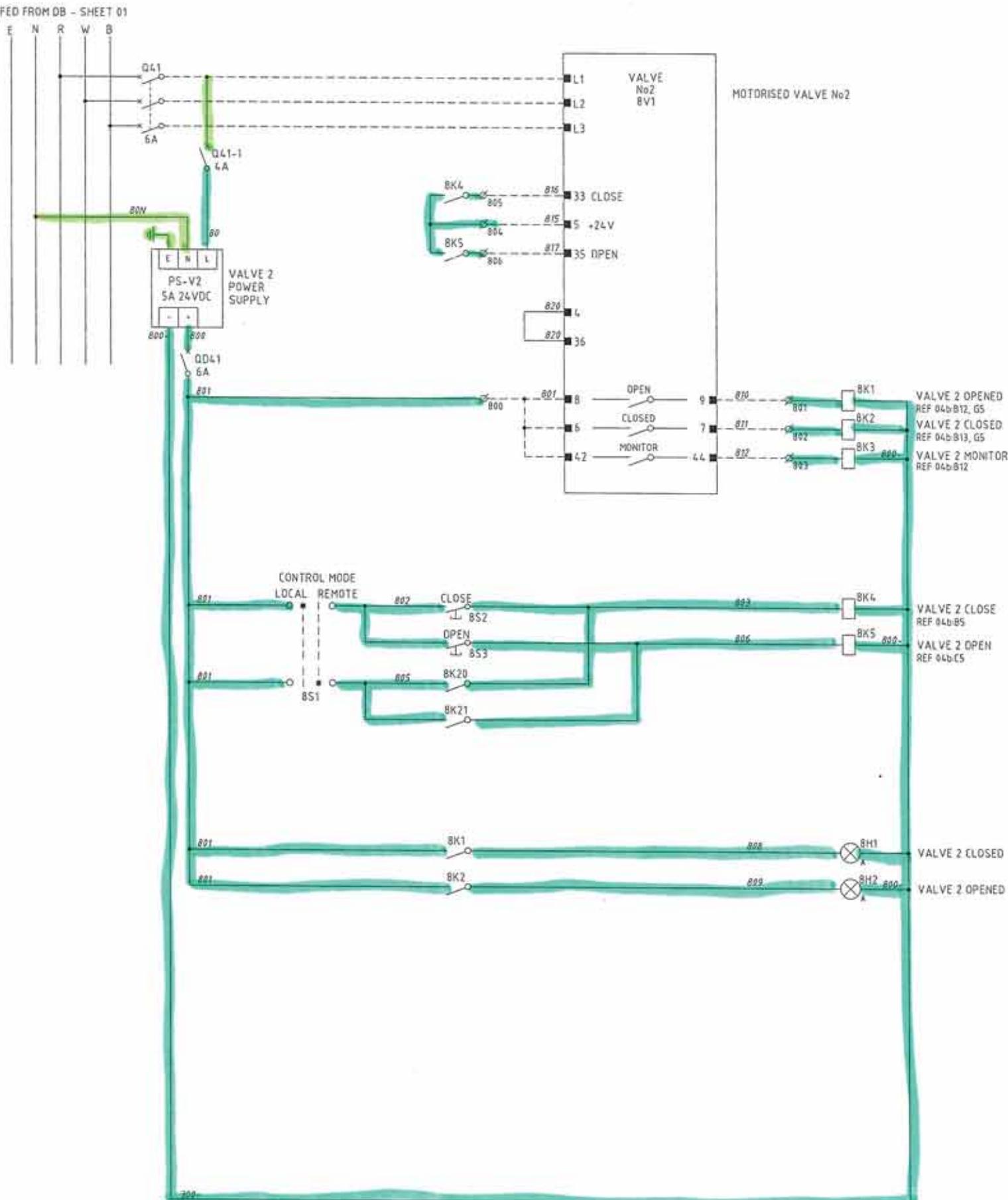
FOR CONSTRUCTION



POINT TO POINT					
DAY	9	MTH	9	YEAR	14
Name: Joshua Parcley					
Licence no:					
Signed: 					

Sheet 4a  
FOR CONSTRUCTION

A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.MAGUE	PHAGUE DESIGN	R.P.E.Q. No.	DATE	3-14						
D 03.14	ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	A.WITTHOFT	8895	DATE							
NB. DATE	AMENDMENT	DRN.	APD.	CAD FILE No.	57-0471set_A	DESIGN CHECK	R.P.E.Q. No.	DATE	33-14						
THIS TEMPLATE IS FOR USE ONLY															
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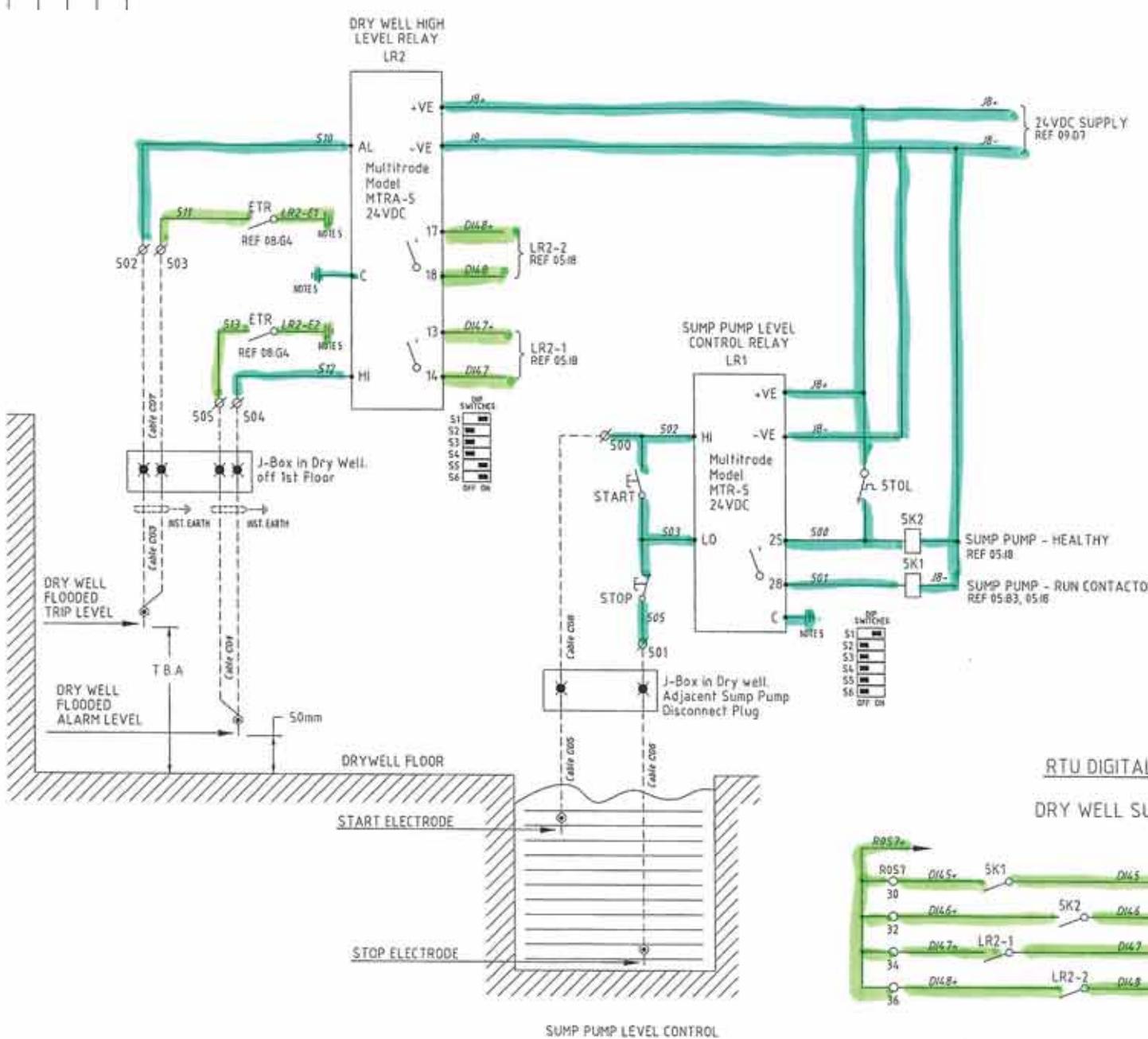
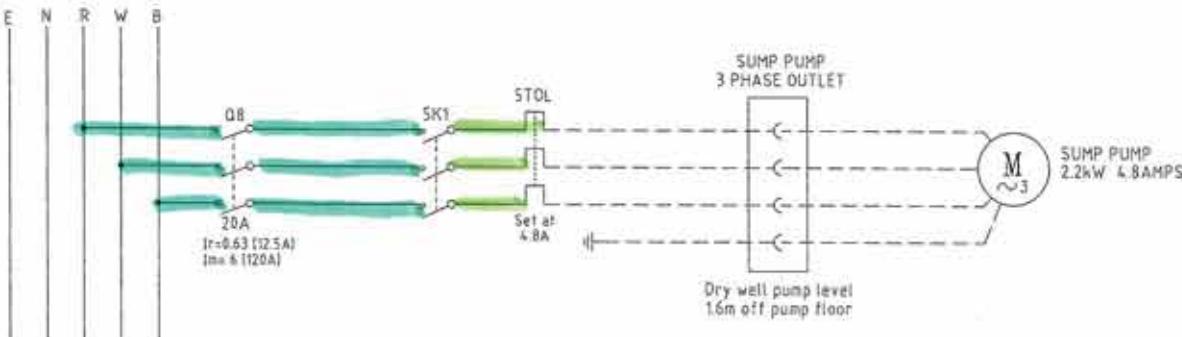


POINT TO POINT					
DAY	19	MTH	9	YEAR	14
Name: Joshua Parday					
Licence no:					
Signed:					

**Sheet 4b**

A 08.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE DESIGN	R.P.E.Q. No.	DATE	3-3-14
O 03.14	ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITHHOLD	A.WITHHOLD	BBBS	DATE	
No DATE	AMENDMENT	DRN.	APP.	CAD FILE	57-0471set_A	DESIGN CHECK	R.P.E.Q. No.	DATE	3-3-14
QUEENSLAND URBAN UTILITIES DELEGATE AUTHORISED FOR 12 MONTHS FROM DATE SHOWN									
Cardno Shaping the Future Queensland Urban Utilities									
Cardno (Qld) Pty Ltd. ACR 181 074 195									
SITE SP033 ADAM STREET SEWAGE PUMP STATION									
TITLE ACTUATOR VALVE No2 SCHEMATIC DIAGRAM									
DRAWING No. 4b Queensland Urban Utilities DRAWING No. 486/5/7-0471-004b AMEND. A									
ST-TEMPLATE ST-IP Ver23									

CONT'D FROM SHEET 036



# RESERVED EMERGENCY STORAGE DEWATERING PUMP

**POINT TO POINT**  
 DAY 19 MTH 9 YEAR 14  
 Name: Joshua Parley  
 Licence no:  
 Signed:

LEGEND:	
◎	RTU MARSH. CCT BREAKER TERM
○	RTU MARSH. LINK TERMINAL
☒	SWITCHBOARD CONTROL TERM.
□	SWITCHBOARD GENERATOR TERM
✖	FIELD TERMINAL
■	RTU TERMINAL
■	VSD TERMINAL
DOI	DIGITAL INPUT
DOI	DIGITAL OUTPUT
AII	ANALOG INPUT
AOI	ANALOG OUTPUT

## NOTES

- SUMP PUMP & STORAGE TANK DEWATERING PUMP CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
- CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE MIN TYPE 1 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
- FAULT LEVEL OF 20KA AT 415V FOR 0.2sec.
- ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.
- RUN SEPARATE DEDICATED EARTH CONDUCTORS TO EARTH BAR.

**Sheet 05**

FOR CONSTRUCTION

A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
D 03.14	ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITHHOFT	A.WITHHOFT	3-3-14	NAME	SIGNATURE	DATE	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
No. DATE	AMENDMENT	DRN.	APD.	CAD FILE	57-0471set_A	A.WITHHOFT	DESIGN CHECK	QUEENSLAND URBAN UTILITIES DELEGATE	QUEENSLAND Urban Utilities	APPROVED FOR 12 MONTHS FROM DATE SHOWN	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
57-0471set_A-IP Ver3								Cardno	Cardno Shaping the Future	APPROVED FOR 12 MONTHS FROM DATE SHOWN	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
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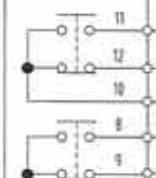
MAIN SWITCH COMPARTMENT

INTERFACE WIRING

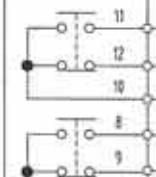
MANUAL TRANSFER SWITCH

NORMAL SUPPLY  
CIRCUIT BREAKER

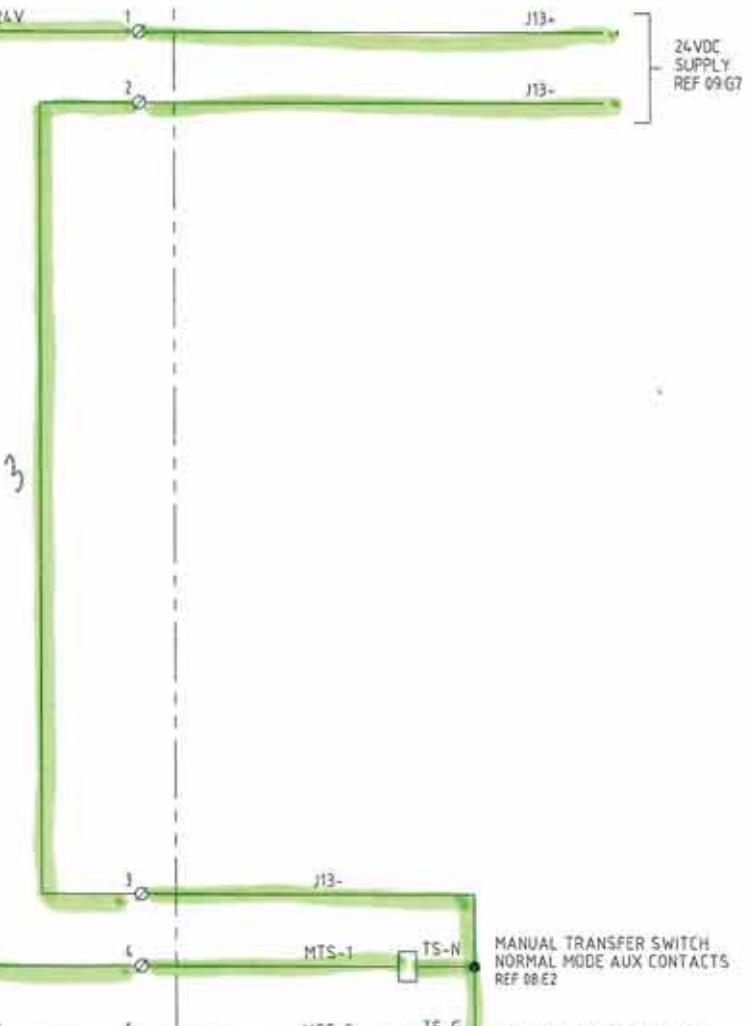
Q2

MECHANICAL  
INTERLOCKGENERATOR SUPPLY  
CIRCUIT BREAKER

Q3



**POINT TO POINT**  
DAY 19 MTH 9 YEAR 04  
Name: Joshua Pardey  
Licence no:  
Signed:



MANUAL TRANSFER SWITCH  
NORMAL MODE AUX CONTACTS  
REF 08.E2

MANUAL TRANSFER SWITCH  
GENERATOR MODE  
AUX CONTACTS

**Sheet 06**  
FOR CONSTRUCTION

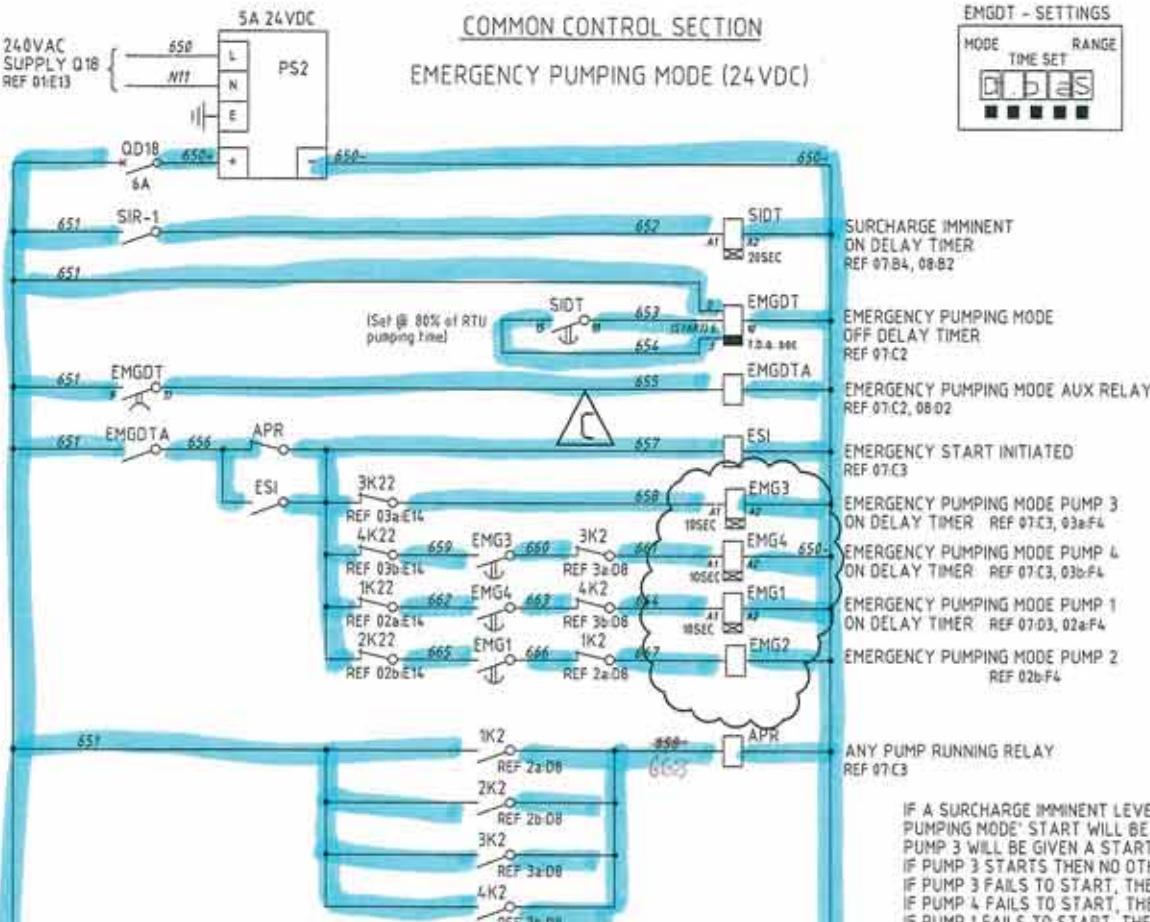
A 05.14 ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	PHAGUE	3-3-14	NAME	SIGNATURE	DATE	RTU MARSH. C/LT BREAKER TERM
0 03.14 ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	DESIGN	R.P.E.O. NO.	QUEENSLAND URBAN UTILITIES DELEGATE			RTU MARSH. LINK TERMINAL
			DAD FILE	57-0471set_A		3-3-14	URBAN UTILITIES			SWITCHBOARD CONTROL LINK TERM.
No. DATE	AMENDMENT	DBN:	APD:	B.D.C. FILE NO.	DESIGN CHECK	R.P.E.O. NO.	DATE	AUTHORISED FOR 12 MONTHS FROM DATE SHOWN		MARSHALLING BOX CONTROL TERM.
										MARSHALLING BOX POWER TERM.
										SWITCHBOARD GENERATOR TERM.
										FIELD TERMINAL
										RTU TERMINAL
										VSD TERMINAL



SITE  
SP033  
ADAM STREET  
SEWAGE PUMP STATION

TITLE  
MTS CONTROL  
WIRING DIAGRAM

SHEET No. 06  
Queensland Urban Utilities DRAWING No.  
486/5/7-0471-006 AMEND. A



Point +  
Point

DAY	<u>13</u>	MTH	<u>5</u>	YEAR	<u>15</u>
Name:	Joshua Pardon				
Licence no.:	128714				
Signed:					

## OPERATION

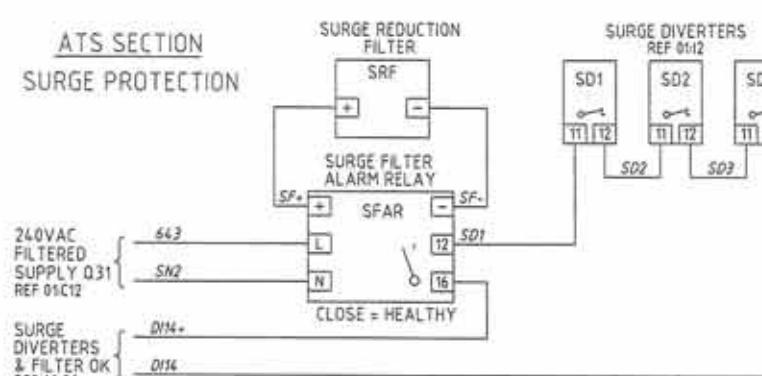
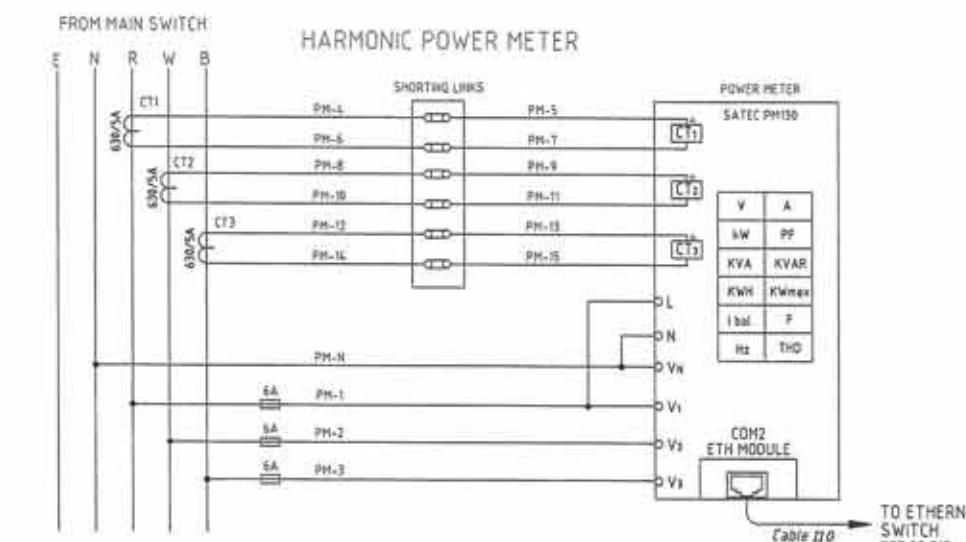
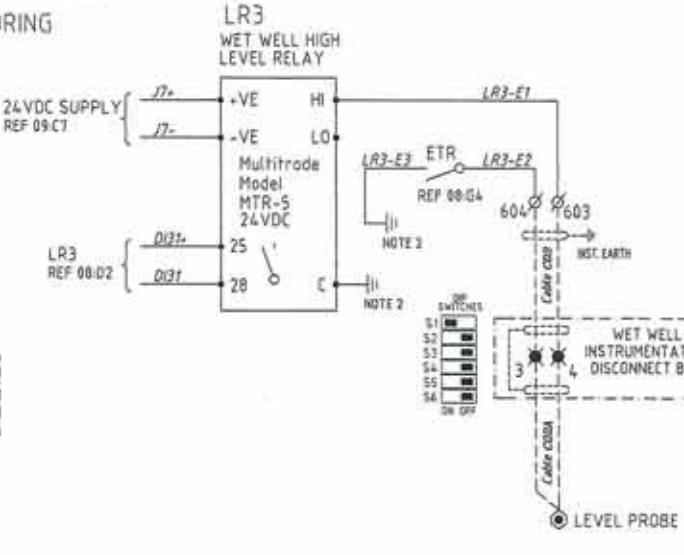
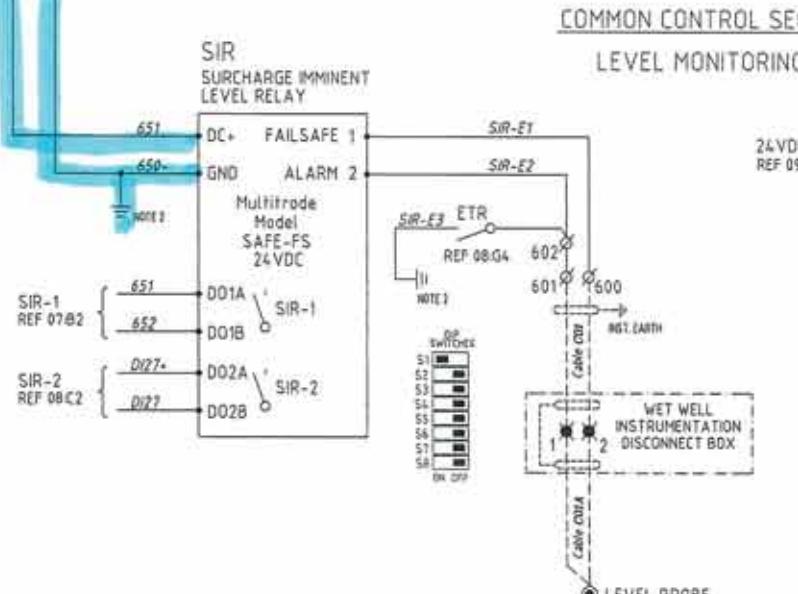
IF A SURCHARGE IMMINENT LEVEL IS ACTIVE AND NO PUMPS ARE RUNNING, THEN AN 'EMERGENCY PUMPING MODE' START WILL BE INITIATED.  
PUMP 3 WILL BE GIVEN A START COMMAND.  
IF PUMP 3 STARTS THEN NO OTHER PUMP WILL BE STARTED.  
IF PUMP 3 FAILS TO START, THEN PUMP 4 WILL BE GIVEN A START COMMAND.  
IF PUMP 4 FAILS TO START, THEN PUMP 1 WILL BE GIVEN A START COMMAND.  
IF PUMP 1 FAILS TO START, THEN PUMP 2 WILL BE GIVEN A START COMMAND.

IF A PREVIOUSLY UNAVAILABLE HIGHER ORDERED PUMP BECOMES AVAILABLE, THEN IT WILL BE STARTED AND THE LOWER ORDERED PUMP WILL STOP, SO THAT ONLY ONE PUMP WILL RUN AT A TIME VIA THE 'EMERGENCY PUMPING MODE' START CIRCUIT.

IF ANY PUMP IS RUNNING AT THE TIME OF AN 'EMERGENCY PUMPING MODE' START BEING INITIATED, THEN NO ADDITIONAL PUMP WILL BE STARTED VIA THE 'EMERGENCY PUMPING MODE' START CIRCUIT. WHILE THE 'EMERGENCY PUMPING MODE' START CIRCUIT IS ACTIVE AND HAS STARTED A PUMP, IT WILL CONTINUE TO MONITOR AND RUN THE HIGHEST ORDERED PUMP. IF A LOWER ORDERED PUMP IS GIVEN A START SIGNAL VIA THE PUMPS' INDIVIDUAL EMERGENCY START SWITCH, THEN THAT PUMP WILL BE STARTED. ANY PUMP CURRENTLY RUNNING VIA THE 'EMERGENCY PUMPING MODE' CIRCUIT WILL CONTINUE TO RUN. IF A HIGHER ORDERED PUMP IS GIVEN A START SIGNAL VIA THE PUMPS' INDIVIDUAL EMERGENCY START SWITCH, THEN THAT PUMP WILL BE STARTED. ANY PUMP CURRENTLY RUNNING VIA THE 'EMERGENCY PUMPING MODE' CIRCUIT WILL BE STOPPED.

USING THESE INDIVIDUAL EMERGENCY HAND START SWITCH, ANY NUMBER OF PUMPS CAN BE STARTED AND RUN AT THE SAME TIME.

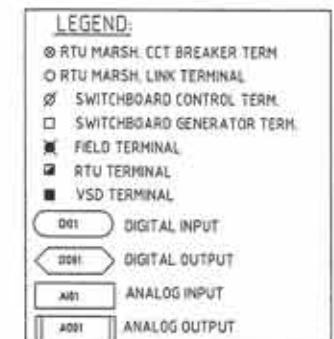
WHEN THE SURCHARGE IMMINENT LEVEL SIGNAL IS DE-ACTIVATED, ONLY THE PUMP THAT WAS CONTROLLED VIA THE 'EMERGENCY PUMPING MODE' WILL STOP, ANY PUMPS CURRENTLY RUNNING VIA THE PUMPS' INDIVIDUAL EMERGENCY HAND START SWITCH, WILL CONTINUE TO RUN.



## NOTES

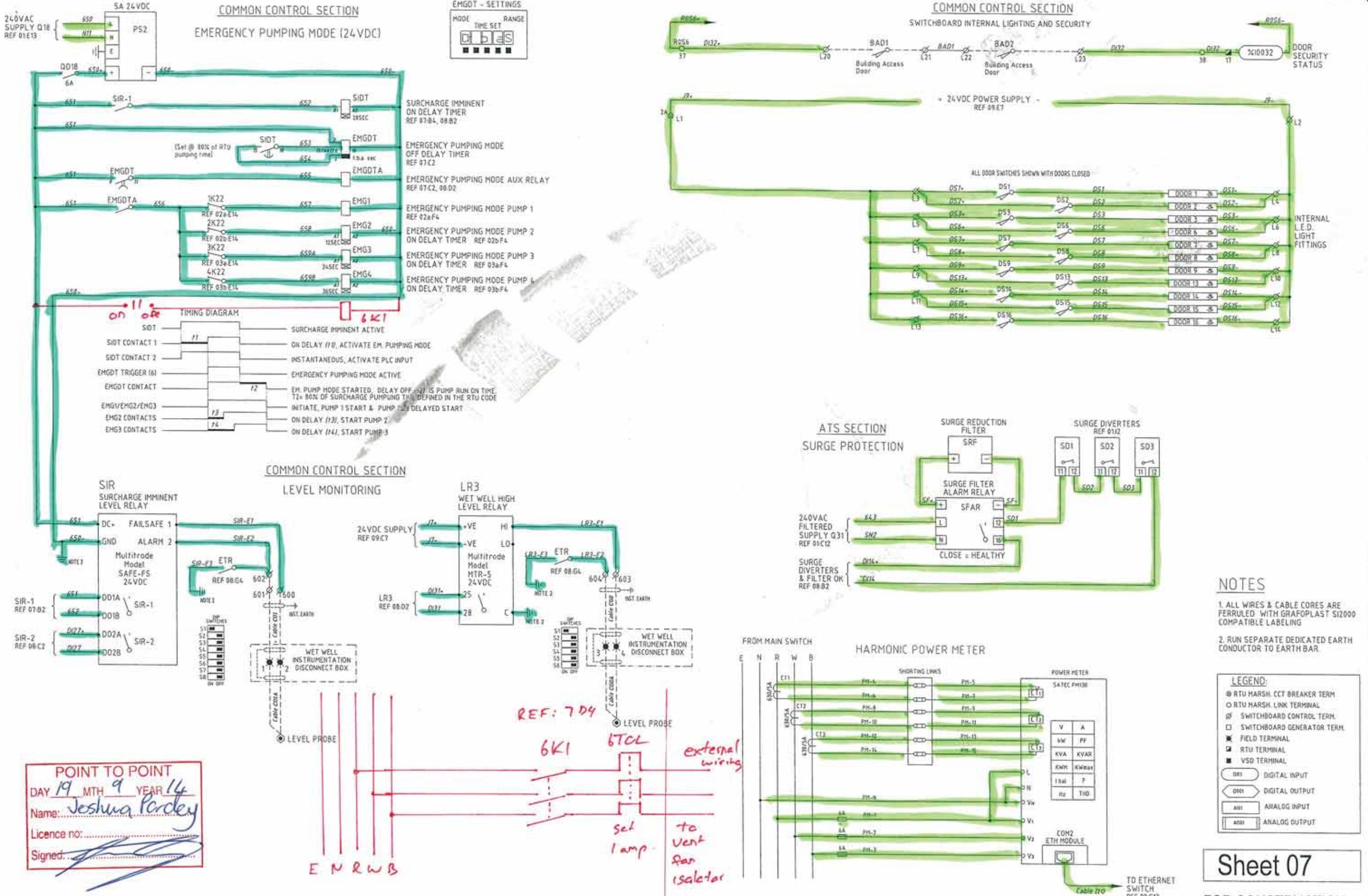
1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.

