Brisbane Water
Project Management

Client : ***BRISBANE WATER***

Document Title : **EDMONDSTONE ST SEWAGE PUMPING STATION
MAIN SWITCHBOARD - UPGRADE
OPERATION and MAINTENANCE MANUAL
Book 1 of 1**

SCSQ

Table of Contents ***Edmondstone St. Main Electrical Switchboard Upgrade*** O & M manuals

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Contains equipment parameters, settings and programming data.

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GENERAL

General Workplace Health and Safety

- The Queensland Workplace Health and Safety Act (1995) details minimum requirements relating to safe working in the electrical industry. Nothing in this document is designed, in any way, to undermine the authority of the Act.
- 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.

Project Overview

Contract BW 19 ½ was for the Design ,manufacture and testing of a new Main switchboard for the Edmondstone Street Sewage Pumping Station located in Brisbane.

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

- Switchboard;
- Generator Terminal Box
- Energex metering Cubicle.

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.

It should be noted that the Danfoss Variable speed drives where supplied by Brisbane Water.

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 hosed down and cleaned regularly.

> **WARNING**
>
> - **Avoid directly hosing <u>any</u> 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 allow 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.

Electrical Control System

General Description

Electrical control equipment for the installation is housed in the switchboard located under the inlet works structure, this switchboard is comprised of the following discrete sections:

- Main Incomer
- Generator Incomer
- Pump Circuit Breakers
- Distribution Section
- Pump Control Cubicles
- Common Control Cubicle.

The switchboard has been constructed of mild steel of a dead front construction.

Control and Monitoring System.

The control and monitoring of the system is performed by the Brisbane Water telemetry system and was not included in this contract.

SET POINTS FOR EDMONDSTONE ST.

The set points will be as follows:

Wet Well Level Metres	**Indicator %**	**Metres AHD**	**Function**
		3.578	Probe suspension level
		9.00mtrs	Probe Suspension Length
7.00	100.0%	1.578	Probe upper range 20mA
0.0	00.00%	5.422	Probe lower range 4mA
5.72	81.7%	0.296	Surcharge Level
5.42	77.4%	-0.004	Surcharge Imminent
1.42	20.3%	-4.002	Start pump (TWL)
0.42	6.0%	-5.002	Stop pump (BWL)
1.82	26.0%	-3.602	High level alarm

Author: Victor Umanzor
Date: 22.08.02
Issue: As Commissioned

375 Amps

Brisbane Water

Edmondstone St. Pump Station
SP23

Variable Speed Drive - Parameter Settings

No.	Name	Setup 1 (REMOTE)	Setup 2 (LOCAL)	Setup 3 (Surcharge Imminent)
1	Language	English	English	English
2	Active Setup	Multi Setup	Multi Setup	Multi Setup
5	Custom readout	100	100	100
6	Cust.read. Unit	%	%	%
8	Small readout 1	Ext Reference [%]	Ext Reference [%]	Ext Reference [%]
9	Small readout 2	Motor Current [A]	Motor Current [A]	Motor Current [A]
10	Small readout 3	Power [kW]	Power [kW]	Power [kW]
11	Unit of loc ref	Hz	Hz	Hz
12	Hand start button	Disable	Disable	Disable
13	Stop button	Disable	Disable	Disable
14	Auto start button	Disable	Disable	Disable
15	Reset button	Enable	Enable	Enable
16	Data change lock	Not Locked	Not Locked	Not Locked
17	Power Up Action	Auto Restart	Auto Restart	Auto Restart
100	Config. Mode	Closed Loop	Open Loop	Closed Loop
101	Vt Charact.	~~AEO~~	~~AEO~~	~~AEO~~
102	Motor Power	224kW	224kW	224kW
103	Motor Voltage	415	415	415
104	Motor Frequency	50 Hz	50 Hz	50 Hz
105	Motor Current	368	368	368
106	Motor Nom. Speed	735 RPM	735 RPM	735 RPM
107	Auto Motor Adapt.	No AMA	No AMA	No AMA
108	Multim. Startvolt	11.3V	11.3V	11.3V
109	Resonance Damp	100%	100%	100%
110	High start torque	Off	Off	Off
111	Start delay	0.0s	0.0s	0.0s
112	Motor Preheat	Disable	Disable	Disable
113	Preheat dc current	50%	50%	50%
114	Dc brake current	50%	50%	50%
115	Dc braking time	10.0s	10.0s	10.0s
116	Dc brake cut-in	0.0Hz	0.0Hz	0.0Hz
117	Mot. Therm protect	Etr trip 1	Etr trip 1	Etr trip 1
200	Frequency range	0-120 Hz	0-120 Hz	0-120 Hz
201	Min. Frequency	44Hz	44Hz	50Hz

Funct 411 on (Data)

375 Amps

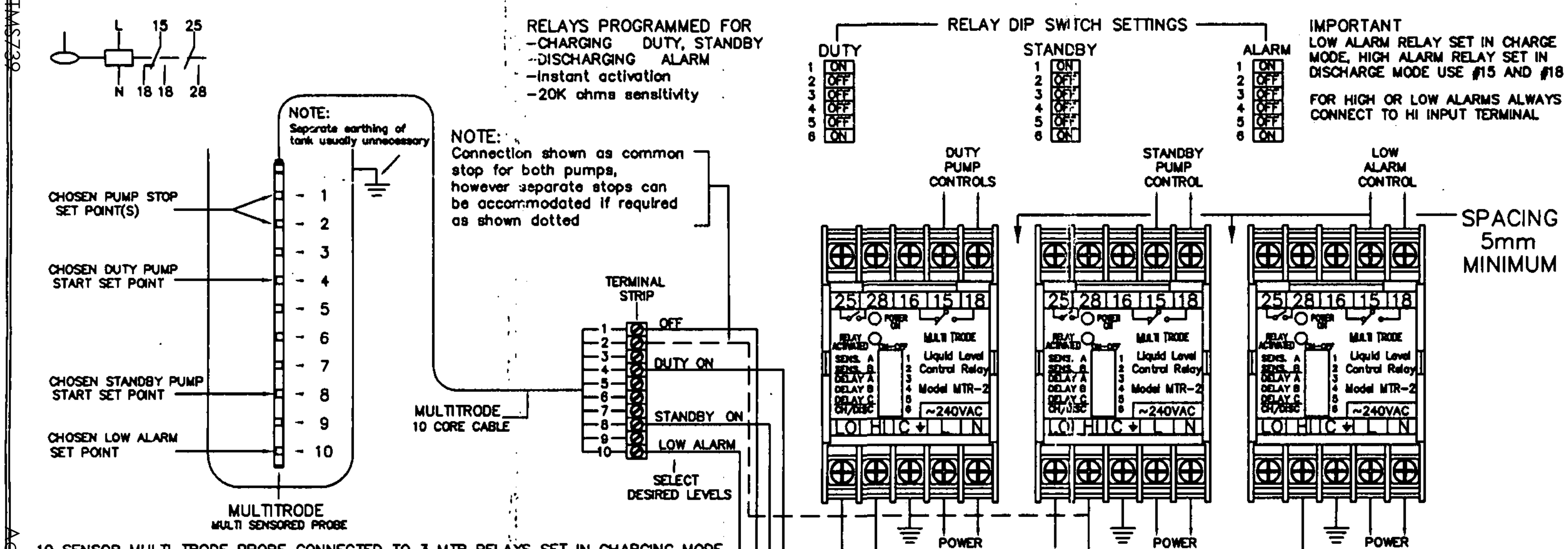
No.	Name	Setup 1	Setup 2	Setup 3
202	Max Frequency	50 Hz	50 Hz	50 Hz
203	Reference Site	Linked to hand/auto	Linked to hand/auto	Linked to hand/auto
204	Min. Reference	0.00	44Hz	0.00
205	Max. Reference	100.00	50 Hz	100.00
206	Ramp Up time	30s	30s	30s
207	Ramp Down time	60s	60s	60s
208	Autoramping	Enable	Enable	Enable
209	Jog Frequency	10.0 Hz	32Hz	10.0 Hz
210	Ref. Function	Sum	Sum	Sum
211	Preset Ref. 1	0.00%	0.00%	0.00%
212	Preset Ref. 2	0.00%	0.00%	0.00%
213	Preset Ref. 3	0.00%	0.00%	0.00%
214	Preset Ref. 4	0.00%	0.00%	0.00%
215	Current Limit Motor	368A	368A	368A
216	Freq. Bypass b.w.	0Hz	0Hz	0Hz
217	Bypass Freq. 1	120.0 Hz	120.0 Hz	120.0 Hz
218	Bypass Freq. 2	120.0 Hz	120.0 Hz	120.0 Hz
219	Bypass Freq. 3	120.0 Hz	120.0 Hz	120.0 Hz
220	Bypass Freq. 4	120.0 Hz	120.0 Hz	120.0 Hz
221	Warn. Current Lo	0.0A	0.0A	0.0A
222	Warn. Current Hi	375A	375A	375A
223	Warn. Freq. Low	0.0 Hz	0.0 Hz	0.0 Hz
224	Warn. Freq. High	120.0 Hz	120.0 Hz	120.0 Hz
225	Warn. Low Ref.	-999999.999	-999999.999	-999999.999
226	Warn. High Ref.	999999.999	999999.999	999999.999
227	Warn. Low Fdbk	-999999.999	-999999.999	-999999.999
228	Warn High Fdbk	999999.999	999999.999	999999.999
300	Digital Input 16	Reset	Reset	Reset
301	Digital Input 17	Freeze Reference	Freeze Reference	Freeze Reference
302	Digital Input 18	Start	Start	Start
303	Digital Input 19	No Operation	No Operation	No Operation
304	Digital Input 27	Safety Interlock	Safety Interlock	Safety Interlock
305	Digital Input 29	Setup Select MSB	No Function	Setup Select MSB
306	Digital Input 32	Setup Select LSB	Setup Select LSB	Setup Select LSB
307	Digital Input 33	No Operation	No Operation	No Operation
308	Ai [V] 53 Funct	No Operation	Reference	No Operation
309	Ai 53 Scale Low	0.0V	0.0V	0.0V
310	Ai 53 Scale High	10.0V	10.0V	10.0V
311	Ai [V] 54 Funct.	No Operation	No Operation	No Operation
312	Ai 54 Scale Low	0.0V	0.0V	0.0V
313	Ai 54 Scale High	10.0V	10.0V	10.0V
314	Ai [mA] 60 Funct.	Feedback	No Operation	Feedback
315	Ai 60 Scale Low	4.0mA	4.0mA	4.0mA
316	Ai 60 Scale High	20mA	20mA	20mA
317	Live Zero Time	10 s	10 s	10 s
318	Live Zero Funct.	No Function	No Function	No Function
319	Ao 42 Function	Motor Cur. 0-20mA	Motor Cur. 0-20mA	Motor Cur. 0-20mA
320	Ao 42 Puls scale	5000 Hz	5000 Hz	5000 Hz
321	Ao 45 Function	Out.Freq. 4-20mA	Out.Freq. 4-20mA	Out.Freq. 4-20mA

No.	Name	Setup 1	Setup 2	Setup 3
322	Ao 45 Puls Scale	5000Hz	5000Hz	5000Hz
323	Relay 1 Function	Ready	Ready	Ready
324	Relay 1 On Delay	0s	0s	0s
325	Relay 1 Off Delay	0s	0s	0s
326	Relay 2 Function	Running	Running	Running
327	Pulse Ref. Max	5000 Hz	5000 Hz	5000 Hz
328	Pulse Fdbk Max	25000Hz	25000Hz	25000Hz
400	Reset Function	Manual Reset	Manual Reset	Manual Reset
401	Autorestart time	10s	10s	10s
402	Flying Start	Disable	Disable	Disable
403	Sleep Mode Timer	Off	Off	Off
404	Sleep Frequency	0.0Hz	0.0Hz	0.0Hz
405	Wakeup Frequency	30Hz	30Hz	30Hz
406	Boost Setpoint	100%	100%	100%
407	Switch Freq.	3.5kHz	3.5kHz	3.5kHz
408	Noise Reduction	Fixed Switching Freq.	Fixed Switching Freq.	Fixed Switching Freq.
409	Funct. Low Curr.	Warning	Warning	Warning
410	Mains Failure	Trip	Trip	Trip
411	Funct. Overtemp.	Trip	Trip	Trip
412	Overload Delay	60s	60s	60s
413	Min. Feedback	0	0	0
414	Max. Feedback	100	100	100
415	Ref./Fdbk. Unit	%	%	%
416	Feedback Conv.	Linear	Linear	Linear
417	2 Feedback Calc.	Maximum	Maximum	Maximum
418	Setpoint 1	20	0	20
419	Setpoint 2	0	0	0
420	Pid nor/inv. Ctrl	Inverse	Normal	Inverse
421	Pid Anti Windup	Enable	Enable	Enable
422	Pid Start Value	0.0Hz	0.0Hz	0.0Hz
423	Pid Prop. Gain	1.5	1.5	1.5
424	Pid Integr. Time	9999	9999	9999
425	Pid Diff. Time	0.0s	0.0s	0.0s
426	Pid Diff. Gain	5	5	5
427	Pid Filter Time	0.01s	0.01s	0.01s
503	Coasting	Logic or	Logic or	Logic or
504	Dc Brake	Logic or	Logic or	Logic or
505	Start delay	Logic or	Logic or	Logic or
506	Reversing	Digital Input	Digital Input	Digital Input
507	Select Setup	Logic or	Logic or	Logic or
508	Select Speed	Logic or	Logic or	Logic or
555	Bus Time Inter.	60s	60s	60s
556	Bus Time Funct.	No Function	No Function	No Function
560	N2 Over. Rel. Time	Off	Off	Off
565	Fln Time Inter.	60s	60s	60s
566	Fln Time Funct.	No Function	No Function	No Function
618	Reset kwh count	Do not Reset	Do not Reset	Do not Reset
619	Reset run hour	Do no Reset	Do no Reset	Do no Reset
620	Operation Mode	Normal Operation	Normal Operation	Normal Operation

No.	Name	Setup 1	Setup 2	Setup 3
700	Relay 06 Function	Drive in Rem. Ref	No Operation	Drive in Rem. Ref
701	Relay 06 On Delay	0s	0s	0s
702	Relay 06 Off Delay	0s	0s	0s
703	Relay 07 Function	Running	Running	Running
704	Relay 07 On Delay	0s	0s	0s
705	Relay 07 Off Delay	0s	0s	0s
706	Relay 08 Function	Drive in Rem. Ref	Drive in Rem. Ref	Drive in Rem. Ref
707	Relay 08 On Delay	0s	0s	0s
708	Relay 08 Off Delay	0s	0s	0s
709	Relay 09 Function	Drive in Rem. Ref	Drive in Rem. Ref	Drive in Rem. Ref
710	Relay 09 On Delay	0s	0s	0s
711	Relay 09 Off Delay	0s	0s	0s

MULTITRODE RELAY 240VAC (MTR 2) INSTALLATION SH[illegible]. N01

CONTROL OF THREE APPLIANCES IN A CHARGING SITUATION

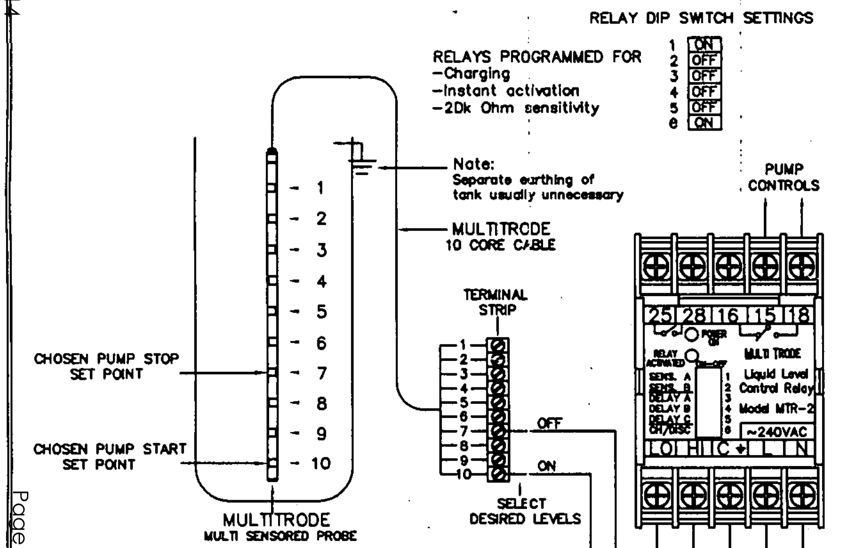


10 SENSOR MULTI TRODE PROBE CONNECTED TO 3 MTR RELAYS SET IN CHARGING MODE
RELAY DUTY CONNECTED FOR ACTIVATION AT SENSOR #4 DEACTIVTION AT #1
RELAY STANDBY CONNECTED FOR ACTIVATION AT SENSOR #8 DEACTIVATION AT #1
RELAY ALARM CONNECTED FOR SINGLE POINT ACTIVATION AT #10