**2. RUN SEPARATE DEDICATED EARTH CONDUCTOR TO EARTH BAR.**



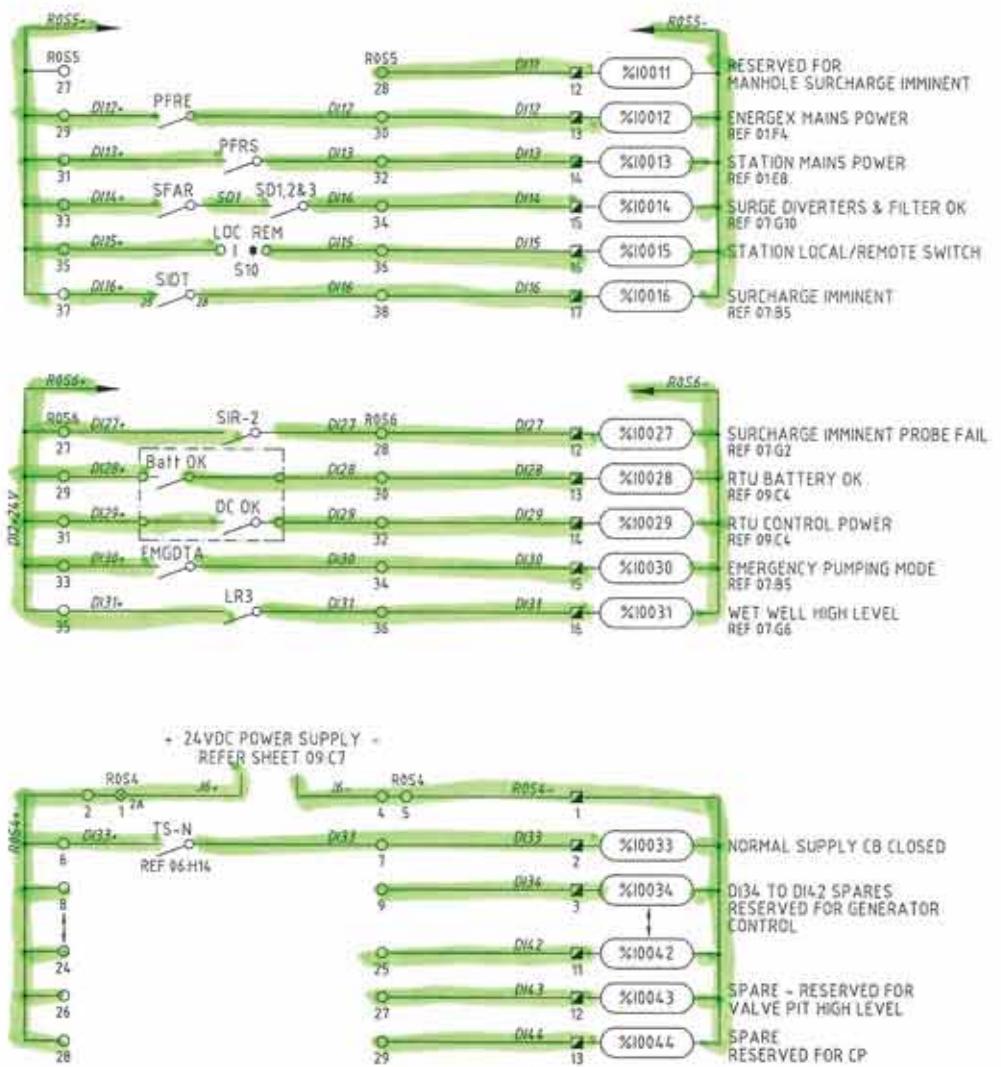
Sheet 07

## FOR CONSTRUCTION

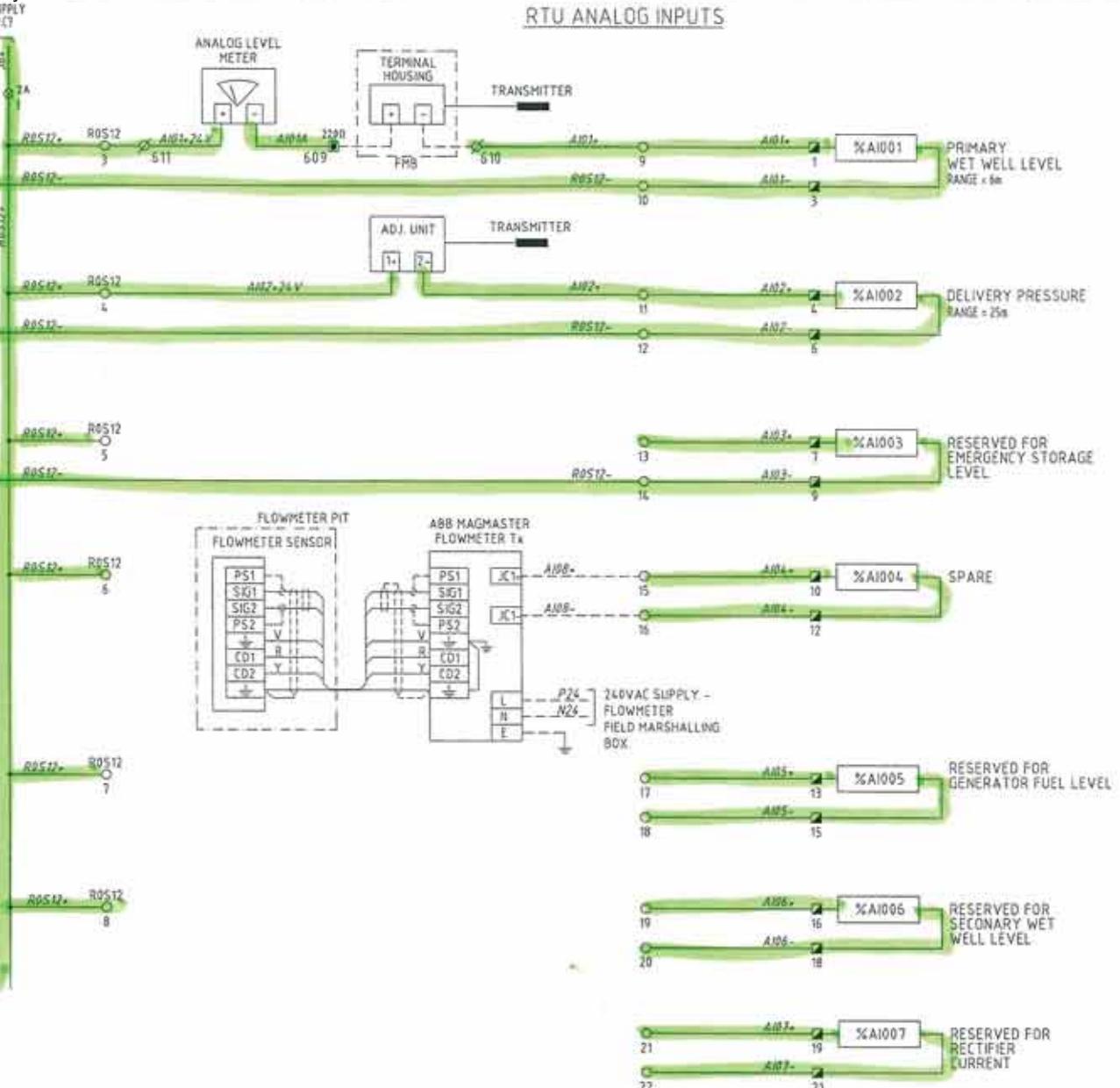


A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	TITLE	FOR CONSTRUCTION
O 03.14	ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN	R.P.E.Q. No.	DATE	QUEENSLAND URBAN UTILITIES DELEGATE	SP033	COMMON CONTROLS	SHEET No. 7
				CAD FILE	57-0471set_A	A.WITTHOFFT	8895	3-3-14	QUEENSLAND Urban Utilities	ADAM STREET	SCHEMATIC DIAGRAM	Queensland Urban Utilities DRAWING No.
No.	DATE	AMENDMENT	DRN.	APD.	B.C.C. FILE No.	DESIGN CHECK	R.P.E.Q. No.	DATE	AUTHORISED FOR 12 MONTHS FROM DATE SHOWN	SEWAGE PUMP STATION		AMEND.
486/5/7-0471-007												A

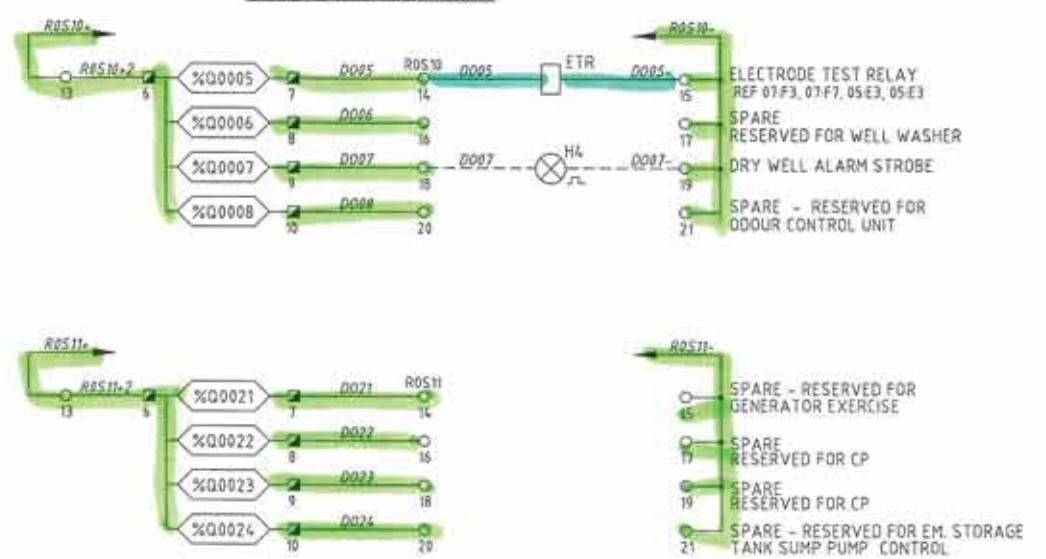
## RTU DIGITAL INPUTS



## RTU ANALOG INPUTS



## RTU DIGITAL OUTPUTS



## RTU ANALOG OUTPUTS

RESERVED FOR CHEMICAL DOSING PUMP SPEED REFERENCE

AI05-I AI05-R

POINT TO POINT  
DAY 19 MTH 9 YEAR 14  
Name: Joshua Pardey  
Licence no.:  
Signed:

## NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.

## LEGEND:

- ◎ RTU MARSH. CCT BREAKER TERM
- RTU MARSH. LINK TERMINAL
- ▢ SWITCHBOARD CONTROL TERM
- SWITCHBOARD GENERATOR TERM
- FIELD TERMINAL
- RTU TERMINAL
- COMPONENT TERMINAL
- VSD TERMINAL
- DIH: DIGITAL INPUT
- DOH: DIGITAL OUTPUT
- AIH: ANALOG INPUT
- AOH: ANALOG OUTPUT

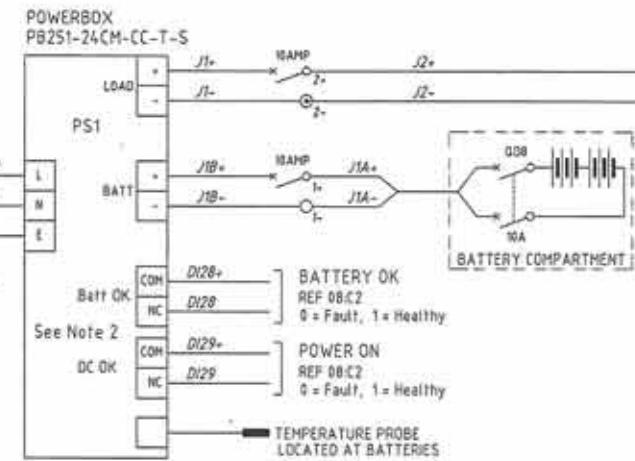
Sheet 08

FOR CONSTRUCTION

A 05.14 ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.J.HAGUE	P.J.HAGUE	3-3-14	NAME	SIGNATURE	DATE	DATE DELEGATE	AMEND.
0 03.14 ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	A.WITTHOFT	57-0471set_A	QUEENSLAND Urban Utilities		APPROVED FOR 12 MONTHS FROM DATE SHOWN		
No. DATE	AMENDMENT	DRN.	B.C.C. FILE NO.	DESIGN CHECK	R.P.E.Q. NO.	3-3-14	Cardno	SP033	SP033 ADAM STREET SEWAGE PUMP STATION	TITLE COMMON RTU I/O SCHEMATIC DIAGRAM	SHEET No. 8 Queensland Urban Utilities DRAWING No. 486/5/7-0471-008 A

240VAC  
FILTERED  
SUPPLY Q30  
REF 01C11

COMMON CONTROLS  
SECTION



CONTROL SYSTEM  
POWER SUPPLY  
10A 24VDC

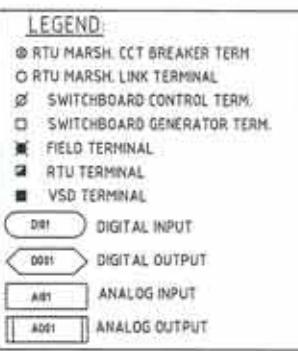
Point to Point

DAY 13 MTH 5 YEAR 15

Name: Joshua Pardley

Licence no: 122714

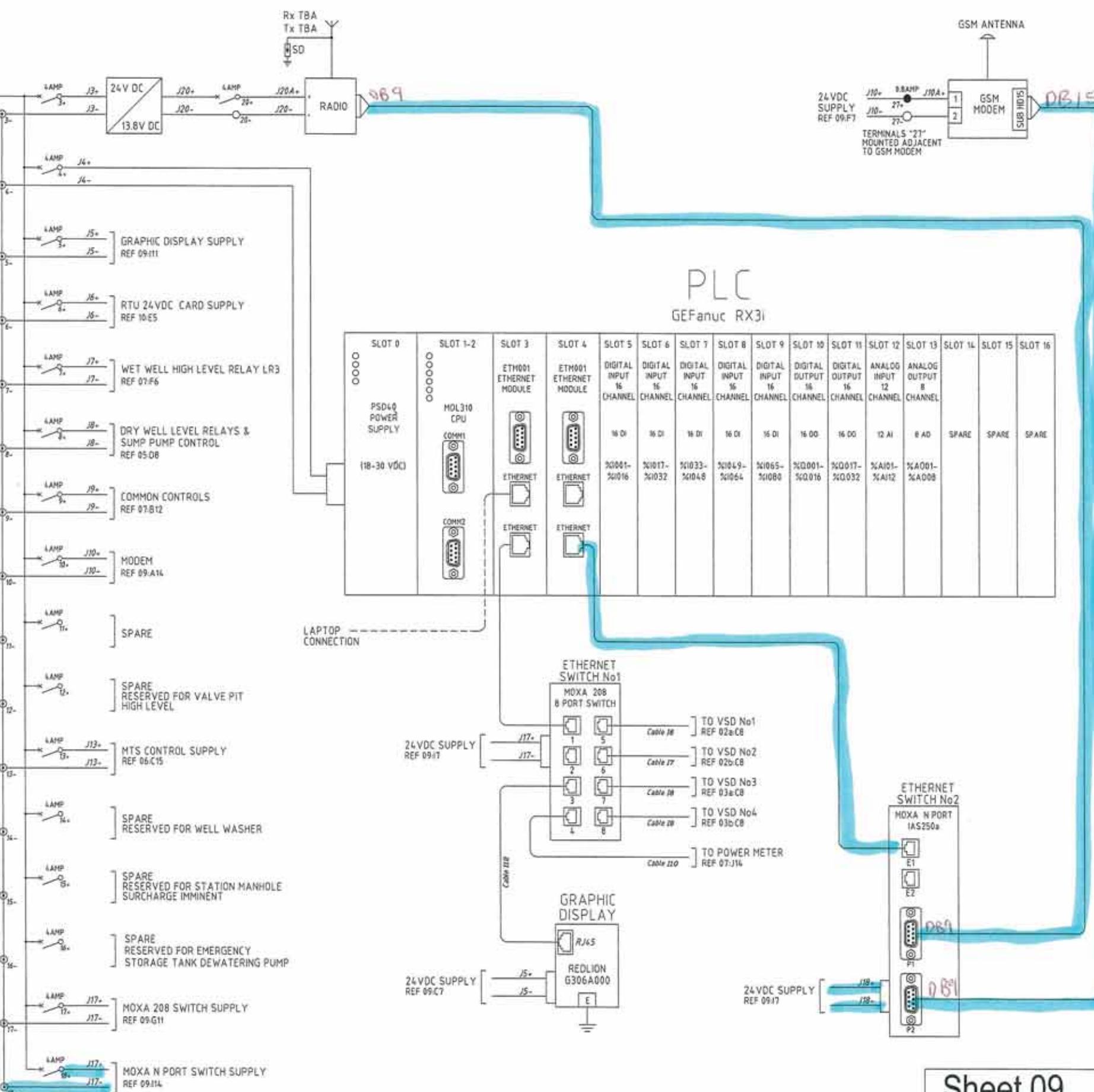
Signed:



#### NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.

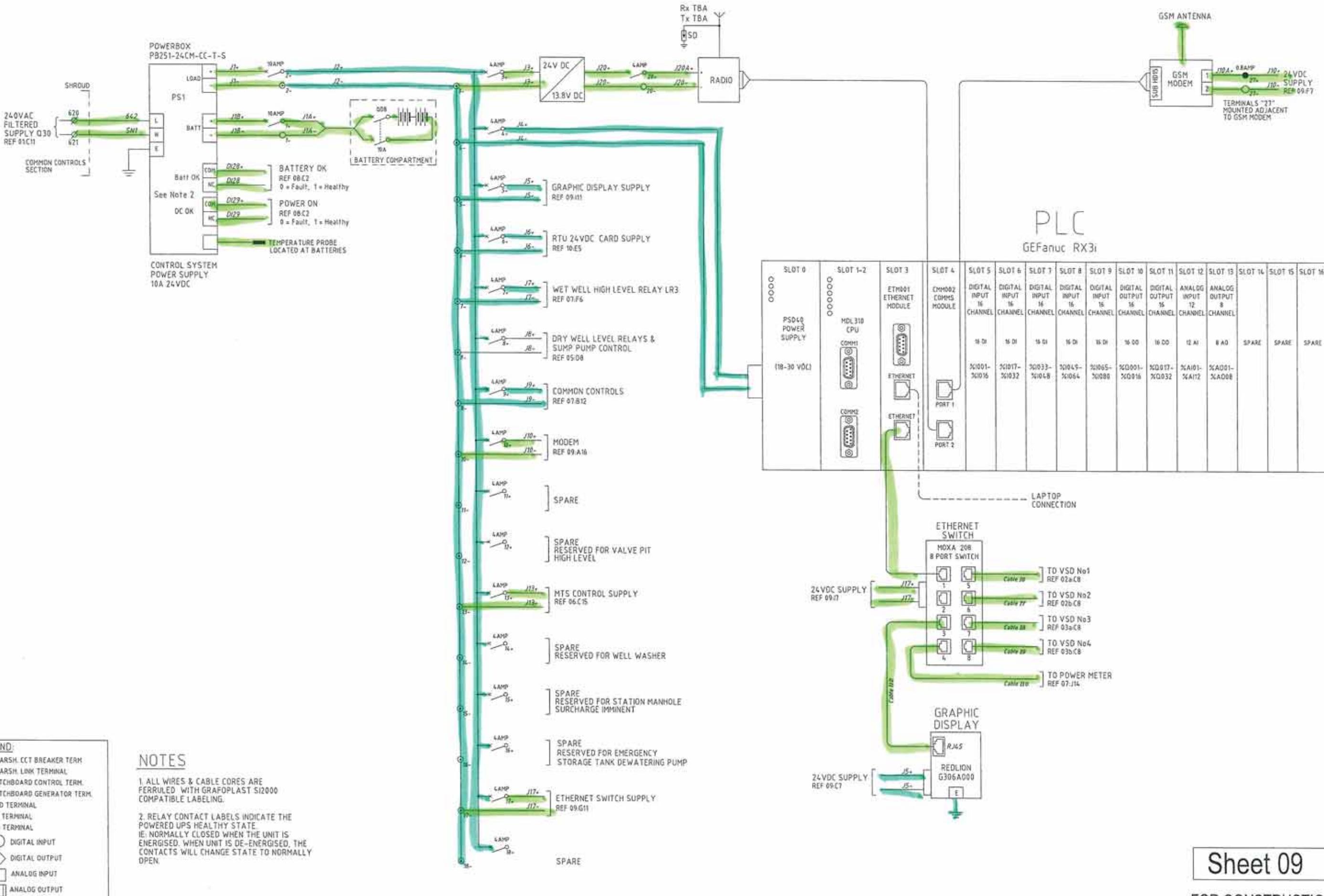
2. RELAY CONTACT LABELS INDICATE THE POWERED UPS HEALTHY STATE.  
IE: NORMALLY CLOSED WHEN THE UNIT IS ENERGISED. WHEN UNIT IS DE-ENERGISED, THE CONTACTS WILL CHANGE STATE TO NORMALLY OPEN.



Sheet 09

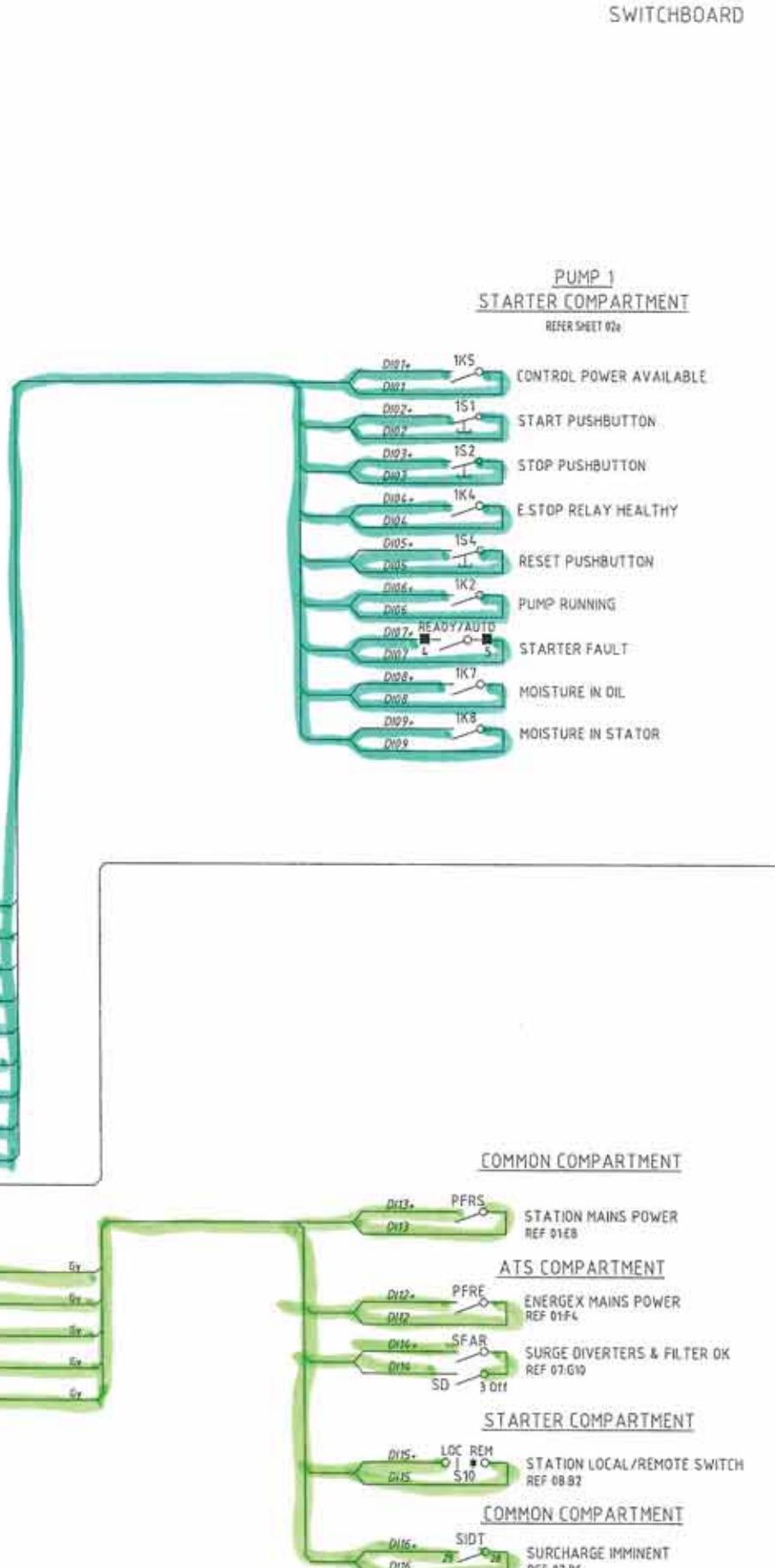
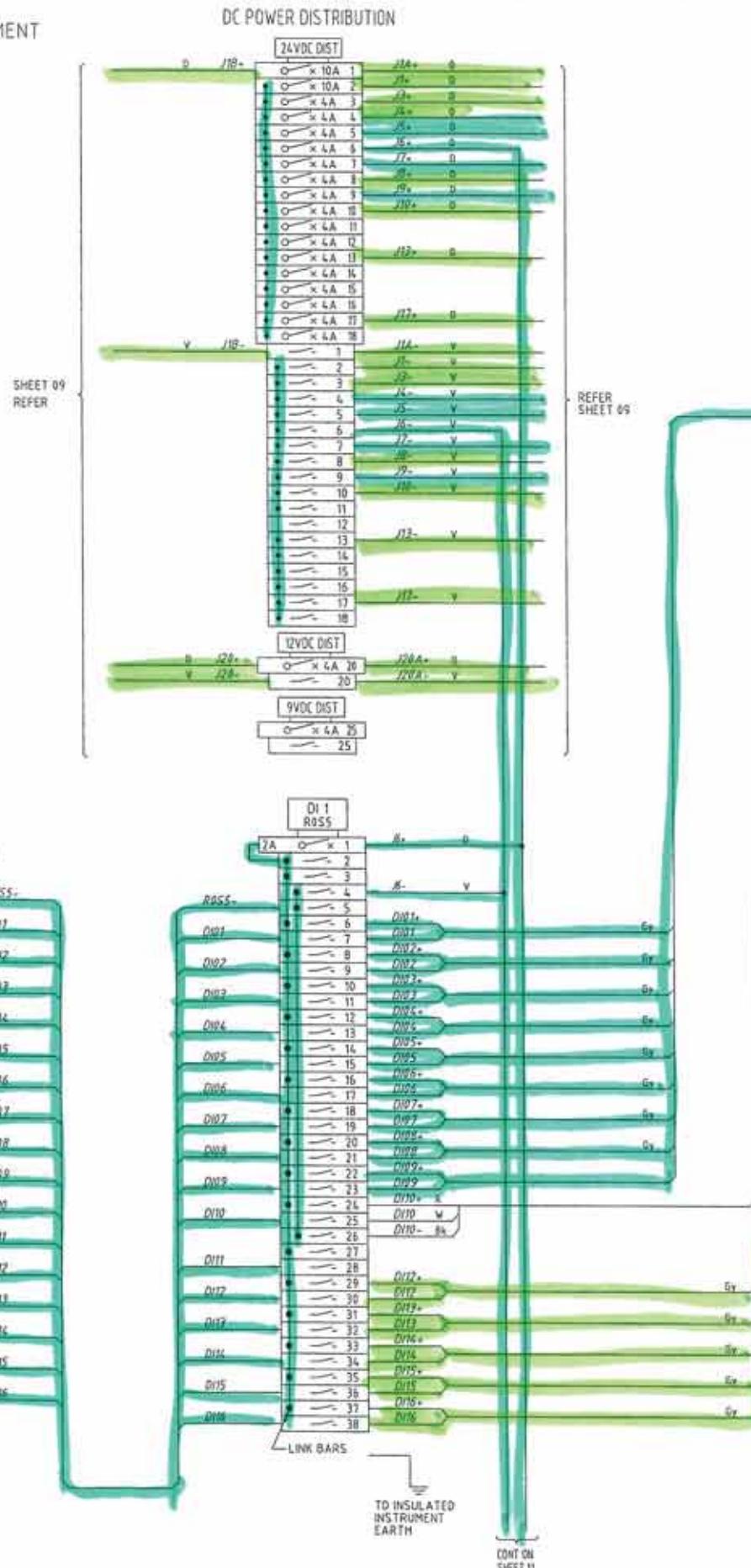
FOR CONSTRUCTION

B 02.15	RE-ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	SITE	TITLE	SHEET No.
A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	A.WITTHOFFT	3-3-14	QUEENSLAND URBAN UTILITIES DELEGATE			SP033	RTU POWER DISTRIBUTION SCHEMATIC AND NETWORK DIAGRAM	Queensland Urban Utilities DRAWING No.
C 03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_C	A.WITTHOFFT	3-3-14	QUEENSLAND URBAN UTILITIES	DESIGN CHECK	APPROVED FOR 12 MONTHS FROM DATE SHOWN	ADAM STREET SEWAGE PUMP STATION		AMEND.
No.	DATE					R.P.E.Q. No.	R.P.E.Q. No.						486/5/7-0471-009
													B

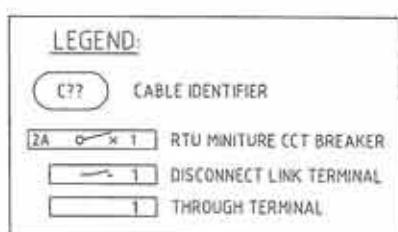


Sheet 09

FOR CONSTRUCTION



POINT TO POINT			
DAY	19	MTH	9
YEAR 14			
Name:	<u>Joshua Pardey</u>		
Licence no.:	.....		
Signed:			



## NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.

Sheet 10

FOR CONSTRUCTION

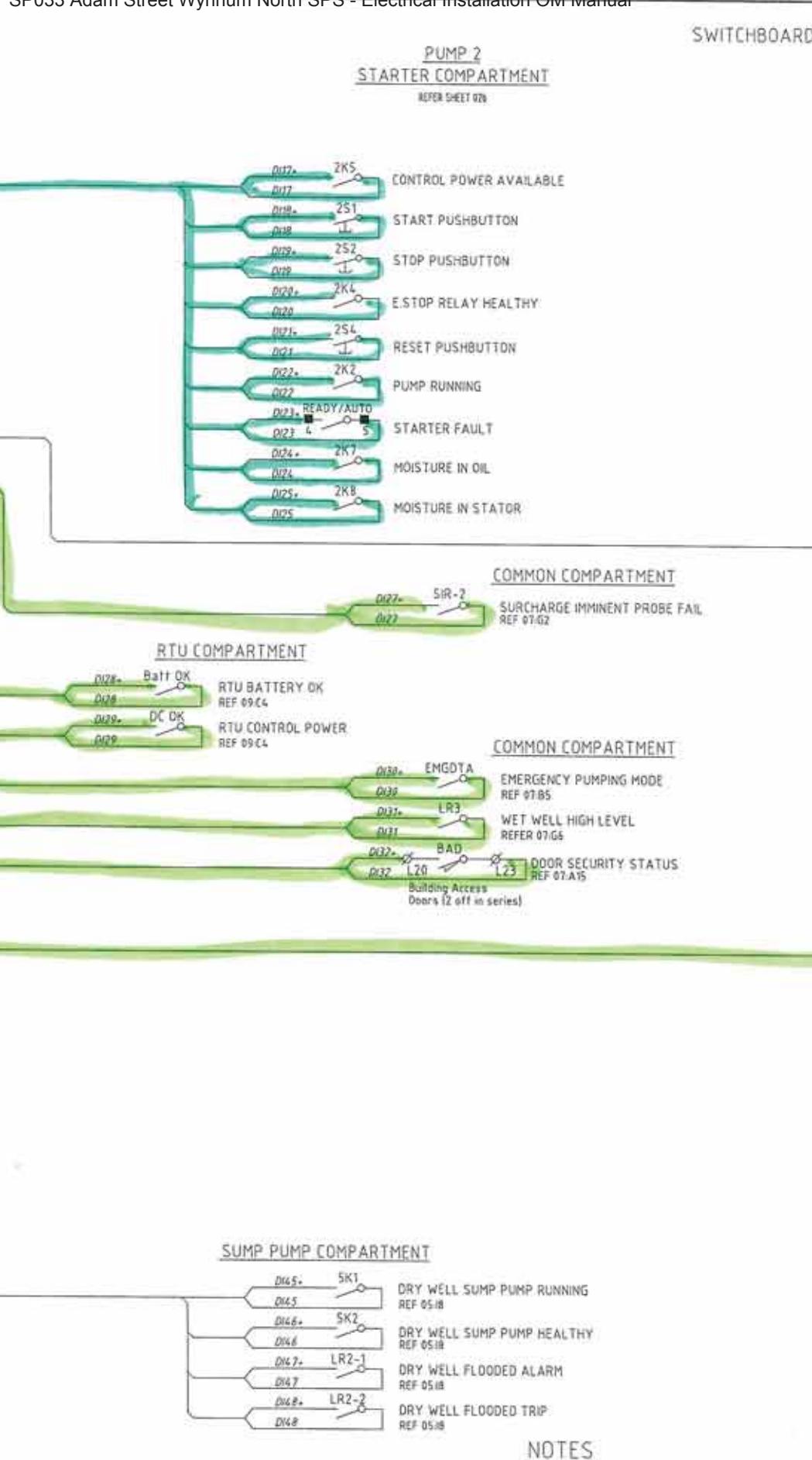
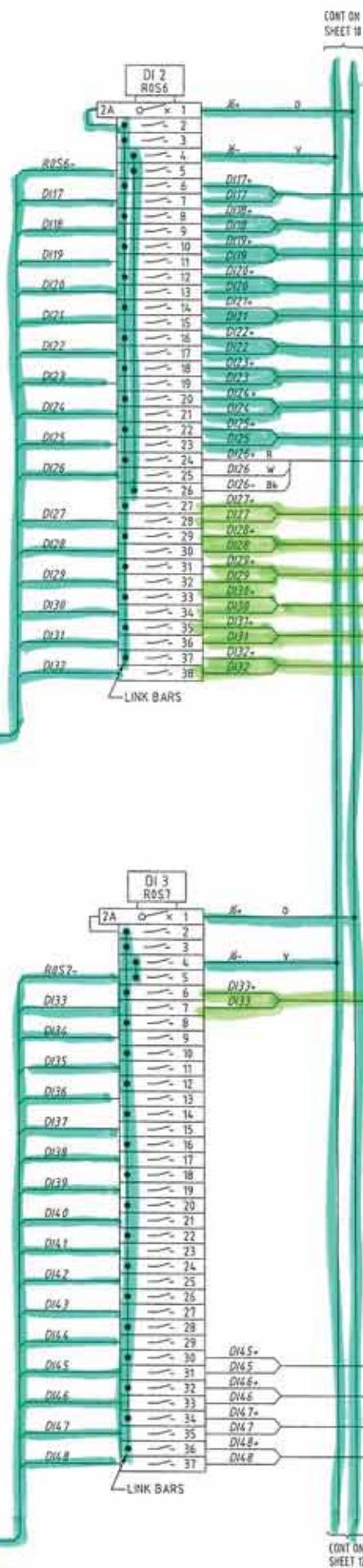
## RTU COMPARTMENT

RACK 0 SLOT 6  
GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

COM	1	R056-
%I0017	2	D117
%I0018	3	D118
%I0019	4	D119
%I0020	5	D120
%I0021	6	D121
%I0022	7	D122
%I0023	8	D123
%I0024	9	D124
%I0025	10	D125
%I0026	11	D126
%I0027	12	D127
%I0028	13	D128
%I0029	14	D129
%I0030	15	D130
%I0031	16	D131
%I0032	17	D132
NOT USED	18	
	19	
	20	

RACK 0 SLOT 7  
GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

COM	1	R057-
%I0033	2	D133
%I0034	3	D134
%I0035	4	D135
%I0036	5	D136
%I0037	6	D137
%I0038	7	D138
%I0039	8	D139
%I0040	9	D140
%I0041	10	D141
%I0042	11	D142
%I0043	12	D143
%I0044	13	D144
%I0045	14	D145
%I0046	15	D146
%I0047	16	D147
%I0048	17	D148
NOT USED	18	
	19	
	20	



## LEGEND:

- C?? CABLE IDENTIFIER
- ZA o x 1 RTU MINIATURE CCT BREAKER
- 1 DISCONNECT LINK TERMINAL
- 1 THROUGH TERMINAL

Sheet 11

FOR CONSTRUCTION

A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	SITE	TITLE	SHEET No.
B 03.14	ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	DESIGN	R.P.E.Q. No.	DATE	QUEENSLAND URBAN UTILITIES DELEGATE	DATE	SP033	RTU DIGITAL INPUTS	11
No. DATE	AMENDMENT	DRN	APD	CAD FILE	57-0471set_A	DESIGN CHECK	A.WITTHOFT	3-3-14	APPROVED FOR 12 MONTHS FROM DATE SHOWN	APPROVED FOR 12 MONTHS FROM DATE SHOWN	ADAM STREET	TERMINATION DIAGRAM	Queensland Urban Utilities DRAWING No.

## RTU COMPARTMENT

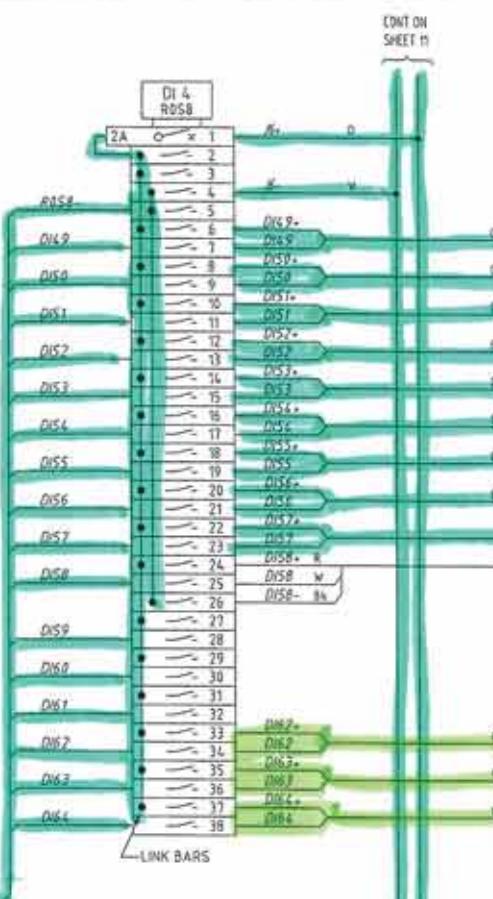
RACK 0 SLOT 8  
GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

	COM	1	8058-
%I0049	2	D149	
%I0050	3	D150	
%I0051	4	D151	
%I0052	5	D152	
%I0053	6	D153	
%I0054	7	D154	
%I0055	8	D155	
%I0056	9	D156	
%I0057	10	D157	
%I0058	11	D158	
%I0059	12	D159	
%I0060	13	D160	
%I0061	14	D161	
%I0062	15	D162	
%I0063	16	D163	
%I0064	17	D164	
NOT USED	18		
	19		
	20		

RACK 0 SLOT 9  
GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

	COM	1	8059-
%I0065	2	D165	
%I0066	3	D166	
%I0067	4	D167	
%I0068	5	D168	
%I0069	6	D169	
%I0070	7	D170	
%I0071	8	D171	
%I0072	9	D172	
%I0073	10	D173	
%I0074	11	D174	
%I0075	12	D175	
%I0076	13	D176	
%I0077	14	D177	
%I0078	15	D178	
%I0079	16	D179	
%I0080	17	D180	
NOT USED	18		
	19		
	20		

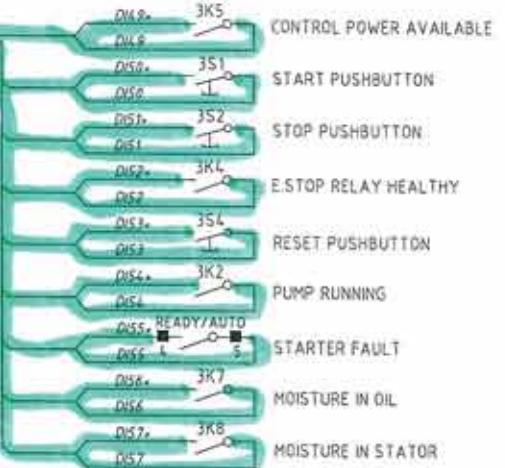
CONT ON SHEET 11



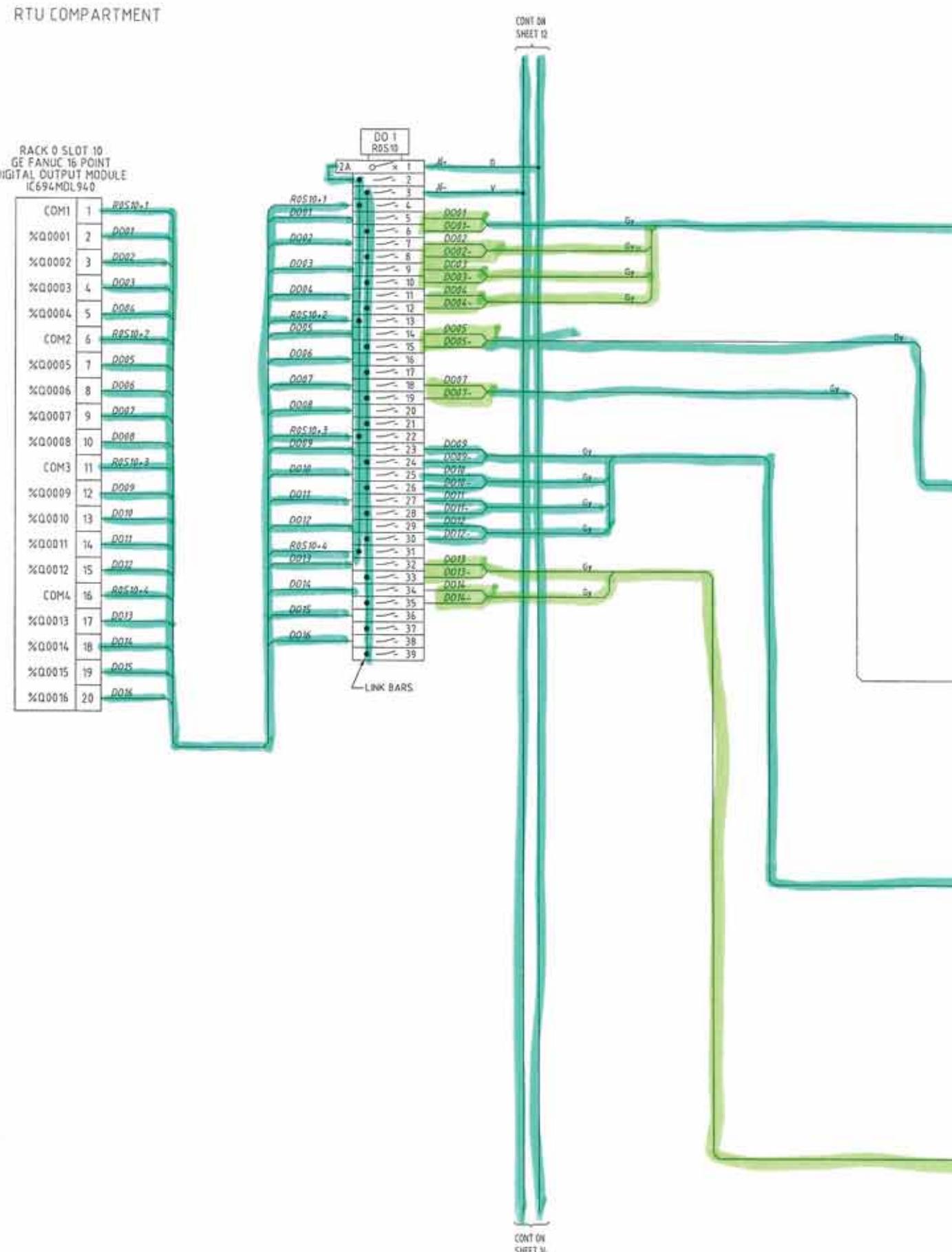
CONT ON SHEET 12

PUMP 3  
STARTER COMPARTMENT

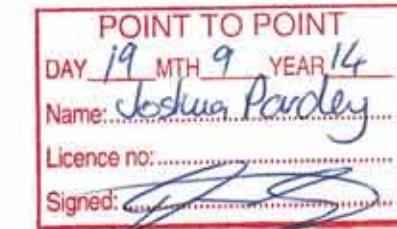
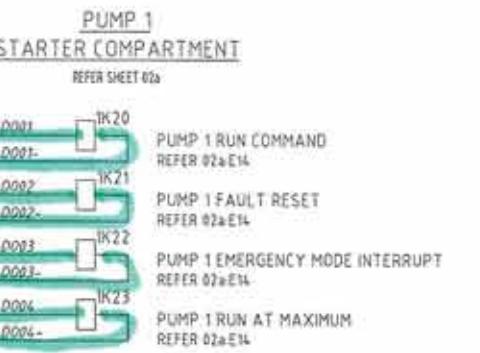
REFER SHEET #3a



#### RTU COMPARTMENT



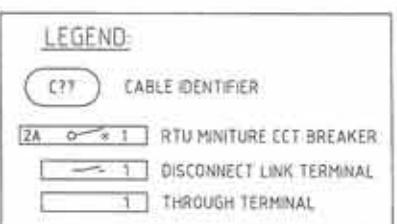
## WITCHBOARD



NOTES

Sheet 13

FOR CONSTRUCTION



			DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME QUEENSLAND URBAN UTILITIES
A	05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	R.P.E.Q. No.
O	03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-D471set_A	DATE
No.	DATE	AMENDMENT	DRW	APD	S.C.C. FILE No.	A.WITTHOFFT	889
						DESIGN CHECK	R.P.E.Q. No.