FIGURE-4

WARNING: Always separate probe cables from power wiring

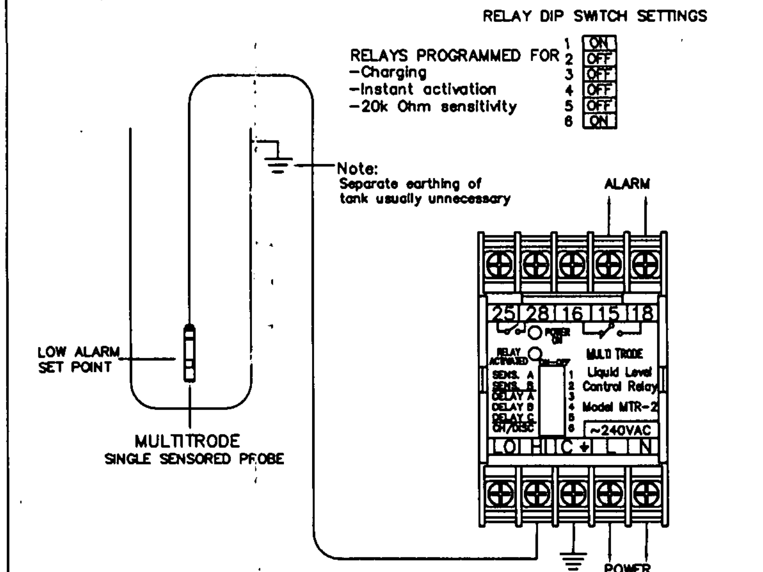
ON-OFF CONTROL IN A CHARGING SITUATION



10 SENSOR MULTI TRODE PROBE CONNECTED TO SINCLE MTR RELAY SET IN DISCHARGING MODE
RELAY CONNECTED FOR ACTIVATION AT SENSOR #10
DEACTIVATED AT SENSOR #7

FIGURE-5

SINGLE POINT OPERATION IN A CHARGING SITUATION



1 SINGLE SENSOR PROBE CONNECTED TO SINGLE MTR RELAY IN CHARGING MODE ACTIVATION AND DEACTIVATION AT SAME POINT

FIGURE-6

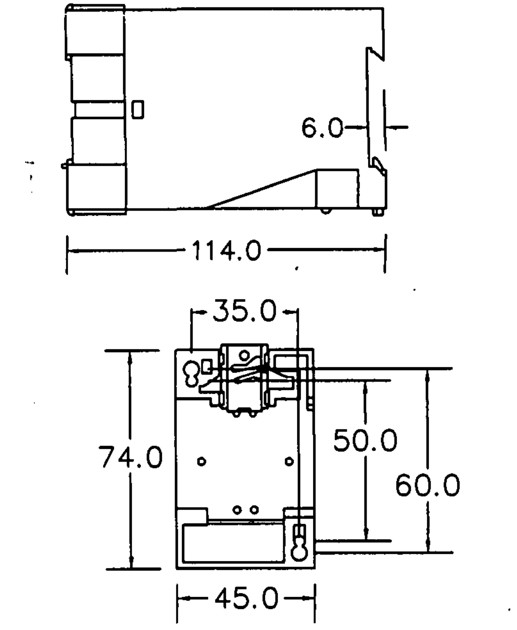
RELAY PROGRAM FUNCT[illegible]

SWITCH Nº SETTING 1	2	SENSITIVITY	
OFF	OFF	1k Ω	Concentrated Acids, Minerals, Alkalines
OFF	ON	4k Ω	Acids, Alkalines, Diluted brine, Sea water
ON	OFF	20k Ω	Sullage, Sewage effluent Town water
ON	ON	80k Ω	Low conductive liquids, Purified water

3	4	5	DELAY ON ACTIVATION
OFF	OFF	OFF	Zero Seconds
OFF	OFF	ON	2.5 Seconds
OFF	ON	OFF	5 Seconds
OFF	ON	ON	10 Seconds
ON	OFF	OFF	20 Seconds
ON	OFF	ON	40 Seconds
ON	ON	OFF	80 Seconds
ON	ON	ON	160 Seconds

6	MODE
OFF	Discharge
ON	Charge

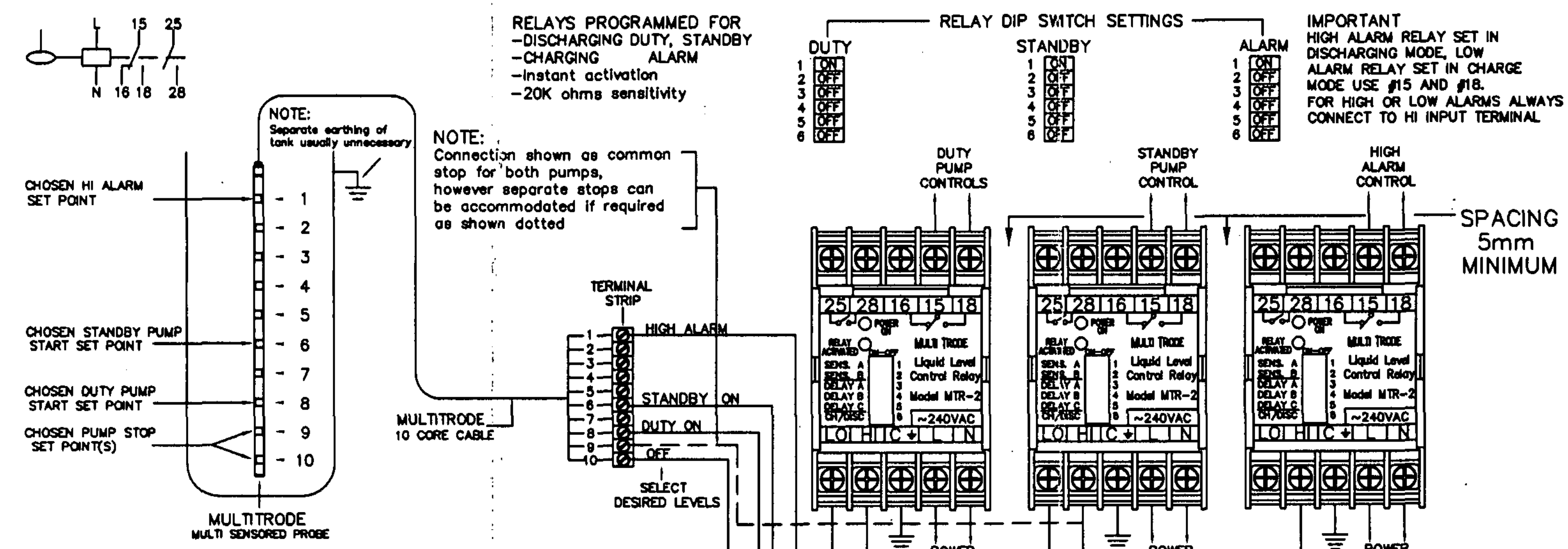
MTR DIMENSIONS IN mm.



PHONE (07) 808-4011 FAX (07) 808-0011
MULTITRODE
FOR INSTALLATION SHEET - INCLUDED WITH PRODUCT
TITLE MTR - WIRING DIAGRAMS Pg 1 of 2
DESIGNED BY REV 2.1 SCALE NO
CHECKED DATE APRIL 2000
DRAWN BY TRAVIS PARKINSON DRAWING # 8858
Designed & Manufactured by MULTITRODE Pty. Ltd. BRISBANE, AUSTRALIA

MULTITRODE RELAY 240VAC ([illegible]R 2) INSTALLATION SHE[illegible]. NO2

CONTROL OF THREE APPLIANCES IN A DISCHARGING SITUATION

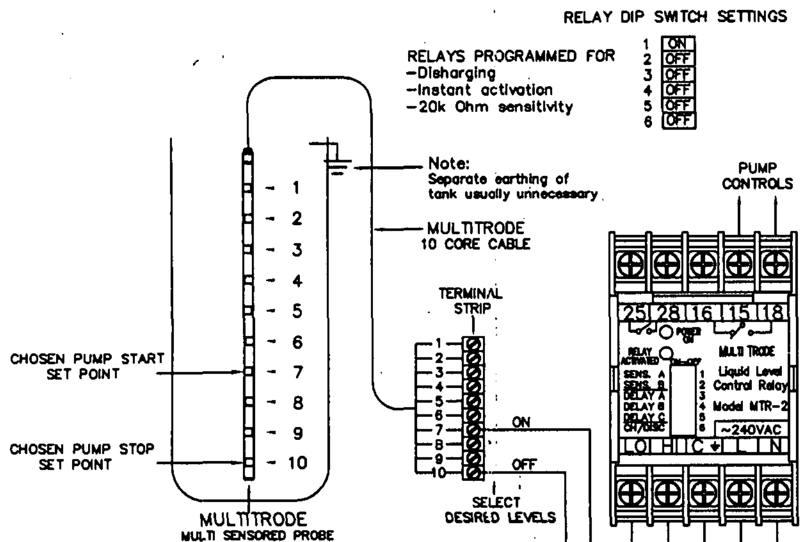


10 SENSOR MULTITRODE PROBE CONNECTED TO 3 MTR RELAYS SET IN DISCHARGING MODE
RELAY DUTY CONNECTED FOR ACTIVATION AT SENSOR #8 DEACTIVTION AT #10
RELAY STANDBY CONNECTED FOR ACTIVATION AT SENSOR #6 DEACTIVATION AT #10
RELAY ALARM CONNECTED FOR SINGLE POINT ACTIVATION AT #1

FIGURE-4

WARNING: Always separate probe cables from power wiring

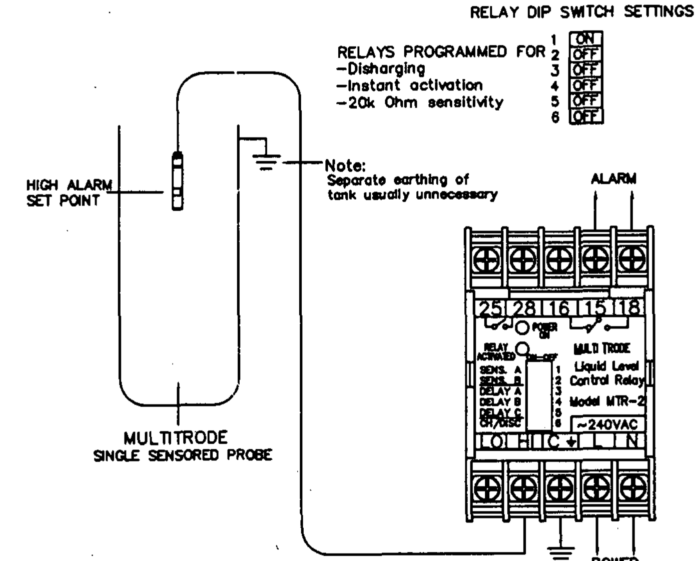
ON-OFF CONTROL IN A DISCHARGING SITUATION



10 SENSOR MULTI TRODE PROBE CONNECTED TO SINGLE MTR RELAY SET IN DISCHARGING MODE
RELAY CONNECTED FOR ACTIVATION AT SENSOR #7
DEACTIVATED AT SENSOR #10

FIGURE-5

SINGLE POINT OPERATION FOR DISCHARGING



1 SINGLE SENSOR PROBE CONNECTED TO SINGLE MTR RELAY IN CHARGING MODE
ACTIVATION AND DEACTIVATION AT SAME POINT

FIGURE-6

RELAY PROGRAM FUNCTI[illegible]

SWITCH Nº SETTING 1	2	SENSITIVITY	
OFF	OFF	1k Ω	Concentrated Acids, Minerals, Alkalines
OFF	ON	4k Ω	Acids,Alkalines, Diluted brine,Sea water
ON	OFF	20kΩ	Sullage,Sewage effluent Town water
ON	ON	80kΩ	Low conductive liquids, Purified water

3	4	5	DELAY ON ACTIVATION
OFF	OFF	OFF	Zero Seconds
OFF	OFF	ON	2.5 Seconds
OFF	ON	OFF	5 Seconds
OFF	ON	ON	10 Seconds
ON	OFF	OFF	20 Seconds
ON	OFF	ON	40 Seconds
ON	ON	OFF	80 Seconds
ON	ON	ON	160 Seconds

6	MODE
OFF	Discharge
ON	Charge

SPECIFICATIONS

SENSOR VOLTAGE	12VAC NOMINAL
NO OF OUTPUTS	2 SETS, 1 NO & 1 CHANGEOVER
CONTACT RATING	5 AMP 250VAC RESISTIVE
CONTACT LIFE	10^5 OPERATIONS
SUPPLY VOLTAGE(+-10%)	240, 110, 240VAC, 50/60Hz 24, 12VDC
POWER CONSUMPTION	3.4VA (MAX)
DIMENSIONS mm (inches)	H74(2.78) X W45(1.77) X D114(4.5)
TERMINAL SIZE mm (in)	2 X 2.5mm^2 (0.64^2 INCH)
DISPLAY LEDS	GREEN - POWER ON RED - ACTIVATION
MOUNTING ARRANGEMENT	DIN RAIL OR 2X4mm SCREWS (3/16")
SENSITIVITY (OHMS)	SELECTABLE VIA SWITCHES 1K, 4K, 20K, 80K
MODE	SELECTABLE VIA SWITCHES CHARGE/DISCHARGE
DELAYS (SECS)	SELECTABLE VIA SWITCHES 2.5, 5, 10, 20, 40, 80, 160
WORKING TEMP C(F)	MINUS 10° C (+14° F) PLUS 60° C (140° F)

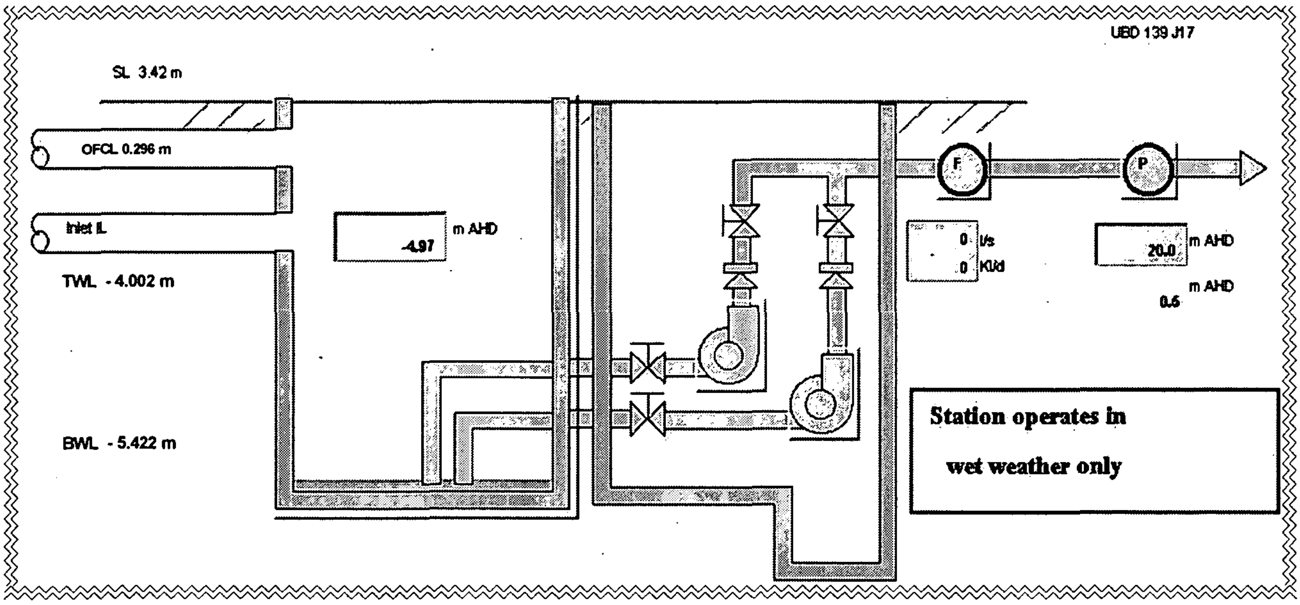
PHONE (07) 808-4011 FAX (07) 808-0011	FOR INSTALLATION SHEET - INCLUDED WITH PRODUCT	
	TITLE MTR - WIRING DIAGRAMS	Pg.2 of 2
MULTITRODE	DESIGNED BY	REV.2 SCALE NO
	CHECKED	DATE JANUARY 1995
	DRAWN BY JAN PARKINSON	DRAWING # 9957

Designed & Manufactured by MULTITRODE Pty. Ltd. BRISBANE, AUSTRALIA

Client: **Network Operations**

Project: **Edmondstone Street Pumping Station Upgrade**

Document Title: **Functional Specification**



Issue: **As Commissioned (Revision 1)**

Date of Issue: **September 2002**

Document Approval

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Contents

1. INTRODUCTION

1.1 OBJECTIVE

This document details the design basis, details the process and specifies the functional requirements of the Instrumentation and Control System for the new Main Switchboard and switchgear ancillaries at Edmondstone Street Pump Station.

This Project is being undertaken by Professional Services - Engineering for and on behalf of Sewage Operation as part of the Edmondstone Street Pumping Station Scheme Upgrade.

The purpose of the new Main Switchboard and switchgear ancillaries at Edmondstone Street Pumping Station is to replace the existing old Main Switchboard. The existing switchboard, now 40 years old, is reaching the end of its electrical life.

1.2 OVERVIEW

Refer to the attached Drawing Nr. 486/4/5-MO003, Process and Instrumentation Diagram.

1.3 EDMONDSTONE STREET PUMPING STATION

The Edmondstone Street Pumping Station, SP23, is a conventional wet and dry well sewage pumping station.

The pump station contains the following items as described below:

- ***Pumps***

  There are two (2) main sewage pumps on this site in a duty/standby arrangement.

- ***Motors Starters & Motors***

  The wound rotors will be modified to enable the use of VSD's. The modification will consists of shorting out the rotor terminals in the motors. The P&ID control loop internal to the VSD will be used to control the speed of the drive as soon as the start level is reached in the wet well.

  Motor specifics are as follows:

  Wound Rotor AC Drives, Motors rating: 224KW (300HP), Motor Stator full load current 375A

- ***Main Switchboard and Ancillaries***

  The main switchboard is rated to handle the starting of **one** (1) 224kW wound-rotor motor at a time.

- ***Wet Well***

  Contains the submersible level meter and surcharge electrodes

- ***Pump Well***

  This well houses the two- (2) main sewage pumps

- ***Flow Meter***

  There is one (1) flowmeter on this site. This transducer measures the delivery flow rate from the sewage pumps. The flowmeter transducer is located outside the pump well downstream of the pump delivery pipework.

- ***Pressure Meter***

  There is one (1) pressure transducer on this site. This transducer measures the delivery pressure from the sewage pumps. The pressure transducer is located within the pump well on the pump delivery pipework.

- ***Sump Pump***

  The sump pump will start when a high level is reached in the sump. The starting and stopping of the pump is controlled via a Multitrode level switch. A high-high level switch, originally set up to lock the station out, will be modified to give a warning only.

1.3.1 Process

The Edmondstone Street Pump Station consists of two (2) pumps: 224 kW (300HP).

	Edmondstone St. Station
Pump 1	300 HP (224 kW)
Pump 2	300 HP (224 kW)

The station is a wet weather station that transfers flows from the Breakfast Creek catchment to Nth Kedron Brook catchment. The pumps are arranged in a duty/standby arrangement.

1.3.2 The Edmondstone Street Pumping Station Control System

The existing MITS RTU will have total control of the Station. This RTU will interface with the telemetry system at the Central Control Room for remote control and monitoring.

For each pump set there will be an Hours Run Timer on the RTU software to record the operating hours for each pump set. This value will be saved in the RTU memory in case of power failure.

An accumulative total hour run timer will also be included in the RTU to detect the operating age of each pump.

The pumping station Main Switchboard will incorporate the following:

- Main Incomer circuit breaker, Moulded Case Circuit Breaker, MCCB, capable of withstanding a prospective fault level of at least 20 kA.
- Auxiliary Incomer circuit breaker, MCCB rated to enable the supply of power via a portable Generator supply.
- Two (2) MCCB feeders suitably rated to supply a 224kW wound-rotor motor.
- Two (2) Variable Speed Drives (VSD's), rated to suit a 224 kW wound-rotor motor. The rotor terminals of the motors are to be shorted to enable the use of the VSD's.
- Control and auxiliary equipment, including: Current and kW Transducers, RTU interface terminals, Control Relays and timers.
- A 48-pole distribution board and miniature circuit breakers, MCB, suitably rated.
- A sump pump starter, including a suitably rated MCB, overload, contactor and control equipment.

The pumping station Switchgear ancillaries will include the following:

- One On/Off wall mounted switch for the electric crane.
- One 3Φ GPO Wall mounted.
- One (1) Remote Telemetry Unit Cabinet.
- One dry well fan.

2. CONTROL SYSTEM FUNCTIONAL REQUIREMENTS

2.1 PUMPING STATION OPERATION MODES

The Edmondstone Street Pumping Station control mode selection will be done via a Remote/Local selector switch. This selector switch will be installed in the Common Control compartment. These modes are described below:

- **Remote Mode**
- **Local Mode**

2.1.1 Remote Mode

Remote mode is the usual mode of operation for the Pumping Station and enables automatic operation via the RTU. This mode is effected by placing the selector in Remote mode.

The remote control mode enables the start/stop of the pumps once a permissive level is reached in the wet well.

The Variable Speed Drives have an in-built PID loop controller. The 4-20mA signal from the level transmitter is connected to the Analogue input in the RTU and then to a loop signal isolator, the signal is then transmitted to both of the variable speed drives.

Once the start level is reached, the RTU will select the duty pump and provide a start signal to the duty pump. The variable speed drive then runs to a minimum preset speed. This preset speed is to be set at 44Hz. The VFD internal PID loop is activated and the speed of the drive will increase if there is a rise above the start level setpoint. The loop will speed the drive up to its maximum speed if the level reaches 38% of wet well level.

If the level decreases below the start level setpoint, the drive will continue running at its preset minimum speed.

Once the stop level is reached, the pump is signalled to stop by the RTU.

The Operator at Control Centre is able to start or stop the pumps via the Citect Screens, at any time provided the stop level has not been reached.

The table below shows the level governing the process:

DUTY PUMP	COMMAND	WET WELL LEVEL (%)
Pump 1 or 2	Start Pump	20
Pump 1 or 2	Stop Pump	6

2.1.2 Local Manual Mode

In local mode, no automatic control is performed. The RTU controls the pumps based on the manual initiation of the pumps individual start and stop pushbuttons. Once started in manual, the pumps will run until requested to stop manually. Hence the operator or electrician is fully responsible for the consequences of running the station in this mode. The speed of the pumps running in local is determined by the Variable Speed Drive speed selector potentiometer.

Should the RTU be unable to provide control in either local or remote mode, the keypad on the VFD can provide local control.

THIS KEYPAD WILL BE DISABLED TO AVOID OPERATION FROM UNTRAINED PERSONNEL.

Electricians with proper training will be able to enable the keypad and allow the pump to be operational in an emergency situation.

2.2 PUMPING STATION SEQUENCE CONTROL

This section relates to sequence control of the Pumping Station in relation to pump set start-up, cycle trip and stop. The function of these sequences are described below:

2.2.1 Pump Set Start-Up Sequence and Availability

The pump individual control function monitors any request for the pump to start/stop. This results in the issuing of a start or a stop signal to control the pump.

The pump will start if all the following conditions are true.

1) The pump is available for RTU control
2) The pump is requested to run
3) Other pump isn't running

The pump will stop if any of the following conditions are true:

1) The pump is requested to stop
2) The pump is no longer available for RTU control

Upon a start request being set, the pump is started using the following sequence:

- Variable speed drive run pump relay shall energise;
- If the reflux valve signal is not active after the time delay has expired, then the run relay remains energised.

Upon a stop request being reset, the pump is stopped using the following sequence:

- Variable speed drive run pump relay output shall open
- Variable speed drive frequency reaches 0 Hz, the status indicator on the panel is de-energised,

The emergency stop sequence for a pump will be executed in the following manner whenever either of the pump Emergency stop pushbuttons is pressed.

- The shunt trip opens the respective pump circuit breaker
- VFD run/stop relay is de-energised
- Status light on pump panel is de-energised

A check on the availability of essential equipment is required before a pump set start sequence can be initiated from Control Room or from the Pumping Station control panel.

In 'remote' state, a pump set will be available if:

1- Station control selector switch is not selected to LOCAL position.
2- Pump set Circuit Breaker is Closed.
3- Main Feeder Circuit Breaker Or Generator Set Circuit Breaker is Closed.
4- Pump VFD in "Ready" state.
5- Emergency stops for the pump set are reset.
6- Dry well isn't flooded

In 'local' state, a pump set will be available if all of the dot points listed above are met except for the first point which will be true when the pump set is selected to 'local' state.

When a pump set is available for RTU control it means the pump set is either running under RTU control or is ready to be used.

If a pump set becomes ɜunavailable' it will be stopped and prevented from starting. The pump set will remain in the ɜunavailable' state only while the cause conditions for availability have not been met.

For an available pump set the start sequence can be initiated in any of the ways listed below:

- When the pump set is in Remote mode and the pump set start command is received from Control Room.
- When the pump set is in Remote mode and the start level on the wet well has been reached.
- When the pump set is in Local Manual mode and the pump set START push-button is pressed.
- When the pump set is in REMOTE MODE and the operating duty pump set has failed while running, the stand-by pump shall take its place and start.
- When surcharge imminent level is reached while in remote mode.

2.2.2 Pump Set Duty Cycle Sequence

The pump set duty cycle sequence is active when the station is in REMOTE mode. The duty cycling sequence only operates when both pump sets are available and each operates alternatively via the RTU at every start command

2.2.3 Surcharge Imminent

The duty pump set will be signalled to start and run at 50Hz (Full speed), once the surcharge imminent input is active.

DIGITAL INPUTS

60 LOCATION		NETWORK	PLANT	QUANTITY	module_type	module_address	slot_number	channel	chassis_number	cubicle_number	time_tagged	scan_rate	point_type	Desig	Pdefault	Nal	Nar	Nlg	Nlr	Aud	Fu	Ns	Dt	Iv	Important
SP023	Edmonstone St SP23	SEWER	Rtu	Battery_power	dit 102	16	2	0						1											OK
SP023	Edmonstone St SP23	SEWER	Rtu	Mains_power	dit 102	16	2	1						1											OK
SP023	Edmonstone St SP23	SEWER	Attention	Acknowledge	dit 102	16	2	2						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Door_limit_switch	dit 102	16	2	3						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Local_reset	dit 102	16	2	4						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Mains_power	dit 102	16	2	5						1											OK
SP023	Edmonstone St SP23	SEWER	Sewage_pumping_station	Mains_power	dit 102	16	2	6																	OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Mains_power_raw	dit 102	16	2	7						1											OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Micro_sw	dit 102	16	2	8						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Local_start	dit 102	16	2	9						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Local_stop	dit 102	16	2	10						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Emergency_stop_fault	dit 102	16	2	11						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Run_status	dit 102	16	2	12						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_availability	dit 102	16	2	13						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_auto	dit 102	16	2	14						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Local_reset	dit 102	16	2	15						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Mains_power_raw	dit 102	17	3	0						2											OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Micro_sw	dit 102	17	3	1						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Local_start	dit 102	17	3	2						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Local_stop	dit 102	17	3	3						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Emergency_stop_fault	dit 102	17	3	4						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Run_status	dit 102	17	3	5						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_availability	dit 102	17	3	6						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_auto	dit 102	17	3	7						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Local_reset	dit 102	17	3	8						2											OK
SP023	Edmonstone St SP23	SEWER	Sewage_pumping_station	Pump_well_flooded	dit 102	17	3	9						1											OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Surcharge_detector	dit 102	17	3	10						1											OK
SP023	Edmonstone St SP23	SEWER	Seqeb	Sdsb_supply_off	dit 102	17	3	11						1											OK
SP023	Edmonstone St SP23	SEWER	Sewage_pumping_station	Local_remote_raw	dit 102	17	3	12						1											OK
SP023	Edmonstone St SP23	SEWER	Sump_pump	Run_status	dit 102	17	3	13						1											OK
SP023	Edmonstone St SP23	SEWER	Sump_pump	Available	dit 102	17	3	14																	OK
SP023	Edmonstone St SP23	SEWER			dit 102	17	3	15																	SP
SP023	Edmonstone St SP23	SEWER	Attention	Automatic_reset	dip 102	128		0						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_current_high	dip 102	128		1						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_current_low	dip 102	128		2						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_fault	dip 102	128		3						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_voltage_high	dip 102	128		4						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_voltage_low	dip 102	128		5						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Off_potential_high	dip 102	128		6						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Off_potential_low	dip 102	128		7						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	On_potential_high	dip 102	128		8						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	On_potential_low	dip 102	128		9						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Off_potential_high	dip 102	128		10						2											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Off_potential_low	dip 102	128		11						2											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	On_potential_high	dip 102	128		12						2											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	On_potential_low	dip 102	128		13						2											OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	High	dip 102	128		14						1											OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Low	dip 102	128		15						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Available	dip 102	129		0						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_high	dip 102	129		1						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_low	dip 102	129		2						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Fault	dip 102	129		3						1											OK

DIGITAL INPUTS

60 LOCATION		NETWORK	PLANT	QUANTITY	module_type	module_address	slot_number	channel	chassis_number	cubicle_number	time_tagged	scan_rate	point_type	Desig	Pdefault	Nal	Nar	Nlg	Nlr	Aud	Fu	Ns	Dt	Iv	Important	
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Start_inhibit	dip 102	129		4						1												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_high	dip 102	129		5						1												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_low	dip 102	129		6						1												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_invalid	dip 102	129		7						1												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Pump_well_flooded	dip 102	129		8						1												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Running	dip 102	129		9						1												OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Invalid	dip 102	129		10						1												OK
SP023	Edmonstone St SP23	SEWER	Pressure_gauge	High	dip 102	129		11						1												OK
SP023	Edmonstone St SP23	SEWER	Pressure_gauge	Low	dip 102	129		12						1												OK
SP023	Edmonstone St SP23	SEWER	Pressure_gauge	Invalid	dip 102	129		13						1												OK
SP023	Edmonstone St SP23	SEWER	Rtu	Battery	dip 102	129		14						1												OK
SP023	Edmonstone St SP23	SEWER	Rtu	Mains_fail	dip 102	129		15						1												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Available	dip 102	130		0						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_high	dip 102	130		1						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_low	dip 102	130		2						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Fault	dip 102	130		3						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Start_inhibit	dip 102	130		4						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_high	dip 102	130		5						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_low	dip 102	130		6						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_invalid	dip 102	130		7						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Pump_well_flooded	dip 102	130		8						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Running	dip 102	130		9						2												OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Volume_invalid	dip 102	130		10						1												OK
SP023	Edmonstone St SP23	SEWER	Sewage_pumping_station	Mains_fail	dip 102	130		11						1												OK
SP023	Edmonstone St SP23	SEWER	Sewage_pumping_station	Outage	dip 102	130		12						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Calibration_aborted	dip 102	130		13						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Calibration_exceeded_8_hour_alm	dip 102	130		14						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Calibration_failed	dip 102	130		15						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Calibration_fault	dip 102	131		0						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Calibration_local_suspend	dip 102	131		1						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Calibration_in_progress	dip 102	131		2						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Calibration_local_resume	dip 102	131		3						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Invalid_high	dip 102	131		4						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Invalid_low	dip 102	131		5						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	High	dip 102	131		6						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Level_invalid	dip 102	131		7						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Low	dip 102	131		8						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Surcharge_imminent	dip 102	131		9						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Surcharge_occuring	dip 102	131		10						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Surcharge_probable	dip 102	131		11						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Auto_calibration_start_request	dip 102	131		12						1												OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Calibration_available	dip 102	131		13						1												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_invalid	dip 102	131		14						1												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_invalid	dip 102	131		15						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Mains_power	dip 102	132		0						1												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Mains_power	dip 102	132		1						2												OK
SP023	Edmonstone St SP23	SEWER	Sewage_pumping_station	Local_remote	dip 102	132		2						1												OK
SP023	Edmonstone St SP23	SEWER	Sewage_pumping_station	Energex Power OK	dip 102	132		3																		OK
SP023	Edmonstone St SP23	SEWER	Sump_pump	Running	dip 102	132		4																		OK
SP023	Edmonstone St SP23	SEWER	Sump_pump	Excessive_run	dip 102	132		5																		OK
SP023	Edmonstone St SP23	SEWER	Sump_pump	Excessive_cycling	dip 102	132		6																		OK
SP023	Edmonstone St SP23	SEWER			dip 102	132		7																		SP

DIGITAL INPUTS

60	LOCATION	NETWORK	PLANT	QUANTITY	module_type	module_address	slot_number	channel	chassis_number	cubicle_number	time_tagged	scan_rate	point_type	Desig	Pdefault	Nal	Nar	Nlg	Nlr	Aud	Fu	Ns	Dt	Iv	Important	
SP023	Edmonstone St SP23	SEWER			dip 102	132		8																		SP
SP023	Edmonstone St SP23	SEWER			dip 102	132		9																		SP
SP023	Edmonstone St SP23	SEWER			dip 102	132		10																		SP
SP023	Edmonstone St SP23	SEWER			dip 102	132		11																		SP
SP023	Edmonstone St SP23	SEWER			dip 102	132		12																		SP
SP023	Edmonstone St SP23	SEWER			dip 102	132		13																		SP
SP023	Edmonstone St SP23	SEWER			dip 102	132		14																		SP
SP023	Edmonstone St SP23	SEWER			dip 102	132		15																		SP
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Close_fault	dip 102	133		0						1												OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Open_count_check	dip 102	133		1						1												OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Open_fault	dip 102	133		2						1												OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Open_auto_fault_reset	dip 102	133		3						1												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_fault	dip 102	133		4						1												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_auto_fault_reset	dip 102	133		5						1												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_count_check	dip 102	133		6						1												OK
SP023	Edmonstone St SP23	SEWER			dip 102	133		7																		SP
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Close_fault	dip 102	133		8						2												OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Open_count_check	dip 102	133		9						2												OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Open_fault	dip 102	133		10						2												OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Open_auto_fault_reset	dip 102	133		11						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_fault	dip 102	133		12						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_auto_fault_reset	dip 102	133		13						2												OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_count_check	dip 102	133		14						2												OK
SP023	Edmonstone St SP23	SEWER			dit 102	133		15																		SP