SITE  
SP033  
ADAM STREET  
SEWAGE PUMP STATION

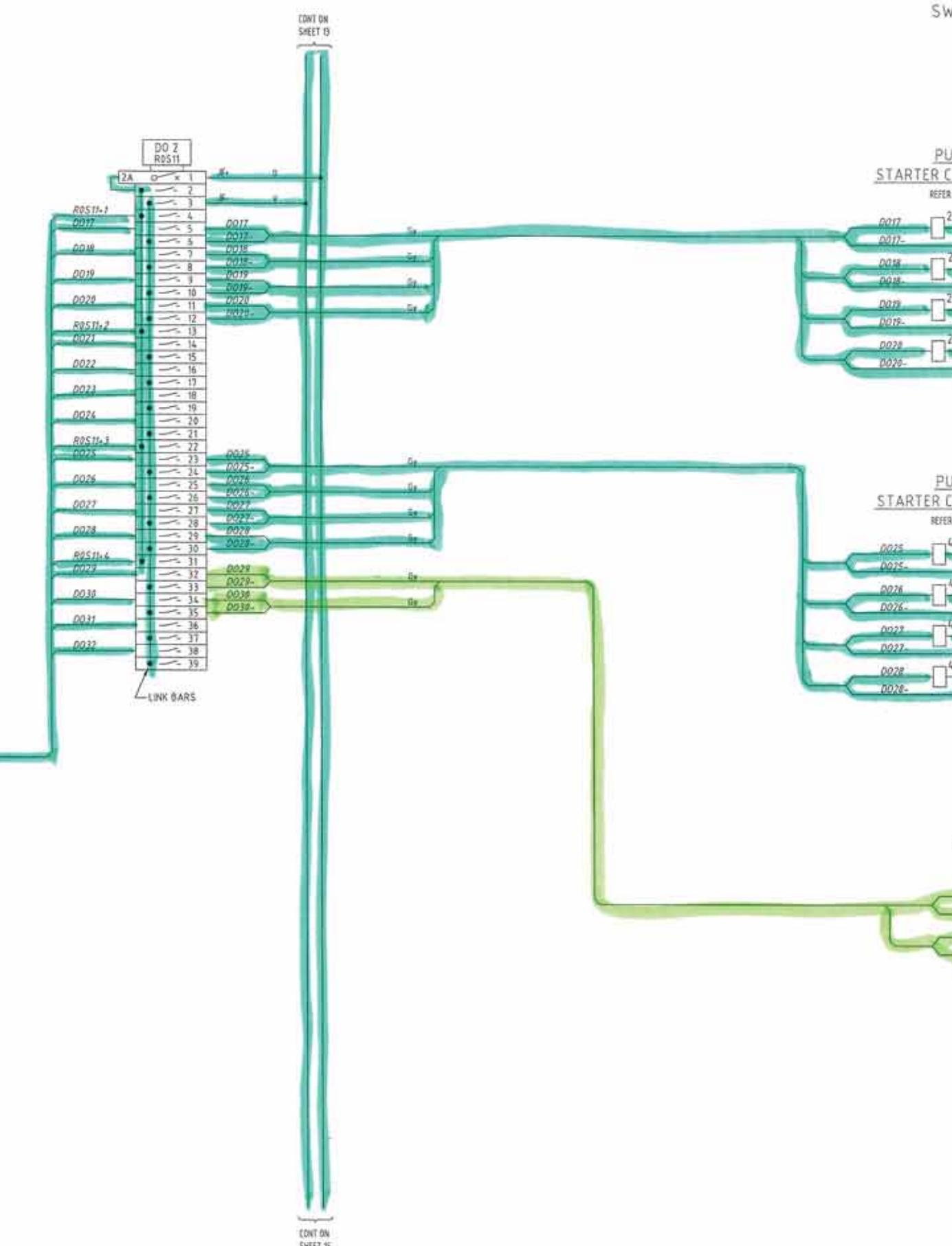
RTU DIGITAL OUTPUTS  
TERMINATION DIAGRAM  
SHEET 1 OF 2

SHEET No. 13  
Queensland Urban Utilities DRAWING No. A  
**486/5/7-0471-013**

## RTU COMPARTMENT

RACK 0 SLOT 11  
GE FANUC 16 POINT  
DIGITAL OUTPUT MODULE  
IC694MDL940

	COM1	1	R0511+1
%Q0017	2	D017	
%Q0018	3	D018	
%Q0019	4	D019	
%Q0020	5	D020	
COM2	6	R0511+2	
%Q0021	7	D021	
%Q0022	8	D022	
%Q0023	9	D023	
%Q0024	10	D024	
COM3	11	R0511+3	
%Q0025	12	D025	
%Q0026	13	D026	
%Q0027	14	D027	
%Q0028	15	D028	
COM4	16	R0511+4	
%Q0029	17	D029	
%Q0030	18	D030	
%Q0031	19	D031	
%Q0032	20	D032	



## SWITCHBOARD

PUMP 2  
STARTER COMPARTMENT

- REFER SHEET 02b
- D017 → 2K20 PUMP 2 RUN COMMAND REFER 02b-E14
  - D017 → 2K21 PUMP 2 FAULT RESET REFER 02b-E14
  - D018 → 2K22 PUMP 2 EMERGENCY MODE INTERRUPT REFER 02b-E14
  - D019 → 2K23 PUMP 2 RUN AT MAXIMUM REFER 02b-E14

PUMP 4  
STARTER COMPARTMENT

- REFER SHEET 03b
- D025 → LK20 PUMP 4 RUN COMMAND REFER 03b-E14
  - D025 → LK21 PUMP 4 FAULT RESET REFER 03b-E14
  - D026 → LK22 PUMP 4 EMERGENCY MODE INTERRUPT REFER 03b-E14
  - D028 → LK23 PUMP 4 RUN AT MAXIMUM REFER 03b-E14

MOTORIZED VALVE 2  
CONTROL COMPARTMENT

- REFER SHEET 4b
- D029 → BK20 VALVE 2 CLOSE REFER 04b-E14
  - D030 → BK21 VALVE 2 OPEN REFER 04b-E14

## FIELD

POINT TO POINT  
DAY 19 MTH 9 YEAR 14  
Name: Joshua Perkey  
Licence no:  
Signed:

## NOTES

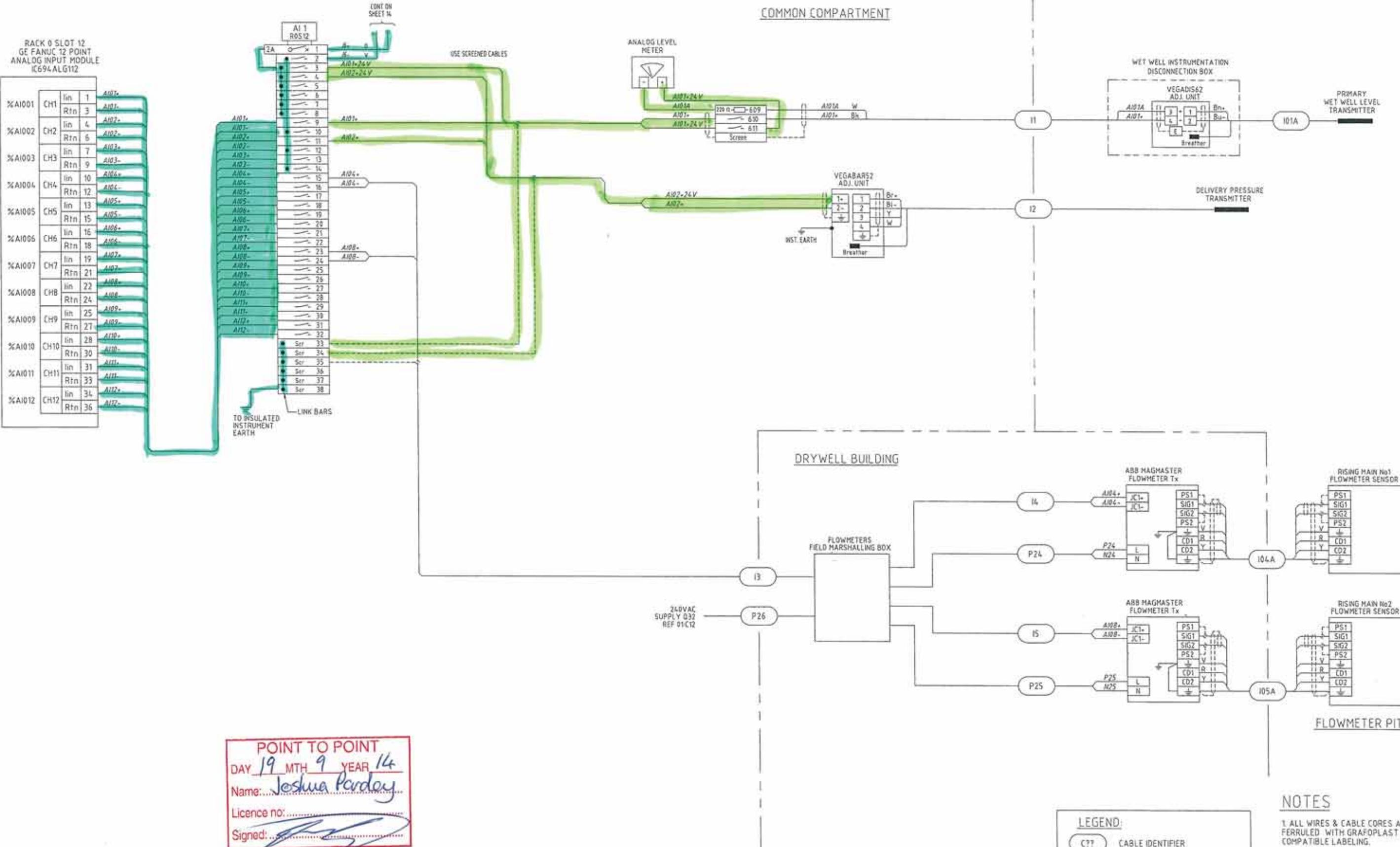
1. ALL WIRES & CABLE CORES ARE  
FERRULED WITH GRAFOPLAST SI2000  
COMPATIBLE LABELING.

## Sheet 14

## FOR CONSTRUCTION

A. 05.14 ISSUED FOR CONSTRUCTION	P.H. A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-14	NAME	SIGNATURE	DATE	DATE	SITE	TITLE	SHEET No.
B. 03.14 ISSUED FOR TENDER	P.H. A.W.	DRAFTING CHECK	A.WITHOFT	A.WITHOFT	57-0471set_A	QUEENSLAND URBAN UTILITIES DELEGATE			APPROVED FOR 12 MONTHS FROM DATE SHOWN	SP033	RTU DIGITAL OUTPUTS TERMINATION DIAGRAM SHEET 2 OF 2	Queensland Urban Utilities DRAWING No.
Re. DATE	DRN	APD	B.C.C. FILE No.	DESIGN CHECK		DESIGN	R.P.E.Q. No.	DATE	R.P.E.Q. No.	Cardno	SP033 ADAM STREET SEWAGE PUMP STATION	486/5/7-0471-014

#### RTU COMPARTMENT



POINT TO POINT			
DAY	19	MTH	9
YEAR 14			
Name: Joshua Parday			
Licence no: 1234567890			
Signed: 			

			DRAFTED	P.HAGUE	P.HAGUE				
A	05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	DESIGN	R.F.Q. No.	DATE
O	03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_A	A.WITTHOFFT	885	33-14
M.	DATE	AMENDMENT	DRW.	APD.	S.C.C. FILE No.		DESIGN CHECK	R.F.Q. No.	DATE



**Cardno**  
Shaping the Future  
Cardno (Qld) Pty Ltd  
ACN 012 191 998

SITE  
SP033  
ADAM STREET  
SEWAGE PUMP STATION

**LEGEND:**

C??	CABLE IDENTIFIER
ZA	RTU MINIATURE CCT BREAKER
—	DISCONNECT LINK TERMINAL
—	THROUGH TERMINAL
Z20B	COMPONENT TERMINAL

NOTES

1. ALL WIRES & CABLE CORES ARE  
FERRULED WITH GRAFOPLAST SI2000  
COMPATIBLE LABELING.

**Sheet 15**

FOR CONSTRUCTION

Sheet 15

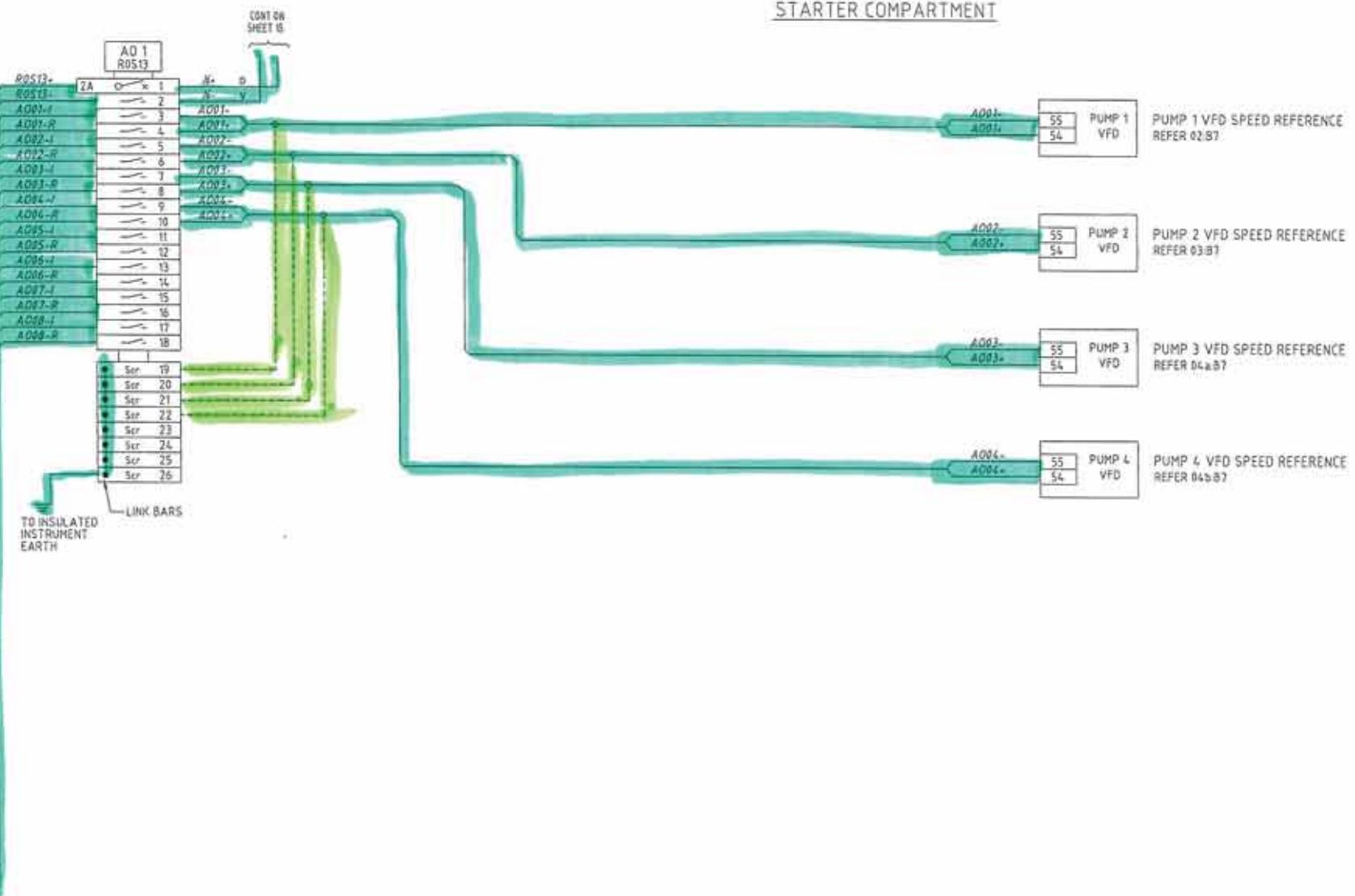
#### RTU COMPARTMENT

## SWITCHBOARD

FIELD

RACK 0 SLOT 13  
GE FANUC 8 POINT  
ANALOG OUTPUT MODULE  
IC694ALG808

%A0001	CH1	Iout1	1	A001-1
		Ret1	2	A001-R
			3	
			4	
%A0002	CH2	Iout2	5	A002-1
		Ret2	6	A002-R
			7	
			8	
%A0003	CH3	Iout3	9	A003-1
		Ret3	10	A003-R
			11	
			12	
%A0004	CH4	Iout4	13	A004-1
		Ret4	14	A004-R
			15	
			16	
%A0005	CH5	Iout5	17	A005-1
		Ret5	18	A005-R
			19	
			20	
%A0006	CH6	Iout6	21	A006-1
		Ret6	22	A006-R
			23	
			24	
%A0007	CH7	Iout7	25	A007-1
		Ret7	26	A007-R
			27	
			28	
%A0008	CH8	Iout8	29	A008-1
		Ret8	30	A008-R
			31	
			32	
			33	
			34	
			35	
			36	



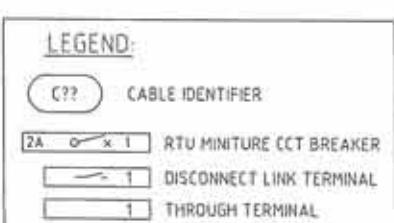
**POINT TO POINT**  
DAY 19 MTH 9 YEAR 14  
Name: Jeshua Pardey  
Licence no.:  
Signed: B.P.

## NOTES

1. ALL WIRES & CABLE CORES ARE  
FERRULED WITH GRAFDPLAST SI2000  
COMPATIBLE LABELING.

Sheet 16

FOR CONSTRUCTION



			DRAFTED	P.HAGUE	P.HAGUE	3-3-14
A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	DESIGN R.P.E.Q. No. DATE
0 03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_A	A.WITTHOFT 8885 3-3-14
No. DATE	AMENDMENT	ORNL	APD	S.C.C. FILE No.		DESIGN CHECK R.P.E.Q. No. DATE



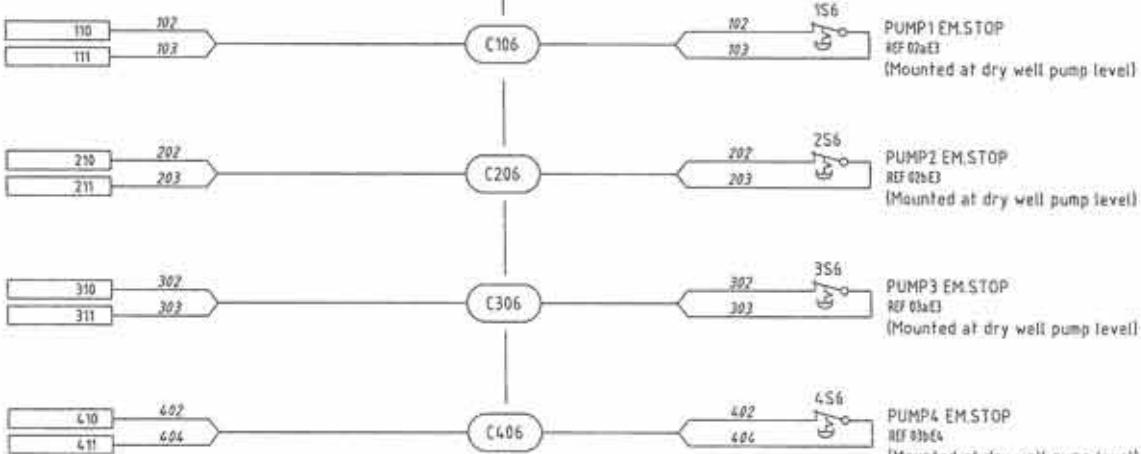
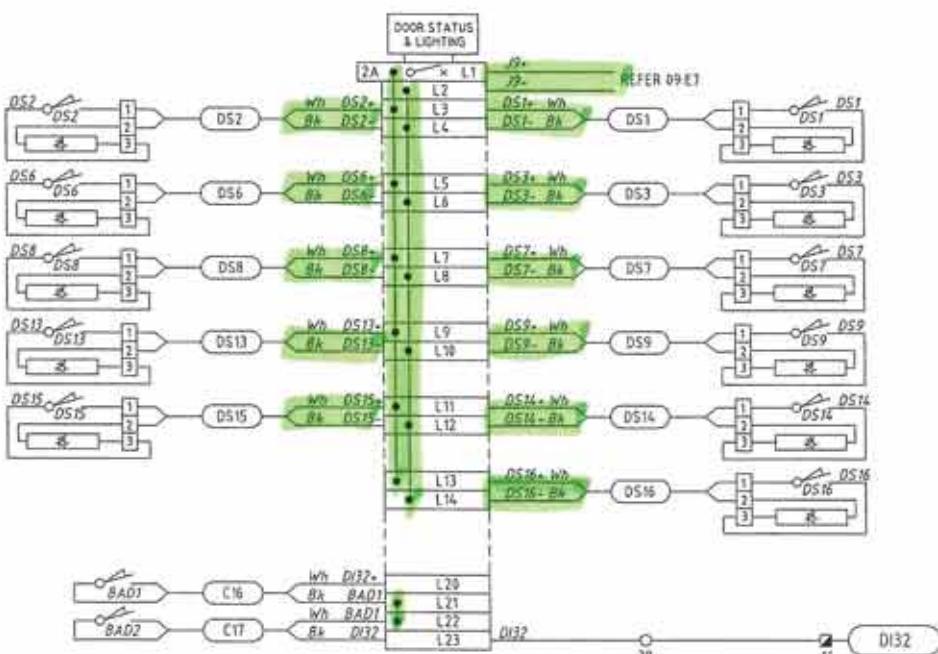
**Cardno**  
Shaping the Future  
Cardno (Qld) Pty Ltd A24 010 074 001

SITE  
SP033  
ADAM STREET  
SEWAGE PUMP STATION

**RTU ANALOG OUTPUTS  
TERMINATION DIAGRAM**

SHEET No. 18  
Cumberland Utilities DRAWING No. AMEND.  
**486/5/7-0471-016** A

**POINT TO POINT**  
 DAY 19 MTH 9 YEAR 14  
 Name: Joshua Hardley  
 Licence no.:  
 Signed: 

**SWITCHBOARD INTERNAL LIGHTING AND SECURITY****LEGEND:**

-  CABLE IDENTIFIER
-  RTU MINIATURE CCT BREAKER
-  DISCONNECT LINK TERMINAL
-  THROUGH TERMINAL

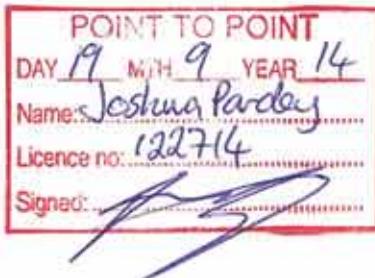
**NOTES**

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.

**Sheet 17****FOR CONSTRUCTION**

		DRAFTED	P.HAQUE	P.HAQUE	3-14	NAME	SIGNATURE	DATE	DATE	SITE	TITLE	SHEET NO.	AMEND.
A	05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	DESIGN	R.P.E.Q. No.	DATE	SP033	COMMON CONTROLS	17	
B	03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_A	A.WITTHOFT	8885	3-14	ADAM STREET	TERMINATION DIAGRAM	Queensland Urban Utilities DRAWING No.	
No.	DATE	AMENDMENT	DRN:	APD:	B.C.C. FILE No.	DESIGN CHECK	R.P.E.O. No.	DATE		SEWAGE PUMP STATION		486/5/7-0471-017	A

# Drawings – Point to Point



QUEENSLAND  
Urban Utilities

# SP033 ADAM STREET SEWAGE PUMPING STATION SITE COVER SHEET

ELECTRICAL DRAWINGS INDEX					
DWG N°.	TITLE	SHEET	REVISIONS		
486/5/7-0471-000	SITE COVER SHEET	00	0	A	
486/5/7-0471-001	POWER DISTRIBUTION SCHEMATIC DIAGRAM	01	0	A	
486/5/7-0471-002a	PUMP 01 SCHEMATIC DIAGRAM	02a	0	A	
486/5/7-0471-002b	PUMP 02 SCHEMATIC DIAGRAM	02b	0	A	
486/5/7-0471-003a	PUMP 03 SCHEMATIC DIAGRAM	03a	0	A	
486/5/7-0471-003b	PUMP 04 SCHEMATIC DIAGRAM	03b	0	A	
486/5/7-0471-004a	ACTUATOR 01 SCHEMATIC DIAGRAM	04a	0	A	
486/5/7-0471-004b	ACTUATOR 02 SCHEMATIC DIAGRAM	04b	0	A	
486/5/7-0471-005	DRY WELL & EM. STORAGE DEWATERING PUMPS SCHEMATIC DIAGRAM	05	0	A	
486/5/7-0471-006	MTS CONTROL WIRING DIAGRAM	06	0	A	
486/5/7-0471-007	COMMON CONTROLS SCHEMATIC DIAGRAM	07	0	A	
486/5/7-0471-008	COMMON RTU I/O SCHEMATIC DIAGRAM	08	0	A	
486/5/7-0471-009	RTU POWER DISTRIBUTION SCHEMATIC & NETWORK DIAGRAM	09	0	A	
486/5/7-0471-010	RTU DIGITAL INPUTS TERMINATION DIAGRAM - SHEET 1 OF 3	10	0	A	
486/5/7-0471-011	RTU DIGITAL INPUTS TERMINATION DIAGRAM - SHEET 2 OF 3	11	0	A	
486/5/7-0471-012	RTU DIGITAL INPUTS TERMINATION DIAGRAM - SHEET 3 OF 3	12	0	A	
486/5/7-0471-013	RTU DIGITAL OUTPUTS TERMINATION DIAGRAM - SHEET 1 OF 2	13	0	A	
486/5/7-0471-014	RTU DIGITAL OUTPUTS TERMINATION DIAGRAM - SHEET 2 OF 2	14	0	A	
486/5/7-0471-015	RTU ANALOG INPUTS TERMINATION DIAGRAM	15	0	A	
486/5/7-0471-016	RTU ANALOG OUTPUTS TERMINATION DIAGRAM	16	0	A	
486/5/7-0471-017	COMMON CONTROLS TERMINATION DIAGRAM	17	0	A	
486/5/7-0471-018	EQUIPMENT LIST	18	0	A	
486/5/7-0471-019	CABLE SCHEDULE	19	0	A	
486/5/7-0471-020	SWITCHBOARD LABEL SCHEDULE	20	0	A	
486/5/7-0471-021	SWITCHBOARD CONSTRUCTION DETAILS - SHEET 1 OF 3	21	0	A	
486/5/7-0471-022	SWITCHBOARD CONSTRUCTION DETAILS - SHEET 2 OF 3	22	0	A	
486/5/7-0471-023	SWITCHBOARD CONSTRUCTION DETAILS - SHEET 3 OF 3	23	0	A	
486/5/7-0471-024	FIELD INSTRUMENTATION - INSTALLATION DETAILS	24	0	A	
486/5/7-0471-025	RESERVED (CATHODIC PROTECTION UNIT)	25			
486/5/7-0471-026	RESERVED (GENERATOR CONTROL)	26			
486/5/7-0471-027	DRY WELL DISCONNECTION BOX GENERAL ARRANGEMENT	27	0	A	
486/5/7-0471-028	WETWELL INSTRUMENTATION DISCONNECT BOX GENERAL ARRANGEMENT	28	0	A	
486/5/7-0471-029	SWBD GENERAL ARRANGEMENT - SHEET 1 OF 4	29	0	A	
486/5/7-0471-030	SWBD GENERAL ARRANGEMENT - SHEET 2 OF 4	30	0	A	
486/5/7-0471-031	SWBD GENERAL ARRANGEMENT - SHEET 3 OF 4	31	0	A	
486/5/7-0471-032	SWBD GENERAL ARRANGEMENT - SHEET 4 OF 4	32	0	A	
486/5/7-0471-033	EXTERNAL GENERATOR CONNECTION CUBICLE	33	0	A	
486/5/7-0471-034	DRY WELL MOTOR DISCONNECTION BOX INSTALLATION DETAILS	34	0	A	
486/5/7-0471-040	SWITCHBOARD SLAB - LOCALITY AND SITE PLANS - SHEET 1 OF 3	40	0	A	
486/5/7-0471-041	SWITCHBOARD SLAB AND CONDUIT DETAILS - SHEET 2 OF 3	41	0	A	
486/5/7-0471-042	SWITCHBOARD AND ELECTRICAL CONDUIT LAYOUT - SHEET 3 OF 3	42	0	A	

STANDARD VARIABLES	
DESCRIPTION	VALUES
CT METERING ISOLATOR	630A SLB 630 3P
NORMAL SUPPLY MAIN SWITCH	1.0 [630A] S630CE/630
GENERATOR SUPPLY MAIN SWITCH	1.0 [630A] S630CE/630
PUMP1 CIRCUIT BREAKER	0.63 [252A] S400GJ/400
PUMP2 CIRCUIT BREAKER	0.63 [252A] S400GJ/400
PUMP3 CIRCUIT BREAKER	0.8 [128A] S160GJ/160
PUMP4 CIRCUIT BREAKER	0.8 [128A] S160GJ/160
DRY WELL SUMP PUMP CIRCUIT BREAKER	20A S125N/20
EM. STORAGE DEWATERING PUMP CCT BREAKER	NOT APPLICABLE
PUMP VSD STARTER SIZE	FC202N132 260A
PUMP RATINGS	132kW 252A 50kW 87A
PUMP LINE CONTACTOR	NOT APPLICABLE
DRY WELL SUMP PUMP RATING	22kW 4.8A
DRY WELL SUMP PUMP CONTACTOR & TOL	CA7-23 CTIN 23 863
PUMP SOCKET OUTLET + INCLINE SLEEVE	NOT APPLICABLE
PUMP INLET PLUG + HANDLE	NOT APPLICABLE
WET WELL LEVEL TRANSMITTER	WLS2XXALAM0001X 6m
EMERGENCY STORAGE WELL LEVEL TRANSMITTER	NOT APPLICABLE
EM. STORAGE DEWATERING PUMP RATING	NOT APPLICABLE
EM. STORAGE DEWATERING PUMP CONTR & TOL	NOT APPLICABLE
FLOWMETER RANGE	500l/s
WET WELL ULTRASONIC LEVEL SENSOR	NOT APPLICABLE
DELIVERY PRESSURE TRANSMITTER	BRS2XXCATEHPMAS L=20 25m
RADIO	DR900-06A02-00
EMERGENCY PUMPING TIME	1basec
No of SINGLE POINT PROBES	6
INCOMING MAINS SUPPLY CABLE	2x185mm <sup>2</sup>
MAIN EARTHING CABLE	120mm <sup>2</sup>
INCOMING GENERATOR SUPPLY CABLE	NOT APPLICABLE
VSD STARTER 3 PHASE SUPPLY	132kW = 95mm <sup>2</sup> 50kW = 35mm <sup>2</sup>

STANDARD DESIGN OPTIONS	
OPTION	DESCRIPTION
A	INDIVIDUAL PUMP MOISTURE IN OIL (IMO) SENSOR AND FAULT RELAY
B	INDIVIDUAL PUMP MOISTURE IN STATOR (MIS) SENSOR AND FAULT RELAY
C	INDIVIDUAL PUMP REFLUX VALVE PROXIMITY SWITCH
D	STATION MANHOLE SURCHARGE IMMINENT
E	STATION DRY WELL SUMP PUMP AND LEVEL INDICATION SENSORS AND RELAYS
F	PERMANENT GENERATOR INSTALLED
G	STATION EMERGENCY STORAGE LEVEL SENSOR, DEWATERING PUMP
H	STATION DELIVERY FLOWMETER - 240VAC ABB
I	BACKUP COMMUNICATION - GSM
J	PUMP CONNECTION (Via Dry Well J-Box)
K	CATHODIC PROTECTION
L	MOTOR THERMISTORS (Via Dry Well J-Box)
M	DOOR CONTROL
N	CURRENT TRANSFORMER (CT) METERING
O	NO PUMP INTERLOCKING
P	WET WELL WASHER
Q	AUX PIT SUMP PUMP AND LEVEL PROBE
R	TELEMETRY RADIO
S	WET WELL SECONDARY LEVEL SENSOR
T	WET WELL PRIMARY LEVEL SENSOR (Via Field Instrument Box)
U	DELIVERY PRESSURE TRANSMITTER (Direct Connected)
V	CHEMICAL DOSING
W	PUMP START METHOD - VARIABLE SPEED DRIVE
X	3rd & 4th PUMP INSTALLED
Y	POWER METER

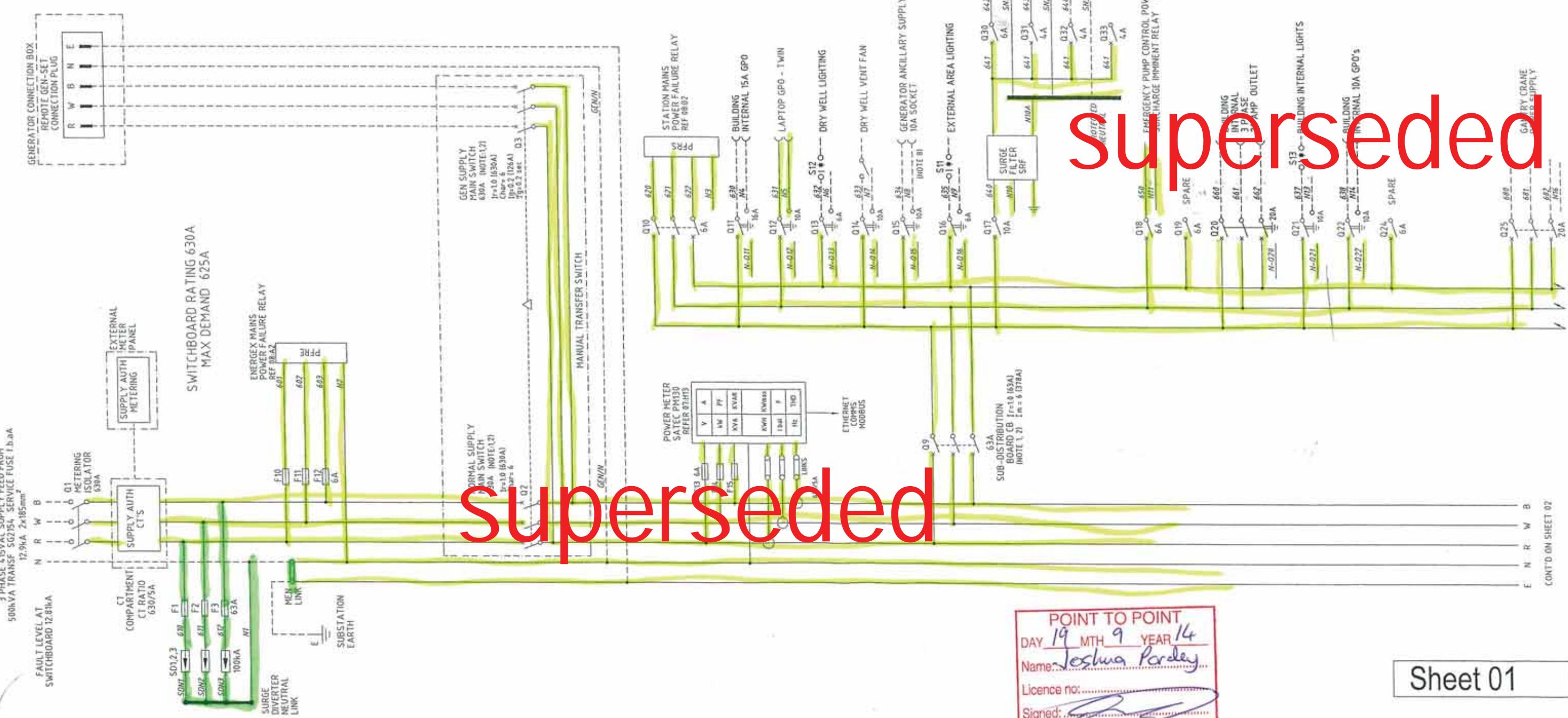
Sheet 00

FOR CONSTRUCTION

ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-14	DESIGN	R.P.E.Q. No.	DATE	NAME	SIGNATURE	DATE	DESIGN	R.P.E.Q. No.	DATE	NAME	SIGNATURE	DATE	DESIGN	R.P.E.Q. No.	DATE	NAME	SIGNATURE	DATE	DESIGN	R.P.E.Q. No.	DATE	NAME	SIGNATURE	DATE			
ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	A.WITTHOFFT	3-14	57-0471-041_A	885	3-14	QUEENSLAND URBAN UTILITIES DELEGATE	Cardno	3-14	QUEENSLAND URBAN UTILITIES	Cardno	3-14	SP033	ADAM STREET	3-14	SP033	ADAM STREET	3-14	SEWAGE PUMP STATION	Cardno	3-14									
AMENDMENT	BRN.	APD.	8.C.C. FILE NO.							APPROVED FOR RELEASE	APPROVED FOR RELEASE		APPROVED FOR RELEASE	APPROVED FOR RELEASE		APPROVED FOR RELEASE	APPROVED FOR RELEASE		APPROVED FOR RELEASE	APPROVED FOR RELEASE		APPROVED FOR RELEASE	APPROVED FOR RELEASE		APPROVED FOR RELEASE	APPROVED FOR RELEASE		APPROVED FOR RELEASE	APPROVED FOR RELEASE		APPROVED FOR RELEASE	APPROVED FOR RELEASE	

## NOTES

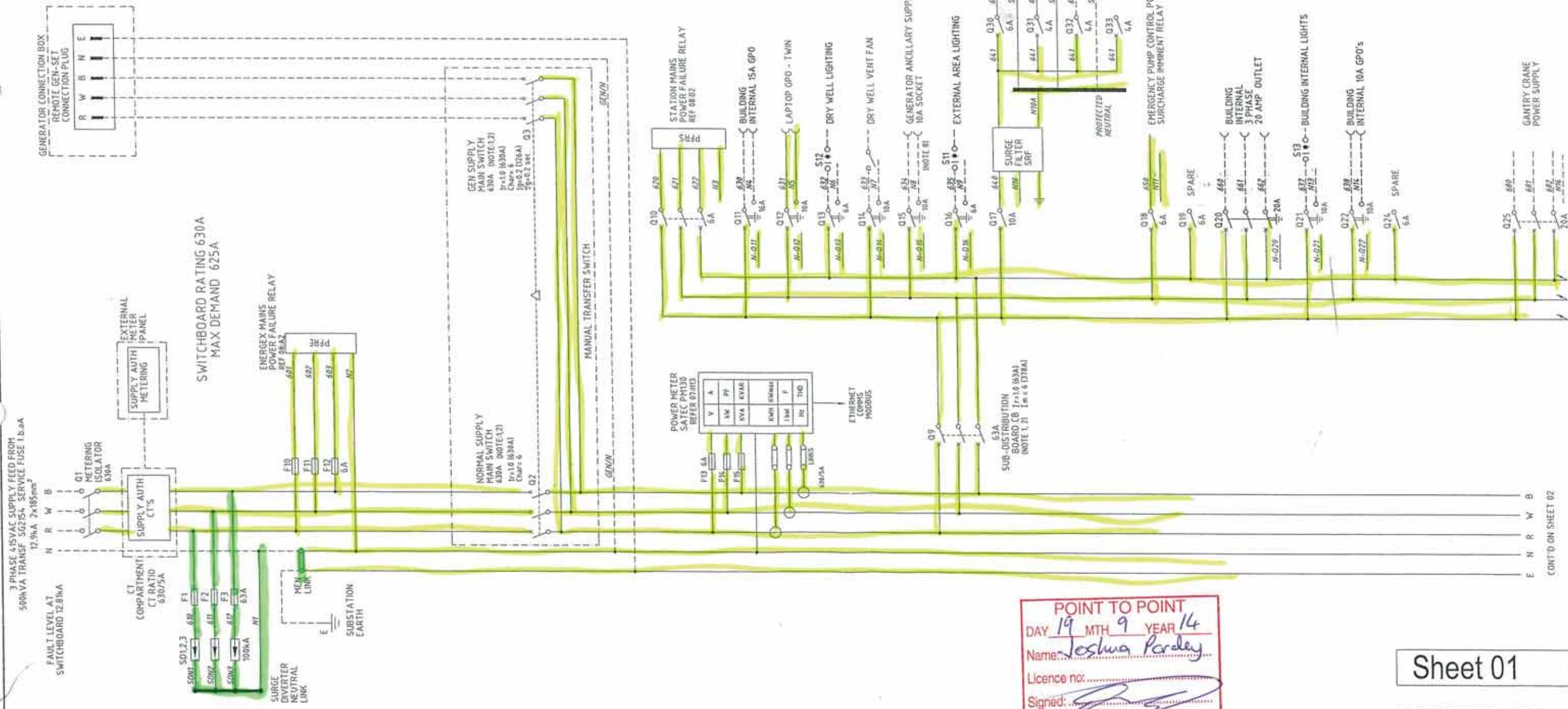
1. INCOMING MAIN, GENSET, PUMP & DB CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. MEN LINK TO BE PROVIDED AS PER AS:3000.2007 SECTION 7.
3. SURGE PROTECTION DEVICE TO BE AS CLOSE TO THE INCOMER AS POSSIBLE.
4. CONDUCTORS SHALL BE A MINIMUM 6mm<sup>2</sup> AT A MAXIMUM LENGTH OF 60mm TO BE USED OVER THE SHORTEST AND MOST DIRECT PATH WITH NO LOOPS CONNECTED TO NEUTRAL.
5. ALL CIRCUIT BREAKERS TO BE PADLOCKABLE. LOCKING IS TO BE INDEPENDENT OF ESCUTCHEON.
6. ALL Wires CABLE CORES ARE FERRULED WITH GRAFOPLAST 2000 CABLE LABELING.
7. ALL LIVE CIRCUITS SHALL BE FITTED WITH RCD PROTECTION, SET AT 30mA. ALL 3φ POWER OUTLETS MOUNTED ON ESCUTCHEONS TO BE WIRED INSULATED CABLES.
8. CIRCUIT CALCULATION AND ALL CIRCUIT BREAKER SIZING DRAWINGS SET HAVE BEEN DERIVED FROM THE SITE PROVIDED SYSTEM ANALYSIS FILE. Interferes with ADAM STREET Power System Analysis and Protection Coordination pdf.
9. CABLES TO GENERATOR CONNECTION BOX AND AUXILIARY SUPPLY SOCKET TO BE DOUBLE INSULATED CABLING.



A 05.14	ISSUED FOR CONSTRUCTION	P.H.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	SITE	TITLE	SHEET No.
D 03.14	ISSUED FOR TENDER	P.H.	DRAFTING CHECK	A.WITTHOFT	A.WITTHOFT	3-3-14	NAME	QUEENSLAND URBAN UTILITIES DELEGATE	DATE	SP033	POWER DISTRIBUTION SCHEMATIC DIAGRAM	486/5/7-0471-001
No. DATE	AMENDMENT	DRN.	APD.	B.C.C. FILE NO.	57-0471set_A	R.P.E.Q. NO.	DESIGN	A.WITTHOFT	APPROVED FOR 12 MONTHS FROM DATE SHOWN	ADAM STREET SEWAGE PUMP STATION	AMEND.	A

## NOTES

1. INCORPORATING MAIN, GENSET, PUMP & DB CIRCUIT BREAKERS SHALL BE LINE SIDE SHROUDED.
2. MEN LINK TO BE PROVIDED AS PER AS:3000.2007 SECTION 7.
3. SURGE PROTECTION DEVICE TO BE AS CLOSE TO THE INOMER AS POSSIBLE.
4. ALL CIRCUIT BREAKERS TO BE PADLOCKABLE. LOCKING IS TO BE INDEPENDENT OF ESCUTCHEON.
5. CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD TO ENSURE TYPE 2 CO-ORDINATION WITH CONTACTORS AND OVERLOADS TO AS:3947-4-1.
6. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST S12000 COMPATIBLE LABELING.
7. ALL LIGHT AND POWER CIRCUITS SHALL BE FITTED WITH RCD PROTECTION, SET AT 30mA.
8. MAXIMUM DEMAND CALCULATION AND ALL CIRCUIT BREAKER SETTINGS WITHIN THIS DRAWINGS SET HAVE BEEN DERIVED FROM THE SITE POWER SYSTEM ANALYSIS FILE.
9. CABLELING TO GENERATOR CONNECTION BOX AND AUXILIARY SUPPLY SOCKET TO BE DOUBLE INSULATED CABLING.



Sheet 01

FOR CONSTRUCTION

A 05.14 ISSUED FOR CONSTRUCTION	P.H.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14
B 03.14 ISSUED FOR TENDER	P.H.	A.W.	GRAFTING CHECK	A.WITTHOFFT	
No. DATE	AMENDMENT	DRN.	APO.	B.C.C. FILE NO.	57-0471set_A

NAME: QUEENSLAND URBAN UTILITIES DELEGATE	SIGNATURE: A.WITTHOFFT	DATE: 3-3-14
DESIGN: A.WITTHOFFT	DESIGN CHECK: 8885	AUTHORISED FOR 12 MONTHS FROM DATE SHOWN
DATE: 3-3-14	R.F.E.Q. NO.: 486/5/7-0471-001	DATE: 3-3-14



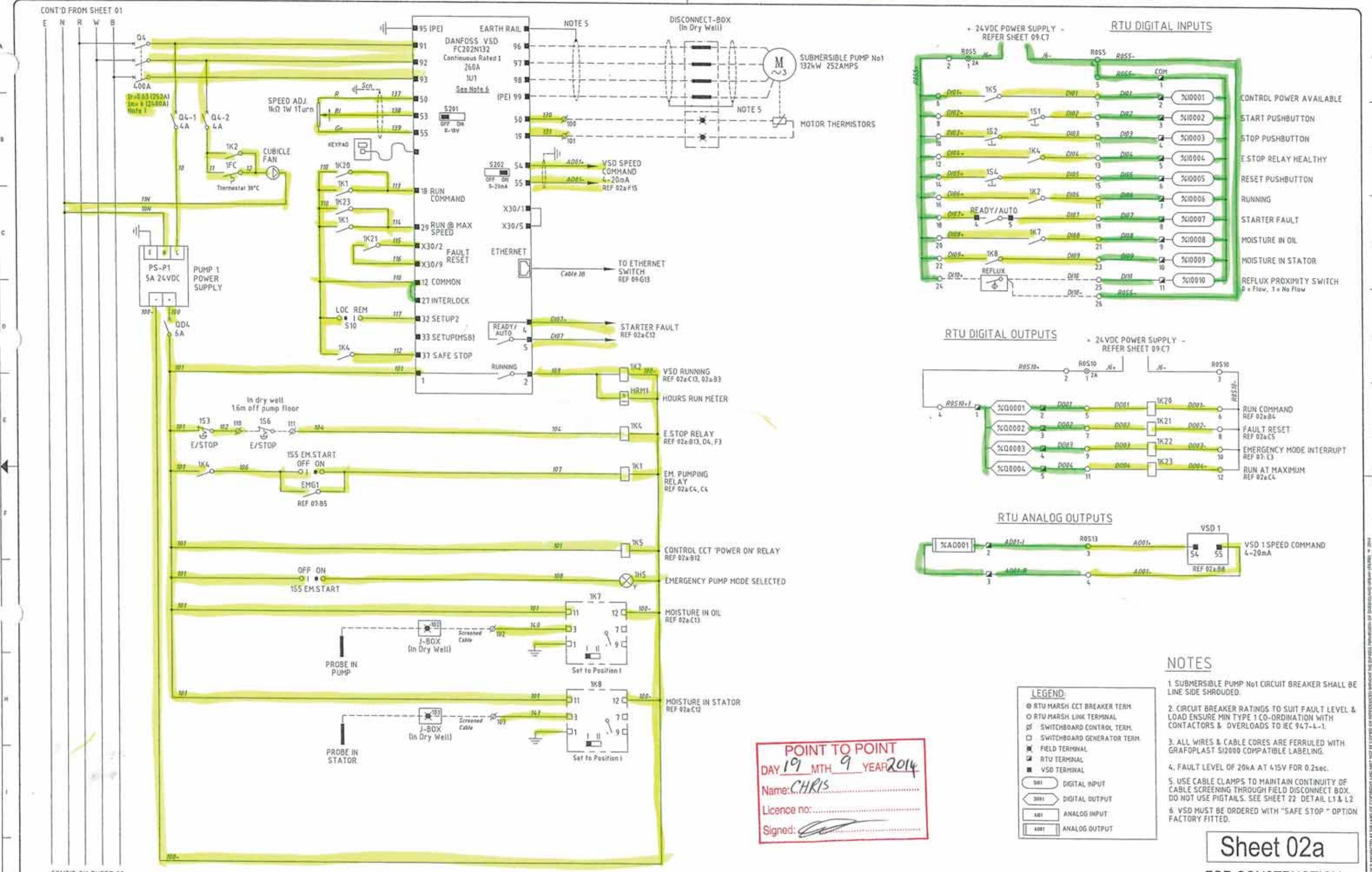
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ADAM STREET  
SEWAGE PUMP STATION

TITLE: POWER DISTRIBUTION SCHEMATIC DIAGRAM

SHEET NO.: 5

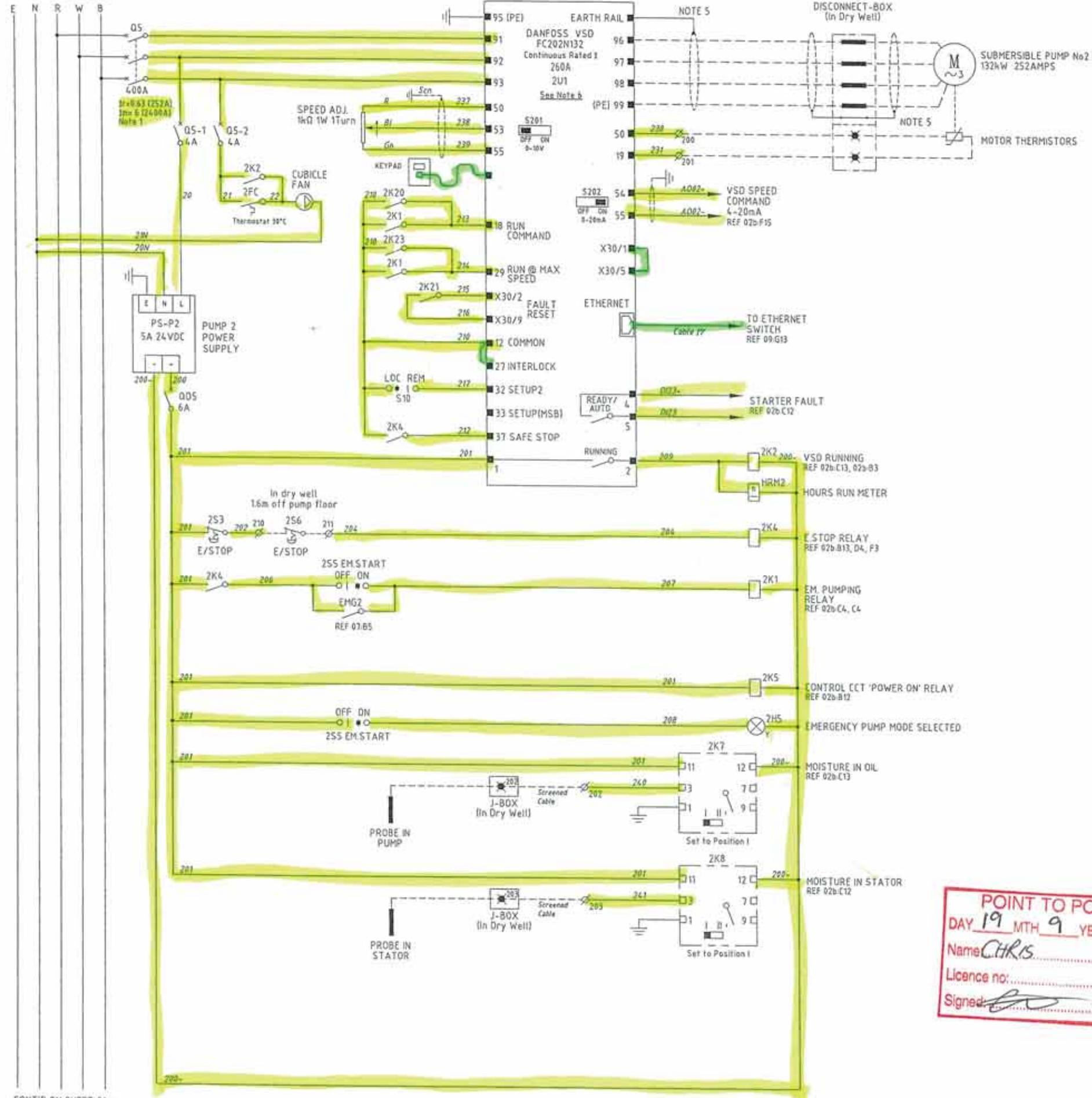
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AMEND.: A

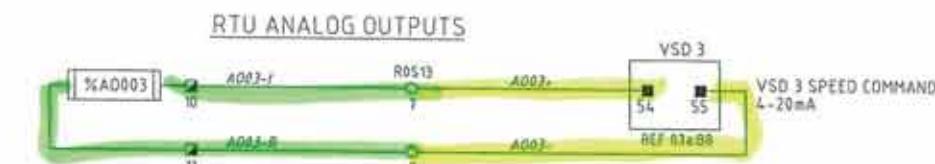
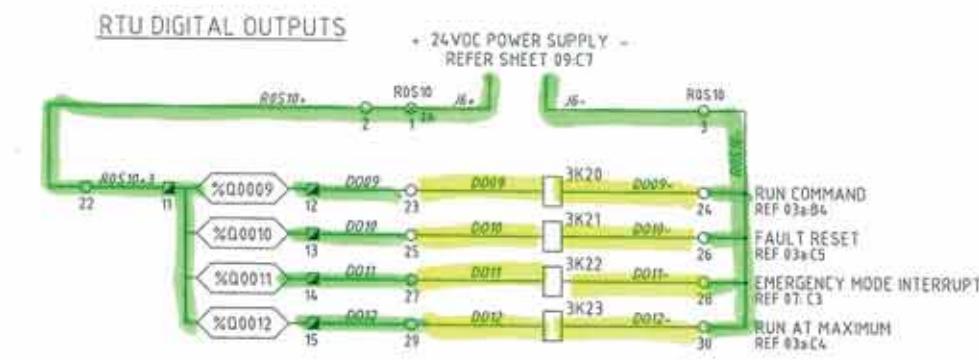
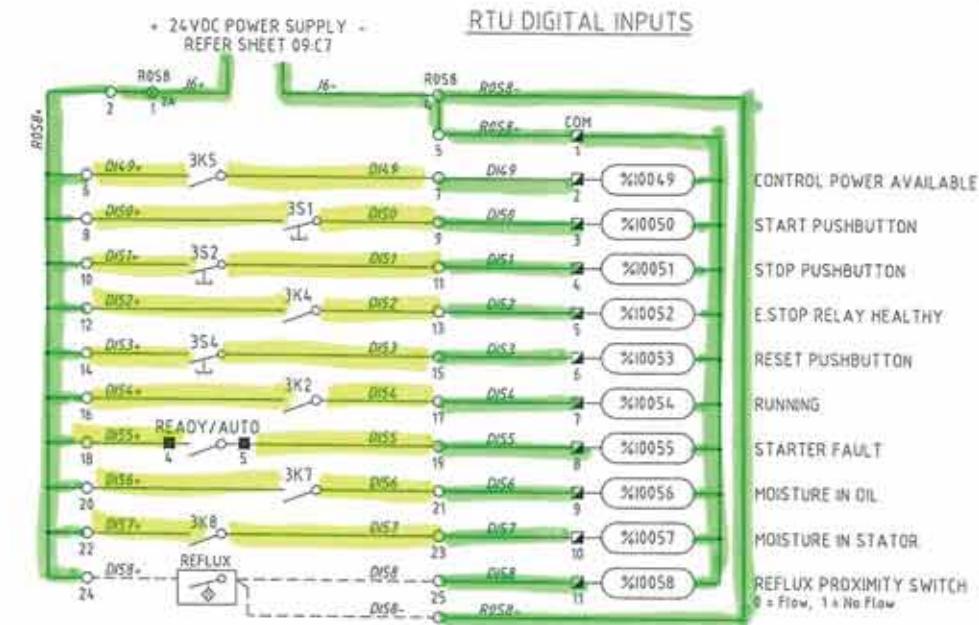
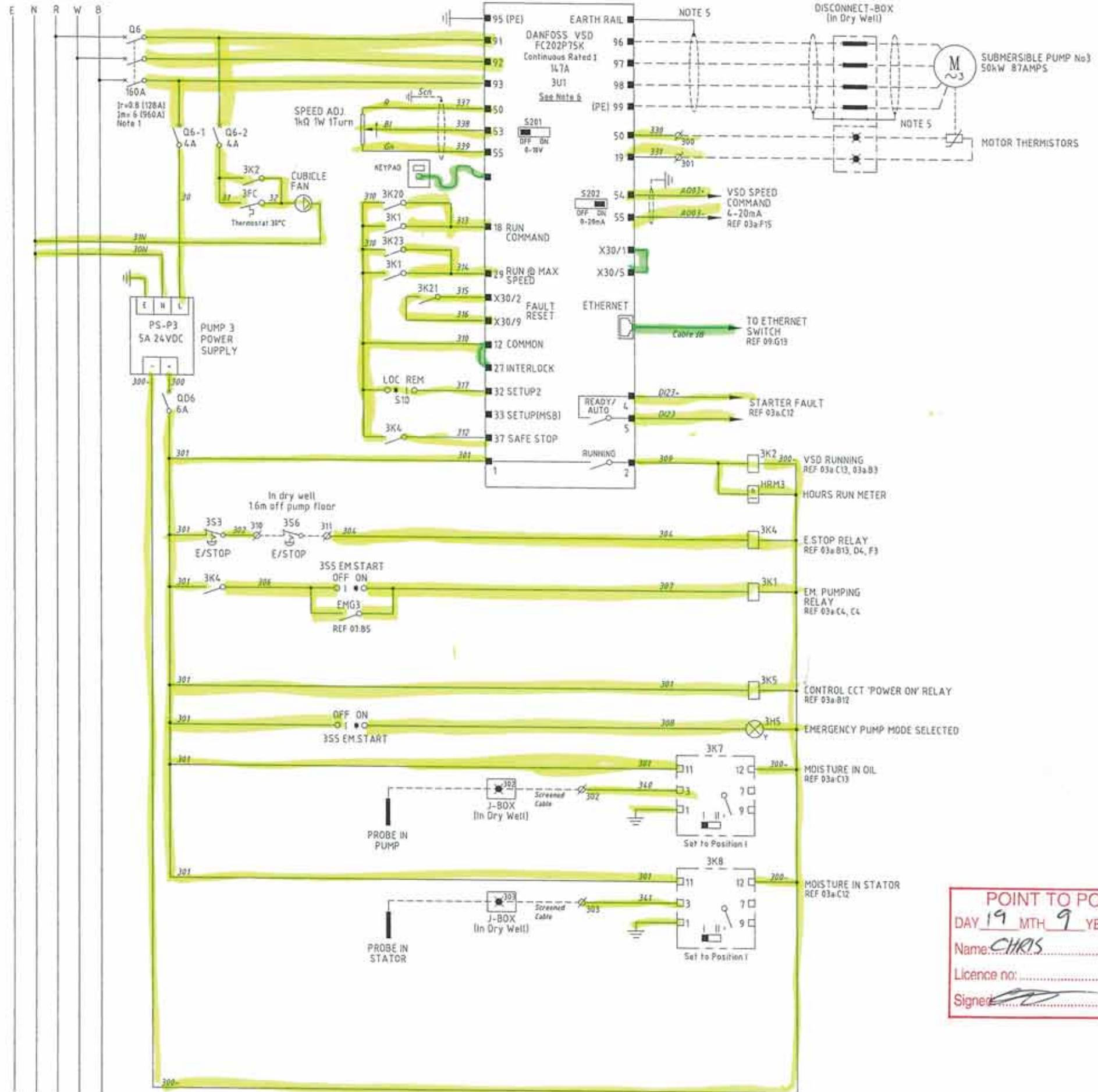
**Sheet 02a****FOR CONSTRUCTION**

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B 03.14	ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT		WITTHOFFT				SP033	PUMP NO1 SCHEMATIC DIAGRAM	2a
No DATE	AMENDMENT	DRN.	APD.	CAD FILE	57-0471set_A		DESIGN	R.P.E.O. No.	DATE	Queensland Urban Utilities Delegated	ADVISER	Queensland Urban Utilities DRAWING No.	486/5/7-0471-002a

CONT'D FROM SHEET 02



CONT'D FROM SHEET 03



## NOTES

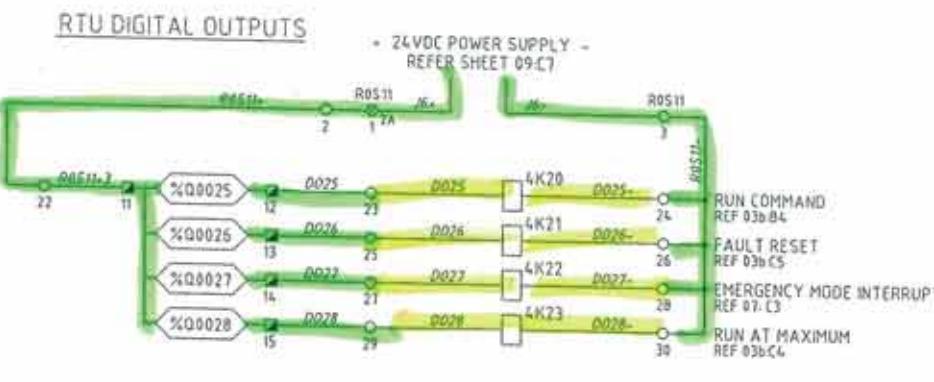
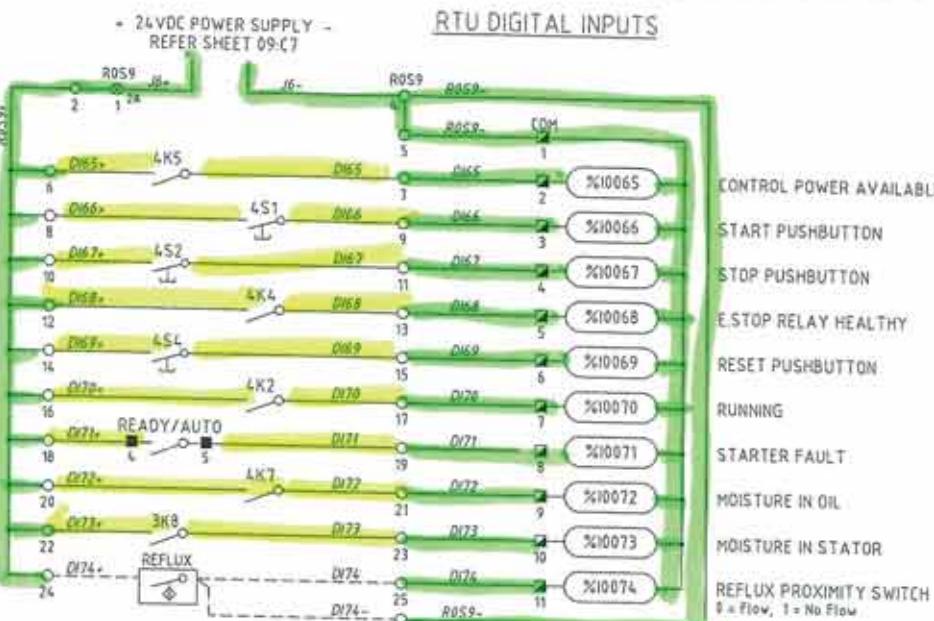
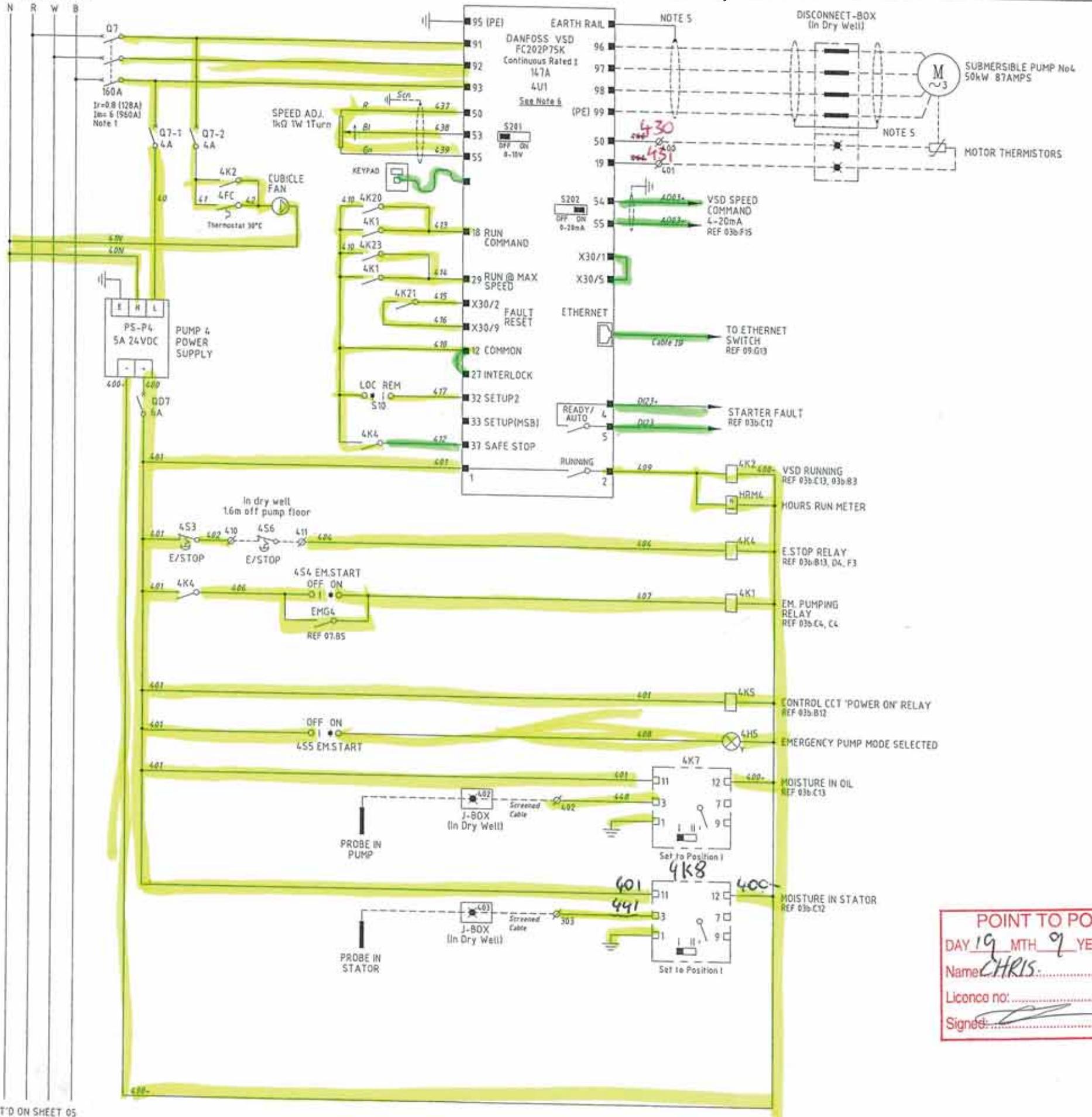
1. SUBMERSIBLE PUMP No3 CIRCUIT BREAKER SHALL BE LINE SIDE SHROUDED.
  2. CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE MIN TYPE 1 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
  3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2090 COMPATIBLE LABELING.
  4. FAULT LEVEL OF 20kA AT 415V FOR 0.2sec
  5. USE CABLE CLAMPS TO MAINTAIN CONTINUITY OF CABLE SCREENING THROUGH FIELD DISCONNECT BOX. DO NOT USE PIGTAILS. SEE SHEET 22 DETAIL L1 & L2
  6. VSD MUST BE ORDERED WITH "SAFE STOP" OPTION FACTORY FITTED.

Sheet 03a

## FOR CONSTRUCTION

A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	SP033	TITLE	PUMP No3	SHEET No.	3a
B 03.14	ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	DESIGN	R.P.E.Q. No.	DATE	QUEENSLAND URBAN UTILITIES DELEGATE	WITTHOFT	6895	AMEND.	SCHEMATIC DIAGRAM	Queensland Urban Utilities DRAWING No.	
N/A	DATE	AMENDMENT	DRN	APD.	B.C.C. FILE No.	57-0471sat_A	DESIGN CHECK	R.P.E.Q. No.	DATE	AUTHORIZED FOR 12 MONTHS FROM DATE SHOWN	Cardno Shaping the Future	ADAM STREET	SEWAGE PUMP STATION	486/5/7-0471-003a	A
C:\M\My Projects\QUADRA - SP033\3rd\wingsP\wings\1200\PE33.htm [REDACTED] Electrical Drawing for Construction\27\241.htm [REDACTED] Power on Thursday, 14 May 2014 10:44 AM															

CONT'D FROM SHEET 04a



## RTU ANALOG OUTPUTS



## NOTES

1. SUBMERSIBLE PUMP NO.4 CIRCUIT BREAKER SHALL BE LINE SIDE SHROUDED.
  2. CIRCUIT BREAKER RATINGS TO SUIT FAULT LEVEL & LOAD ENSURE MIN TYPE 1 CO-ORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
  3. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.
  4. FAULT LEVEL OF 20KA AT 415V FOR 0.2sec.
  5. USE CABLE CLAMPS TO MAINTAIN CONTINUITY OF CABLE SCREENING THROUGH FIELD DISCONNECT BOX. DO NOT USE PIGTAILS. SEE SHEET 22 DETAIL L1 & L2
  6. VSD MUST BE ORDERED WITH "SAFE STOP" OPTION FACTORY FITTED.

POINT TO POINT  
DAY 19 MTH 9 YEAR 14  
Name CHRIS.