Short Name	LOCATION	NETWORK	PLANT	QUANTITY	module_type	module_address	slot_number	Channel	chassis_number	cubicle_number	time_tagged	scan_rate	point_type	Desig	Pdefault	Fu	Important	Value	Timeout	
CONTROL POINTS																				
SP023	Edmonstone St SP23	SEWER	Attention	Indicator_lamp	dom 102	32	7	0						1						OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Indicator_lamp	dom 102	32	7	1						1						OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Connect_reference_electrode	dom 102	32	7	2						1						OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	De_energise_rectifier	dom 102	32	7	3						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_operate	dom 102	32	7	4						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VFD_reset	dom 102	32	7	5						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Indicator_lamp	dom 102	32	7	6						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_operate	dom 102	32	7	7						2						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VFD_reset	dom 102	32	7	8						2						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Indicator_lamp	dom 102	32	7	9						2						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Run_at_max	dom 102	32	7	10						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Run_at_max	dom 102	32	7	11						2						OK
SP023	Edmonstone St SP23	SEWER			dom 102	32	7	12												SP
SP023	Edmonstone St SP23	SEWER			dom 102	32	7	13												SP
SP023	Edmonstone St SP23	SEWER			dom 102	32	7	14												SP
SP023	Edmonstone St SP23	SEWER			dom 102	32	7	15												SP
SP023	Edmonstone St SP23	SEWER	Attention	Activate	dop 102	144	0	0						1						OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Remote_reset	dop 102	144	0	1						1						OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Remote_start	dop 102	144	0	2						1						OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Timed_start	dop 102	144	0	3						1						OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Overwrite	dop 102	144	0	4						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Efficiency_reset	dop 102	144	0	5						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Hours_run_reset	dop 102	144	0	6						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Remote_reset	dop 102	144	0	7						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Remote_start_50percent_control	dop 102	144	0	8						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Remote_start	dop 102	144	0	9						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Remote_stop	dop 102	144	0	10						1						OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Volume_reset	dop 102	144	0	11						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Pump_start_count_reset	dop 102	144	0	12						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Timed_start	dop 102	144	0	13						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Timed_stop	dop 102	144	0	14						1						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Efficiency_reset	dop 102	144	0	15						2						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Hours_run_reset	dop 102	145	0	0						2						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Remote_reset	dop 102	145	0	1						2						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Remote_start_100percent_control	dop 102	145	0	2						2						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Remote_start	dop 102	145	0	3						2						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Remote_stop	dop 102	145	0	4						2						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Pump_start_count_reset	dop 102	145	0	5						2						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Timed_start	dop 102	145	0	6						2						OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Timed_stop	dop 102	145	0	7						2						OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Calibration_timed_start	dop 102	145	0	8						1						OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Remote_inhibit_calibration	dop 102	145	0	9						1						OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Remote_initiate_calibration	dop 102	145	0	10						1						OK
SP023	Edmonstone St SP23	SEWER	Sump_pump	Excessive_run_reset	dop 102	145	0	11												OK
SP023	Edmonstone St SP23	SEWER			dop 102	145	0	12												
SP023	Edmonstone St SP23	SEWER			dop 102	145	0	13												
SP023	Edmonstone St SP23	SEWER			dop 102	145	0	14												
SP023	Edmonstone St SP23	SEWER			dop 102	145	0	15												

Short Name	LOCATION	NETWORK	PLANT	QUANTITY	module_type	module_address	slot_number	channel	chassis_number	cubicle_number	time_tagged	scan_rate	point_type	Desig	Pdefault	Nal	Nar	Nlg	Nlr	Aud	Fu	Naz	rmin	rmax	
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_current	aim 105	48		0						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_voltage	aim 105	48		1						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Reference_electrode	aim 105	48		2						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Reference_electrode	aim 105	48		3						2											OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Level_raw	aim 105	48		4						1											OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Flow_rate_raw	aim 105	48		5						1											OK
SP023	Edmonstone St SP23	SEWER	Pressure_gauge	Pressure	aim 105	48		6						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_raw	aim 105	48		7						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_raw	aim 105	48		8						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_speed_Fbk_raw	aim 105	48		9						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_raw	aim 105	48		10						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_raw	aim 105	48		11						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_speed_Fbk_raw	aim 105	48		12						2											OK
SP023	Edmonstone St SP23	SEWER			aim 105	48		13																	SPARE
SP023	Edmonstone St SP23	SEWER			aim 105	48		14																	SPARE
SP023	Edmonstone St SP23	SEWER			aim 105	48		15																	SPARE
SP023	Edmonstone St SP23	SEWER	Flow_meter	Flow_kl	fip 101	160		0						1											OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Flow_rate	fip 101	160		1						1											OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Volume	fip 101	160		2						1											OK
SP023	Edmonstone St SP23	SEWER	Pump_combination	Efficiency	fip 101	160		3						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Hours_run	fip 101	160		4						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current	fip 101	160		5						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power	fip 101	160		6						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Number_of_starts	fip 101	160		7						1											OK
SP023	Edmonstone St SP23	SEWER	Pump_combination	Efficiency	fip 101	161		0						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Hours_run	fip 101	161		1						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current	fip 101	161		2						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power	fip 101	161		3						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Number_of_starts	fip 101	161		4						2											OK
SP023	Edmonstone St SP23	SEWER	Pressure_gauge	Pressure_kpa	fip 101	161		5						1											OK
SP023	Edmonstone St SP23	SEWER	Pressure_gauge	Pressure_mahd	fip 101	161		6						1											OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Volume_snap_shot	fip 101	161		7						1											OK
SP023	Edmonstone St SP23	SEWER	Sewage_pumping_station	Availability_index	fip 101	162		0						1											OK
SP023	Edmonstone St SP23	SEWER	Sewage_pumping_station	Current_availability	fip 101	162		1						1											OK
SP023	Edmonstone St SP23	SEWER	Sewage_pumping_station	Utility_index	fip 101	162		2						1											OK
SP023	Edmonstone St SP23	SEWER	Sewage_pumping_station	Current_utilisation	fip 101	162		3						1											OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Level	fip 101	162		4						1											OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Surcharge_duration	fip 101	162		5						1											OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Surcharge_predicted	fip 101	162		6						1											OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Surcharge_volume	fip 101	162		7						1											OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Inflow	fip 101	163		0						1											OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Total_inflow	fip 101	163		1						1											OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Volume	fip 101	163		2						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Reference_off_potential	fip 101	163		3						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Reference_on_potential	fip 101	163		4						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Reference_off_potential	fip 101	163		5						2											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Reference_on_potential	fip 101	163		6						2											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_alarm_current	fip 101	163		7						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_alarm_voltage	fip 101	164		0						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_speed_Fbk	fip 101	164		1						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_speed_Fbk	fip 101	164		2						2											OK
SP023	Edmonstone St SP23	SEWER			fip 101	164		3																	OK
SP023	Edmonstone St SP23	SEWER			fip 101	164		4																	
SP023	Edmonstone St SP23	SEWER			fip 101	164		5																	
SP023	Edmonstone St SP23	SEWER			fip 101	164		6																	
SP023	Edmonstone St SP23	SEWER			fip 101	164		7																	

Short Name	LOCATION	NETWORK	PLANT	QUANTITY	module_type	module_address	slot_number	channel	chassis_number	cubicle_number	time_tagged	scan_rate	point_type	Desig	Pdefault	Nal	Nar	Nlg	Nlr	Aud	Fu	Naz	rmin	rmax	
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Off_potential_high_limit	fop 101	208		0						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Off_potential_low_limit	fop 101	208		1						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	On_potential_high_limit	fop 101	208		2						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	On_potential_low_limit	fop 101	208		3						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Off_potential_high_limit	fop 101	208		4						2											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	Off_potential_low_limit	fop 101	208		5						2											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	On_potential_high_limit	fop 101	208		6						2											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_electrode	On_potential_low_limit	fop 101	208		7						2											OK
SP023	Edmonstone St SP23	SEWER	Attention	Duration	fop 101	209		0						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_current_high_limit	fop 101	209		1						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_current_low_limit	fop 101	209		2						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_voltage_high_limit	fop 101	209		3						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Rectifier_voltage_low_limit	fop 101	209		4						1											OK
SP023	Edmonstone St SP23	SEWER	Cathodic_protection	Test_delay	fop 101	209		5						1											OK
SP023	Edmonstone St SP23	SEWER	Sewage_pumping_station	Availability_minimum	fop 101	209		6						1											OK
SP023	Edmonstone St SP23	SEWER	Sewage_site	Percent	fop 101	209		7						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_alarm_inhbt_time	fop 101	210		0						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_alarm_inhibit_time	fop 101	210		1						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Capacity	fop 101	210		2						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_high_limit	fop 101	210		3						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_low_limit	fop 101	210		4						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Efficiency_test_char	fop 101	210		5						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_high_limit	fop 101	210		6						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_low_limit	fop 101	210		7						1											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_alarm_inhbt_time	fop 101	211		0						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_alarm_inhibit_time	fop 101	211		1						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Capacity	fop 101	211		2						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_high_limit	fop 101	211		3						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_current_low_limit	fop 101	211		4						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Efficiency_test_char	fop 101	211		5						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_high_limit	fop 101	211		6						2											OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	Motor_power_low_limit	fop 101	211		7						2											OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Alarm_inhibit_time	fop 101	212		0						1											OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	High_limit_pump_1	fop 101	212		1						1											OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	High_limit_pump_2	fop 101	212		2						1											OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Low_limit_pump_1	fop 101	212		3						1											OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Low_limit_pump_2	fop 101	212		4						1											OK
SP023	Edmonstone St SP23	SEWER	Flow_meter	Update_value	fop 101	212		5						1											OK
SP023	Edmonstone St SP23	SEWER	Wet_well	High_limit	fop 101	212		6						1											OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Low_limit	fop 101	212		7						1											OK
SP023	Edmonstone St SP23	SEWER	Pressure_gauge	Alarm_inhibit_time	fop 101	213		0						1											OK
SP023	Edmonstone St SP23	SEWER	Pressure_gauge	High_limit_pump_1	fop 101	213		1						1											OK
SP023	Edmonstone St SP23	SEWER	Pressure_gauge	High_limit_pump_2	fop 101	213		2						1											OK
SP023	Edmonstone St SP23	SEWER	Pressure_gauge	Low_limit_pump_1	fop 101	213		3						1											OK
SP023	Edmonstone St SP23	SEWER	Pressure_gauge	Low_limit_pump_2	fop 101	213		4						1											OK
SP023	Edmonstone St SP23	SEWER	Wet_well	Surcharge_pumping_duration_min	fop 101	213		5						1											OK
SP023	Edmonstone St SP23	SEWER			fop 101	213		6																	SPARE
SP023	Edmonstone St SP23	SEWER			fop 101	213		7																	SPARE
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Fault_delay	fop 101	214		0																	OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Fault_max	fop 101	214		1																	OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Auto_reset_delay	fop 101	214		2																	OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_fault_maximum	fop 101	214		3																	OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_auto_reset_delay	fop 101	214		4																	OK
SP023	Edmonstone St SP23	SEWER			fop 101	214		5																	OK
SP023	Edmonstone St SP23	SEWER			fop 101	214		6																	OK
SP023	Edmonstone St SP23	SEWER			fop 101	214		7																	OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Fault_delay	fop 101	215		0																	OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Fault_max	fop 101	215		1																	OK
SP023	Edmonstone St SP23	SEWER	Reflux_valve	Auto_reset_delay	fop 101	215		2																	OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_fault_maximum	fop 101	215		3																	OK
SP023	Edmonstone St SP23	SEWER	Sewer_pump	VF_Drive_auto_reset_delay	fop 101	215		4																	OK
SP023	Edmonstone St SP23	SEWER			fop 101	215		5																	OK
SP023	Edmonstone St SP23	SEWER			fop 101	215		6																	OK
SP023	Edmonstone St SP23	SEWER			fop 101	215		7																	OK

INSPECTION & TEST RESULTS

QUALITY PLAN:....................
CHECK LIST NO: QA3CH - 005
ISSUE NO: 2 PAGE 1 OF 2

ELECTRIC

SWITCHBOARD AND CONTROL PANEL SWITCHGEAR ASSEMBLY

CUSTOMER: BRISBANE WATER
PROJECT: EDMONDSTONE STREET P/STATION
ORDER NO:

PLANT: MAIN SWITCHBOARD LOCATION / AREA: DRG NO:	TEST EQPT: VISUAL TYPE: SERIAL NO:

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	Comment
	Engraving		
1	Labels level	(✓)	....
2	Legible (letter height as per specification)	(✓)	....
3	Fixing	(✓)	....
4	Material as per specification	(✓)	
	Duct/din rail		
5	Level	(✓)	....
6	Fixing	(✓)	....
	Earth and Neutral Bars		
7	Neutral no. of holes	(✓)	....
8	Earth no. of holes	(✓)	....
9	Neutral bar no. screws	(✓)	....
10	Earth bar no screws	(✓)	....
11	Neutral bar hole size	(✓)	....
12	Neutral bar hole size	(✓)	
	Equipment		
13	Equipment Layout	(✓)	....
14	Correct Equipment	(✓)	....
15	Equipment level	(✓)	....
16	Equipment fix	(✓)	PASS

CHECKED BY: JUSTIN MULLIGAN SIGNATURE: DATE: 22/4/02 ELECTRICAL LICENCE NO:	APPROVED BY: C. HOLMES SIGNATURE: DATE: 22/4/02

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 1994, AS3000:2000 and AS3008.1.1.1998.

AUTHORISED BY: Peter Mercer SIGNATURE:.................... DATE: 21/8/02

QUALITY PLAN:...................
CHECK LIST NO: QA3CH - 005
ISSUE NO: 2 PAGE 2 OF 2

ELECTRIC

SWITCHBOARD AND CONTROL PANEL SWITCHGEAR ASSEMBLY

CUSTOMER: BRISBANE WATER
PROJECT: EDMONOSTONE STREET
ORDER NO:

PLANT: BRISBANE WATER	TEST EQPT: VISUAL
LOCATION / AREA:	TYPE:
DRG NO:	SERIAL NO:

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	Comment
	Wiring		
17	Wire size and temperature rating is correct	(✓)	....
18	Wire colour	(✓)	....
19	Wire number system as per specification	(✓)	....
20	Wire numbers	(✓)	....
21	Isolators are correct size	(✓)	....
22	Fuses are correct size	(✓)	....
23	Contact/o/load are correct size	(✓)	....
24	Terminals (allow spares as per specification)	(✓)	
25	Circuit breakers are correct size	(✓)	
	Looms		....
26	Supported	(✓)	....
27	Protected	(✓)	....
28	Cable off steel edges (allow bushing)	(✓)	....
29	Cable lugs	(✓)	
30	Cable crimp	(✓)	
			PASS.

CHECKED BY: JUSTIN MULLIGAN SIGNATURE: [signature] DATE: 22/4/02 ELECTRICAL LICENCE NO: 38779	APPROVED BY: C. HOLMES SIGNATURE: [signature] DATE: 22/4/02

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 1994, AS3000:2000 and AS3008.1.1.1998.

AUTHORISED BY: Peter Mercer SIGNATURE:.....[signature]..... DATE:..21/05/02..

QUALITY PLAN:....................
CHECK LIST NO: QA3CH - 015
ISSUE NO: 2 PAGE 1 OF 1

ELECTRIC

SWITCHBOARD AND CONTROL PANEL
INSULATION TEST TO AS3439.1-1993 (2,500 volts)

CUSTOMER: BRISBANE WATER
PROJECT: EDMONDSTONE STREET
ORDER NO:

PLANT: LOCATION / AREA: DRG NO:	TEST EQPT: MEGGAR. TYPE: KYORITSU SERIAL NO: 0769012

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	Comment
1	Rated insulation voltage	(✓)	415V.
2	Disconnect control circuits and all electronics	(✓)	Done
3	Insulation test - volts	(✓)	1000V.
4	Insulation test - Red to White.	(✓)	∞
5	Insulation test - Red to Blue.	(✓)	∞
6	Insulation test - Red to Earth.	(✓)	∞
7	Insulation test - Red to Neutral.	(✓)	∞
8	Insulation test - White to Earth.	(✓)	∞
9	Insulation test - White to Neutral.	(✓)	∞
10	Insulation test - Blue to Earth.	(✓)	∞
11	Insulation test - Blue to Neutral.	(✓)	∞
12	2.5 KV FOR 1 MIN PTOP 3 PTON 3PTOE.	(✓)	PASS
	WHITE TO BLUE.	(✓)	∞

CHECKED BY: JUSTIN MOLLIGAN SIGNATURE: DATE: 22-4-02 ELECTRICAL LICENCE NO: 38779	APPROVED BY: C. HOLMES SIGNATURE: DATE: 22/4/02

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 1994, AS3000:2000 and AS3008.1.1.1998.