License no.: \_\_\_\_\_  
Signature: 

### Skills

Digitized by srujanika@gmail.com

Sheet 03b

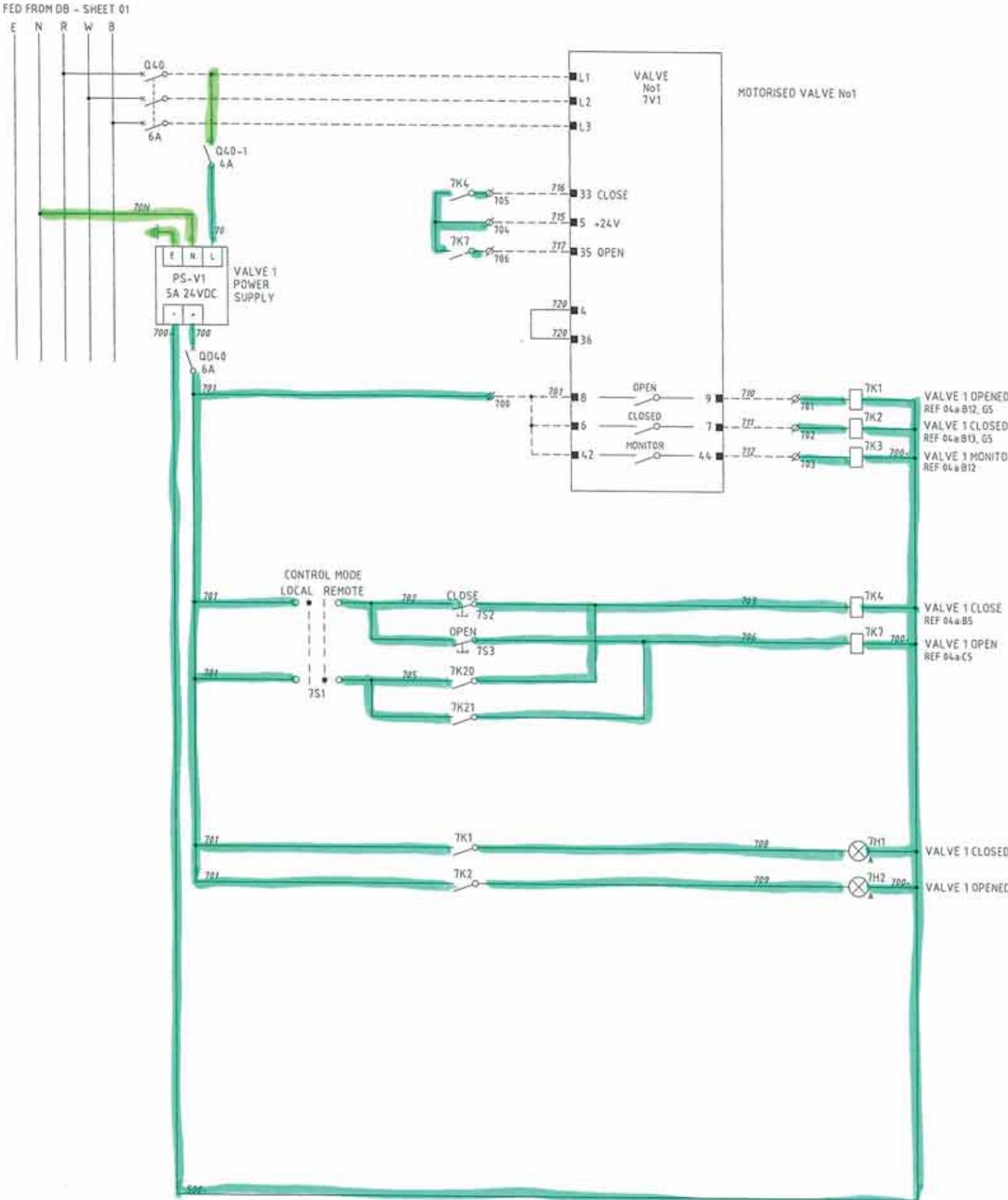
## FOR CONSTRUCTION



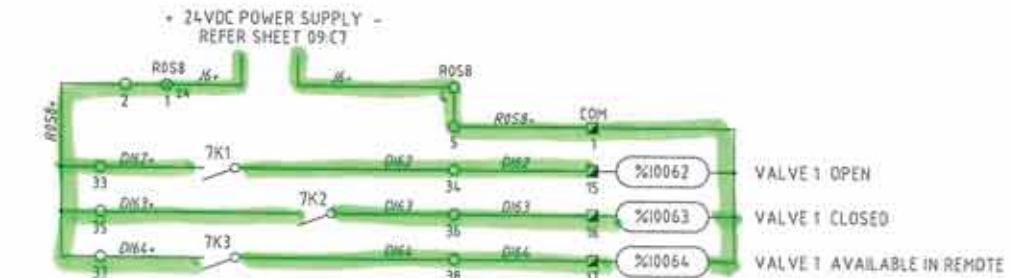
SITE  
SP033  
ADAM STREET  
SEWAGE PUMP STATION

**TITLE**  
**PUMP No4**  
**SCHEMATIC DIAGRAM**

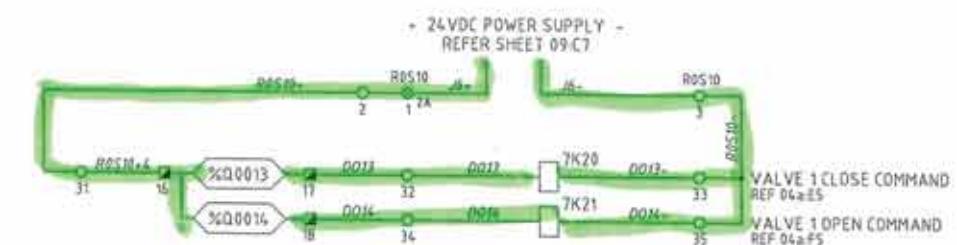
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Queensland Urban Utilities DRAWING No.  
**486/5/7-0471-003b**



## RTU DIGITAL INPUTS



RTU DIGITAL OUTPUTS

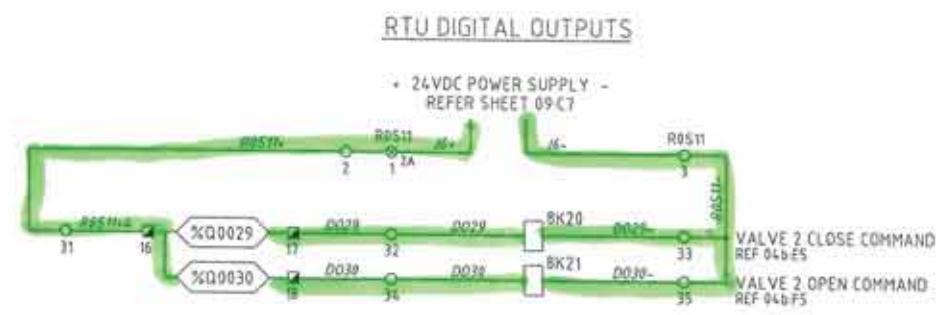
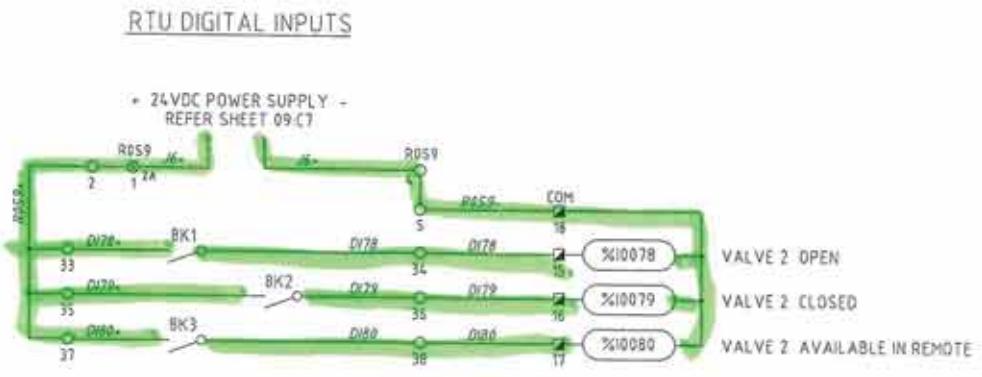
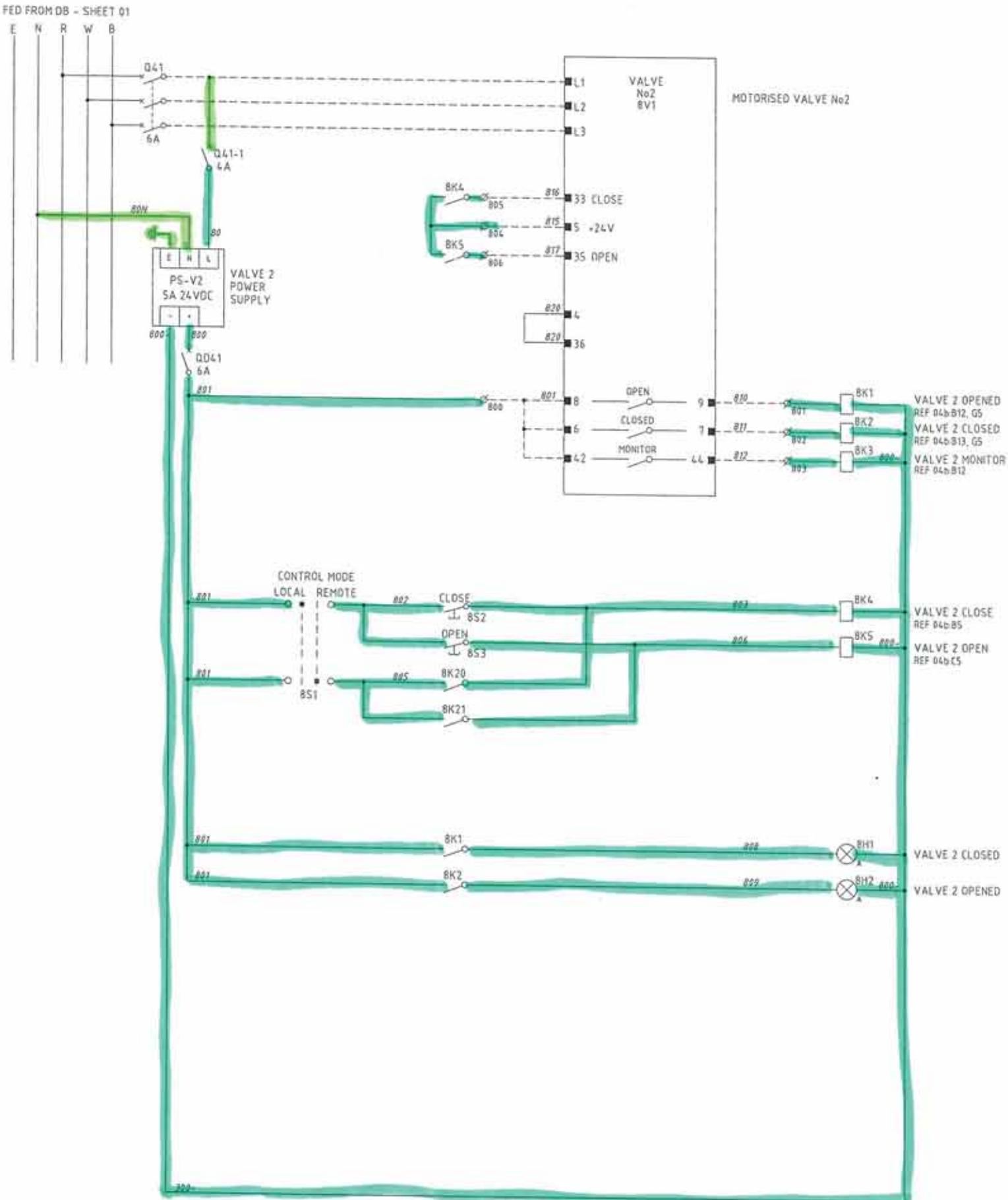


POINT TO POINT					
DAY	9	MTH	9	YEAR	14
Name: Joshua Parcley					
Licence no:					
Signed: 					

Sheet 4a

FOR CONSTRUCTION

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0 03.14	ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	DESIGN	R.P.E.Q. No.	DATE	QUEENSLAND URBAN UTILITIES DELEGATE	SP033	ACTUATOR VALVE No1	
No.	DATE	AMENDMENT		DRN	APD.	57-0471 set_A	57-0471	3-3-14	ADAM STREET	ADAM STREET	SCHEMATIC DIAGRAM	
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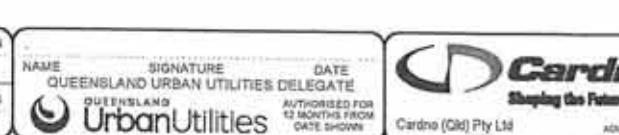


**POINT TO POINT**  
DAY 19 MTH 9 YEAR 14  
Name: Joshua Pardley  
Licence no.: .....  
Signed: [Signature]

Sheet 4b

FOR CONSTRUCTION

			DRAFTED	P.HAGUE	P.HAGUE				
A	05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	DESIGN	R.P.E.Q. No.	DATE
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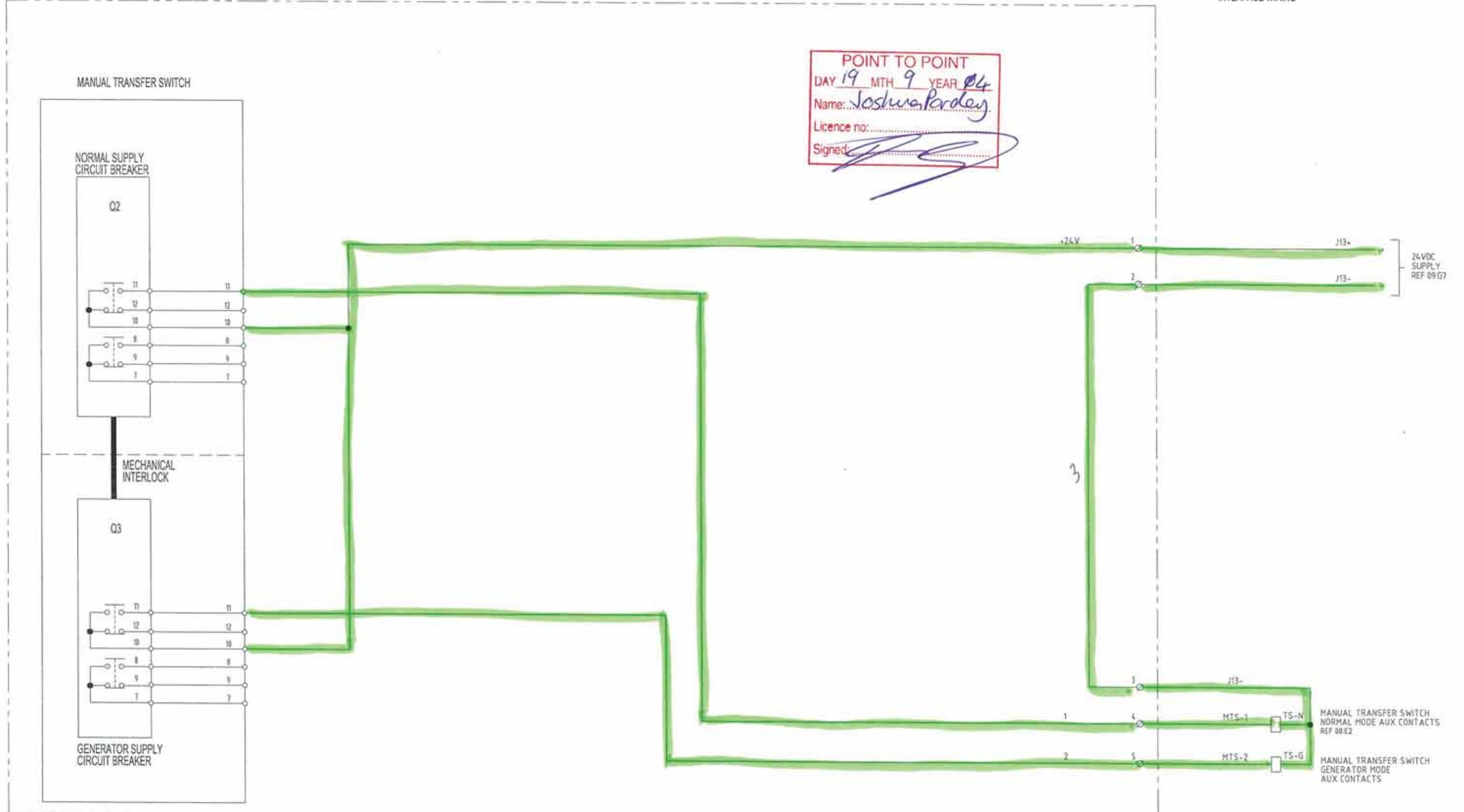
SH  
SP  
AD  
SE

E  
P033  
DAM STREET  
SEWAGE PUMP STATION

TITLE  
ACTUATOR VALVE No2  
SCHEMATIC DIAGRAM

Queensland Urban Utilities DRAWING No.  
486/5/7-0471-004b

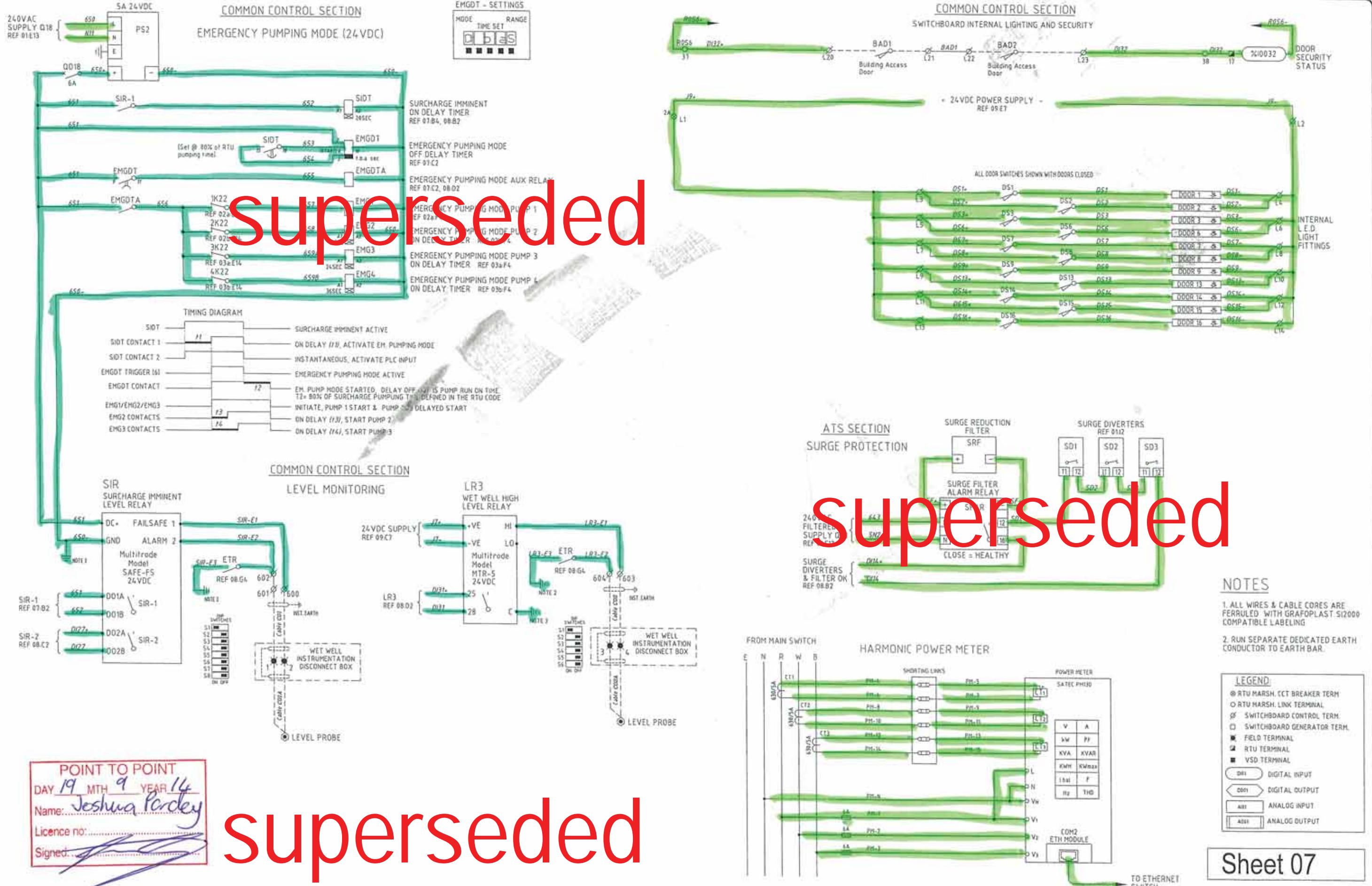




Sheet 06

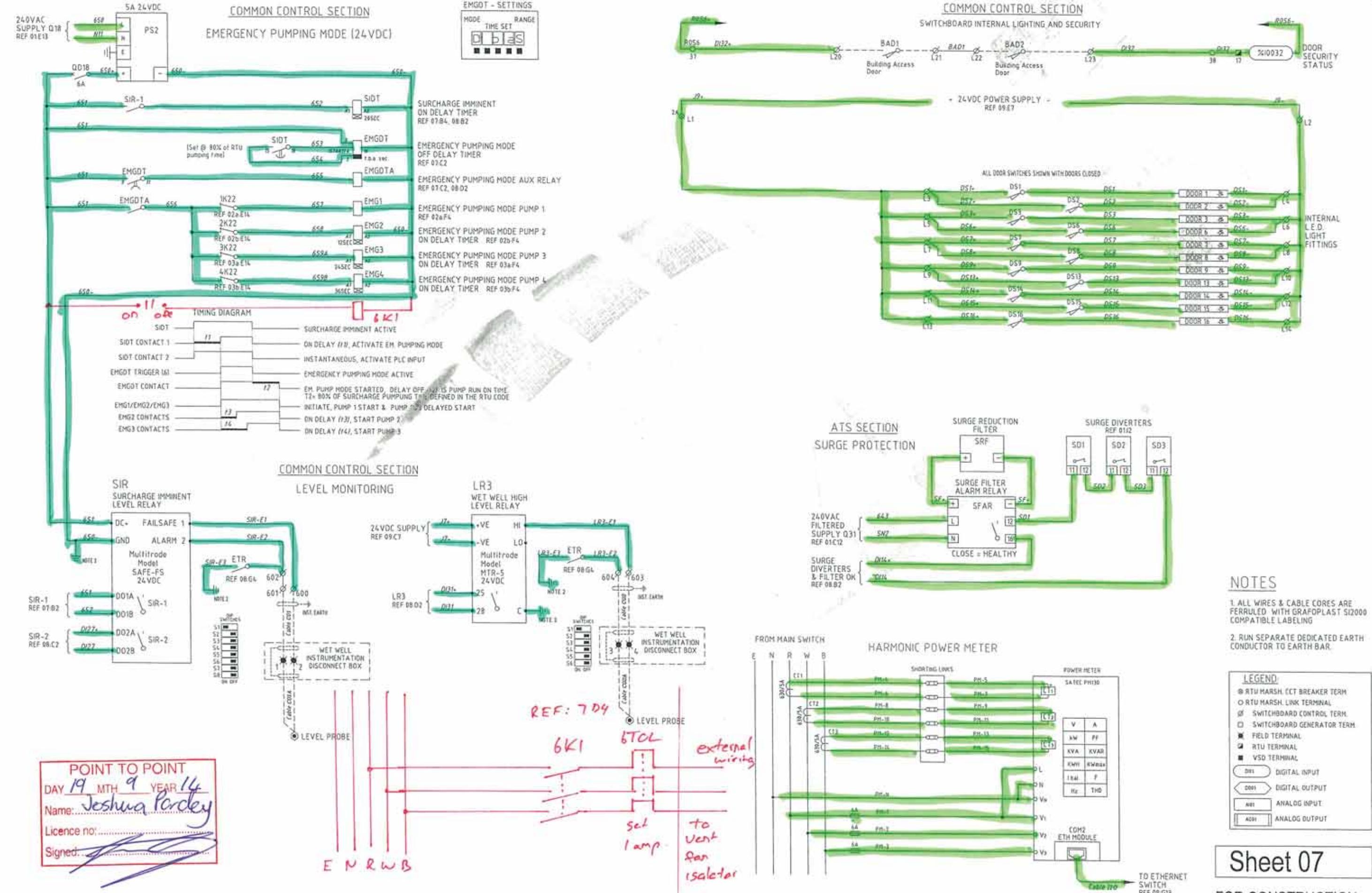
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								SP033	ADAM STREET		
								SEWAGE PUMP STATION			
									TITLE	MTS CONTROL	
									WIRING DIAGRAM		
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										Queensland Urban Utilities DRAWING No.	
										486/5/7-0471-006	A



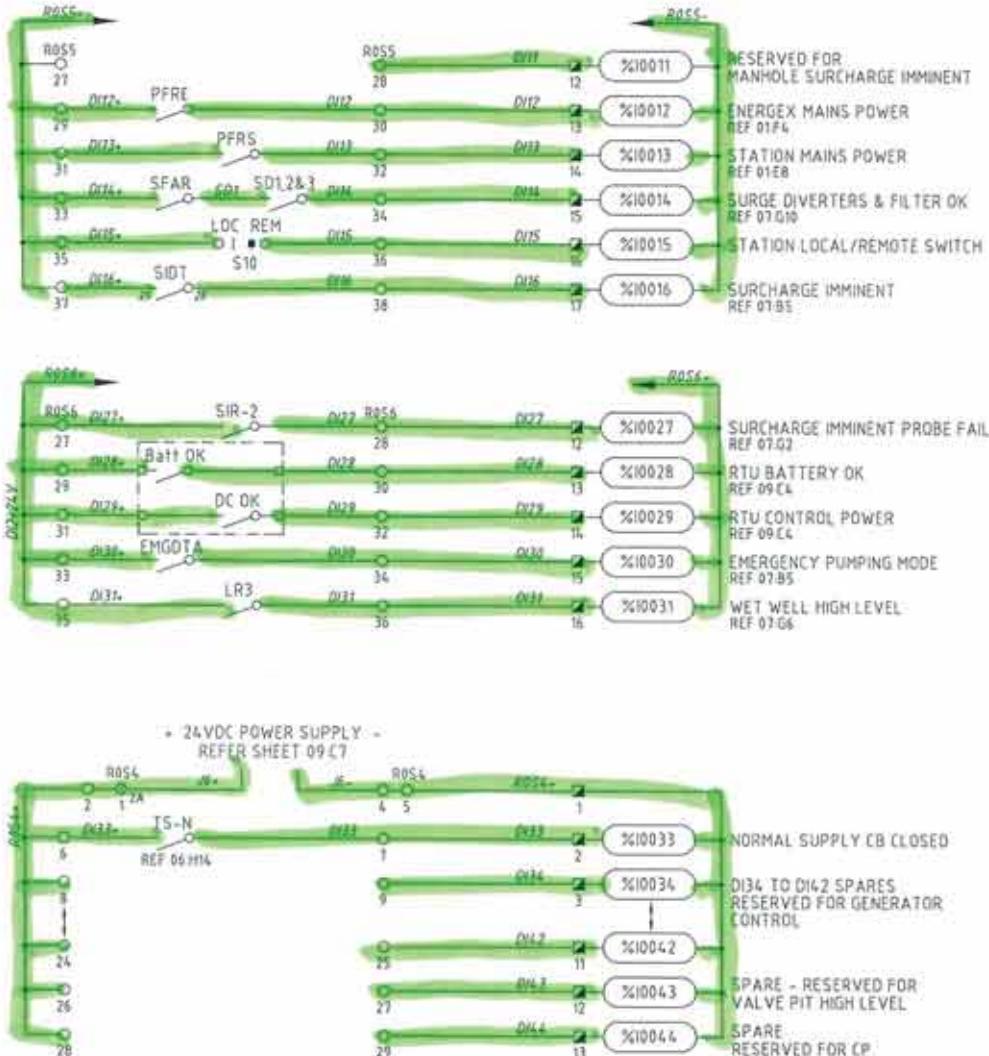
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FOR CONSTRUCTION											
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O 03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_A	A.WITTHOFT	8895	5-3-14	ADAM STREET	SCHEMATIC DIAGRAM	Queensland Urban Utilities DRAWING No.
No. DATE	AMENDMENT	DRILL	APL	B.I.C.C. FILE No.		DESIGN CHECK	R.P.E.Q. No.	DATE	SEWAGE PUMP STATION		AMEND.
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URBAN UTILITIES QUEENSLAND											
THIS TEMPLATE IS FOR Version 1.0											

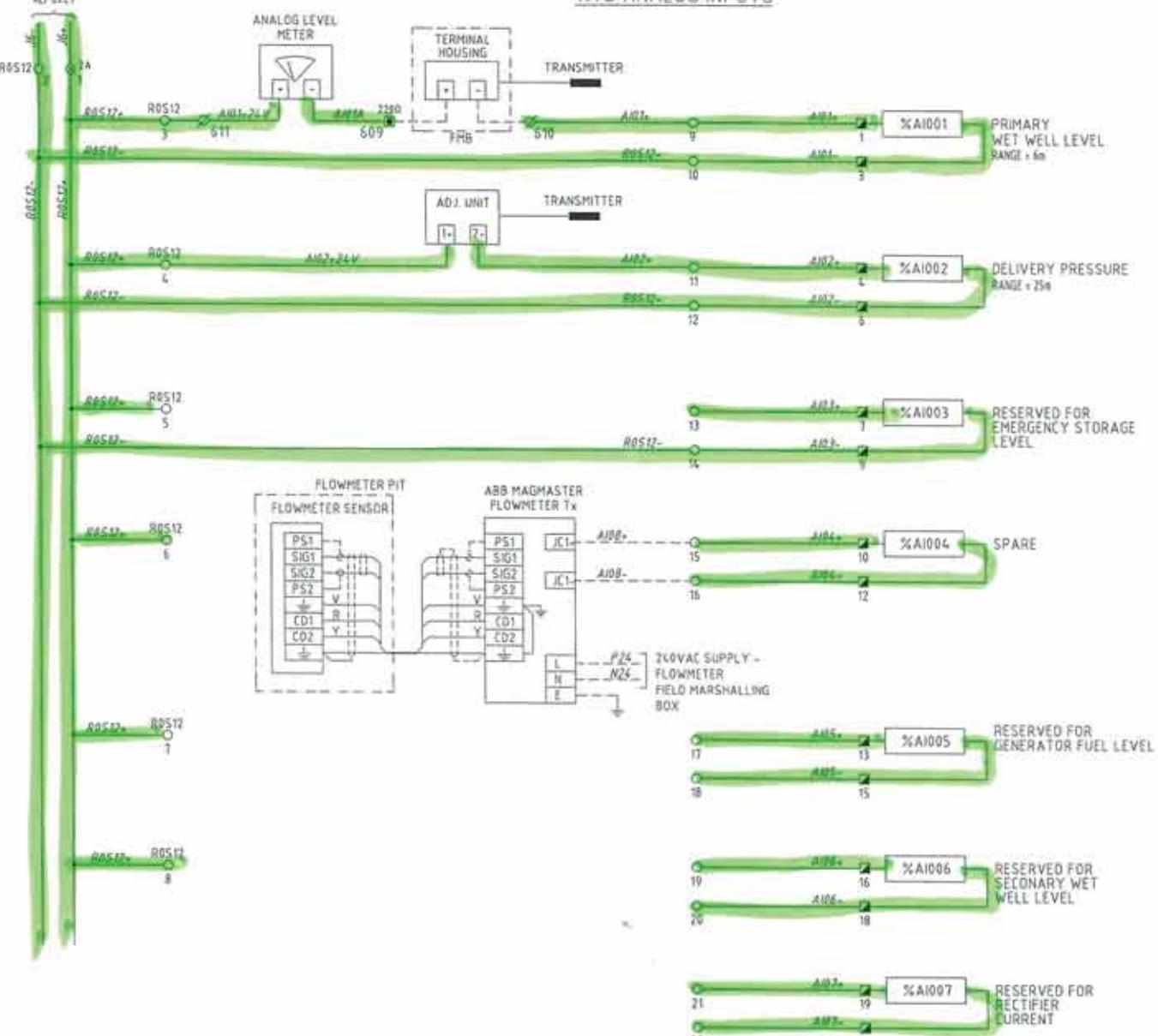


POINT TO POINT			
DAY	19	MTH	9
YEAR 14			
Name:	Joshua Porchey		
Licence no:			
Signed:			

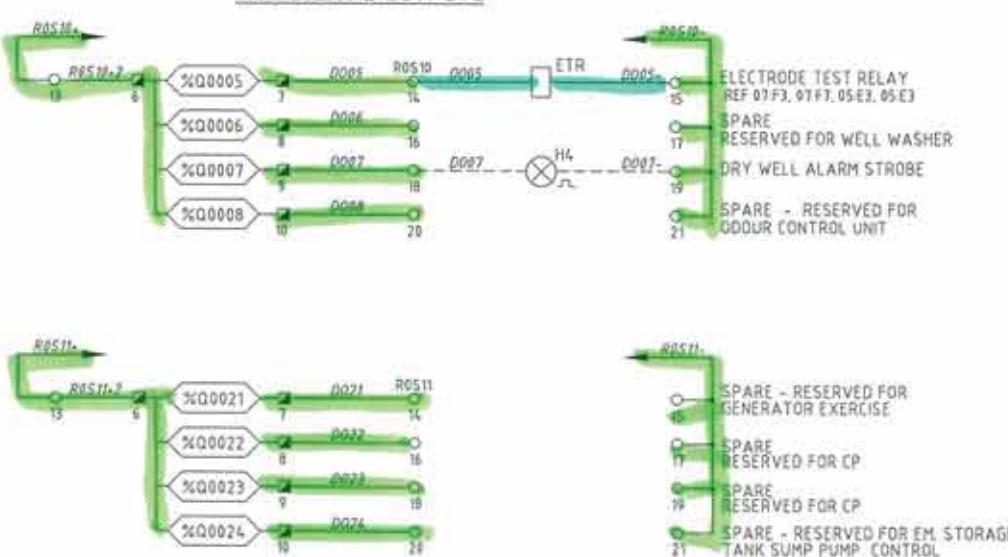
RTU DIGITAL INPUTS



#### RTU ANALOG INPUTS



## RTU DIGITAL OUTPUTS



#### RTU ANALOG OUTPUTS

POINT TO POINT		
DAY	19	MTH 9 YEAR 14
Name: Joshua Pardoe		
Licence no.		
Signed: 		

## NOTES

- 1 ALL WIRES & CABLE CORES ARE  
FERRULED WITH GRAFOPLAST SI2000  
COMPATIBLE LABELING.