AUTHORISED BY: Peter Mercer SIGNATURE:.......................... DATE: 21/05/02

ELECTRICAL ENGINEERS, CONTRACTORS & SWITCHBOARD MANUFACTURERS

QUALITY PLAN:....................
CHECK LIST NO: QA3CH - 020
ISSUE NO: 2 PAGE 1 OF 1

ELECTRIC

SWITCHBOARD AND CONTROL PANEL FUNCTIONAL TEST

CUSTOMER: BRISBANE WATER
PROJECT: EDMONDSTONE STREET
ORDER NO:

PLANT: **LOCATION / AREA:** **DRG NO:**	**TEST EQPT:** VISUAL/MULTIMETER. **TYPE:** FLUKE 11. **SERIAL NO:** 70540192.

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	Comment
	Prior to Supply Connection		
1	Do a point to point test on all cables as per the skematic drawings.	(✓)	....
2	Check no crossed voltages 24/240.	(✓)	....
3	Ensure cable colour coding as per specification	(✓)	....
4	Check analog inputs/outputs have shielded cable.	(✓)	....
5	Check all cables are numbered.	(✓)	
6	Ensure indicator lights have right colour lenses.	(✓)	....
7	Check all CT's are earthed.	(✓)	....
8	Ensure relays are switching correctly.	(✓)	....
9	Check push buttons work correctly.	(✓)	....
10	Check selector switches work correctly.	(✓)	....
11	Ensure signal inputs/outputs are correct.	(✓)	....
	Connect Supply		
12	Test operations step by step following specified procedure.	(✓)	.... PASS.

CHECKED BY: JUSTIN MULLIGAN. SIGNATURE: [signature] DATE: 22-4-02 ELECTRICAL LICENCE NO: 38779.	APPROVED BY: [signature] SIGNATURE: DATE: 22/4/02.

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 1994, AS3000:2000 and AS3008.1.1.1998.

AUTHORISED BY: Peter Mercer SIGNATURE: [signature]........................... DATE: 21/05/02

ELECTRICAL ENGINEERS, CONTRACTORS & SWITCHBOARD MANUFACTURERS

SWITCHBOARD AND CONTROL PANEL
EARTH CONTINUITY TEST

CLIENT: BRISBANE WATER.
PROJECT: EDMONSTONE STREET.
JOB NO: JO 6375 MB.

SWITCHBOARD DESCRIPTION: MAIN SWITCHBOARD. DRG NO:	TEST EQUIPMENT: MEGGAR. TYPE: KYORITSU. SERIAL NO: 0769012. CALIBRATION DUE DATE: 5/6/02.

ITEM NO	DESCRIPTION	CHECKED (TICK)	Results
1	Main Earth to DOOR 1 SEWAGE PUMP 1 DOOR USD SECTION	✓	>1 Ohm
2	Main Earth to DOOR 2 CABLE ZONE USD1 SECTION (BELOW)	✓	>1
3	Main Earth to DOOR 3 CABLE ZONE BESIDE USD 1 SECTION	✓	>0.5
4	Main Earth to DOOR 4 PUMP 1 CONTROL ZONE.	✓	>1
5	Main Earth to DOOR 5 COMMON CONTROL SECTION	✓	>1
6	Main Earth to DOOR 6 SUMP PUMP SECTION	✓	>0.5
7	Main Earth to DOOR 7 SPARE ~~[illegible]~~ COMPARTMENT SECTION	✓	>1
8	Main Earth to DOOR 8 PUMP 1 MAIN BREAKER SECTION	✓	>0.5

TESTED BY: JUSTIN MULLIGAN. SIGNATURE: DATE: 22-4-02 ELECTRICAL LICENCE NO: 38779.	WITNESSED BY: SIGNATURE: DATE:

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SWITCHBOARD AND CONTROL PANEL
EARTH CONTINUITY TEST

CLIENT: BRISBANE WATER.
PROJECT: EDMONDSTONE ST
JOB NO: JO 6375.

SWITCHBOARD DESCRIPTION: DRG NO:	TEST EQUIPMENT: MEGGAR. TYPE: KYORITSU SERIAL NO: 0769012 CALIBRATION DUE DATE: 5-6-02

ITEM NO	DESCRIPTION	CHECKED (TICK)	Results
1	Main Earth to DOOR 9 POWER MONITOR DOOR	(✓)	>1
2	Main Earth to DOOR 10 SUPPLY AUTHORITY SECTION	(✓)	>1
3	Main Earth to DOOR 11 PUMP 2 MAIN BREAKER SECTION	(✓)	>0.5
4	Main Earth to DOOR 12 GENERATER MAIN BREAKER SECTION	(✓)	>0.5
5	Main Earth to DOOR 13 GENERATER INCOMER SECTION	(✓)	>0.5
6	Main Earth to DOOR 14 PUMP 2 CONTROL SECTION	(✓)	>1
7	Main Earth to DOOR 15 DISTRIBUTION SECTION	(✓)	>0.5
8	Main Earth to DOOR 16 PUMP 2 VSD SECTION CABLE ZONE	(✓)	>0.5

TESTED BY: JUSTIN MULLIGAN. SIGNATURE: [signature] DATE: 22-4-02. ELECTRICAL LICENCE NO: 38779.	WITNESSED BY: SIGNATURE: DATE:

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SWITCHBOARD AND CONTROL PANEL
EARTH CONTINUITY TEST

CLIENT: BRISBANE WATER.
PROJECT: EDMONDSTONE ST
JOB NO: JO 6375.

SWITCHBOARD DESCRIPTION: DRG NO:	TEST EQUIPMENT: MEGGAR. TYPE: KYORITSU. SERIAL NO: 0769012 CALIBRATION DUE DATE: 5-6-02

ITEM NO	DESCRIPTION	CHECKED (TICK)	Results
1	Main Earth to DOOR 17 PUMP 2 VSD SECTION CABLE ZONE (BELOW)	(✓)	>0.5
2	Main Earth to DOOR 18 VSD PUMP2 SECTION	(✓)	>1
3	Main Earth to GLAND PLATE 1 VSD1 CABLE ZONE BOTTOM LEFT	(✓)	>.5
4	Main Earth to " " 2 VSD1 CABLE ZONE BOTTOM	(✓)	>0.5
5	Main Earth to " " 3 VSD1 CABLE ZONE BOTTOM RIGHT	(✓)	>0.5
6	Main Earth to " " 4 MAINS INCOMER	(✓)	>0.5
7	Main Earth to " " 5 GENERATOR INCOMER	(✓)	>0.5
8	Main Earth to " " 6 VSD 2 CABLE ZONE BOTTOM LEFT	(✓)	>0.5

TESTED BY: JUSTIN MULLIGAN. SIGNATURE: DATE: 22-4-02. ELECTRICAL LICENCE NO: 38779.	WITNESSED BY: SIGNATURE: DATE:

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SWITCHBOARD AND CONTROL PANEL EARTH CONTINUITY TEST

CLIENT: BRISBANE WATER.
PROJECT: EDMONDSTONE ST
JOB NO: JO 6375.

SWITCHBOARD DESCRIPTION: DRG NO:	TEST EQUIPMENT: MEGGAR. TYPE: KYORITSU. SERIAL NO: 0769012 CALIBRATION DUE DATE: 5-6-02

ITEM NO	DESCRIPTION	CHECKED (TICK)	Results
1	Main Earth to GLAND PLATE 7 USD2 CABLE ZONE BOTTOM	(✓)	20.5
2	Main Earth to GLAND PLATE 8 USD2 CABLE ZONE BOTTOM RIGHT.	(✓)	21
3	Main Earth to DOOR 19 ESCHEON	(✓)	21
4	Main Earth to	( )	....
5	Main Earth to	( )	....
6	Main Earth to	( )	....
7	Main Earth to	( )	....
8	Main Earth to	( )	....
		( )	....

TESTED BY: JUSTIN MULLIGAN. SIGNATURE: [signature] DATE: 22-4-02 ELECTRICAL LICENCE NO: 38779.	WITNESSED BY: SIGNATURE: DATE:

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SWITCHBOARD AND CONTROL PANEL
INSULATION RESISTANCE TEST (2,500 volts)

CLIENT: BRISBANE WATER

PROJECT: EDMONDSTONE ST.

JOB NO: 50 6375 MB

SWITCHBOARD DESCRIPTION: MAIN SWITCH BOARD **DRG NO:** INCOMING SECTION	**TEST EQUIPMENT:** HI - POT. **TYPE:** **SERIAL NO:** 952 463 **CALIBRATION DUE DATE:**

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	Results
1	Rated insulation voltage	(✓)	2.5 KV.
2	Disconnect control circuits and all electronics	(✓)	
3	Insulation test - Red to White.	(✓)	1 min. O.K
4	Insulation test - Red to Blue.	(✓)	– " –
5	Insulation test – White to Blue.	(✓)	– " –
6	Insulation test - Red to Earth.	(✓)	– " –
7	Insulation test - Red to Neutral.	(✓)	– " –
8	Insulation test - White to Earth.	(✓)	– " –
9	Insulation test - White to Neutral.	(✓)	– " –
10	Insulation test - Blue to Earth.	(✓)	– " –
11	Insulation test - Blue to Neutral.		

TESTED BY: JUSTIN MULLIGAN SIGNATURE: [signature] DATE: 22-4-02 ELECTRICAL LICENCE NO: 38779	WITNESSED BY: SIGNATURE: DATE:

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SWITCHBOARD AND CONTROL PANEL
INSULATION RESISTANCE TEST (2,500 volts)

CLIENT: BRISBANE WATER

PROJECT: EDMONDSTONE ST.

JOB NO: 50 6575 MB.

SWITCHBOARD DESCRIPTION: MAIN SWITCH BOARD. **DRG NO:** MAIN BUS	**TEST EQUIPMENT: TYPE:** HI-POT **SERIAL NO:** 952 463 **CALIBRATION DUE DATE:**

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	Results
1	Rated insulation voltage	(✓)	2.5KV
2	Disconnect control circuits and all electronics	(✓)	....
3	Insulation test - Red to White.	(✓)	1MIN. O.K
4	Insulation test - Red to Blue.	(✓)	" "
5	Insulation test – White to Blue.	(✓)	" "
6	Insulation test - Red to Earth.	(✓)	" "
7	Insulation test - Red to Neutral.	(✓)	" "
8	Insulation test - White to Earth.	(✓)	" "
9	Insulation test - White to Neutral.	(✓)	" "
10	Insulation test - Blue to Earth.	(✓)	" "
11	Insulation test - Blue to Neutral.		

TESTED BY: JUSTIN MULLIGAN SIGNATURE: [signature] DATE: 22-4-02 ELECTRICAL LICENCE NO: 38779	WITNESSED BY: SIGNATURE: DATE:

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SWITCHBOARD AND CONTROL PANEL
INSULATION RESISTANCE TEST (1,000 volts)

CLIENT: BRISBANE WATER

PROJECT: EDMONDSTONE STREET

JOB NO: J0 6375

SWITCHBOARD MAIN SWITCHBOARD **DESCRIPTION:** INCOMER **DRG NO:**	**TEST EQUIPMENT:** MEGGER **TYPE:** KYORITSU **SERIAL NO:** 0764012 **CALIBRATION DUE DATE:** 5/6/02

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	Results
1	Rated insulation voltage	(✓)	1000V.
2	Disconnect control circuits and all electronics	(✓)	....
3	Insulation test - Red to White.	(✓)	∞
4	Insulation test - Red to Blue.	(✓)	∞
5	Insulation test – White to Blue	(✓)	∞
6	Insulation test - Red to Earth.	(✓)	∞
7	Insulation test - Red to Neutral.	(✓)	∞
8	Insulation test - White to Earth.	(✓)	∞
9	Insulation test - White to Neutral.	(✓)	∞
10	Insulation test - Blue to Earth.	(✓)	∞
11	Insulation test - Blue to Neutral.	✓	∞

TESTED BY: JUSTIN MULLIGAN SIGNATURE: [signature] DATE: 22-4-02 ELECTRICAL LICENCE NO: 38779.	WITNESSED BY: SIGNATURE: DATE:

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SWITCHBOARD AND CONTROL PANEL
INSULATION RESISTANCE TEST (1,000 volts)

CLIENT: BRISBANE WATER

PROJECT: EDMONDSTONE STREET

JOB NO: JO 6375.

SWITCHBOARD MAIN SWITCHBOARD DESCRIPTION: MAIN BUS DRG NO:	TEST EQUIPMENT: MEGGER TYPE: KYORITSU SERIAL NO: 0764012 CALIBRATION DUE DATE: 5/6/02

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	Results
1	Rated insulation voltage	(✓)	1000V.
2	Disconnect control circuits and all electronics	(✓)	
3	Insulation test - Red to White.	(✓)	∞
4	Insulation test - Red to Blue.	(✓)	∞
5	Insulation test – White to Blue	(✓)	∞
6	Insulation test - Red to Earth.	(✓)	∞
7	Insulation test - Red to Neutral.	(✓)	∞
8	Insulation test - White to Earth.	(✓)	∞
9	Insulation test - White to Neutral.	(✓)	∞
10	Insulation test - Blue to Earth.	(✓)	∞
11	Insulation test - Blue to Neutral.	✓	∞

TESTED BY: JUSTIN MULLIGAN. SIGNATURE: [signature] DATE: 22-4-02 ELECTRICAL LICENCE NO: 38779	WITNESSED BY: SIGNATURE: DATE:

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SWITCHBOARD AND CONTROL PANEL FUNCTIONAL TEST

CLIENT: BRISBANE WATER

PROJECT: EDMONSTONE ST.

JOB NO: JO 6375 MB

SWITCHBOARD DESCRIPTION: MAIN SWITCHBOARD DRG NO:	TEST EQUIPMENT: VISUAL/MULTIMETER TYPE: FLUKE 11. SERIAL NO: 70540192. CALIBRATION DUE DATE: 19-4-03.

ITEM NO	ACTIVITY DESCRIPTION	CHECKED (TICK)	Comment
1	**Prior to Supply Connection** Do a point to point test on all cables as per the schematic drawings to ensure correct circuit connection.	(✓)	....
2	**Visual Inspection** Check no crossed voltages i.e.24/240.	(✓)	....
3	Check analog inputs/outputs have shielded cable.	(✓)	....
4	Check all cables are numbered.	(✓)	....
5	Ensure indicator lights have right colour lenses.	(✓)	....
6	Check all CT's are earthed and not open circuit.	(✓)	....
7	Ensure signal inputs/outputs are correct.	(✓)	....
8	**Connect Supply (Personal Protection Equipment must be used)** Test functional operation of switchboard following specific construction issue drawing.	(✓)	....
			PASS

TESTED BY: JUSTIN MOLLIGAN. SIGNATURE: DATE: 22-4-02 ELECTRICAL LICENCE NO: 38779.	WITNESSED BY: SIGNATURE: DATE:

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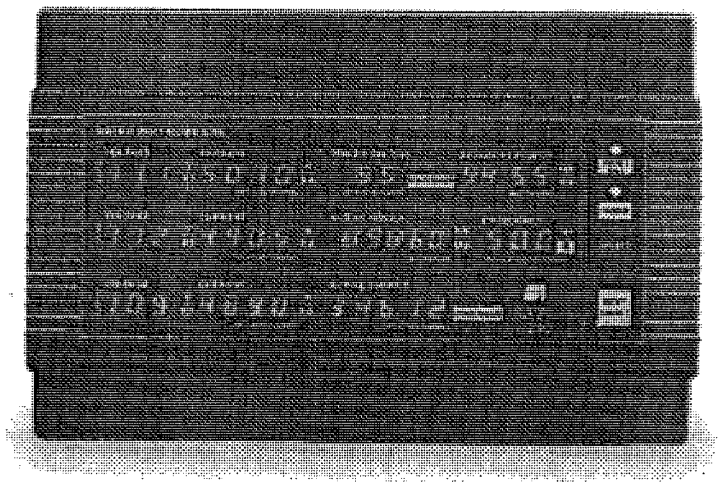
PM290 POWERMETER



Installation and Operation Manual

LIMITED WARRANTY

The manufacturer offers the customer an 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, setup or operate the instrument according to the instructions herein will void the warranty.

Your instrument may be opened only by a duly authorized representative of the manufacturer. 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.

NOTE

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.

IMPORTANT

Please read instructions contained in this manual before performing installation, and take note of the following precautions:

1. **Ensure that all incoming AC power and other power sources are turned OFF** before performing any work on the instrument.
2. **Check the labels** on the side of the instrument **before** connecting to the power source to ensure that your instrument is equipped with the appropriate power supply voltage, input voltages, currents, analog output and communication protocol for your application.
2. **Do not connect the instrument** to a power source if it is damaged.
3. **Do not expose the instrument** to rain or moisture.

4. **The secondary of an external current transformer must never be allowed to** be open circuit when the primary is energized. Ensure that the current transformer wiring is made through shorting switches and is secured using an external strain relief to reduce mechanical strain on the screw terminals, if necessary.

5. **Setup procedures must be performed only by qualified personnel familiar** with the instrument and its associated electrical equipment.

6. **DO NOT attempt to open the instrument under any circumstances.**

Modbus is a trademark of Modicon, Inc.

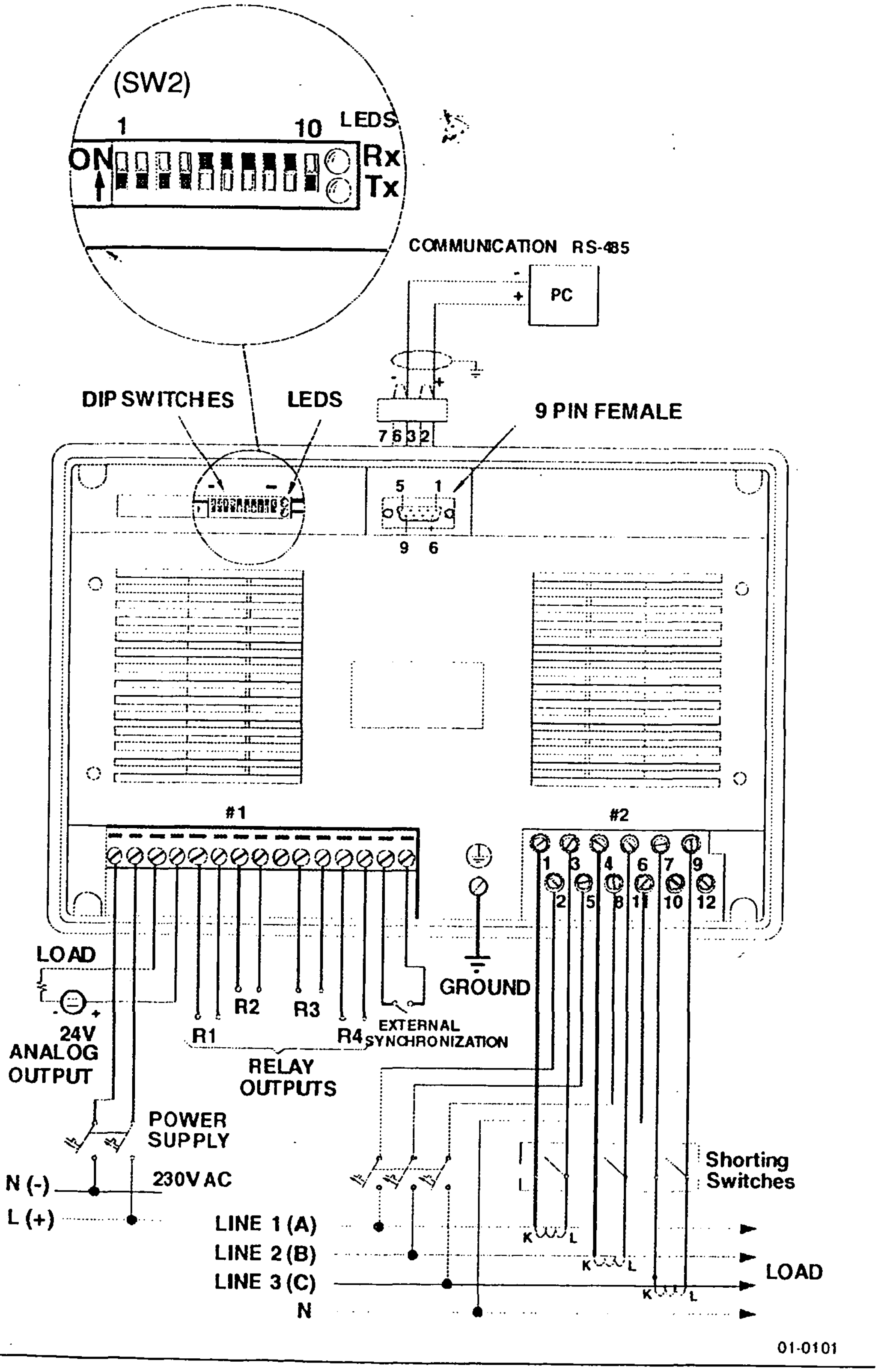
☞ **Read through this manual thoroughly before connecting the instrument to the current carrying circuits. During operation, hazardous voltages are present on input terminals. Failure to observe precautions can result in fatal injury and/or damage to equipment.**

BG0208 Rev. A1

Table of Contents

Quick Start

TYPICAL INSTALLATION



BASIC and COMMUNICATION PARAMETERS SETUP

(default setting)*

Code	Parameter	Options	Description
CnF	Wiring mode	*3OP* *4Ln* *3dir* *4LL**	3-wire open delta using 2 CTs 4-wire Wye using 3 PTs 3-wire direct connection using 2 CTs 4-wire Wye using 3 PTs
Pt	PT ratio	*1.0* - 6,500.0*	Potential transformer ratio
Ct	CT primary current	*1-50,000A* *(5000*)*	Primary rating of the phase current transformer
Ct.G	Ground Leakage CT primary current	*1-50,000mA* *(5000*)*	Primary rating of the ground leakage current transformer (*Option L* only)
P	Power demand period	*1, 2, 5, 10, 15*, 20, 30, 60, E*	Length of demand period for power demand calculations, in minutes. E = external synchronization
A.dP	Ampere demand period	*0-1800* s (15*)	Length of demand period for ampere demand calculations 0 = measuring peak current
#	Relay number	*1, 2, 3* or *4*	Relay setpoints
buF	Buffer size	*8*, 32*	No. of measurements for RMS sliding averaging
rSt	Reset	*diS, En **	Protects all reset functions if disabled
br	Baud rate / data format	*110, 300, 600, 1200, 2400, 4800, 9600** bps/ *7E* (7 bits, even parity), *8E* (8 bits, even parity), *8n** (8 bits, no parity)	
Add	Address	ASCII protocol: *0*-99*; Modbus protocol: *1*-247*	
H.Sh	Incoming flow control (handshaking)	*nonE** *SOFt* *Hard*	No handshaking Software handshaking (XON/XOFF protocol) Hardware handshaking (CTS protocol)
CoP	Communications protocol and interface standard	*ASCI232* *ASCI422* *ASCI485** *bin232* *bin422* *bin485* *Prnt232*	ASCII protocol, RS-232 ASCII protocol, RS-422 ASCII protocol, RS-485 Modbus RTU protocol, RS-232 Modbus RTU protocol, RS-422 Modbus RTU protocol, RS-485 Printer mode
Pr	Printout period	*1*,2,5,10,15,20, 30,60* minutes	Time interval between successive printouts

1 Introduction

The *PM290* is a 3-phase AC Powermeter specially designed to meet the needs of users ranging from electrical panel builders to substation operators. The *PM290* performs all basic power measurements; Option L provides ground leakage current measurements (instead of external synchronization).

Measured Parameters

The *PM290* measures and displays the following parameters:

Parameter	*PM290*	*Option L*
True RMS voltage (3-phase or line-to-line)	•	•
True RMS current per phase	•	•
Active Power	•	•
Apparent Power	•	•
Reactive Power	•	•
Active Power Maximum Demand	•	•
Active Power Accumulated Demand	•	•
Ampere Maximum Demand per phase	•	•
Apparent Power Maximum Demand	•	• [1]
System Power Factor	•	•
Active Energy (Consumption)	•	•
Returned Energy	•	•
Reactive Energy	•	•
Frequency	•	•
Unbalanced Current (Zero Sequence) - for 4 wire system	•	•
Ground Leakage Current (Option L)		•
External Synchronization Input	•	

[1] This parameter can be read only via Modbus communications.

Control and Alarm Relays

Four programmable relays provide alarms, control and load shedding. Any combination of setpoints listed below can be assigned to any relay. See *Section 3.13*.

- High current
- High voltage
- Low voltage
- High apparent power
- High reactive power
- Low power factor
- High active power accumulated demand
- High unbalanced current (zero sequence) ***or*** High ground leakage current (Option L)

Communications Connection (optional)

Connection to a printer, computer or central control room is enabled by an RS-232/RS-422/RS-485 communications port that can operate at baud rates of up to 9,600 bps. The RS-422/RS-485 port can operate in multi-drop mode, permitting the connection of up to 32 instruments to a single communications line. In the printer mode, the Powermeter provides direct output of measurement parameters in printable format. See *Section 2.2.9* for pinouts and *Appendix C* for cable drawings.

Analog Output (optional)

One optional internal analog output is available for the following measured values:

- Voltage (3-phase or line-to-line)
- Current (3-phase or line-to-line)
- Active power accumulated demand
- Power factor
- Active power
- Apparent power
- Reactive power
- Frequency

An external power supply (15-30VDC,24 VDC nominal) is required. See *Section 2.2.8* for connection.

If more than one analog output is desired, up to two AX-8 analog expanders are available, providing up to 12 analog outputs. Contact your distributor for purchasing AX-8 units.

Digital Input

One optically isolated digital input is provided for external synchronization of power demand period. See Typical Installation on page *iv* for connection.

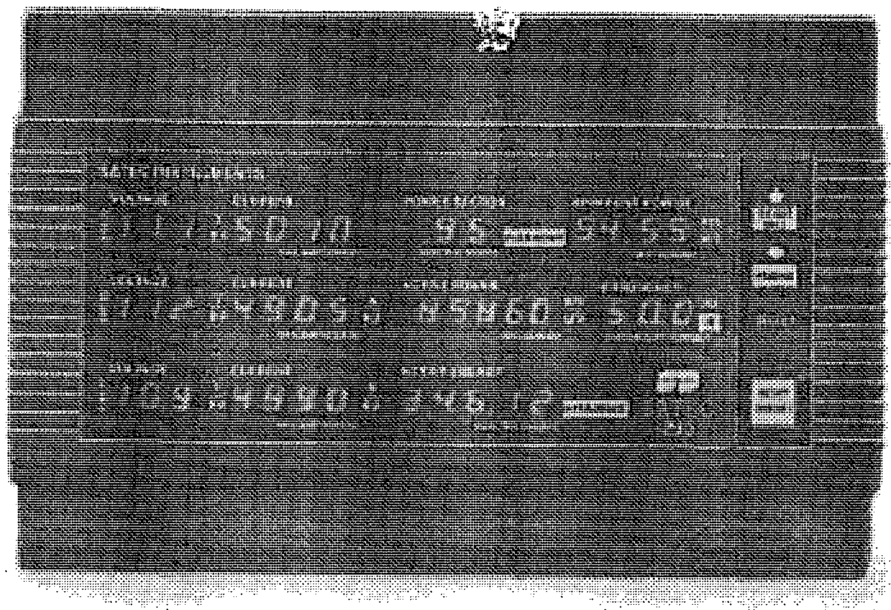
Ground Leakage (Option L)

Option L provides ground leakage current measurements for monitoring and alarm setting. A special ground leakage current transformer (secondary current 5 mA) is required. See Section 2.2.10 for connection.

Getting Started

Connect the Powermeter to a suitable power supply. The Powermeter will initiate a series of self-tests. Upon completion of the self-tests, all of the front panel LEDs will light up for one second and indicate a one-digit diagnostic code. An '8' represents normal power up. If a different diagnostic code constantly appears when you apply power to the instrument, contact your local distributor.

The Front Panel



- **Up/Down arrow** keys are used to scroll pages forward/backward
- **Select** is used to enter the *setup* mode from the default *monitoring* mode; it is also used to define the setup parameters (see *Chapter 3, Initial Setup*)
- **Enter/Reset** is used to reset measured values (if in monitoring mode) or to enter setup parameter values (if in setup mode)

2 Installation and Interfaces

2.1 Mechanical Installation

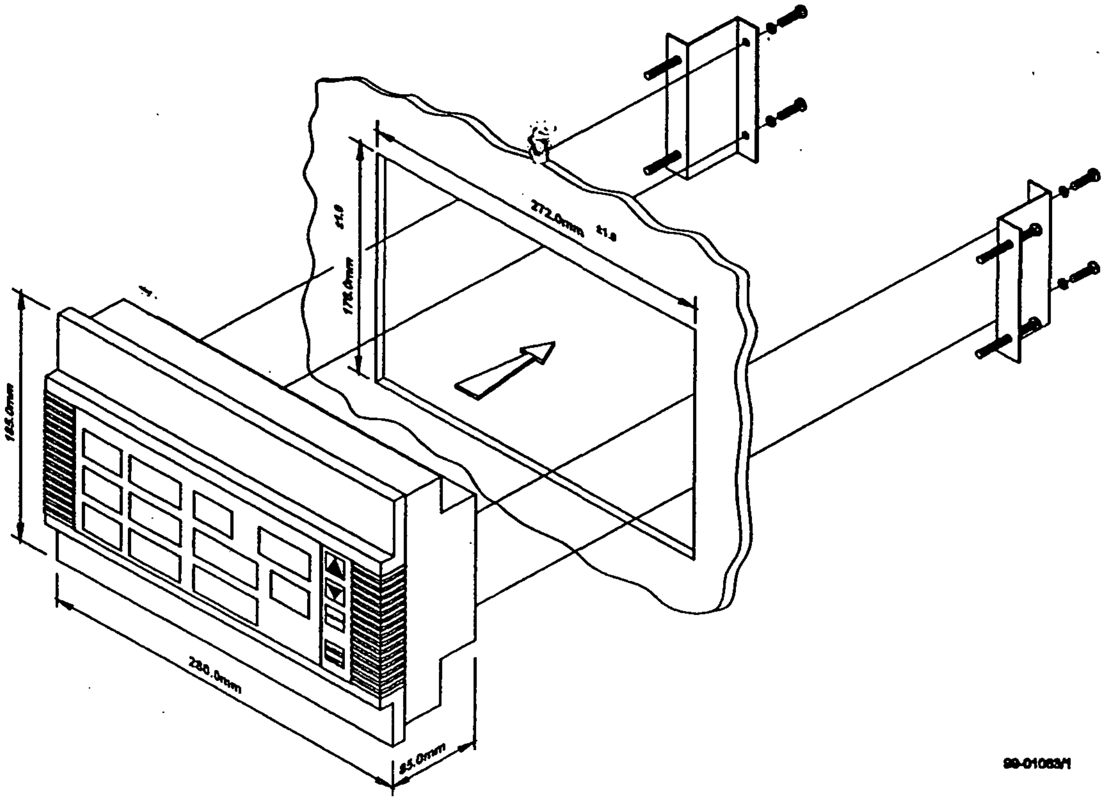


Figure 2-1 Front Panel Mounting (standard)