**LEGEND:**

- ④ RTU MARSH. CCT-BREAKER TERM
  - RTU MARSH. LINK TERMINAL
  - ▢ SWITCHBOARD CONTROL TERM.
  - SWITCHBOARD GENERATOR TERM.
  - FIELD TERMINAL
  - ▲ RTU TERMINAL
  - COMPONENT TERMINAL
  - VSD TERMINAL

**DIB** DIGITAL INPUT

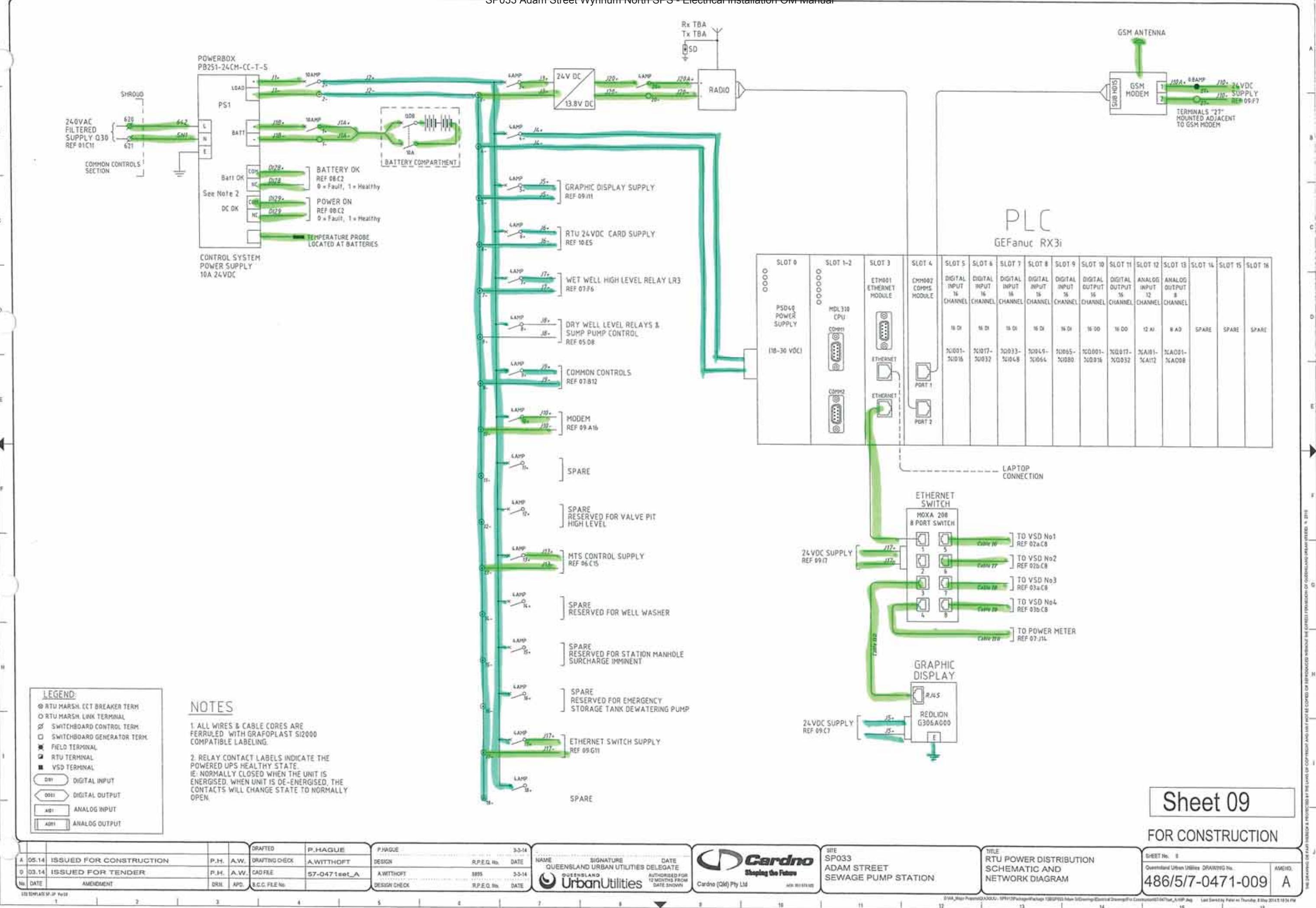
**DOB** DIGITAL OUTPUT

**AIO** ANALOG INPUT

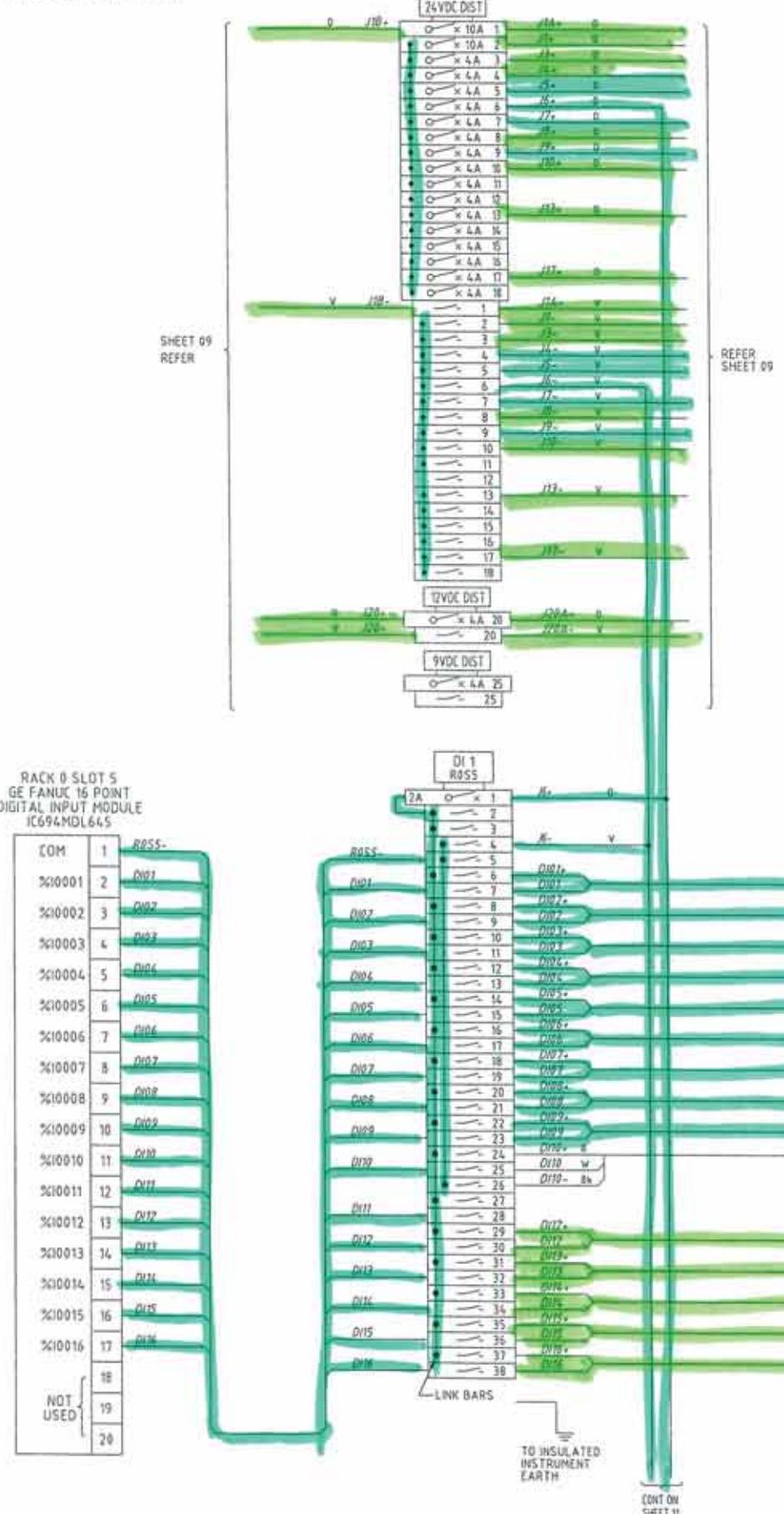
**AOD** ANALOG OUTPUT

Sheet 08

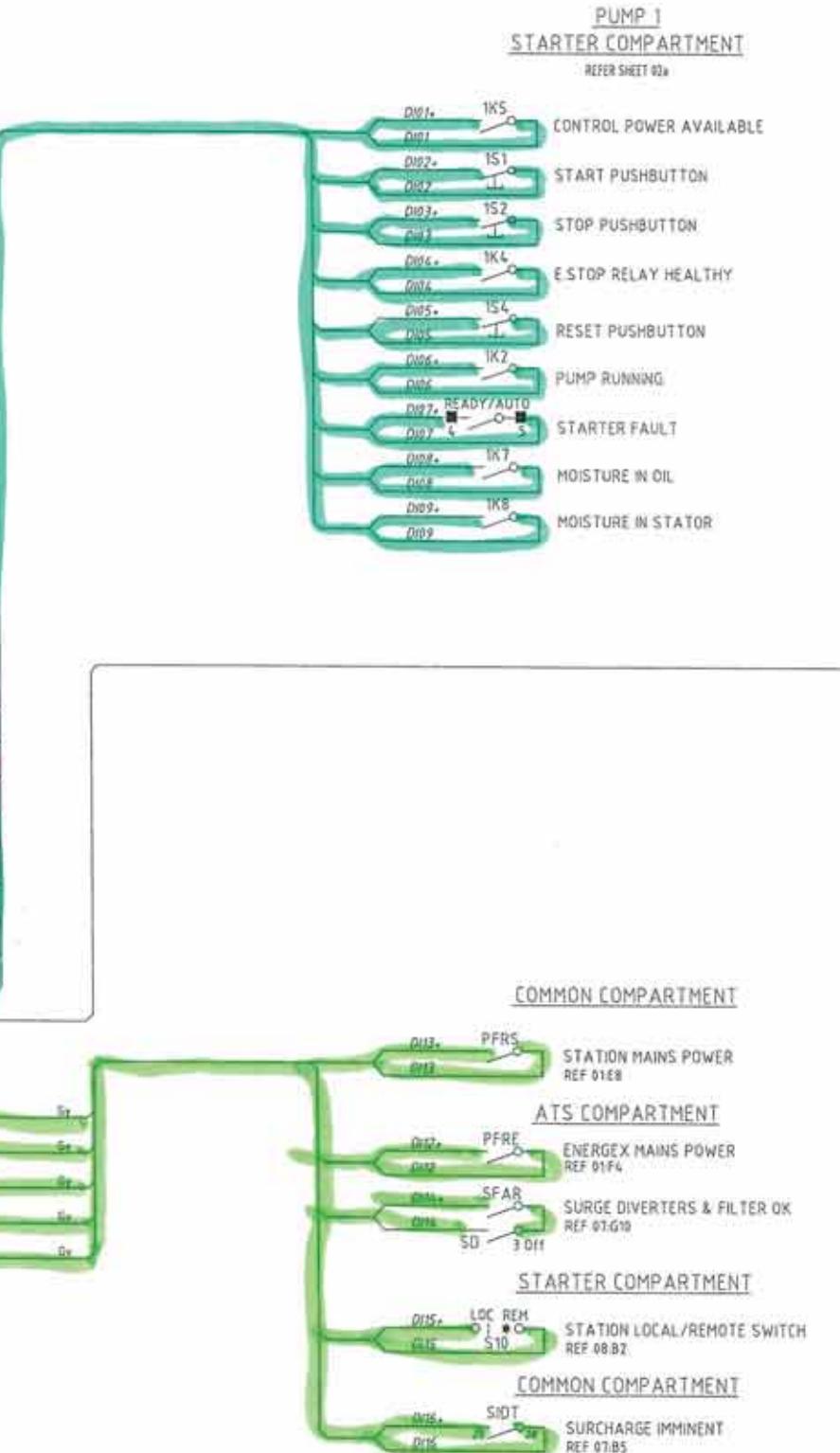
FOR CONSTRUCTION



## RTU COMPARTMENT



## SWITCHBOARD



**POINT TO POINT**  
DAY 19 MTH 9 YEAR 14  
Name: Joshua Pardley  
Licence no:  
Signed:

**Sheet 10**

**FOR CONSTRUCTION**

A 05.14 ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	SITE	TITLE	SHEET No.
O 03.14 ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	A.WITTHOFT	3-3-14	QUEENSLAND URBAN UTILITIES DELEGATE			SP033	RTU DIGITAL INPUTS	10
No DATE	AMENDMENT	DRN.	APD.	B.C.C. FILE N.	57-0471set_A		DESIGN	R.P.E.Q. No.	DATE	ADAM STREET SEWAGE PUMP STATION	TERMINATION DIAGRAM	Queensland Urban Utilities DRAWING No.

## RTU COMPARTMENT

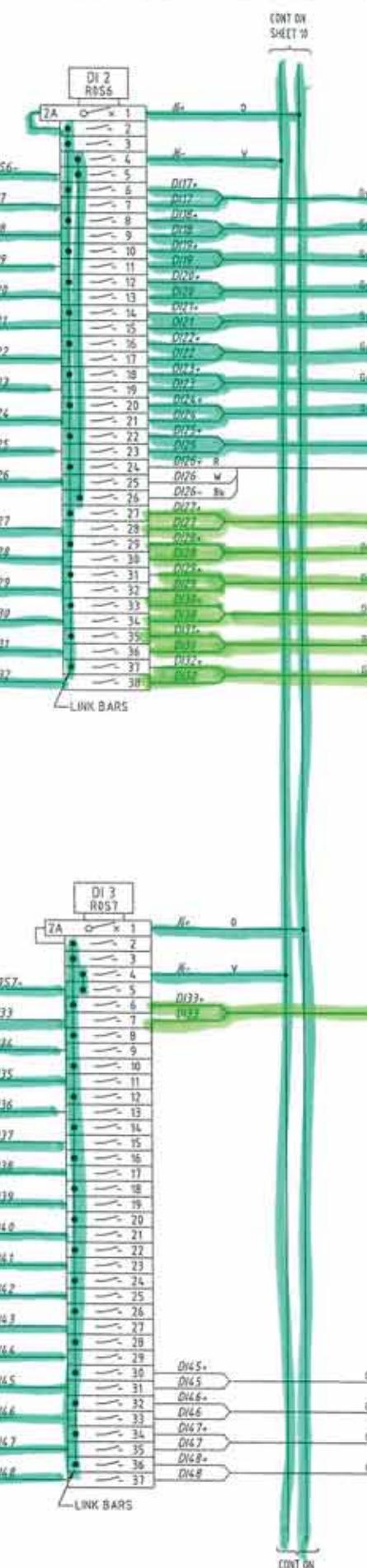
RACK 0 SLOT 6  
GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

COM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
%I0017																				
%I0018																				
%I0019																				
%I0020																				
%I0021																				
%I0022																				
%I0023																				
%I0024																				
%I0025																				
%I0026																				
%I0027																				
%I0028																				
%I0029																				
%I0030																				
%I0031																				
%I0032																				
NOT USED																				

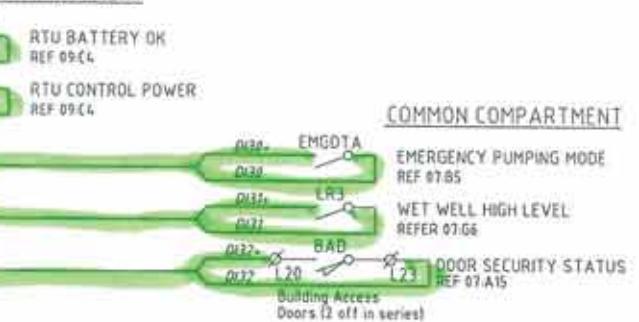
RACK 0 SLOT 7  
GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

COM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
%I0033																				
%I0034																				
%I0035																				
%I0036																				
%I0037																				
%I0038																				
%I0039																				
%I0040																				
%I0041																				
%I0042																				
%I0043																				
%I0044																				
%I0045																				
%I0046																				
%I0047																				
%I0048																				
NOT USED																				

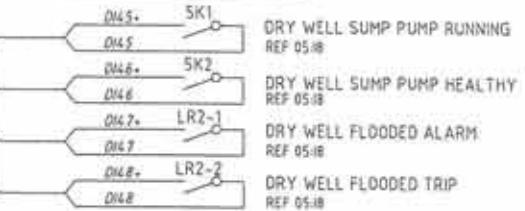
CONT ON SHEET 11



CONT ON SHEET 12

PUMP 2  
STARTER COMPARTMENT  
REFER SHEET 07COMMON COMPARTMENT  
SURCHARGE IMMINENT PROBE FAIL  
REF 07.G2

## SUMP PUMP COMPARTMENT

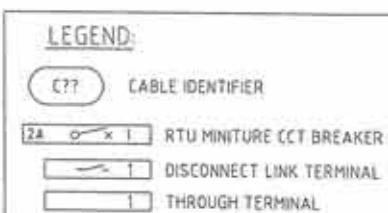
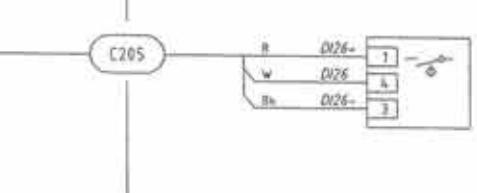


## NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.

## SWITCHBOARD

POINT TO POINT  
DAY 19 MTH 9 YEAR 14  
Name: Joshua Pardey  
Licence no:  
Signed:

PUMP 2  
REFLUX PROXIMITY SWITCH  
REF 07.E12

Sheet 11  
FOR CONSTRUCTION

A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	AMEND.
D 03.14	ISSUED FOR TENDER	P.H.	A.W.	DRAFT FILE	AWITTHOFT	AWITTHOFT	3-3-14	QUEENSLAND URBAN UTILITIES DELEGATE	APPROVED FOR 12 MONTHS FROM DATE SHOWN		
NA	DATE			APD:	57-0471set_A						
	AMENDMENT			B.C.C. FILE NO.							

**Cardno**  
Shaping the Future  
Cardno (Qld) Pty Ltd

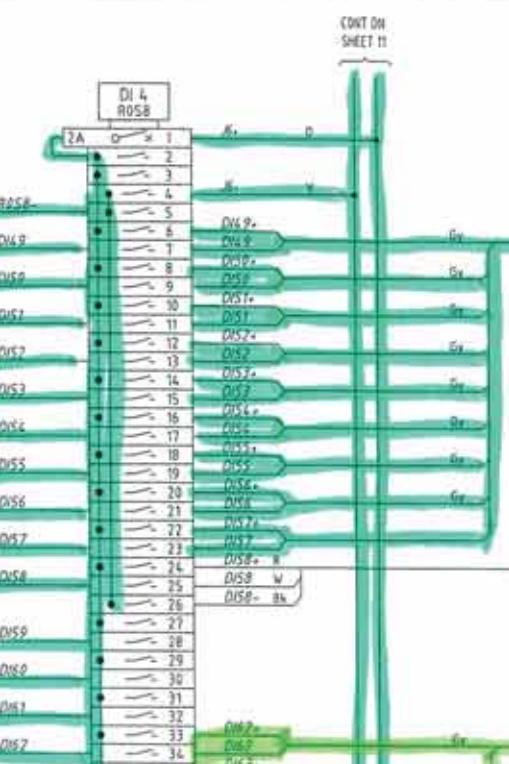
SP033  
ADAM STREET  
SEWAGE PUMP STATION  
TITLE  
RTU DIGITAL INPUTS  
TERMINATION DIAGRAM  
SHEET 2 OF 3

Sheet No. 11  
Queensland Urban Utilities DRAWING No.  
486/5/7-0471-011 A

## RTU COMPARTMENT

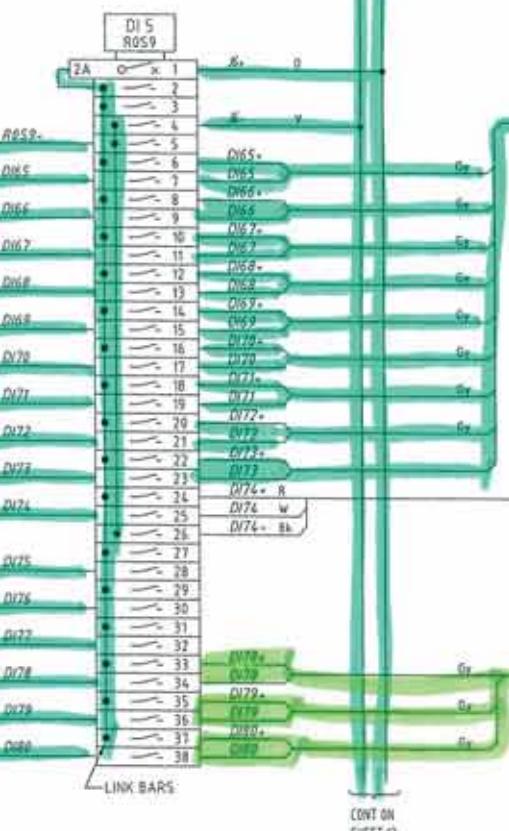
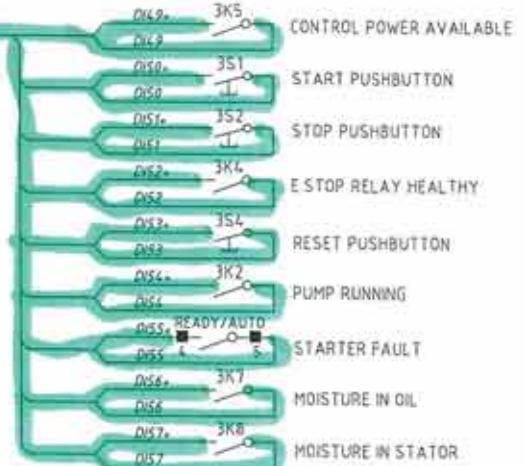
RACK 0 SLOT 8  
GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

COM	1	R058-
%I0049	2	D169
%I0050	3	D150
%I0051	4	D151
%I0052	5	D152
%I0053	6	D153
%I0054	7	D154
%I0055	8	D155
%I0056	9	D156
%I0057	10	D157
%I0058	11	D158
%I0059	12	D159
%I0060	13	D160
%I0061	14	D161
%I0062	15	D162
%I0063	16	D163
%I0064	17	D164
NOT USED	18	
	19	
	20	



RACK 0 SLOT 9  
GE FANUC 16 POINT  
DIGITAL INPUT MODULE  
IC694MDL645

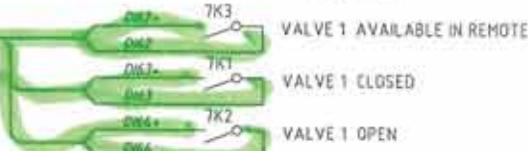
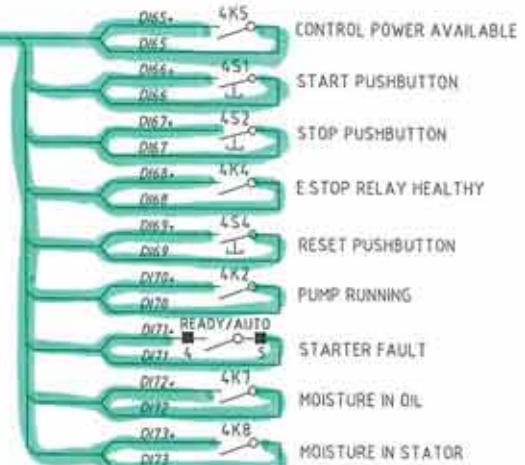
COM	1	R059-
%I0065	2	D175
%I0066	3	D176
%I0067	4	D177
%I0068	5	D178
%I0069	6	D179
%I0070	7	D170
%I0071	8	D171
%I0072	9	D172
%I0073	10	D173
%I0074	11	D174
%I0075	12	D175
%I0076	13	D176
%I0077	14	D177
%I0078	15	D178
%I0079	16	D179
%I0080	17	D180
NOT USED	18	
	19	
	20	

PUMP 3  
STARTER COMPARTMENT  
REFER SHEET 03a

## SWITCHBOARD

POINT TO POINT  
DAY 19 MTH 9 YEAR 14  
Name: Joshua Bordey  
Licence no.:  
Signed:

PUMP 3  
REFLUX PROXIMITY SWITCH  
REF 03a.C12

MOTORIZED VALVE 1  
CONTROL COMPARTMENT  
REFER SHEET 4aPUMP 4  
STARTER COMPARTMENT  
REFER SHEET 03b

NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING.

## LEGEND:

- C?? CABLE IDENTIFIER
- 2A O x 1 RTU MINIATURE CCT BREAKER
- 1 DISCONNECT LINK TERMINAL
- 1 THROUGH TERMINAL

Sheet 12

FOR CONSTRUCTION

A 05.14 ISSUED FOR CONSTRUCTION	P.H.	DRAFTED	P.HAGUE	PHAGUE	3-14
0 03.14 ISSUED FOR TENDER	P.H.	A.W.	GRAFTING CHECK	A.WITHHOFT	DESIGN
0 DATE	0 DATE	0 CAD FILE	0 57-0471set_A	0 A.WITHHOFT	0 R.F.E.Q. No. 0 DATE

NAME: QUEENSLAND URBAN UTILITIES DELEGATE  
SIGNATURE:   
DATE: 23-14  
R.F.E.Q. No. 3395 R.F.E.Q. No. 3395

DATE: 23-14  
AUTORISED FOR 12 MONTHS FROM DATE SHOWN

DATE: 23-14  
Cardno (Qld) Pty Ltd

SITE: SP033  
ADAM STREET  
SEWAGE PUMP STATION

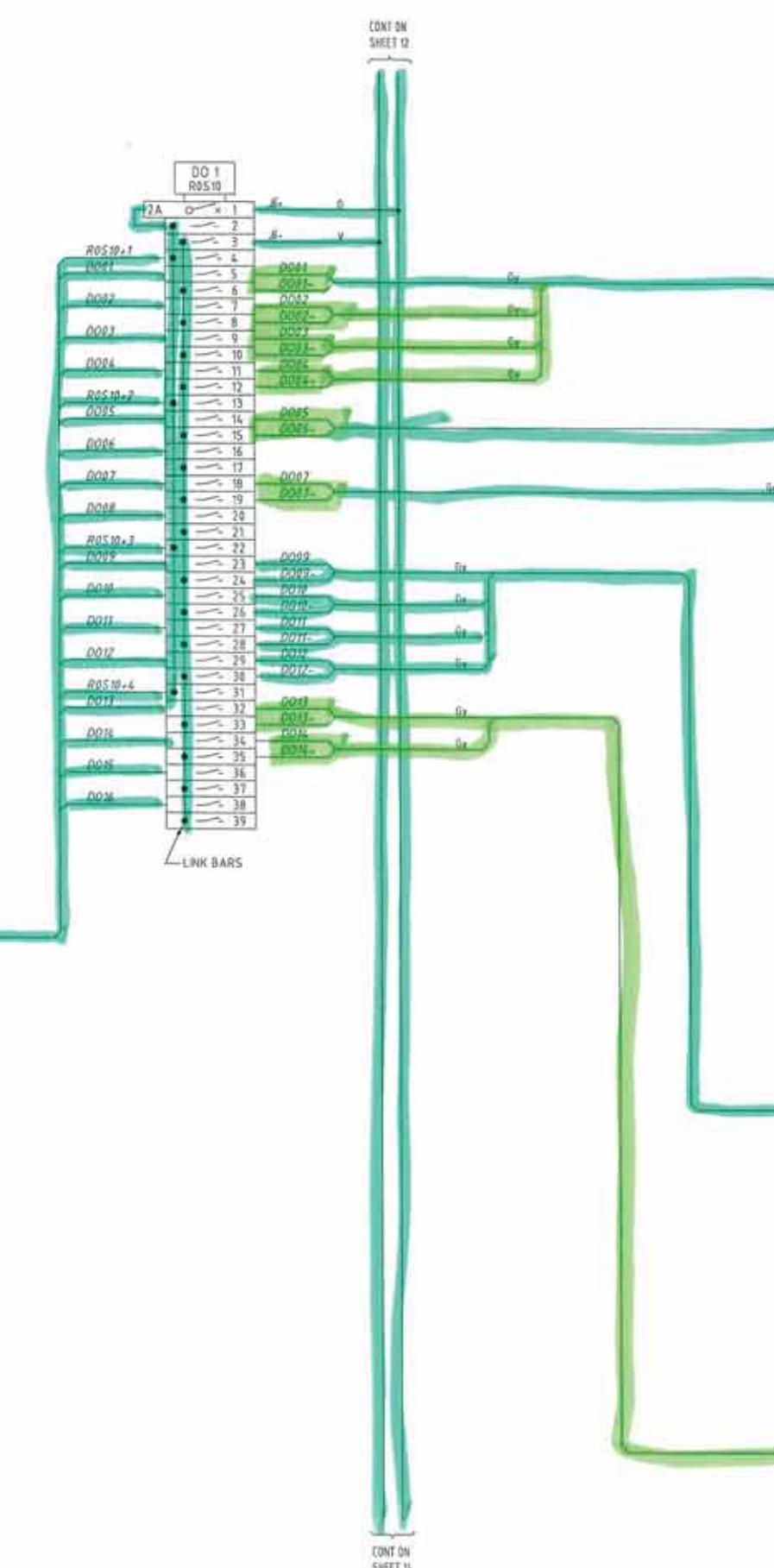
TITLE: RTU DIGITAL INPUTS  
TERMINATION DIAGRAM  
SHEET 3 OF 3

SHEET NO. 12  
Queensland Urban Utilities DRAWING NO.  
486/5/7-0471-012 AMEND. A

## RTU COMPARTMENT

RACK 0 SLOT 10  
GE FANUC 16 POINT  
DIGITAL OUTPUT MODULE  
IE694MDL940

COM1	1	R05M1
	2	DO1
%Q0001	3	DO2
%Q0002	4	DO3
%Q0003	5	DO4
%Q0004	6	R05M1.2
COM2	7	DO5
%Q0005	8	DO6
%Q0006	9	DO7
%Q0007	10	DO8
COM3	11	R05M1.3
%Q0008	12	DO9
%Q0009	13	DO10
%Q0010	14	DO11
%Q0011	15	DO12
COM4	16	R05M1.4
%Q0012	17	DO13
%Q0013	18	DO14
%Q0014	19	DO15
%Q0015	20	DO16



## SWITCHBOARD

PUMP 1  
STARTER COMPARTMENT

REFER SHEET 02a

- |     |      |                                 |
|-----|------|---------------------------------|
| 001 | 1K20 | PUMP 1 RUN COMMAND              |
| 002 | 1K21 | REFER 02a.E14                   |
| 003 | 1K22 | PUMP 1 FAULT RESET              |
| 004 | 1K23 | REFER 02a.E14                   |
| 005 | 1K24 | PUMP 1 EMERGENCY MODE INTERRUPT |
| 006 | 1K25 | REFER 02a.E14                   |
| 007 | 1K26 | PUMP 1 RUN AT MAXIMUM           |
| 008 | 1K27 | REFER 02a.E14                   |

## COMMON COMPARTMENT

ETR  
ELECTRODE TEST RELAY  
REFER 08.04C13 → BI D007 → H4  
DRY WELL ALARM STROBEPUMP 3  
STARTER COMPARTMENT

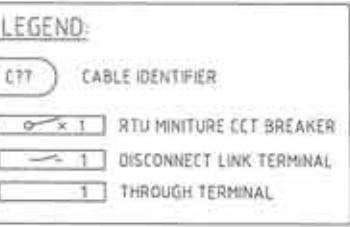
REFER SHEET 03a

- |      |      |                                 |
|------|------|---------------------------------|
| D009 | 3K20 | PUMP 3 RUN COMMAND              |
| D010 | 3K21 | REFER 03a.E14                   |
| D011 | 3K22 | PUMP 3 FAULT RESET              |
| D012 | 3K23 | REFER 03a.E14                   |
| D013 | 3K24 | PUMP 3 EMERGENCY MODE INTERRUPT |
| D014 | 3K25 | REFER 03a.E14                   |
| D015 | 3K26 | PUMP 3 RUN AT MAXIMUM           |
| D016 | 3K27 | REFER 03a.E14                   |

MOTORIZED VALVE 1  
CONTROL COMPARTMENT

REFER SHEET 04a

- |      |      |               |
|------|------|---------------|
| 0013 | 7K20 | VALVE 1 CLOSE |
| 0014 | 7K21 | REFER 04a.E14 |
| 0015 | 7K22 | VALVE 1 OPEN  |
| 0016 | 7K23 | REFER 04a.E14 |



## FIELD

POINT TO POINT  
DAY 19 MTH 9 YEAR 14  
Name: Joshua Pardley  
Licence no:  
Signed:

Sheet 13

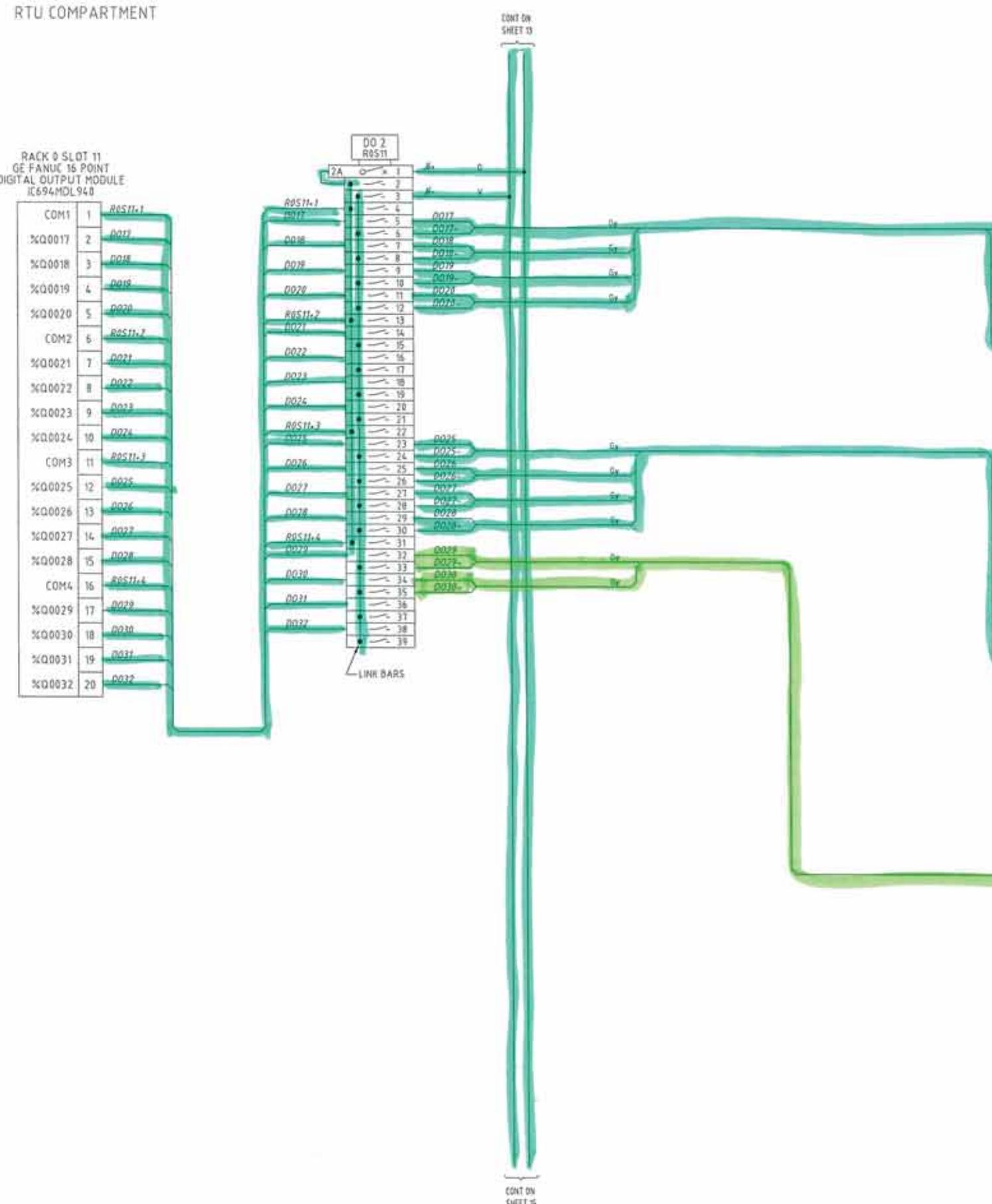
FOR CONSTRUCTION

SHEET NO. 13  
Queensland Urban Utilities DRAWING NO.  
486/5/7-0471-013 AMEND. ANOTES  
1. ALL WIRES & CABLE CORES ARE  
FERRULED WITH GRAFOPLAST 512000  
COMPATIBLE LABELING

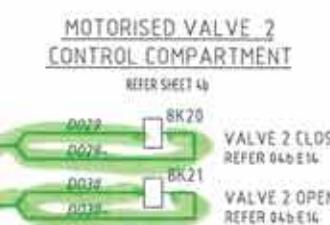
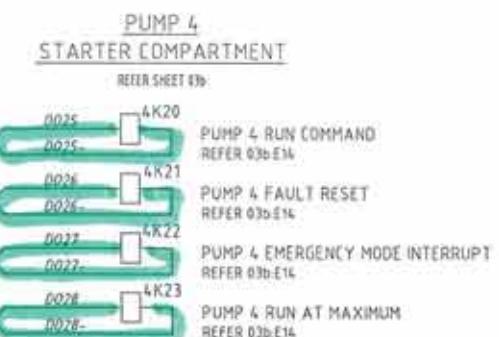
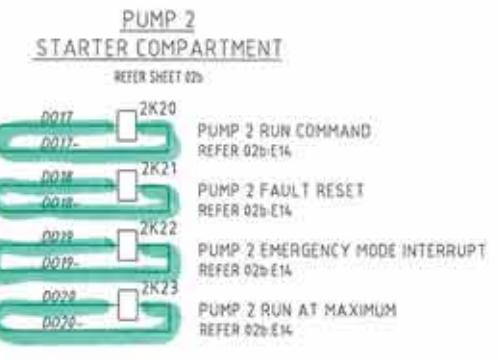
A 05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTED	P.HAGUE	P.HAGUE	5-14	NAME	SIGNATURE	DATE	SITE	TITLE	SHEET NO.
0 03.14	ISSUED FOR TENDER	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	A.WITTHOFT		QUEENSLAND URBAN UTILITIES DELEGATE		DATE	SP033	RTU DIGITAL OUTPUTS	
No. DATE	AMENDMENT	DRN.	APD.	CAD FILE	57-0471set_A	DESIGN CHECK		A.WITTHOFT	DATE	APR 2014	ADAM STREET	TERMINATION DIAGRAM	



RTU COMPARTMENT



**SWITCHBOARD**



POINT TO POINT
DAY <u>19</u> MTH <u>9</u> YEAR <u>14</u>
Name: <u>Joshua Parkey</u>
Licence no: _____
Signed: 

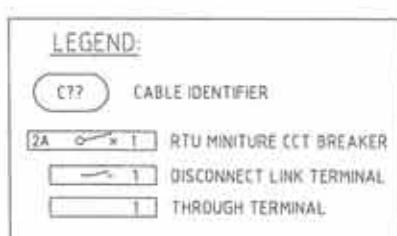
FIELD

## NOTES

ALL WIRES & CABLE CORES ARE  
FERRULED WITH GRAFOPLAST SI2000  
COMPATIBLE LABELING

Sheet 14

FOR CONSTRUCTION



			DRAFTED	P.HAGUE	HAGUE	3-3-14	NAME	SIGNATURE
A	05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFFT	R.P.E.O. No.	DATE
B	03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_A	A.WITTHOFFT	RESS
No.	DATE	AMENDMENT	OPAL	APD	B.C.C. FILE NO.		DESIGN CHECK	R.P.E.O. No.