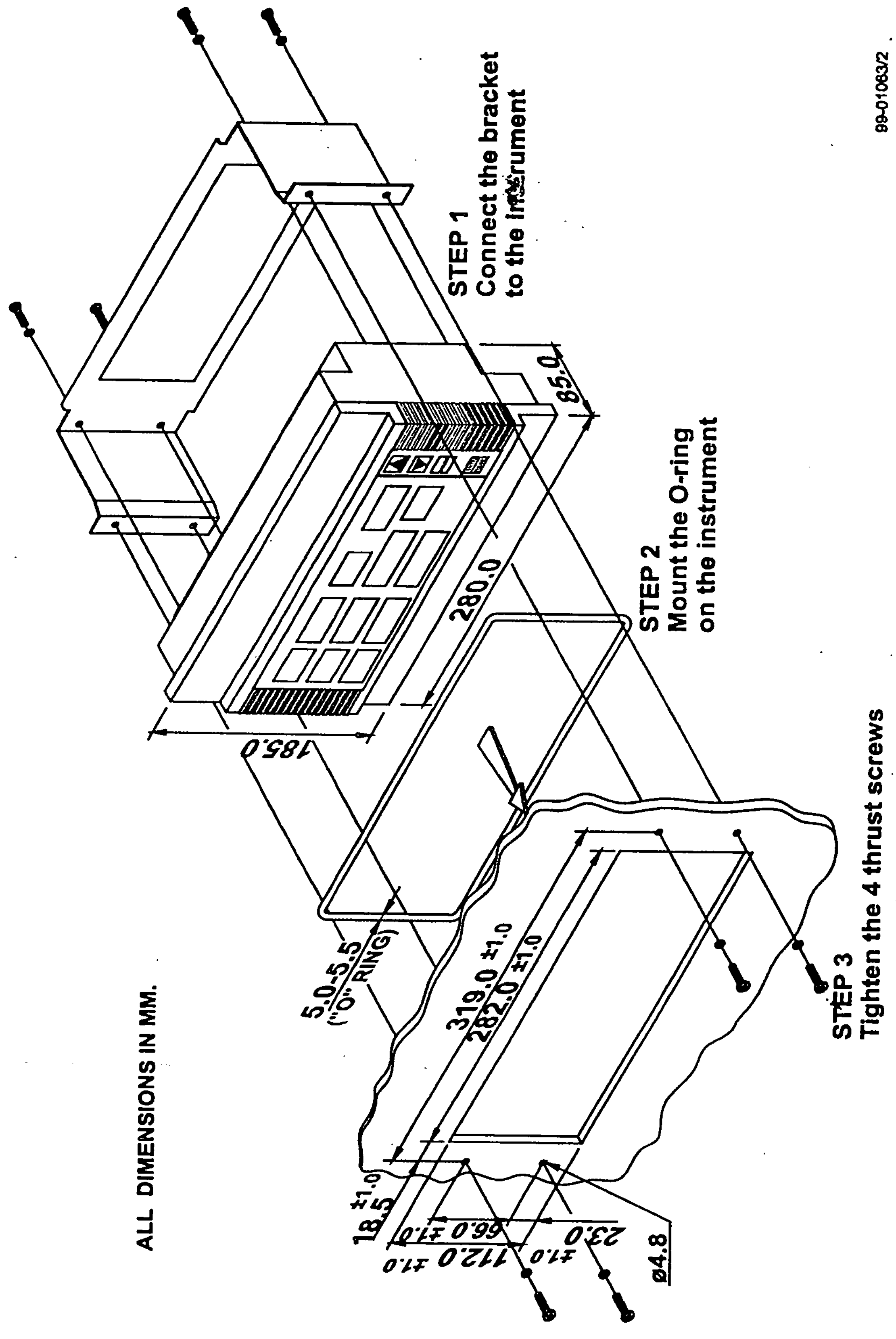


Figure 2-2 Rear Mounting

2.2 Electrical Installation

2.2.1 Dip Switches

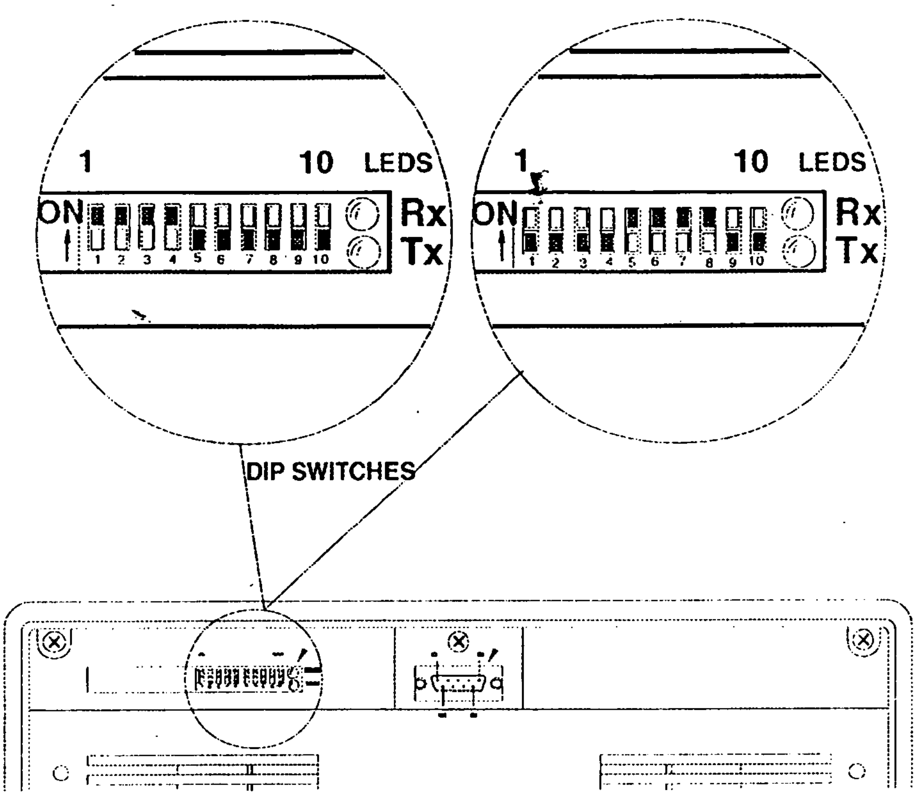


Figure 2-3 Dip Switches (Rear View)

Communications (see *section 2.5*):

RS-232: switches 1-4 ON, switches 5-8 OFF;

RS-422/RS-485: switches 1-4 OFF, switches 5-8 ON.

Setup (see *Chapter 3*): switch 9 ON = enable, OFF = disable

Page scrolling: switch 10 ON = stay at current page, OFF = return to page 1 after 30 seconds.

Analog Expander: switch 2 ON = enabled, OFF= disabled (in this case the internal analog output remains available).

If the instrument is installed in a harsh environment with potential for electromagnetic impulses from heavy switch gears, motors or lightning, then it is mandatory to use the EMI/RFI suppression cores provided with the instrument, as shown in *Figure 2-4*.

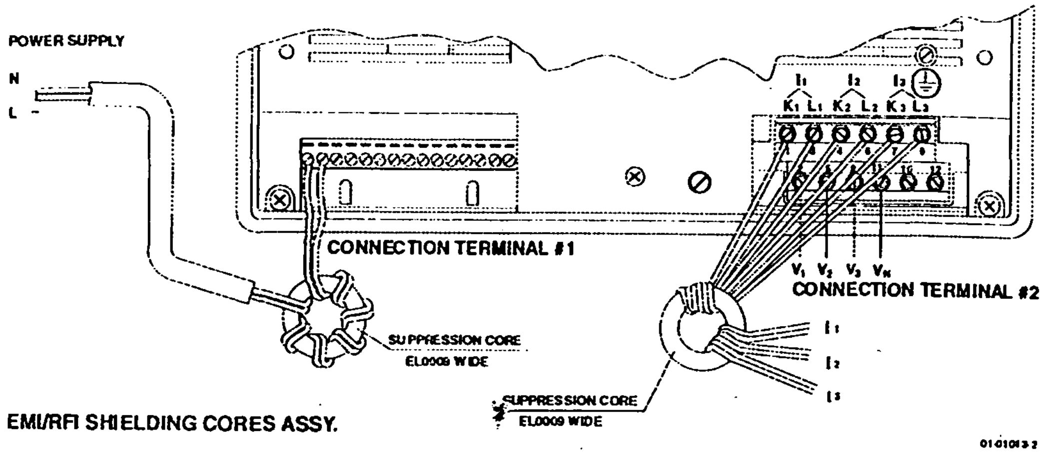


Figure 2-4 *Use of Suppression Cores*

2.2.2 Power Source Connection

AC power supply: connect the live line of the power source to terminal 14 and the neutral to terminal 13.

DC power supply: connect the positive supply wire to terminal 14 and the negative wire to terminal 13 (see *Typical Installation* on page iv).

2.2.3 Voltage Input Connections

660V Input: Direct Connection

Wiring diagrams for these are provided in *Figures 2.5, 2.7,* and *2.9.*

660V Input: Using Potential Transformers

Wiring diagrams for applications where potential transformers (PT) are used are provided in *Figures 2-6* and *2-8.*

120V Input

Instruments with 120V input (Option U) must be wired via potential transformers. Wiring diagrams are provided in *Figures 2-6* and *2-8.*

2.2.4 Current Input Connections

See *Typical Installation* on page iv for current input connections.

☞ **All CTs must be connected in the correct order and with the correct polarity as shown in the wiring diagrams for the instrument to operate properly. If the instrument displays a power factor of zero or close to it, or if power readings show unreasonable values, this may indicate a reversal of polarity of the CT connections.**

2.2.5 Ground Connection

Connect the instrument chassis ground to the switchgear earth ground using dedicated wire greater than $2mm^2$/14AWG. See *Typical Installation* on page iv for ground connection.

2.2.6 Wiring Configurations

There are 5 possible wiring configurations, illustrated in *Figures 2-5* through *2-9*:

No.	Wiring Configuration	Wiring Mode
1)	3-wire direct connection using 2 CTs	*3dir*
2)	3-wire open delta connection using 2 PTs, 2 CTs	*3OP*
3)	4-wire WYE direct connection using 3 CTs	*4L-n* or *4L-L*
4)	4-wire WYE connection using 3 PTs, 3 CTs	*4L-n* or *4L-L*
5)	4-wire grounded delta connection using 3 CTs	*4L-n* or *4L-L*

L-n = line-to-neutral; *L-L* = line-to-line voltage readings; voltage readings in 3-wire configurations always represent *line-to-line* voltages

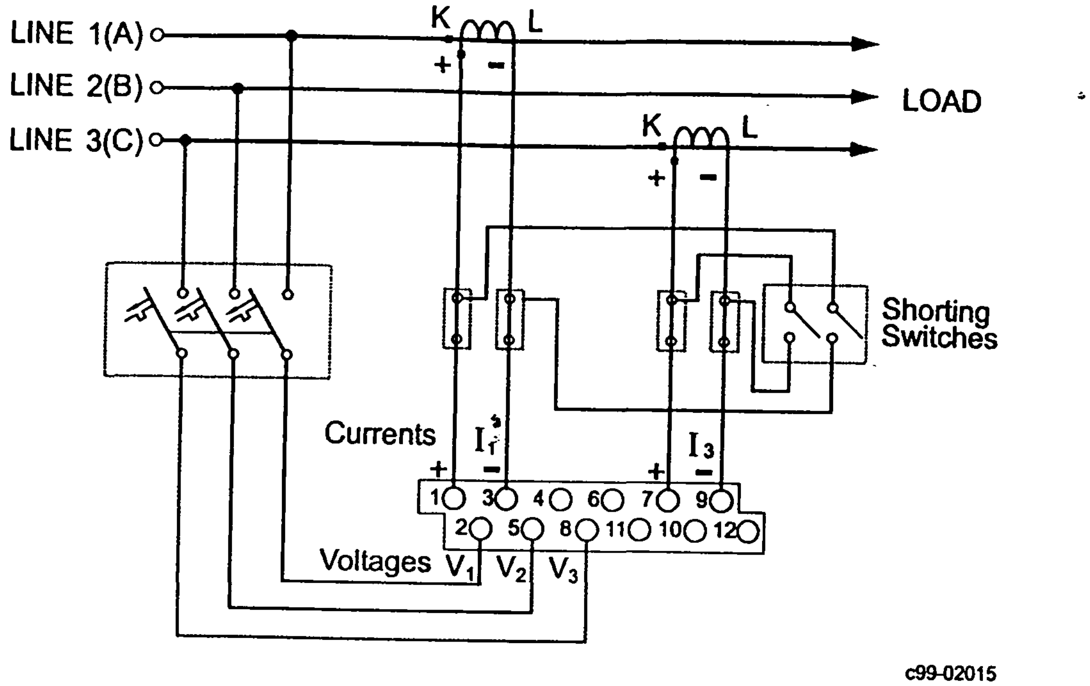


Figure 2-5 3-wire Direct Connection Using 2 CTs - Wiring Mode **3dir**

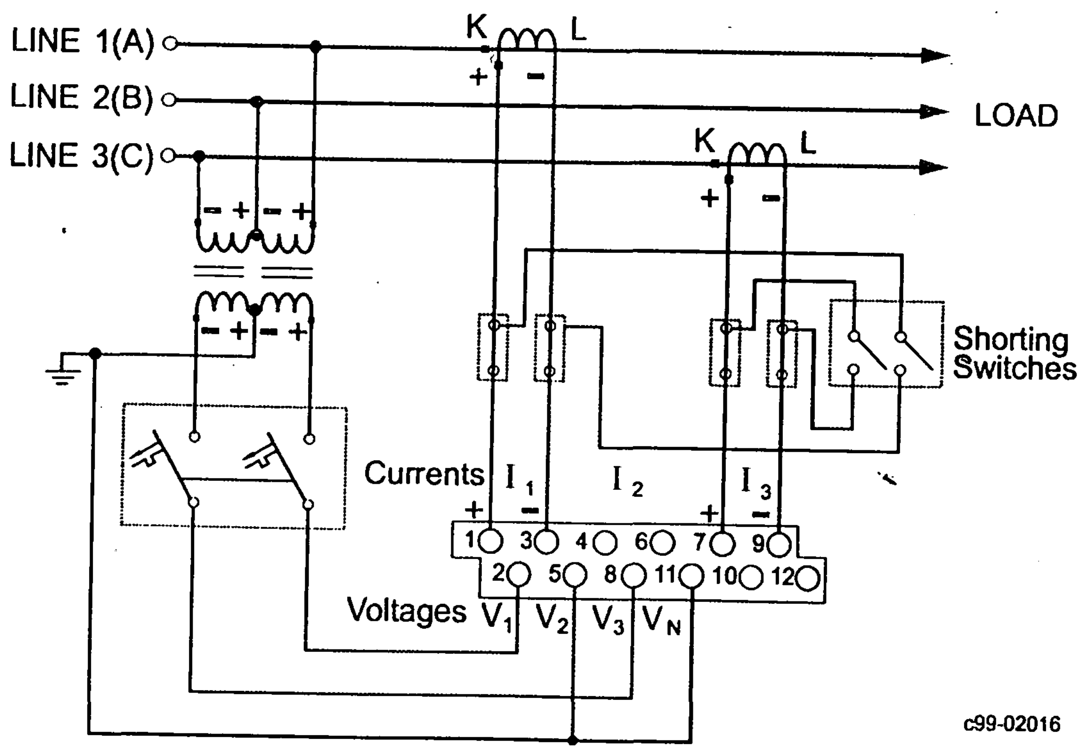


Figure 2-6 3-Wire Open Delta Connection Using 2 PTs, 2 CTs - Wiring Mode **3OP**
(Note the connection between terminals 5 and 11)