 **Cardno**  
Shaping the Future  
Cardno (Qld) Pty Ltd      ACN 001 274 942

SITE  
SP033  
ADAM STREET  
SEWAGE PUMP STATION

**RTU DIGITAL OUTPUTS  
TERMINATION DIAGRAM**

Queensland Urban Utilities DRAWING No.  
486/5/7-0471-014

## RTU COMPARTMENT

A

RACK 0 SLOT 12  
GE FANUC 12 POINT  
ANALOG INPUT MODULE  
IC694ALG112

%AI001	CH1	lin 1	A107a
	Rtn 3	A107b	
%AI002	CH2	lin 4	A107c
	Rtn 6	A107d	
%AI003	CH3	lin 7	A107e
	Rtn 9	A107f	
%AI004	CH4	lin 10	A107g
	Rtn 12	A107h	
%AI005	CH5	lin 13	A105+
	Rtn 15	A105-	
%AI006	CH6	lin 16	A106+
	Rtn 18	A106-	
%AI007	CH7	lin 19	A107+
	Rtn 21	A107-	
%AI008	CH8	lin 22	A108+
	Rtn 24	A108-	
%AI009	CH9	lin 25	A109+
	Rtn 27	A109-	
%AI010	CH10	lin 28	A110+
	Rtn 30	A110-	
%AI011	CH11	lin 31	A111+
	Rtn 33	A111-	
%AI012	CH12	lin 34	A112+
	Rtn 36	A112-	

CONT'D  
ON SHEET 14

B

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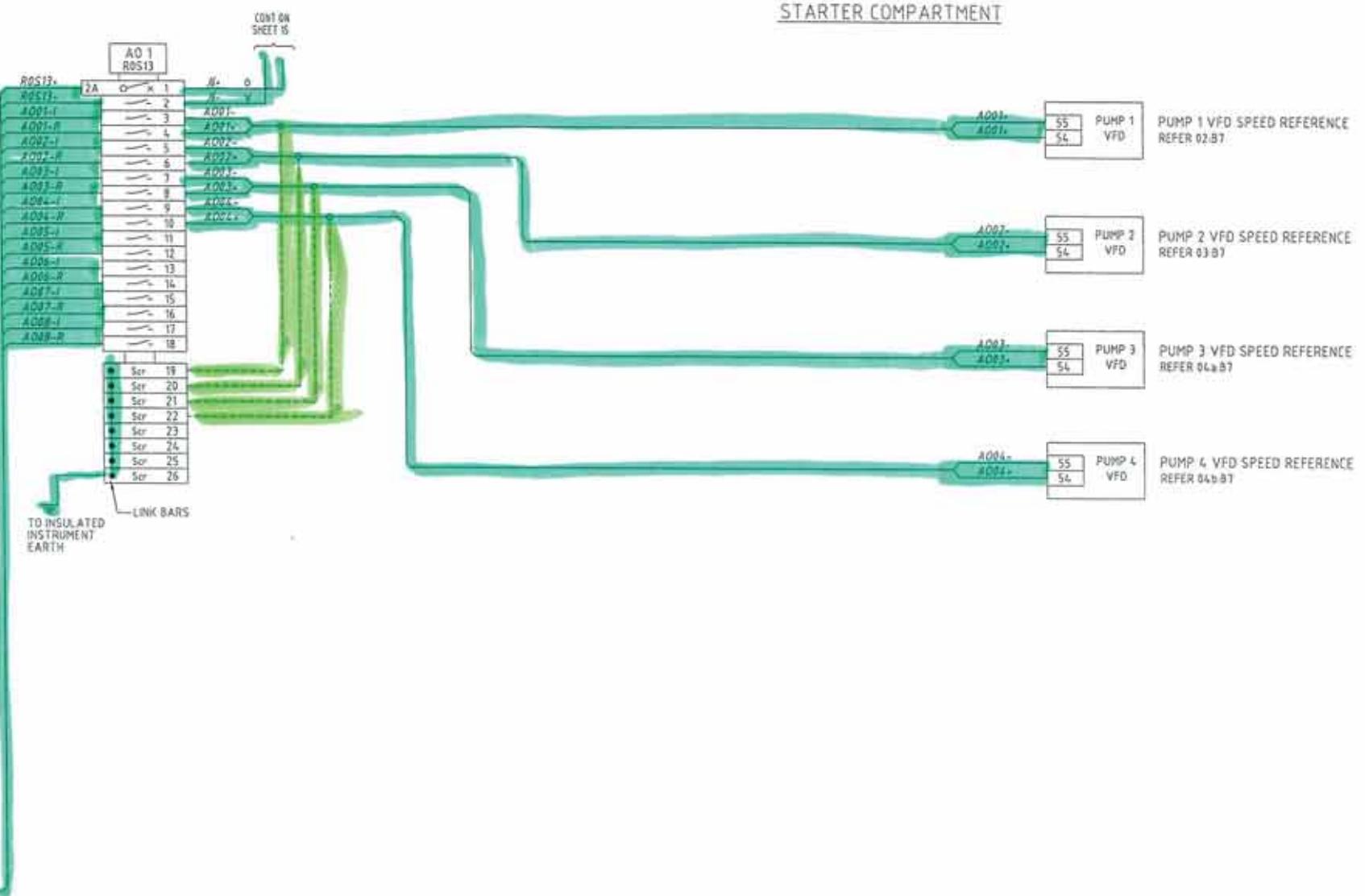
## RTU COMPARTMENT

## SWITCHBOARD

FIELD

RACK 0 SLOT 13  
GE FANUC 8 POINT  
NALOG OUTPUT MODULE  
IC694ALGB08

%A0001	CH1	Iout1	1	A001-I
		Ret1	2	A001-R
			3	
			4	
%A0002	CH2	Iout2	5	A002-I
		Ret2	6	A002-R
			7	
			8	
%A0003	CH3	Iout3	9	A003-I
		Ret3	10	A003-R
			11	
			12	
%A0004	CH4	Iout4	13	A004-I
		Ret4	14	A004-R
			15	
			16	
%A0005	CH5	Iout5	17	A005-I
		Ret5	18	A005-R
			19	
			20	
%A0006	CH6	Iout6	21	A006-I
		Ret6	22	A006-R
			23	
			24	
%A0007	CH7	Iout7	25	A007-I
		Ret7	26	A007-R
			27	
			28	
%A0008	CH8	Iout8	29	A008-I
		Ret8	30	A008-R
			31	
			32	
			33	
			34	
			35	
			36	



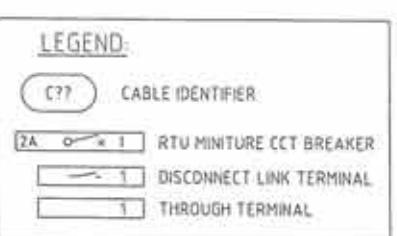
**POINT TO POINT**  
19 MTH 9 YEAR 14  
*Joshua Pardey*

## NOTES

1. ALL WIRES & CABLE CORES ARE  
FERRULED WITH GRAFOPLAST SI2000  
COMPATIBLE LABELING

Sheet 16

## FOR CONSTRUCTION



			DRAFTED	P.HAGUE	P.HAGUE				
A	05.14	ISSUED FOR CONSTRUCTION	P.H.	A.W.	DRAFTING CHECK	A.WITTHOFT	DESIGN	R.P.E.O. No.	DATE
O	03.14	ISSUED FOR TENDER	P.H.	A.W.	CAD FILE	57-0471set_A	A.WITTHOFT	BBB	3-3-14
No	DATE	AMENDMENT	DRN.	APD.	S.C.C. FILE No.		DESIGN CHECK	R.P.E.O. No.	DATE



DATE  
DELEGATE  
AUTHORISED FOR  
13 MONTHS FROM  
DATE SHOWN



**Cardin**  
Shaping the Future

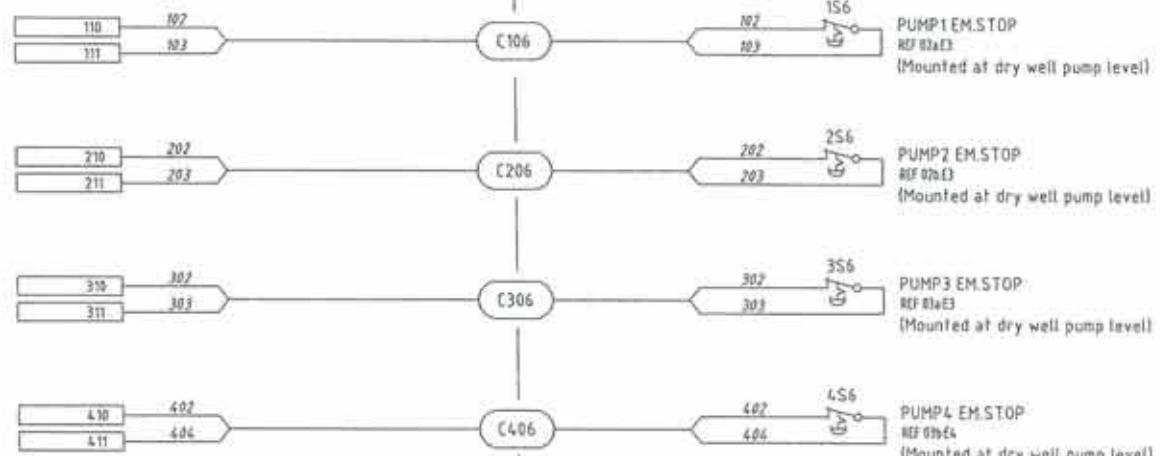
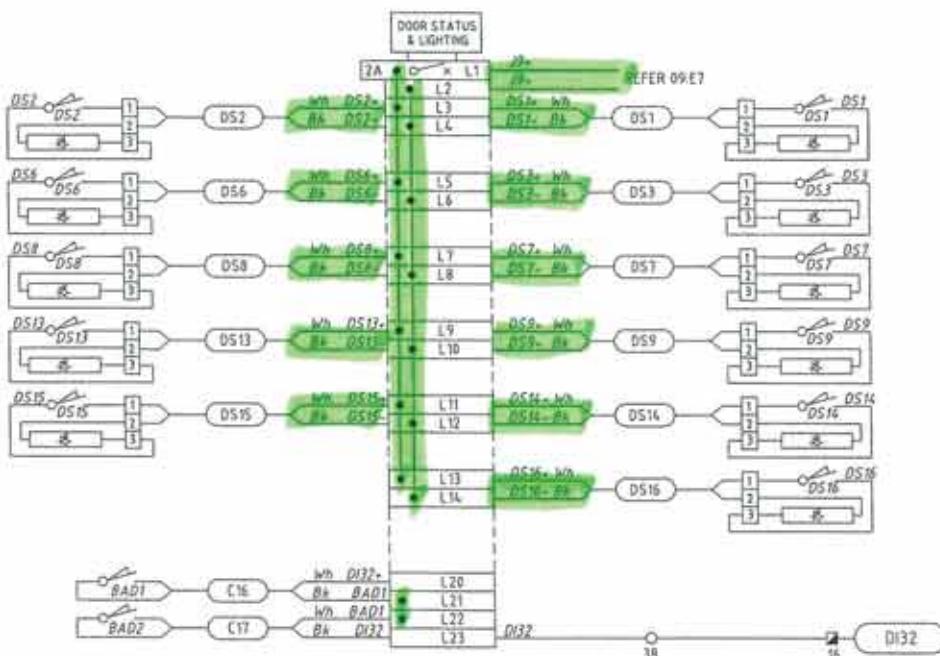
Cardin (Qld) Pty Ltd

SITE  
SP033  
ADAM STREET  
SEWAGE PUMP STATION

**RTU ANALOG OUTPUTS  
TERMINATION DIAGRAM**

SHEET No. 16  
Queensland Urban Utilities DRAWING No.  
**486/5/7-0471-016**

**POINT TO POINT**  
 DAY 19 MTH 9 YEAR 14  
 Name: Joshua Parday  
 Licence no.:  
 Signed: [Signature]

**SWITCHBOARD INTERNAL LIGHTING AND SECURITY**

LEGEND:	
C??	CABLE IDENTIFIER
2A	RTU MINIATURE CCT BREAKER
—	DISCONNECT LINK TERMINAL
—	THROUGH TERMINAL

**NOTES**

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELING

**Sheet 17****FOR CONSTRUCTION**

A 05.14	ISSUED FOR CONSTRUCTION	P.H.	DRAFTED	P.HAGUE	P.HAGUE	3-3-14	NAME	SIGNATURE	DATE	SITE	TITLE	SHEET No.
D 03.14	ISSUED FOR TENDER	P.H.	DRAFTING CHECK	A.WITTHOFT	A.WITTHOFT	3-3-14	QUEENSLAND URBAN UTILITIES DELEGATE			SP033	COMMON CONTROLS	17
N/A	AMENDMENT	P.H.	CAD FILE	57-0471set_A	A.WITTHOFT	3-3-14	QUEENSLAND Urban Utilities			ADAM STREET	TERMINATION DIAGRAM	Queensland Urban Utilities DRAWING No.
		APD.	B.C.C. FILE NO.		DESIGN CHECK	R.P.E.Q. No.				SEWAGE PUMP STATION		486/5/7-0471-017

# 4. Inspection and Test Results



## Inspection and Test Check List

Project: Adam St Pump Station		SJ Electric Job No. 43402226
Contractor / Order No.		
ITC No. 003	Date: 24/9/14	Corresponding ITP No. 001
General Data		
Built By: Joshua Parday/Chris L	Test Equipment: Multimeter / Megger	
Location Tested: SJ W/Shop	Type: Fluke / Kyoritsu	
Drg Rev No.	Serial No. 15120299 / 5132742	

Check List (Tick ( ) acceptable items only, note deviations under "REMARKS") (If not applicable mark as N/A)

## Switch Board and Control Panels Construction Check List

"This check list is to be used in conjunction with the correct construct schematic / wiring diagrams"

Item	Activity Description	Hold Points	Checked	By (Initial)
Busbar				
1	Correct size busbar to rated current load to meet AS 2067		(✓)	
2	Appearance is good i.e. Straight & level		(✓)	
3	Correct phase identification		(✓)	
4	Correct hole sizes for joins and terminations		(✓)	
5	All clearances have been meet		(✓)	
6	Correct busbar support material has been used and edges sealed with varnish.		(✓)	
7	Busbar supports are at the correct distances apart		(✓)	
8	Correct tensioning at all joins & terminations and witnessed marked.		(✓)	
9	Correct hole format in joining cubicle		(✓)	
10	Sufficient clearances for terminating cable		(✓)	
11	All joins are dressed flat		(✓)	
12	Busbar is insulated at supports when required,		(✓)	
Cabling				
13	Correct size for demand of circuit		(✓)	
14	Correct phase colouring		(✓)	
15	Correct termination & insulated		(✓)	
16	Correct numbering		(✓)	
17	Correctly formed and neat		(✓)	
18	Correctly supported		(✓)	
19	All cable entry holes are insulated		(✓)	
20	Check cable tray is mounted correctly & all sharp surfaces are removed		(✓)	
21	All cable ties are neatly trimmed		(✓)	
22	All cable clear from busbar's		(✓)	
23	Check all analog inputs and outputs are shielded		(✓)	
26	All shielded cables have been earthed		(✓)	✓

Remarks/Remedial Action Required Hold Points:

Remedial Actions Completed

Signature: .....

Date: .....



## Inspection and Test Check List

Switch Board and Control Panels Construction Check List (SJQF 502)				
Item	Activity Description	Hold Points	Checked	By (Initial)
<b>Switchgear</b>				
1	Check all main switches & circuit breakers are the correct <ul style="list-style-type: none"> <li>• current rating</li> <li>• ka rating.</li> <li>• trip settings</li> <li>• correct to cabling</li> <li>• to labels.</li> <li>• shunt trips</li> <li>• inter locks</li> </ul>		(✓) (✓) (✓) (✓) (✓) (✓) (✓)	JP
2	Check the fixings		(✓)	
3	Check the number of poles		(✓)	
4	Check correct operation		(✓)	
5	Correct mechanism		(✓)	
<b>Control Switches</b>				
6	Check correct number of positions		(✓)	
7	Check correct size		(✓)	
8	Check correct to labels		(✓)	
9	Check mountings		(✓)	
<b>Contactors</b>				
10	Check for correct model no		(✓)	
11	Check for correct current rating to control		(✓)	
12	Correct auxiliary contacts		(✓)	
13	Correct phasing		(✓)	
14	Correct coil size		(✓)	
15	Check that it is accessible		(✓)	
16	Check it has correct overloads		(✓)	
17	Correct labelling		(✓)	
<b>Relays and Timers</b>				
18	Check correct rated voltage		(✓)	
19	Correct contacts		(✓)	
20	Correct variances		(✓)	
21	Dip switches in required position		(✓)	
22	Timers set to correct settings		(✓)	Some values not given
23	Correct operation		(✓)	
24	Correct auxiliaries		(✓)	
<b>Transformers and Power Supplies</b>				
25	Check for correct voltage ratings		(✓)	
26	Check for correct current ratings		(✓)	
27	Check cabling is correct (no crossed voltage)		(✓)	
28	Check the secondary has been earthed when applicable		(✓)	
29	Check correct labelling		(✓)	
30	Check mountings		(✓)	
31	Check for clearance around for heat extraction		(✓)	✓
Remarks/Remedial Action Required:				
Remedial Actions Completed <input type="checkbox"/>		Signature.....		Date:



## Inspection and Test Check List

Switch Board and Control Panels Construction Check List (SJQF 502)				
Item	Activity Description	Hold Points	Checked	By (Initial)
<b>Fuses</b>				
1	Check that the cartridge is correct size		(✓)	JP
2	Correct mountings		(✓)	
3	Correct labelling		(✓)	
4	Check that line side conductors are SDI		(✓)	
<b>Current Transformers</b>				
5	Correct ratio & size		(✓)	
6	Correct direction of feed		(✓)	
7	Correct earthing		(✓)	
8	Correct cabling		(✓)	
<b>Voltage / Current Monitoring Equipment</b>				
9	Correct voltage / current range on meter to the installation		(✓)	
10	Correct Ct Ratio		(✓)	
11	Voltmeter terminations are insulated		(✓)	
12	Check that all meters are preset to zero		(✓)	
13	Correct indication labels applied		(✓)	
<b>Indication Equipment</b>				
14	Correct colour		(✓)	
15	Correct voltage size with matching lamp attached		(✓)	
16	Correct operation eg. Push to test		(✓)	
17	Correct labelling		(✓)	
<b>Terminal Blocks</b>				
18	Correct size to cable		(✓)	
19	Correct colour coding		(✓)	
20	Correct numbering		(✓)	
21	Correctly mounted with lock ends		(✓)	
22	Correct labels		(✓)	
<b>Neutral Links</b>				
23	Check that they are accessible		(✓)	
24	Correct labelling		(✓)	
25	Correct numbers stamped to match circuit identification		(✓)	
26	Correct cabling to circuit identification		(✓)	
27	Check that all neutral links & bar are insulated from the switchboard frame		(✓)	
<b>Earthing</b>				
28	Check that all main earth bar is correct size		(✓)	
29	Check that the main earth is continuous		(✓)	
30	Correctly labelled		(✓)	
31	Continuous for CT wiring		(✓)	
32	Check that all doors with equipment mount are electrically earthed		(✓)	
33	Check all frames are earthed		(✓)	
<b>Remarks/Remedial Action Required:</b>				
Remedial Actions Completed <input type="checkbox"/>		Signature: .....		Date: .....



## Inspection and Test Check List

Switch Board and Control Panels Construction Check List (SJQF 502)				
Item	Activity Description	Hold Points	Checked	By (Initial)
Earthing Resistance & Continuity Test (Note all readings should be < 0.5 Ω )				
1	Make sure the MEN connection is removed		(✓)	JP
2	Attach lead to main earth connection point than test with other lead between		(✓)	
3	The frame of each section		(✓)	
4	The doors		(✓)	
5	All mounting bolts to all equipment		(✓)	
6	All brackets		(✓)	
7	All earth links		(✓)	
8	All bolts & threads for the mounting of escutcheon		(✓)	
9	All gland plates		(✓)	
10	All cable trays		(✓)	
11	All earth connection		(✓)	
12	Earth secondary of transformers and power supplies where applicable		(✓)	
13	Earth surge diverters		(✓)	
14	Current transformers		(✓)	
Insulation Test		Hold Points	Test Result	By (Initial)
1	Make sure all control fuses and earths are removed from all electronic equipment before this test is carried out		(✓)	JP
2	Set insulation tester (meggar) to 500 volts before proceeding. Note reading to be > 1M Ω		(✓)	
3	Test between:		+200MΩ	
	• Red - White		+200MΩ	
	• Red - Blue		+200MΩ	
	• Red - Earth		+200MΩ	
	• Red - Neutral		+200MΩ	
	• White - Blue		+200MΩ	
	• White - Earth		+200MΩ	
	• White - Neutral		+200MΩ	
	• Blue - Earth		+200MΩ	
	• Blue - Neutral		+200MΩ	
4	If all readings are clear the insulation tester is to be set at 1000 volts then proceed with the following. Note reading to be > 1M Ω		( )	
5	Test between:		+200MΩ	
	• Red - White		+200MΩ	
	• Red - Blue		+200MΩ	
	• Red - Earth		+200MΩ	
	• Red - Neutral		+200MΩ	
	• White - Blue		+200MΩ	
	• White - Earth		+200MΩ	
	• White - Neutral		+200MΩ	
	• Blue - Earth		+200MΩ	
	• Blue - Neutral		+200MΩ	
Remarks/Remedial Action Required:				
Remedial Actions Completed <input type="checkbox"/>		Signature: .....		Date: .....



## Inspection and Test Check List

Switch Board and Control Panels Construction Check List (SJQF 502)				
Item	Activity Description	Hold Points	Checked	By (Initial)
	2.5 KV Test This test is used to prove all busbar construction			
1	Make sure all control fuses and earths are removed from all electronic equipment before this test is carried out		( )	
2	All the following tests must be set at a 1 minute time period		( )	
		Hold Points	Test Result	By (Initial)
3	Test between: <ul style="list-style-type: none"> <li>• Red - White</li> <li>• Red - Blue</li> <li>• Red - Earth</li> <li>• Red - Neutral</li> <li>• White - Blue</li> <li>• White - Earth</li> <li>• White - Neutral</li> <li>• Blue - Earth</li> <li>• Blue - Neutral</li> </ul>			
Supply Authority section				
1	Check supply authority main isolator lockable in the on position		(✓)	JP
2	Check all doors before the Ct's. Or meters are lockable		(✓)	
3	Check where the neutral link is located for the site connection if metres are remotely mounted		(↔)	
4	Check where the earth link is located for the site connection if meters are remotely mounted		(↔)	
5	Check double insulated cable for POT fuses are less than 500 mm		(✓)	
6	Check double insulated cable are taken on line side of Ct.s		(✓)	
7	Check meter wiring is in building wire and correct size		(✓)	
8	Check if Ct meter wiring is in steel conduit when closer than 100mm to other conductors		(↔)	
9	Check there is no equipment connected before on the line side of meters or Ct.s (i.e., surge diverters)		(✓)	
10	Check list may vary if switch board is going interstate. Alter where applicable		(↔)	
11	Provide black wrap when needed		(✓)	
Remarks/Remedial Action Required:				
Remedial Actions Completed <input type="checkbox"/>		Signature: .....		Date: .....

## Inspection and Test Check List

Switch Board and Control Panels Construction Check List (SJQF 502)				
Item	Activity Description	Hold Points	Checked	By (Initial)
	Functional Test			
Prior to connection of supply all inspection and test check lists must be completed		Hold Points	Checked	By (Initial)
1	Point to point test on all cables as per schematic and single line drgs. (Leave spot for drawing. No's and Rev No's)		(✓)	JP
2	Check all Cts are not open circuit		✓	
Connect supply (personal protection equipment must be used)		Hold Points	Test Result	By (Initial)
3	Check polarity of connection <ul style="list-style-type: none"> <li>• Red - White</li> <li>• Red - Blue</li> <li>• Red - Earth</li> <li>• Red - Neutral</li> <li>• White - Blue</li> <li>• White - Earth</li> <li>• White - Neutral</li> <li>• Blue - Earth</li> <li>• Blue - Neutral</li> </ul>		(✓)	JP
		Hold Points	Checked	By (Initial)
4	Correct voltage / current range on meter to the installation		(✓)	
5	Check functional operation of switchboard following specific construction issue drawings (leave spot for drawing No's and Rev No's)		(✓)	JP
6	Check operation of all RCD's		(✓)	
	Final delivery check list		( )	
1	Check all punch list items are complete		(✓)	
2	Check if Compliance label is mounted and correct		(✓)	
3	Check if heat shrinks is supplied when necessary		(✓)	
4	Check all load bolts are supplied		(✓)	
5	Check if m.e.n is mounted after testing		(✓)	
6	All drawings have been as built red lined and supplied and signed for to drafting office		(✓)	
	Received by drafting Office (Sign) .....		(✓)	
7	Photos have been taken of every section and given to manager		(✓)	
8	Test reports have been photo copied and placed in the client folder and SJ Electric folder		(✓)	
9	Manuals placed in client folder		(✓)	✓
10	As built drawings placed in client folder. (Latest revision (✓) Copy of red lined marked Drawing (✓)			

Remarks/Remedial Action Required:

Remedial Actions Completed  Signature: ..... Date: .....Tested By: Joshua Farley

Signature: ..... Date: .....

Signature: David LawrenceWitnessed By: David LawrenceElectrical Licence No. 122714Signature: David Lawrence Date: 24/9/14

All the above signatories certify that the Electrical switchboard work listed has been checked and tested in accordance with the prescribed procedure and that such work complies in every respect with the requirements of the Electricity Act 2002, AS3000 2007 and AS3008.1 1998

## CB RATINGS SHEET

Job No. 43402216

Project Adam St  
switchboard Pump Station

Circuit Breaker Reference	Circuit Breaker Manufacturer	Type	KA rating	Rating	In	Ir	$I_f$	Isd	Settings
Normal Supply	Terasaki	C/B	50	630	1	6			
Main Switch	Terasaki	C/B	50	630	1	6			
Generator Supply									
Main Switch	Terasaki	C/B	30	63	1	.8			
Sub Isolator	Terasaki	C/B	50	400	.7	6			
Pump 1	Terasaki	C/B	50	400	.7	6			
Pump 2	Terasaki	C/B	36	160	.8	6			
Pump 3	Terasaki	C/B	36	160	.8	6			
Pump 4	Terasaki	C/B	30	20	.63	.8			
Swing Pump	Terasaki								



**Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests**

<b>Site ID</b> SP033	<b>Site Name</b> - Adam St, Wynnum	<b>Date</b> 12/5/15	
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#### A. Electrical Installation Test Records

AS/NZS 3000:2007 requires that prior to placing an electrical installation or any part thereof in service following its construction, alteration, addition or repair, it shall be inspected and tested to verify that the installation is safe to energize and that it will operate correctly in accordance with the requirements of AS3000:2007.

This section is aimed to ensure that the switchboard manufacturer has carried out and documented all applicable AS3000:2007 tests considered as mandatory, prior to execution of the Factory Acceptance Test.

AS/NZS 3017 Electrical Installations – Verification Guidelines provides inspection, test methods and test acceptance parameters to verify AS3000:2007 safety requirements, however these methods are provided for guidance and other alternative methods are acceptable, AS3017:2007 may be applied through legislative requirements made in each State and Territory of Australia and in New Zealand.

Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
A.1						AS3000:2007 Section 8.3.5 AS3017:2007 Section 3.1
A.2						For acceptance criteria and test methods refer to: AS3000:2007 Section 8.3.6 AS3017:2007 Section 3.2

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**Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests**

Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
A.3						For acceptance criteria and test methods refer to: AS3000:2007 Section 8.3.7 AS3017:2007 Sections 3.3 and 3.5
A.4	Records for the verification of Correct Circuit connection tests records shall include:  a) Interconnection between conductors of different circuits b) Socket-Outlet Sub-Circuits c) Lighting Points d) Equipment Sub-circuits	✓  ✓  ✓  ✓				For acceptance criteria and test methods refer to: AS3000:2007 Section 8.3.8 AS3017:2007 Section 3.4
A.5	Records for the verification of operation of RCD's shall include:  a) Circuits protected by an RCD	✓				For acceptance criteria and test methods refer to: AS3000:2007 Section 8.3.10 AS3017:2007 Section 3.7

Company Name SJ Electric Group Qld

Company Electrical Licence No:73286

Contractor's Tester Name - Joshua Parday Signature

Date 12/5/15

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QUU Electrical Inspector Name John Clayton

Signature.....

A handwritten signature in black ink that reads "John Clayton". The signature is fluid and cursive, with "John" on top and "Clayton" below it.

Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests

Date

25/5/15

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## B. Testing Area, Documentation and Test Set Up Arrangements

This section is aimed to ensure that all documentation and test set up arrangements have been provided to allow execution and readiness to carry out the FAT.

Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
B.1	Verify that a suitable test area has been provided, the test area shall be: <ul style="list-style-type: none"><li>• Clearly identified and barricaded</li><li>• Test bench with enough space for testing equipment and documentation</li><li>• Well ventilated</li></ul>	✓ ✓ ✓				
B.2	All testing equipment to simulate field inputs and outputs including field instruments and motors shall be pre-connected	✓				
B.3	Progressive "As Built" drawings marked up available.	✓				
B.4	"Point to Point" test drawing and Function Test schematic mark-ups provided	✓				A set for each

Company Name SJ Electric Group Qld

Contractor's Tester Name Joshua Parday

QUU Electrical Inspector Name John Clayton

Signature.....

Signature.....

Company Electrical Licence No: 73286

Date 12/5/15

Date 25/5/15

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**Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests**

**C. Visual Inspections - Sheet Metal / Mechanical Construction Works**

The following visual inspections shall take place previous to energising the switchboard circuits. All power supplies shall be disconnected, including the main power supply, generator power supplies and battery power supplies.

Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
C.1	Switchboard dimensions correct as per contract drawings	✓				
C.2	Panel layout as per drawings	✓				
C.3	All equipment is to be removable from switchboard via front access.	✓				
C.4	Power distribution chassis not to be installed too close to the left of the door aperture	✓				
C.5	Check operation and orientation of doors and door handles	✓				
C.6	Switchboard mounting feet as per drawing	✓				
C.7	Material finish as per specification	✓				
C.8	IP Rating as per specifications. Fitting of sun shields shall maintain IP56 rating.			✓		
C.9	All bolts fitted / tight	✓				
C.10	All sheet metal edging to be de-burred,	✓				

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Major Projects & Commercial Services  
 Checklist  
 Pre Factory Inspection Tests

Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
	special attention given to handle/lock access heat shield cuts.					
C.11	Door, hinges and locks are properly fitted to allow closing without forcing the door or being loose.	✓				
C.12	Lock barrels are mounted neatly. Door penetration and holes shall be suited to the particular lock barrel type.	✓				
C.13	Lock barrel types are provided as required and operate correctly	✓				
C.14	Energex Padlock Supplied		✓			
C.15	All doors sealing shall be properly fitted and firmly secured to the switchboard. Glue shall be provided if necessary.	✓				
C.16	Verify that proximity switch metal plates are fixed to doors as indicated in the drawings.		✓			
C.17	Ensure to pre-drill holes in plates that are difficult to access after the construction or installation of the switchboard on site.  Particular attention shall be given to internal barrier plates and access plate on distribution board.			✓		

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**Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests**

Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
C.18	Cut outs from one cubicle to another please shall be large enough to accommodate all cables.	✓				
C.19	Sealing between plinth and switchboard.	✓				
C.20	Sealing of disconnect zone.			✓		
C.21	Verify that portable generator cable access plate allows the generator plug pass into the switchboard and reach the generator connection outlet.			✓		
C.22	Inspection plates are properly labelled and not used as gland plates. Inspection plates are only provided to ease access to field wiring.			✓		
C.23	Verify that all gland entries are sealed – No split gland plates	✓				
C.24	All spare holes to be plugged with conduit plugs.	✓				
C.25	Enclosure free of debris	✓				
C.26	Lap top support tray provided including 1/4 turn wing knob on laptop support shelf. Knobs types that cannot be operated by hand are not acceptable.	✓				

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Major Projects & Commercial Services  
 Checklist  
 Pre Factory Inspection Tests

Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
C.27	Drawings & log book holder provided	✓				
C.28	Aerial support is adjustable		✓			Fit the male to female elbow and barrel union to the switchboard
C.29	A minimum clearance of 55mm shall be provided around the Redlion HMI to other components mounted in common controls door.	✓				
C.30	Check that selector switches are correctly engraved	✓				
C.31	Check that Indicators are fitted with correct coloured bezels	✓				
C.32	Verify that all external labels are fitted to the switchboard.	✓				
C.33	Labelling is correct and complete - wording, size, fixing, material, level.	✓				
C.34	All internal and external labels are to have bevelled edges, sharp edges are not allowed.	✓				
C.35	Verify that <del>240</del> <sup>415</sup> VAC warning sign is fitted to the switchboard.	✓		☒		

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**Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests**

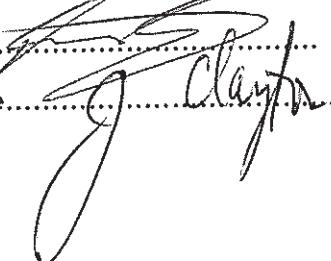
**Company Name** SJ Electric Group Qld

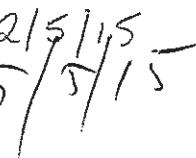
**Contractor's Tester Name** Joshua Parday

**QUU Electrical Inspector Name** John Clayton

**Company Electrical Licence No:** 73286

Signature .....

Signature.....  


Date 12/5/15  
Date 25/5/15  


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#### D. Visual Inspections- Neutral and Earthing

A visual inspection shall be made when work on an electrical installation has been completed in order to verify that the work complies with the requirements of AS/NZS 3000.

The visual inspection shall be carried out before, or in association with testing, and as far as possible it should be made before the electrical installation is placed in service.

Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
D.1	N/L & E/L have adequate bolts for main Neutral & Earth	✓				
D.2	Earth bar / earth connections fitted & OK	✓				
D.3	All neutral connections are accessible	✓				
D.4	MEN connections provided	✓				
D.5	Neutral & earth connections are not in CT section	✓				
D.6	Surge diverter earthed to adjacent stud.		✓			Taken to neutral
D.7	Confirm a Direct connection from main earth bar to switchboard chassis	✓				

Company Name SJ Electric Group Qld

Company Electrical Licence No: 73286

Contractor's Tester Name Joshua Parday Signature

Date 12/5/15

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QUU Electrical Inspector Name John Clayton

Signature.....

Date

#### E. Visual Inspections - Electrical Components Mounting, Wiring and Labelling

As a minimum a visual inspection shall be made when work on an electrical installation has been completed in order to verify that the work complies with the requirements of AS/NZS 3000. This visual inspection section includes AS/NZS 3000 checks as well as several checks to verify that the electrical installation meets the specific design and quality requirements and scope of work.

The visual inspection shall be carried out before, or in association with testing, and as far as possible it should be made before the electrical installation is placed in service.

Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
E.1	Busbars appropriately shielded	✓		✓		
E.2	Verify that main switches/circuit breakers and fuses are supplied to the specification (equipment schedule)	✓		✓		
E.3	Main switches lockable/ defeatable as per spec.	✓		✓		
E.4	Check operation of Main Supply and Generator supply mechanical and/or key interlocks as applicable.	✓		✓		
E.5	Verify that metering fuses & CT's are fed off from main switch line side	✓		✓		

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**Major Projects & Commercial Services  
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Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
E.6	Verify that cable lugs are provided into CRITEC 20 kA surge filter circuit breaker (in most cases Q17)	✓	7	.		
E.7	Equipment fed from line side shall be appropriately labelled.	✓	7	.		
E.8	Include 2nd label for Surge Diverter and Surge Diverter fuses "FED FROM LINE SIDE OF MAIN SWITCH" as applicable (Items 37/38 on switchboard label schedule).	✓	7	.		
E.9	All Circuit Breakers shall be set as indicated in the electrical schematic drawings.	✓	7	.		Require circuit breaker setting document
E.10	All circuit breakers shall be wired line side at the top / load side at the bottom	✓	7	.		
E.11	Verify that cables current carrying capacity is as indicated in the electrical schematic drawings.	✓	7	.		
E.12	Colour coding of wiring as per specification.	✓	7	.		
E.13	Wiring in PVC ducting shall be kept tidy.	✓	7	.		
E.14	Check cable access dimensions	✓	7	.		
E.15	Check cable access & routes for field cabling.	✓	7	.		
E.16	Check phasing of circuits are as per					

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**Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests**

Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
	drawing.					
E.17	Electrical components fitted are as specified in the equipment schedule	✓		✓		
E.18	Verify that quantity and location of GPOs are provided as required in the drawings.	✓		✓		
E.19	Confirm all Idec relays are LED type and wired the correct polarity	✓		✓		
E.20	Verify that digital timer is mounted on its own specific base (IDEC base) as specified in the equipment list (Item 99 -EMGDT)	✓		✓	<i>[Signature]</i>	Using a different type of timer (omron)
E.21	Check that generator plug has protective cover fitted	✗		✓	<i>[Signature]</i>	
E.22	Verify that power disconnection outlets and plugs are supplied with the switchboard as required			✓		
E.23	Verify that terminals & busbar connections are tight	✓		✓		
E.24	Verify that terminals are identified as per drawings and spares are provided	✓		✓		
E.25	All terminals shall be correct part number, shrouded to IP20 and labelled.	✓		✓		

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**Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests**

Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
E.26	All cable cores ferruled & numbered.	✓		✓		
E.27	24VDC power supply shall be mounted to prevent obstruction to the field instrument terminals.	✓		✓		
E.28	Multicore cables shall be used for RTU harnesses to provide neat wiring installation.	✓		✓		
E.29	Verify that adequate access to RTU and communication plug is provided	✓		✓		
E.30	Modbus communication cables (RS 485) shall be 120ohm impedance twisted pair's.	✓		✓		Road Worx is a good cable to use
E.31	Aerial surge arrestor shall be mounted with a small section of DIN rail	✓		✓		the earthed shall be run as directly as possible 6mm
E.32						
E.33						
E.34						
E.35						

Company Name SJ Electric Group Qld

Contractor's Tester Name Joshua Parday

QUU Electrical Inspector Name John Clayton

Company Electrical Licence No: 73286

Signature.....

Signature.....

Date 12/5/15  
Date 25/5/15

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#### F. Live Power and Operational Tests

The following tests shall be made with all switchboard electrical circuits energized in order to check that the switchboard meets all operational requirements.

Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
F.1	Verify that all circuit breakers isolate their stated circuits	✓				
F.2	Verify that all electrical components energize when power circuits are energized	✓				
F.3	Switchboard lights operate	✓				
F.4	Confirm that E-Stops actually stop its corresponding drive.	✓				
F.5	Thermal overloads or soft starter protection appropriately set	✓				Adjust for site specific on site (No values for vent fan supplied) JPDS
F.6	Set up all of the soft starter parameters	✓				
F.7	Verify that all Soft starter operation and all display parameters are displaying correctly.	✓				
F.8	A copy of Soft Starter and/or VSD parameter configuration to match site equipment					Include in the O&M
F.9	Record output of 24VDC power supply	✓				

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**Major Projects & Commercial Services  
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Item No.	Activity Description	Contractor Results			Signed QUU	Comments
		Pass	Fail	N/A		
	when connected to 240 VAC main.					
F.10	Record output of 24VDC power supply when disconnected to 240 VAC main.	✓				27.1 VDC 26.2
F.11	RTU provided with corresponding firmware/software	✓				Software Version: _____
F.12	Redlion HMI provided with corresponding software configuration	✓				Software Version: _____
F.13	I/O tested to RTU terminals	✓				
F.14	Manual functions tested as per the below list	✓				Before the function test the RTU & Redlion has been loaded with the correct code OK <input checked="" type="checkbox"/>

**"CONTRACTOR FUNCTION TEST ACTIVITIES"**

**MOTOR STARTER**

Task	Outcome
Check that the motor starter is programmed and able to start the each pump	Pump 1 - OK <input checked="" type="checkbox"/> Pump 2 - OK <input checked="" type="checkbox"/>

Pump 3 - OK ✓  
Pump 4 - OK ✓

**MODBUS**

Task	Outcome
Confirm that the modbus link from the RTU to the Soft Starters and the Display Panel is operating correctly	OK <input checked="" type="checkbox"/>

**BATTERY**

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**Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests**

Task	Outcome
Check that the battery is connected and charging (i.e. 26V across the terminals).	OK <input checked="" type="checkbox"/>
Check that the RTU is running off battery when the mains supply is isolated	OK <input checked="" type="checkbox"/>

**POINT TO POINT**

Task	Outcome
<p>Using the schematic page I/O list check each individual physical I-O            Wired to the RTU from beginning to end.            ie press the actual button and watch the I-O change in the Redlion debug page            Output lights and relays activate            Inject 4-20mA into the Analog Inputs monitor the result on the Redlion debug page            The schematic page I/O should be highlighted and signed by the tester and attached to this FAT Test Document. Also confirm that the display panel is showing the correct information during each point to point check</p>	OK <input checked="" type="checkbox"/> OK <input checked="" type="checkbox"/>
<p><b>Run Both pumps (Check for Interlocking)</b>            Turn the station to local and start pump 1.            Then simultaneously start pump 2.            Stop both pumps and then start pump 2. and then start pump 1. Confirm test results match expected. Repeat this exercise via the emergency pump mode switches and in remote, inherit a wet well level signal above the duty "B" start point.            (For Interlocked sites – also complete the next section)</p>	4 2 pumps run <input checked="" type="checkbox"/> Site is Interlocked <input type="checkbox"/>

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**Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests**

### HARD WIRED EMERGENCY PUMPING MODE FUNCTIONALITY CHECK

Task	Outcome
Turn off the RTU and perform the following steps to confirm that the emergency pumping mode is functioning correctly.	
Simulate a surcharge imminent and ensure that the SIDT Timer starts to time	OK <input checked="" type="checkbox"/>
Ensure that the SIDT Timer expires after 10 sec and activates the EMGDT Timer	OK <input checked="" type="checkbox"/>
Ensure the EMGDT Timer (Delay off) is set to the correct functionality and that it immediately activates EMG1 relay and pump No.1 starts	OK <input type="checkbox"/>
Ensure that the EMG2 timer is set at 110 sec (equal to the ramp up time in the pump starter) and that it starts pump No. 2 (10 seconds after pump 1 starts)	OK <input type="checkbox"/>
Ensure both pumps are able to be stopped via the interrupt function, remove the interrupt relay for pump No.1 and confirm that the EMGDT timer de-energises and pump No.1 stops. Replace this relay and then remove pump No.2 interrupt relay confirm pump No.2 stops.	OK <input type="checkbox"/>
De-activate the surcharge imminent timer and ensure that both pumps continue to run until the EMGDT timer expires and that both pumps ramp down when the timer expires	OK <input checked="" type="checkbox"/>

→ Refer schematic sheet C  
for procedure

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**GENERATOR FUNCTIONALITY****(OPTION F)**

Task	Outcome
Ensure all Inteposing Relays are wired as per the drawings test all relays and monitor the Redlion debug page to confirm all inputs are correct.	OK <input checked="" type="checkbox"/>

**CATHODIC PROTECTION****(OPTION K)**

Task	Outcome
Ensure all CP Circuit has been wired as per the drawings	OK <input type="checkbox"/>

**SUMP PUMP AND DRY WELL CIRCUIT****(OPTION E)**

Task	Outcome
Activate the stop electrode input to simulate a level above the stop level – The sump pump should still be off at this stage	OK <input checked="" type="checkbox"/>
Activate the start electrode input to simulate a level above the start level – The sump pump should now start	OK <input checked="" type="checkbox"/>
De-activate the start electrode – the pump should keep running	OK <input checked="" type="checkbox"/>
De-activate the stop electrode – the pump should stop	OK <input checked="" type="checkbox"/>
Activate the Alarm level electrode	✓
Confirm operation of relay and input to RTU	OK <input checked="" type="checkbox"/>
Activate the Trip level electrode wait 10 seconds  This will stop all sewer pumps from running in local, remote (via Software) or under the control of the Emergency Pumping Circuit Circuit (Via the sewer pump interlock relays).  Confirm this by trying to start the sewer pumps in all 3 modes.	Pump 1 - OK <input type="checkbox"/> Pump 2 - OK <input type="checkbox"/>
Confirm that the each sewer pump can still be run under the control of that pump's Emergency Start Switch	Pump 1 - OK <input type="checkbox"/> Pump 2 - OK <input type="checkbox"/>

**PUMP INTERLOCKING****(OPTION O)**

Task	Outcome
For a fully interlocked site	

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**Major Projects & Commercial Services  
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Ensure that the 2 pumps can not run either from a RTU command, Emergency Pumping Circuit or the Emergency Pumping Mode Switch	OK <input type="checkbox"/>
<b>For a generator only interlocked site</b>	
Ensure that 2 pumps can run simultaneously when the station is powered by Energex. (From the RTU, Emergency Pumping Circuit and the Emergency Pumping Mode Switch)	OK <input type="checkbox"/>
Ensure that the 2 pumps can <u>not</u> run either from a RTU command, Emergency Pumping Circuit or the Emergency Pumping Mode Switch while the station is powered from the Generator	OK <input type="checkbox"/>
<b>Pump Faulted Scenario</b>	
Ensure that if pump 1 is faulted, pump 2 can still start both via the RTU and the Emergency Pumping Circuit.	OK <input checked="" type="checkbox"/>
Ensure that if pump 2 is faulted, pump 1 can still start both via the RTU and the Emergency Pumping Circuit.	OK <input checked="" type="checkbox"/>

**Company Name** SJ Electric Group Qld

**Company Electrical Licence No:** 73286

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**Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests**

Contractor's Tester Name Joshua Parchey

Signature.....

Date

QUU Electrical Inspector Name John Clayton

Signature.....

Date

**G. Non-Conformances and Unauthorised Modifications**

G.1	FIT SHROUD TO 132 kW Drive ISO/ATOPS	✓
G.2	SHROUD 24VDC AC SUPPLY	✓
G.3		
G.4		
G.5		
G.6		

Company Name SJ Electric Group Qld

Company Electrical Licence No: 73286

Contractor's Tester Name

NICK SMALL Signature.....

Date

QUU Electrical Inspector Name John Clayton

Signature.....

Date

25/5/15

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**Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests**

This section is to be completed only at the conclusion of the FAT:

Final FAT Results	YES	NO	Comments
Pre-FAT Completed	✓		
Minor NCRs Generated	✓	✓	
Major NCRs Generated	✓		
Pre-FAT Accepted	✓		

**Notes:**

1. FAT results to be recorded above by Contractor.
2. FAT results to be approved by Queensland Urban Utilities Electrical Inspector.
3. Pre-FAT results to be approved by Queensland Urban Utilities Electrical Inspector at Pre-FAT (if present) or at the start of the FAT.
4. NCRs are to be generated by the Queensland Urban Utilities Electrical Inspector for all NCRs not resolved by the end of the test.

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Company Name SJ Electric Group Qld

Contractor's Tester Name *Nick Small*

QUU Electrical Inspector Name John Clayton

Major Projects & Commercial Services  
Checklist  
Pre Factory Inspection Tests

Signature.....  
*[Handwritten signature of Nick Small]*

Signature.....  
*[Handwritten signature of John Clayton]*

Company Electrical Licence No: 73286

Date 25/5/15  
Date 25/5/15

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Job No. 43402226

Project Adam St

Switchboard Pump Station



SJ Electric Group (Qld) Pty Ltd  
A Division of the Trivantage Group

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E mail.qld@sjelectric.com.au ABN 45 124 414 768 REC 73286  
www.trivantage.com.au

## SP033 ADAM STREET, WYNNUM SEWAGE PUMP STATION

### COMMISSIONING PLAN

#### In Attendance

Name	Role During Commissioning	Company
A. Walmsley	SSE ELEC	
R. Clayton	SSE ELEC.	
C. Wiersdorf	SSE ELEC	
Z. Hawke	SSE APP. ELEC	
John Clayton	Commissioning Manager	QLV

Electrical Contractor's Supervisor

Name: Andy Walmsley ..... Date: 1-6-15

QLU Commissioning Manager

Name: John Clayton ..... Date: 1/6/15

Signature: .....

Signature: .....

## 1 INTRODUCTION

### !! IMPORTANT !!

**This commissioning Procedure is not to replace the electrical contractors own internal quality control and statutory documentation.**

At all times during the switchboard upgrade, the pump station must be capable of running at least 2 of the 4 pumps.

This changeover will progress over four to five days.

The sequence of works shall be:

1. Station Preliminary Works.
2. Set up temporary switchboard with two pumps
3. Run temporary switchboard on alternate power
4. Shut down existing switchboard
5. Install new switchboard start connecting cables
6. Remove existing switchboard and ancillaries
7. Continue to connect switchboard
8. Run new switchboard on main power
9. Connect pump 4 to new switchboard and test.
10. Connect pump 3 to new switchboard and test.
11. Connect pump 2 to new switchboard and test.
12. Connect pump 1 to new switchboard and test.
13. Confirm communications work
14. Post Changeover

### 1.1 MAINTENANCE CHECK OF EXISTING INSTALLATION

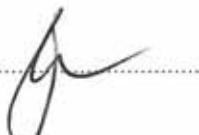
Before the works on site can commence, QUU staff to ensure that both pumps are fully operational shall perform a thorough maintenance inspection of the site.

Andy Walmsley initial:.....



2

John Clayton initial:.....



## 1.2 PRE COMMISSIONING CHECKLIST

The following checklist is to be completed and signed by the electrical contractor.

### 1.2.1 Switchboard Factory Acceptance Test

Contractor Task	Completed
FAT has been completed as per QUU FAT Document and all defects that were identified have been rectified.	OK <input type="checkbox"/>

### 1.2.2 Pump Station preliminary operational checks

QUU Task	Checked
These are checks will ensure the pump station is fully operational and that no delays will be incurred due to any pump station problem out side of the contract. These tasks are <b>desirable to have completed before the SAT but are not essential</b> . The job can proceed if they are not done. Commissioning Manager to request networks maintenance to inspect and rectify if necessary	OK <input checked="" type="checkbox"/>
The wet well does not need pumping out.	OK <input checked="" type="checkbox"/>
Ensure that the station is fully functional (all pumps can run)	OK <input checked="" type="checkbox"/>

Andy Walmsley initial:.....

3

John Clayton initial:.....

**1.2.3****2 STATION PRELIMINARY WORKS**

Contractor Task	Completed
Install internal lighting	
Install 3 phase and 1 phase outlets	
Install wet well instrument box	
Install Surge Imminent Probe	
Install High Level Probe	
Install Hydrostatic level Probe	OK <input checked="" type="checkbox"/>
Install new pressure transmitter	
Install Pump Field Disconnection Boxes and cable ladder	
Install Sump Pump Outlet	
Install Sump Pump level probes	
Install E Stop switches	

**3 QUU CONTAINER SWITCHROOM**

Contractor Task	Outcome
QUU are to provide a containerised VSD switch room that is equipped with VSD's, an RTU and a communications module.	OK <input checked="" type="checkbox"/>
This switch room will be delivered to site before the changeover starts and placed on the new concrete driveway next to the wet well.	OK <input checked="" type="checkbox"/>

**4 SWITCHBOARD CHANGEOVER PROCEDURE****OVERVIEW**

The following sequence of change over works is the order in which they must be followed. **Two** pumps must be operational at all times. After each phase has been completed, the commissioning manager will record the results and instruct the commissioning team to commence work on the next phase.

Andy Walmsley initial:.....



4

John Clayton initial:.....



## 4.1 CHANGEOVER SWITCHBOARD

### DAY 1

#### 4.1.1 Register with Control Room

Contractor and Commissioning Manager Task	Outcome
<p>Call the QUU Control Room Operator (CRO) and inform him that you are on site. Record the CRO's Name and Officer Code and record the time of the call.</p> <p>Advise CRO that you are performing a switchboard changeover and that you will initially be taking one pump off line. <b>Give the operator your contact name and number and advise the operator that communications will be lost to the pump station until the job is finished</b></p>	Name: <u>James</u> CRO: Time: <u>05-30</u>

#### 4.1.2

Contractor Task	Outcome
Total Generators are to provide a 200 KVA Generator this will be delivered at 7.00 am and placed in front of the container switch room	OK <input checked="" type="checkbox"/>
Run temporary power cabling (95 mm <sup>2</sup> Flexible) from the generator to the container switch room and connect. Temporary cables are to be hired from Total Generators	OK <input checked="" type="checkbox"/>
Carry out the appropriate testing	OK <input checked="" type="checkbox"/>
Start the generator	OK <input checked="" type="checkbox"/>

Andy Walmsley initial:.....



5

John Clayton initial:.....



#### 4.1.3 Existing Switchboard Parameters

Contractor Task	Outcome
Ensure that the station is fully functional (all pumps can run)	P1 <input checked="" type="checkbox"/> P2 <input checked="" type="checkbox"/> P3 <input checked="" type="checkbox"/> P4 <input checked="" type="checkbox"/>
Check 3 phase voltages and phase rotation	U. ____ V. ____ W. ____ <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
Record 3 phase motor currents pump#1 pump#2 pump#3 pump#4	U. ____ V. ____ W. ____ U. ____ V. ____ W. ____ U. ____ V. ____ W. ____ U. ____ V. ____ W. ____
<b>THIS IS A HOLD POINT.</b>  Do not proceed until the All PUMPS are confirmed to be fully operational	Signature _____ TIME _____

#### 4.1.4

#### 4.1.5 Connect pumps to switch room

Contractor Task	Outcome
Pumps 3 and 4 (50Kw) will be used during the changeover	OK <input checked="" type="checkbox"/>
Shut down Pump 4 Lock and Tag the circuit breaker	OK <input checked="" type="checkbox"/>
Disconnect the cable (35 mm <sup>2</sup> 3 C+E) and redirect through the core hole located behind the switchboard	OK <input checked="" type="checkbox"/>

Andy Walmsley initial.....

John Clayton initial.....

This cable will be extended using the hire cables (35 mm <sup>2</sup> ) so that it will reach the container switch room Bolt cables together and place in temporary conduits Cables should be able to feed through the wall where the existing generator cables run.	OK <input checked="" type="checkbox"/>
While the pump cables are being connected at the container switch room install temporary probes in the wet well and connect.	OK <input checked="" type="checkbox"/>
At the container switch room open, lock & tag vsd 1 circuit breaker open, lock & tag vsd 2 circuit breaker	OK <input checked="" type="checkbox"/>
Energise circuit breaker feeding container switch room	OK <input checked="" type="checkbox"/>
Carry out appropriate electrical tests at the container switch room	OK <input checked="" type="checkbox"/>
QUU to test communications to confirm that they work and to disable communications on the site RTU.	OK <input checked="" type="checkbox"/>

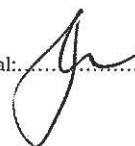
#### 4.1.6 Commission Pump 4 on container switch room

Contractor Task	Outcome
At the container switch room unlock, remove tag and close VSD 1 circuit breaker	OK <input checked="" type="checkbox"/>
Carry out appropriate electrical tests	OK <input checked="" type="checkbox"/>
Energise Pump 4 confirm that it is running in correct direction and empties the well	OK <input checked="" type="checkbox"/>
QUU to test appropriate signals are being received at the control room	OK <input checked="" type="checkbox"/>

Andy Walmsley initial: .....



John Clayton initial: .....



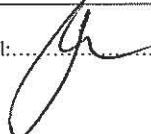
At this stage pump 4 is running from the container switch room on generator power with communications working. Pumps 2, 3 and 4 are still running on the existing switchboard	OK <input checked="" type="checkbox"/>
--	--

#### 4.1.7 Commission Pump 3 on container switch room

Contractor Task	Outcome
At existing switchboard shut down pump 3 open, lock & tag pump 3 circuit breaker test for dead at pump 3 disconnect the cable and remove from the switchboard	OK <input checked="" type="checkbox"/>
The cable feeding pump 3 is 120 mm <sup>2</sup> 3C+E therefore will be too large to fit through the core hole therefore feed the 35 mm <sup>2</sup> hire cables through <del>N/A</del> core hole and connect to the Pump 3 cable	OK <input type="checkbox"/>
At the container switch room unlock, remove tag and close VSD 2 circuit breaker	OK <input checked="" type="checkbox"/>
Carry out appropriate electrical tests	OK <input checked="" type="checkbox"/>
At this stage pumps 3 and 4 are running on the Container Switch room on Generator power with communications working. Pumps 1 and 2 are still running on the existing switchboard	OK <input checked="" type="checkbox"/>

#### 4.1.8 Shut down existing switchboard

Contractor Task	Outcome
Shut down Pumps 1 and 2	OK <input checked="" type="checkbox"/>
Shut down existing switchboard at the switch labelled Main Switch and at the Metering Isolator (this is also labelled Main Switch but sits above the Manual Transfer Switch)	OK <input checked="" type="checkbox"/>

Andy Walmsley initial: ..... John Clayton initial: ..... 

Test for dead at the Original Main Switch (there will still be power on the LINE side of the Metering Isolator)	OK <input checked="" type="checkbox"/>
Disconnect any batteries from existing equipment	OK <input checked="" type="checkbox"/>
Disconnect mains at existing switchboard	OK <input checked="" type="checkbox"/>
Disconnect field cabling and equipment that will no longer be used and dispose of.	OK <input checked="" type="checkbox"/>
When all field cabling has been removed from the switchboard unbolt switchboard from the Metering Isolator Tier and move outside building. The Metering Isolator Tier will stay in place until Energex have isolated power to the transformer.	OK <input checked="" type="checkbox"/>
Old Switchboard to be disposed of at .....  United Scrap Metal Traders 913 Lytton Rd Murarrie 4172 Phone 38902637	OK <input checked="" type="checkbox"/>

## DAY 2

### 4.1.9 Transformer to be De-energised

Contractor Task	Outcome
Energex to be onsite Tuesday 8.00 2 June 2015 to isolate transformer.	OK <input checked="" type="checkbox"/>
After Energex have isolated power to transformer remove the last tier from the building.	OK <input checked="" type="checkbox"/>
The existing consumer mains are to be reused at this stage.	OK <input checked="" type="checkbox"/>

Andy Walmsley initial: John Clayton initial: 

#### 4.1.10 Install new Switchboard

Contractor Task	Outcome
Freo Cranes to transport new switchboard from workshop to site	OK <input checked="" type="checkbox"/>
On site they will move the board into place using Franna with a spreader bar.	OK <input checked="" type="checkbox"/>
Move new switchboard into position and bolt down	OK <input checked="" type="checkbox"/>
Connect all field cabling - confirm quantities with cable schedule on drawing no 19	OK <input checked="" type="checkbox"/>
Cables to connect – P01 – 4 x 1 core consumer mains <i>2x 150 per phase</i> These are to be reused neutral is 2 x 95 mm <sup>2</sup> <i>1x 150 Neutral</i>	OK <input checked="" type="checkbox"/>
E01 – main earth to be reused <i>EXTENDED</i>	OK <input checked="" type="checkbox"/>
E02 – bonding earths	OK <input checked="" type="checkbox"/>
P03 – External Generator Box	OK <input checked="" type="checkbox"/>
P04 – External Generator Box 240 v supply	OK <input checked="" type="checkbox"/>
P05 – Pump1 Switchboard to Disconnect Box No 1	OK <input checked="" type="checkbox"/>
P06 – Pump2 Switchboard to Disconnect Box No 2	OK <input checked="" type="checkbox"/>
P07 – Pump3 Switchboard to Disconnect Box No 3	OK <input checked="" type="checkbox"/>
P08 – Pump4 Switchboard to Disconnect Box No 4	OK <input checked="" type="checkbox"/>

Andy Walmsley initial:.....

John Clayton initial:.....

P11 – Dry well sump pump 3 Phase outlet	OK <input checked="" type="checkbox"/>
P12 – Dry well lighting	OK <input checked="" type="checkbox"/>
P14 – Dry well vent fan isolator	OK <input checked="" type="checkbox"/>
P18 – 15 Amp single phase GPO	OK <input checked="" type="checkbox"/>
P19 – 20 Amp three phase GPO	OK <input checked="" type="checkbox"/>
P21 – 10 Amp single phase GPO	OK <input checked="" type="checkbox"/>
P22 – Building internal lights	OK <input checked="" type="checkbox"/>
P23 – Building external lights	OK <input checked="" type="checkbox"/>
P26 – Switchboard to Flowmeter Field Marshalling Box 1	OK <input checked="" type="checkbox"/>
P27 – Switchboard to Actuator Valve No 1	OK <input checked="" type="checkbox"/>
P28 – Switchboard to Actuator Valve No 2	OK <input checked="" type="checkbox"/>
C100 – Switchboard to Pump 1 Aux terminals	OK <input checked="" type="checkbox"/>
C105 – Pump 1 reflux valve proximity switch	OK <input checked="" type="checkbox"/>
C106 – Pump1 Field Emergency Stop	OK <input checked="" type="checkbox"/>
C200 – Switchboard to Pump 2 Aux terminals	OK <input checked="" type="checkbox"/>
C205 – Pump 2 reflux valve proximity switch	OK <input checked="" type="checkbox"/>

Andy Walmsley initial.....

John Clayton initial.....

C206 – Pump2 Field Emergency Stop	OK <input checked="" type="checkbox"/>
C300 – Switchboard to Pump 3 Aux terminals	OK <input checked="" type="checkbox"/>
C305 – Pump 3 reflux valve proximity switch	OK <input checked="" type="checkbox"/>
C306 – Pump 3 Field Emergency Stop	OK <input checked="" type="checkbox"/>
C400 – Switchboard to Pump 4 Aux terminals	OK <input checked="" type="checkbox"/>
C405 – Pump 4 reflux valve proximity switch	OK <input checked="" type="checkbox"/>
C406 – Pump 4 Field Emergency Stop	OK <input checked="" type="checkbox"/>
C500 – Switchboard to Actuator Valve No 1 - controls	OK <input checked="" type="checkbox"/>
C600 – Switchboard to Actuator Valve No 2 - controls	OK <input checked="" type="checkbox"/>
C07 – Dry well station level probes J Box	OK <input checked="" type="checkbox"/>
C08 – Dry well station stop/start probes J Box	OK <input checked="" type="checkbox"/>
C10 – Wet Well Instrumentation Disconnection Box	OK <input checked="" type="checkbox"/>
C13 – Dry well alarm probe	OK <input checked="" type="checkbox"/>
C16 - Building access limit switch 1	OK <input checked="" type="checkbox"/>
C17 - Building access limit switch 2	OK <input checked="" type="checkbox"/>
I01 – Wet Well Instrumentation Disconnection Box	OK <input checked="" type="checkbox"/>

Andy Walmsley initial:.....

John Clayton initial:.....

I02 – Delivery pressure transmitter	OK <input checked="" type="checkbox"/>
I03 – Flowmeter Field Marshalling Box	OK <input checked="" type="checkbox"/>
When all field cables connected carry out the appropriate tests and note results on attached test page <i>Book</i> . <i>Test Book</i>	OK <input checked="" type="checkbox"/>

## DAY 3

### 4.1.11 Transformer to be Energise

Contractor Task	Outcome
After the consumer mains have been reconnected and tested Energex can re-energise the transformer Energex Booker for Wednesday 3 June 2015	OK <input checked="" type="checkbox"/>

### 4.1.12 ENERGISE NEW SWITCHBOARD

Contractor Task	Outcome
After power has been restored at the switchboard close the meter isolator	OK <input checked="" type="checkbox"/>
Check 3 phase voltages and rotation	U. <input checked="" type="checkbox"/> V. <input checked="" type="checkbox"/> W. <input checked="" type="checkbox"/> <i>U<input checked="" type="checkbox"/> V<input checked="" type="checkbox"/> W<input checked="" type="checkbox"/></i>
At this point the new switchboard is running on mains power with the temporary container switch room is running pumps 3 and 4	OK <input checked="" type="checkbox"/>
Complete testing of field cables noting results	OK <input checked="" type="checkbox"/>

Andy Walmsley initial:.....

*A*

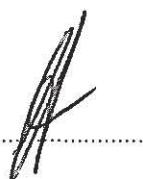
John Clayton initial:.....

*J*

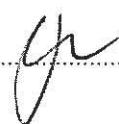
#### **4.1.13 COMMISSION PUMP 1**

Contractor Task	Outcome
Test for dead at existing field disconnect box for pump 1	DEAD <input checked="" type="checkbox"/>
Disconnect pump 1 cabling from existing field disconnect box	OK <input type="checkbox"/>
Redirect pump 1 cabling to new field disconnect box	OK <input checked="" type="checkbox"/>
Connect pump 1 cabling at new field disconnect box	OK <input type="checkbox"/>
On new switchboard close circuit breaker Q4	OK <input type="checkbox"/>
Test pump 1 confirm that the probes work and that the pump will empty the wet well	OK <input checked="" type="checkbox"/>
Commission pump 1	OK <input checked="" type="checkbox"/>
Confirm with the QUU Commissioning Manager if the thermistors on the existing motor are operational. If they are confirm that the parameters are set to 1.Load and Motor\1.9 Motor Temperature.ID 190 Motor Thermal Protection	OK <input type="checkbox"/>
<b>Setup 1 to be set to Thermistor Trip</b> Confirm the VSD shuts down when the thermistor wires are removed	OK <input type="checkbox"/>

Andy Walmsley initial.....



John Clayton initial.....



At this stage the new switchboard is running on mains power and pump 1 is commissioned	OK <input checked="" type="checkbox"/>
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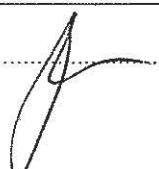
#### 4.1.14 COMMISSION PUMP 2

Contractor Task	Outcome
Test for dead at existing field disconnect box for pump 2	DEAD <input checked="" type="checkbox"/>
Disconnect pump 2 cabling from existing field disconnect box	OK <input checked="" type="checkbox"/>
Redirect pump 2 cabling to new field disconnect box	OK <input checked="" type="checkbox"/>
Connect pump 2 cabling at new field disconnect box	OK <input checked="" type="checkbox"/>
On new switchboard close circuit breaker Q5	OK <input checked="" type="checkbox"/>
Test pump 2 confirm that the probes work and that the pump will empty the wet well	OK <input checked="" type="checkbox"/>
Commission pump 2	OK <input checked="" type="checkbox"/>
Confirm with the QUU Commissioning Manager if the thermistors on the existing motor are operational. If they are confirm that the parameters are set to 1.Load and Motor\1.9 Motor Temperature ID 190 Motor Thermal Protection	OK <input checked="" type="checkbox"/>
<b>Setup 1 to be set to Thermistor Trip</b> Confirm the VSD shuts down when the thermistor wires are removed	OK <input checked="" type="checkbox"/> 
At this stage the new switchboard is running on mains power and pump 2 is commissioned	OK <input checked="" type="checkbox"/>

Andy Walmsley initial:.....



John Clayton initial:.....



#### **4.1.15 COMMISSION PUMP 3**

Contractor Task	Outcome
Shut down Pump3 in the container switchboard	OK <input checked="" type="checkbox"/>
Test for dead at existing field disconnect box for pump 3	DEAD <input checked="" type="checkbox"/>
Disconnect pump 3 cabling from existing field disconnect box	OK <input checked="" type="checkbox"/>
Redirect pump 3 cabling to new field disconnect box	OK <input checked="" type="checkbox"/>
Connect pump 3 cabling at new field disconnect box	OK <input checked="" type="checkbox"/>
On new switchboard close circuit breaker Q6	OK <input checked="" type="checkbox"/>
Test pump 3 confirm that the probes work and that the pump will empty the wet well	OK <input checked="" type="checkbox"/>
Commission pump 3	OK <input checked="" type="checkbox"/>
Confirm with the QUU Commissioning Manager if the thermistors on the existing motor are operational. If they are confirm that the parameters are set to 1.Load and Motor\1.9 Motor Temperature ID 190 Motor Thermal Protection	OK <input checked="" type="checkbox"/>
<b>Setup 1 to be set to Thermistor Trip</b> Confirm the VSD shuts down when the thermistor wires are removed	OK <input checked="" type="checkbox"/>
At this stage the new switchboard is running on mains power and pump 3 is commissioned	OK <input checked="" type="checkbox"/>

Andy Walmsley initial.....

John Clayton initial.....

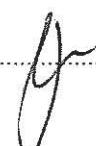
**4.1.16 COMMISSION PUMP 4**

Contractor Task	Outcome
Shut down Pump 4 in the container switchboard	OK <input checked="" type="checkbox"/>
Test for dead at existing field disconnect box for pump 4	DEAD <input checked="" type="checkbox"/>
Disconnect pump 4 cabling from existing field disconnect box	OK <input checked="" type="checkbox"/>
Redirect pump 4 cabling to new field disconnect box	OK <input checked="" type="checkbox"/>
Connect pump 4 cabling at new field disconnect box	OK <input checked="" type="checkbox"/>
On new switchboard close circuit breaker Q7	OK <input checked="" type="checkbox"/>
Test pump 4 confirm that the probes work and that the pump will empty the wet well	OK <input checked="" type="checkbox"/>
Test pump 4 confirm that the probes work and that the pump will empty the wet well	OK <input checked="" type="checkbox"/>
Commission pump 4	OK <input checked="" type="checkbox"/>
Confirm with the QUU Commissioning Manager if the thermistors on the existing motor are operational. If they are confirm that the parameters are set to 1.Load and Motor\1.9 Motor Temperature ID 190 Motor Thermal Protection	OK <input checked="" type="checkbox"/>
<b>Setup 1 to be set to Thermistor Trip</b> Confirm the VSD shuts down when the thermistor wires are removed	OK <input checked="" type="checkbox"/>

Andy Walmsley initial.....



John Clayton initial.....



#### **4.1.17 DECOMMISSION CONTAINER SWITCHROOM**

Contractor Task	Outcome
Shut down the container switch room and generator	OK <input checked="" type="checkbox"/>
Test for dead at circuit breakers	OK <input checked="" type="checkbox"/>
Disconnect cabling supplying container switchboard	OK <input checked="" type="checkbox"/>
Arrange for generator and container switchboard to be removed from site	OK <input checked="" type="checkbox"/>
Demobilise from site	OK <input type="checkbox"/>

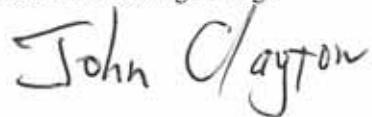
#### **4.2 SUGGESTIONS FOR IMPROVEMENT**

Suggestion	Recommended By

Electrical Contractor supervisor and QUU Commissioning manager to sign document to indicate that this site has been commissioned successfully.

Electrical Contractor's Supervisor

QUU Commissioning Manager



Andy Walmsley initial: 

John Clayton initial: 

**TEST SHEET**

 CUSTOMER NAME: ADAM

 SWITCHBOARD ID: SP033

 DATE: 2-6-15

 CUSTOMERS ADDRESS: ADAM ST., WYNNUM

 JOB No.: 13402225

C/B NO.	CABLE SIZE	C/B SIZE	N NO.	CIRCUIT DESCRIPTION	VISUAL INSPECTION	CORRECT CIRCUIT CONNECTION	EARTH CONT.	A-E MΩ	N-E MΩ	A-E VOLTS	A-N VOLTS	Φ-Φ VOLTS	RCD TEST		Fault loop Impedance measurement
													mA	mS	
Q2	2x150	630		MAINS CABLES	✓	✓	0.01	100	N/A	240	240	45			0.14
Q3	1x300	630		GEN CABLES.	✓	✓	0.1	200	200	N/A	N/A	N/A			
Q4	120	252		PUMP NO 1	✓	/	1.2	200	N/A	240	N/A				0.15
Q5	120	252		PUMP NO 2	✓	/	0.12	200	N/A	240	N/A				0.09
Q6	35	128		PUMP NO 3	✓	/	0.112	200	N/A	240	N/A				0.11
Q7	35	128		PUMP NO 4	✓	✓	0.12	200	N/A	240	N/A				0.12
Q11	2.5	16		15A GPO	✓	✓	0.12	200	200	240	240	N/A	30	31	
Q12	2.5	10		LAPTOP GPO	✓	/	0.12	200	200	240	240	N/A	30	31	
Q13	2.5	6		DJ WELL LIGHTING	✓	✓	1.32			240	240	N/A	30	30	
Q15	2.5	10		GEN AUX GPO	✓	✓	0.1	200	200	240	240	N/A	30	31	
Q16	2.5	6		EXT. LIGHTING.	✓	✓	0.92			240	240	N/A	30	26	
Q20	2.5	20		30h GPO.	✓	✓	0.12	200	200	240	N/A	45	30	25.	
Q21	2.5	10		INTERNAL LIGHTS	✓	✓	0.32			240	240	N/A	30	30	
Q22	2.5	10		INTERNAL GPOS.	✓	✓	0.3	200	200	240	240	240	30	31	
Q25	4.0	20		Gantry crane.	✓	✓	0.3	200	200	240	N/A	45			0.24
Q32	2.5	4		Flowmeters	✓	✓	0.16	100	200	240	240	N/A			0.81
Q8	2.5	12.5		Sump Pump.	✓	✓	0.16	200	N/A	240	240	N/A	45		0.42

TEST EQUIPMENT: MEGGER, Loop, RCD

PTO

 SERIAL NO.: 5171380, 7011093, 0043156

 TEST DUE DATE: Nov 2015

 NAME: Amy Warkusky

 LIC NO: Q30723

 SIGNATURE: 

## TEST SHEET

**CUSTOMER NAME:** QW

**SWITCHBOARD ID:** SP033

**DATE:** 2-6-15

CUSTOMERS ADDRESS: Adam St., Wyoming.

...JOB No.: 43402225

TEST EQUIPMENT: MEGGER, Loop, Inc.

NAME: Andy Womack

SERIAL NO: 5M1380, 7311093, 0043156

LIC NO: A30723

TEST DUE DATE: Nov 2015

**SIGNATURE:** 

# 5. Compliance Certificate



SJ Electric Group (Qld) Pty Ltd  
A Division of the Trivantage Group

19 Elliot Street, Albion QLD 4010  
P 07 3256 1522 F 07 3256 1533 E mail.qld@sjelectric.com.au  
ABN 45 124 414 768 REC 73286 QBSA No. 1265641  
www.trivantage.com.au

## CERTIFICATE OF:

(Please mark relevant check-box)

### X TESTING AND COMPLIANCE (Electrical Installations)

*Issued in accordance with s227 of the Electrical Safety Regulation 2013*

### X TESTING AND SAFETY (Electrical Equipment)

*Issued in accordance with s26 of the Electrical Safety Regulation 2013*

\*Work performed for:

Customer: Queensland Urban Utilities  
(Company Name)

Address: Level 2, 15 Green Square Close  
(Street)

Fortitude Valley  
(Suburb/town)

Qld  
(State)

4006  
(Postcode)

\*Electrical installation / equipment tested (please include site address for electrical installation work if different from above):

Work carried out at SP033 Adam Street, Wynnum

Installation tested as per Drawings 486/5/7-0471-000 to 486/5/7-0473-042

\*Date of test 5 / June / 2015 \*Electrical contractor licence number: 73286

Name on contractor licence: SJ Electric Group (Qld) Pty Ltd

Electrical contractor phone number: 07 3256 1522

For **electrical installations**, this certifies that the electrical installation, to the extent it is affected by the electrical work, has been tested to ensure that it is electrically safe and is in accordance with the requirements of the wiring rules and any other standard applying under the Electrical Safety Regulation 2013 to the electrical installation.

For **electrical equipment**, this certifies that the electrical equipment, to the extent it is affected by the electrical work, is electrically safe.

Name: Andy Walmsley

*(Person who performed, or person who is responsible for the electrical work)*

Signature:

Date:

15 16 15

\*Indicates a mandatory field

# 6. Photos

# Photos - Before



IMG\_0449



IMG\_0451



IMG\_3300



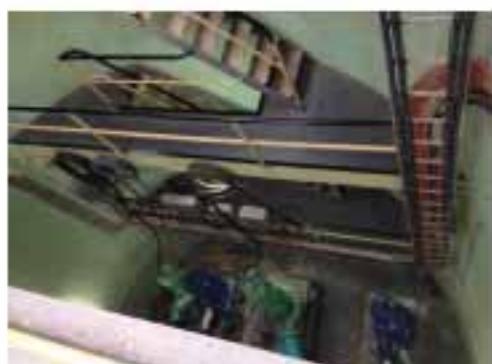
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IMG\_3304



IMG\_3305



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IMG\_3307



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IMG\_3309



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IMG\_3311



IMG\_3312



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IMG\_3314



IMG\_3315



IMG\_3316



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IMG\_3318



IMG\_3319



IMG\_3320



IMG\_4396



IMG\_4397



IMG\_4398



IMG\_4399



IMG\_4400

Q-Pulse Id:TMS1407



IMG\_4401

Active: 30/09/2015



IMG\_4402

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IMG\_4403



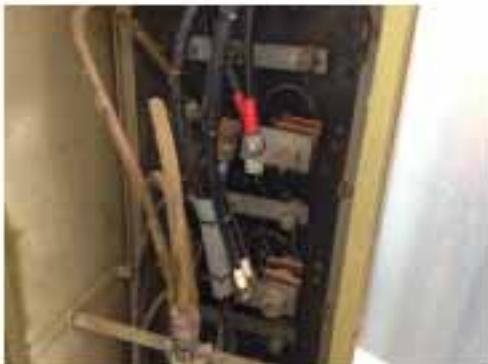
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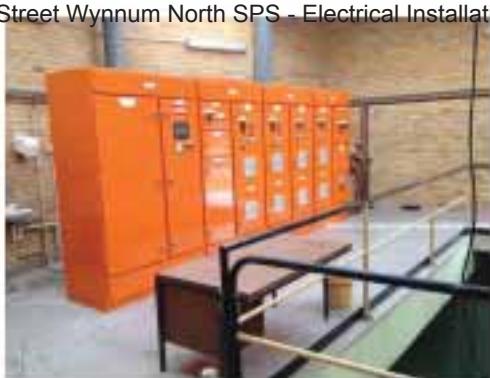


IMG\_4524

# Photos - After



IMG\_5233



IMG\_5234



IMG\_5235



IMG\_5236