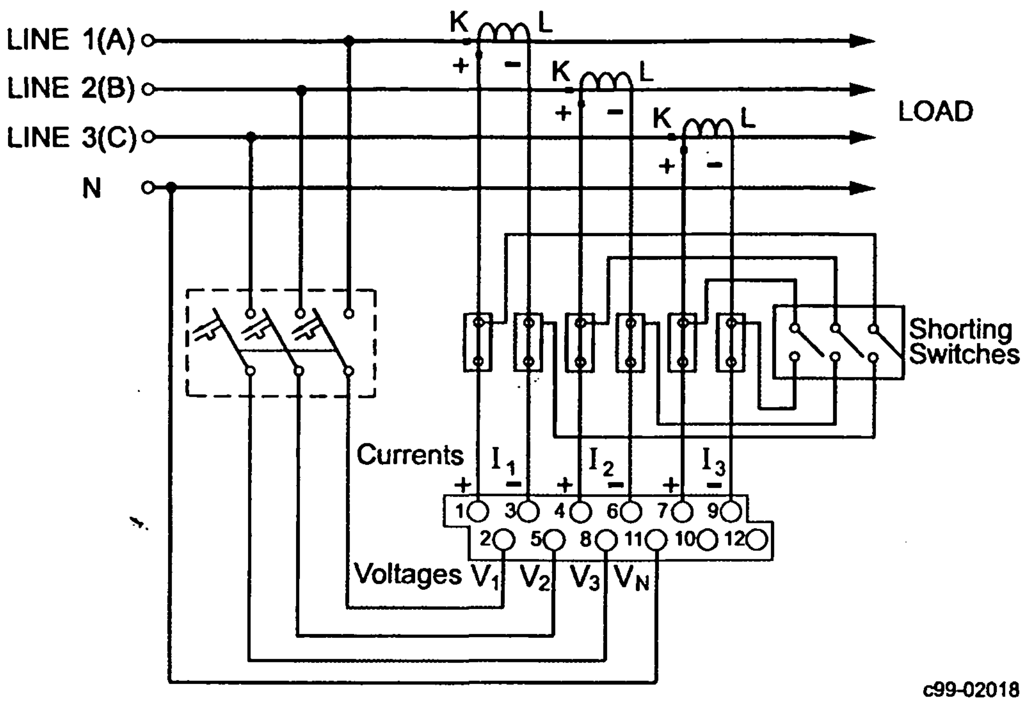


Figure 2-7 4-Wire Wye Direct Connection Using 3 CTs - Wiring Mode **4L-n/4L-L**

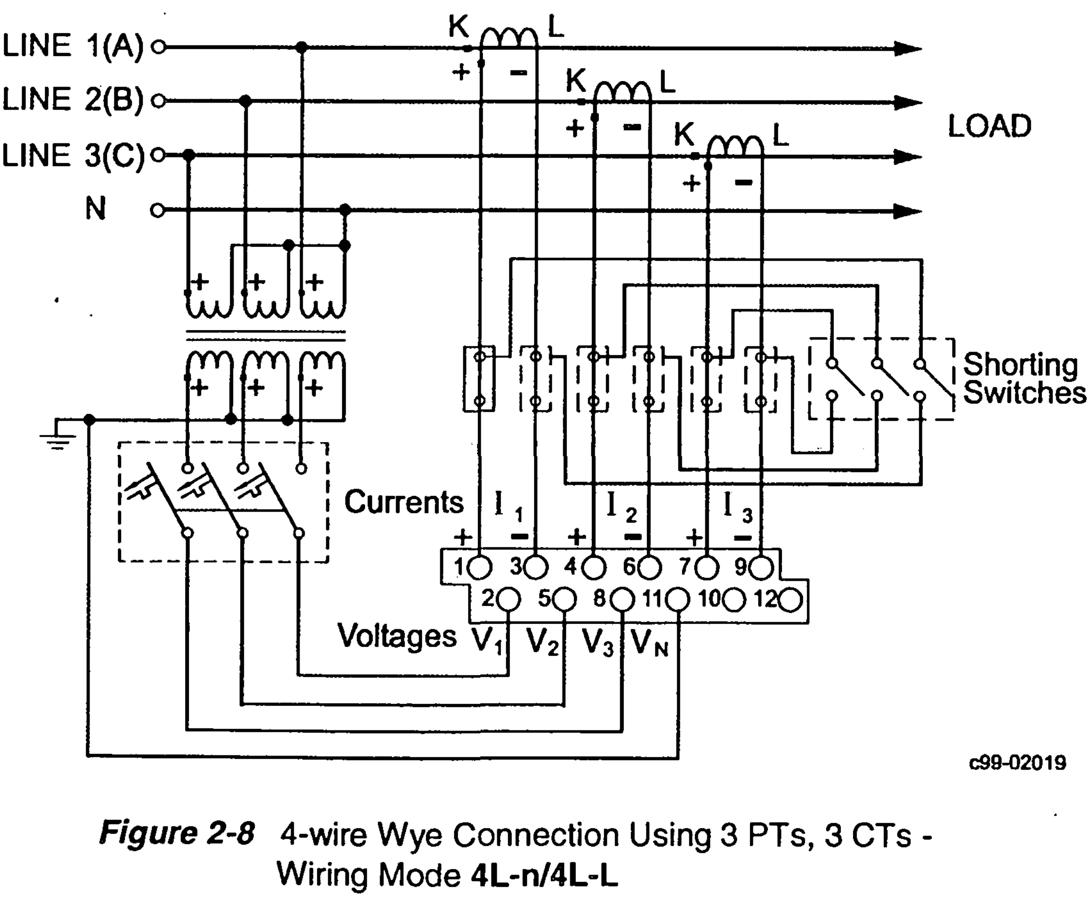


Figure 2-8 4-wire Wye Connection Using 3 PTs, 3 CTs - Wiring Mode **4L-n/4L-L**

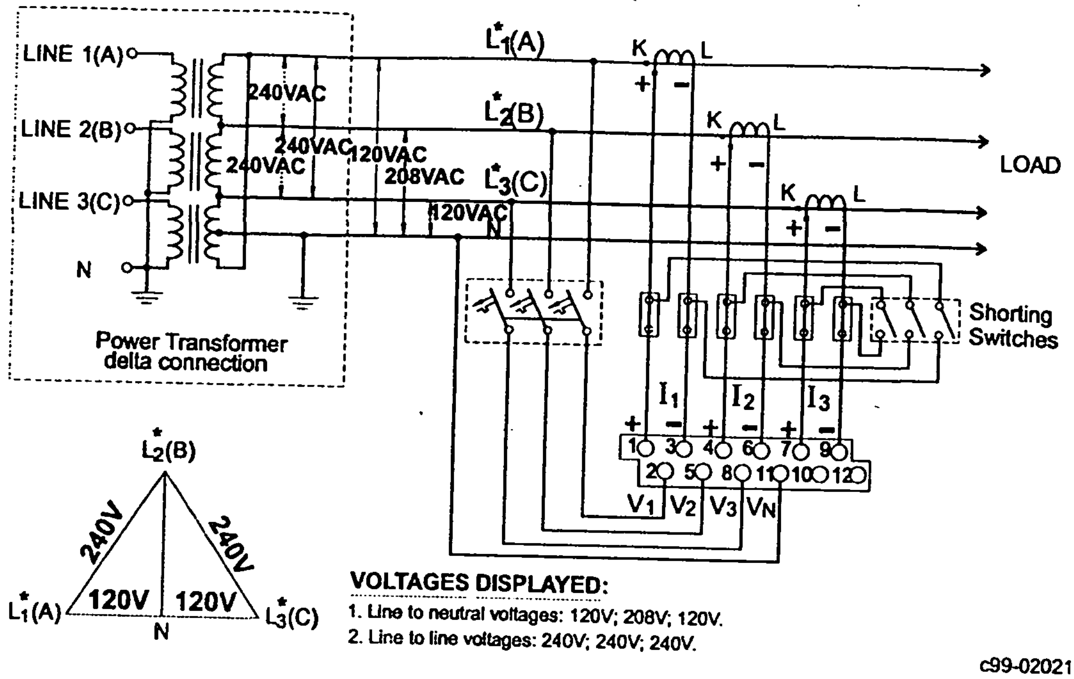


Figure 2-9 4-wire Grounded Delta Connection Using 3 CTs - Wiring Mode **4L-n/4L-L**

2.2.7 Relay Output Connections

Use relays #1, 2 and 4 for setpoints or KYZ pulsing. These relays do not energize on power up.

Use relay #3 for alarm/trip setpoint. This relay energizes on power up and de-energizes on trip condition.

Figure 2-10 illustrates wiring connections for the relays.

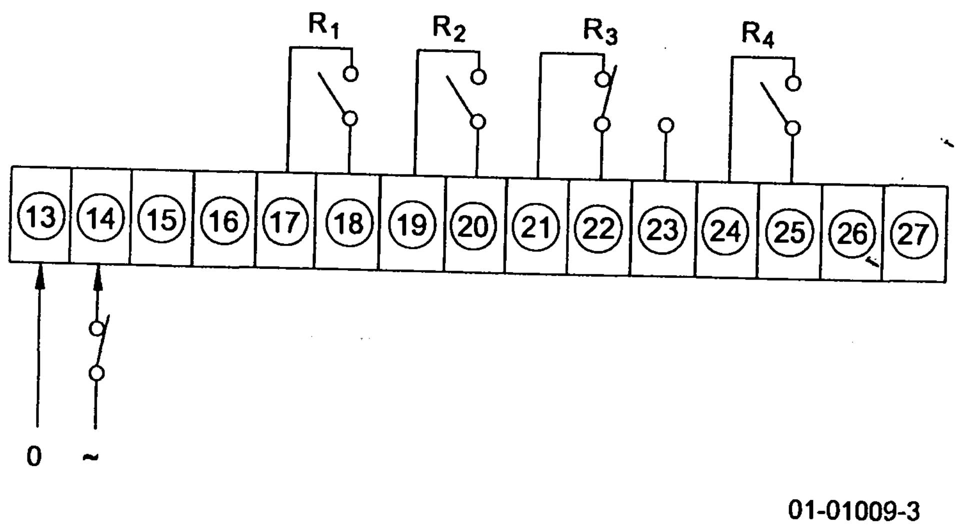
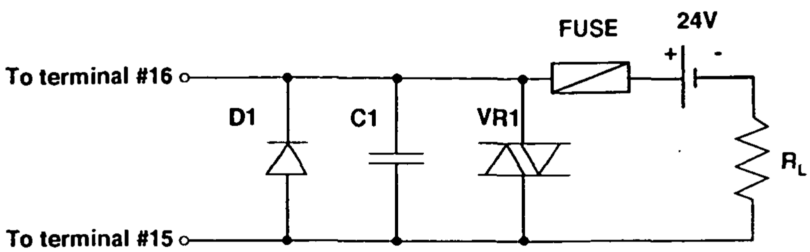


Figure 2-10 Relay Output Connections
(Note: Power supply shown switched on)

2.2.8 Analog Output

The Analog Output requires a galvanically isolated external power supply. See *Figure 2-11* for connections: negative to terminal 15 and positive to terminal 16. In certain industrial applications, a circuit may be required to protect against accidental shorts.



D1=1N4002
C1=0.1MF/50V
VR1=250Vrms
FUSE=100mA(S.B.)

Figure 2-11 Analog Output Connection

2.2.9 Communications

Connector Pinout

The serial interface connector is a standard D-type 9-pin plug-in, located at the top center of the back of the instrument. *Tables 2-1* and *2-2* list the pinout of the connector.

Table 2-1 RS-232 Pinout

Pin	*Name*	*Function*
1	Gnd	Ground (common)
2	TxD	Transmit Data
3	RxD	Receive Data
4	DTR	Data Terminal Ready
5	DSR	Data Set Ready

DIP Switch Block

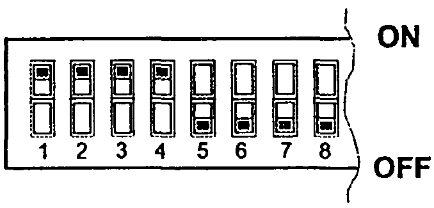
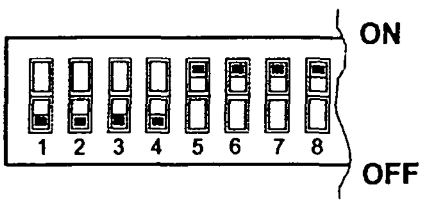


Table 2-2 RS-422/RS-485 Pinout

Pin	*Name*	*Function*
2	TxD+	+ Transmit Data
3	RxD+	+ Receive Data
6	TxD -	- Transmit Data
7	RxD -	- Receive Data

DIP Switch Block



For RS-485 communications, connect together pins 2-3 (TXD+ and RXD+), and pins 6-7 (TXD- and RXD-).

For cable drawings, refer to *Appendix C*.

2.2.10 Ground Leakage (Option L)

Ground leakage connection is at terminals 26 and 27.

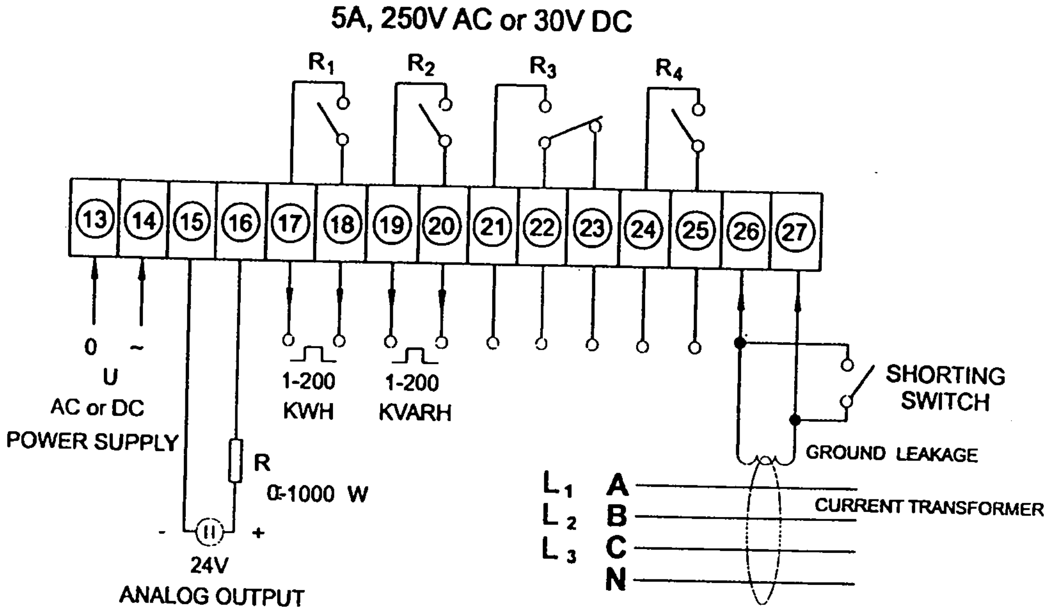


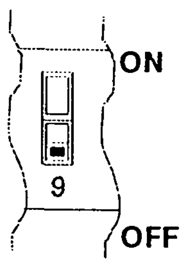
Figure 2-12 Ground Leakage Current Transformer Connection

3 Setup

NOTE: Setup is performed *after* installation is completed.

3.1 Setup Procedure

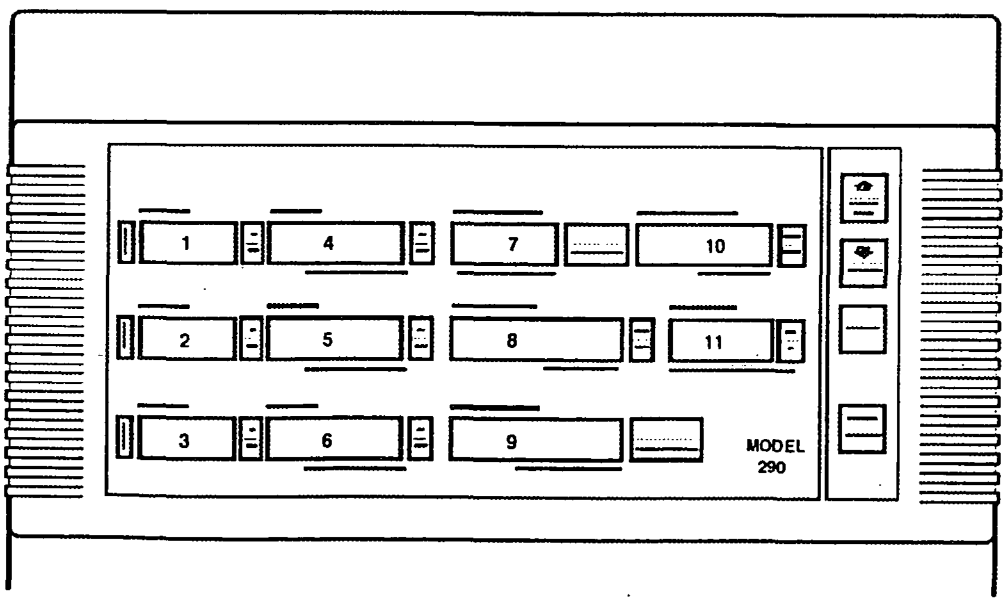
To enable setup, turn OFF Dip Switch 9 on SW2 located at the top left of the rear of the instrument (see Figure 2-3). When the switch is down it is OFF.



3.1.1 Entering Setup Mode

On power up, the instrument is in *monitoring* mode. Press SELECT to enter the *setup* mode.

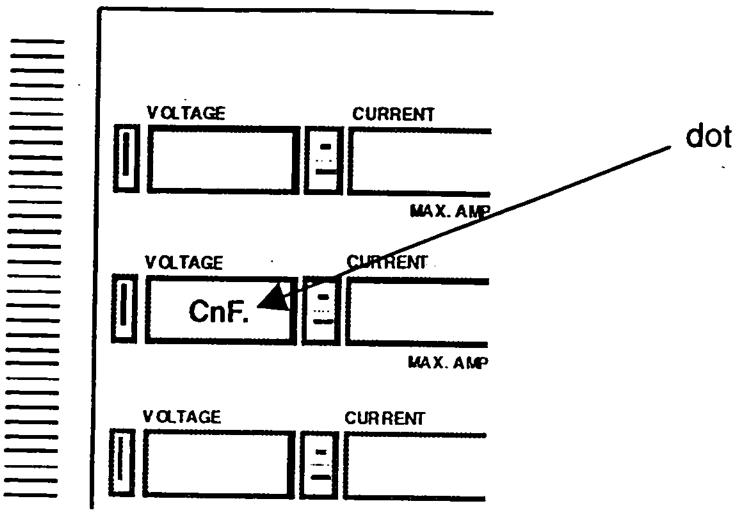
Setup is performed using windows 2, 5, and 8.



Window 2 displays the setup parameter code; window 8 (in some cases, windows 5 and 8) display the value for that parameter. Use the ⇑ ⇓ keys to scroll between parameters.

3.1.2 Changing Parameter Values

Press SELECT again and the dot beside the parameter code will disappear.



Use the ⇑ ⇓ keys to scroll to the desired value.

When the setup parameter is correctly defined, press on the RESET key and the dot will re-appear.

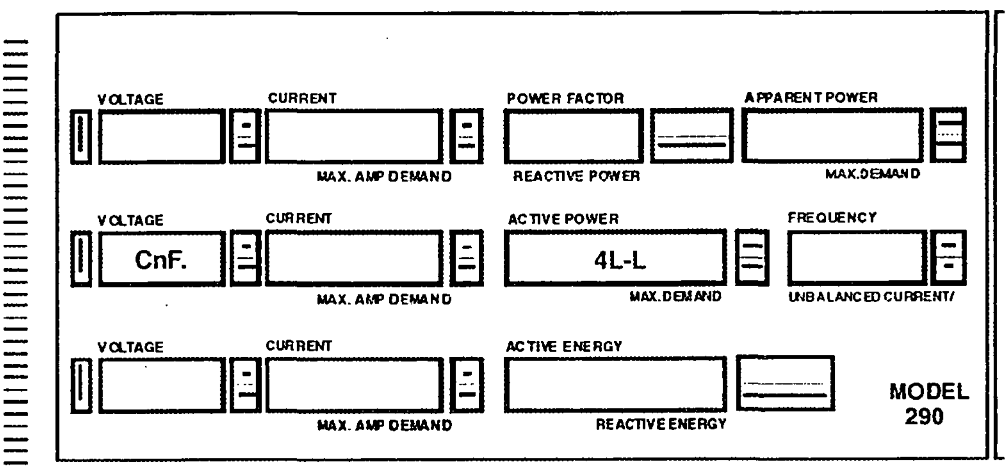
Press RESET again to return to the monitoring mode.

3.2 Wiring Mode: CnF

Choose from 4 wiring modes:

1) **3dir** 3-wire direct connection using 2 CTs
2) **3OP** 3-wire open delta connection using 2 PTs, 2 CTs
3) **4L-n** 4-wire direct or WYE or grounded delta connection using 3 CTs, with or without PTs, using line-to-neutral values
4) **4L-L** 4-wire direct or WYE or grounded delta connection using 3 CTs, with or without PTs, using line-to-line values

- Press SELECT; the dot will disappear.
- Use the ⇑ ⇓ keys to scroll to the appropriate value.
- Press RESET; the dot will re-appear.



Use the ⇑ key to move to the next setup parameter.

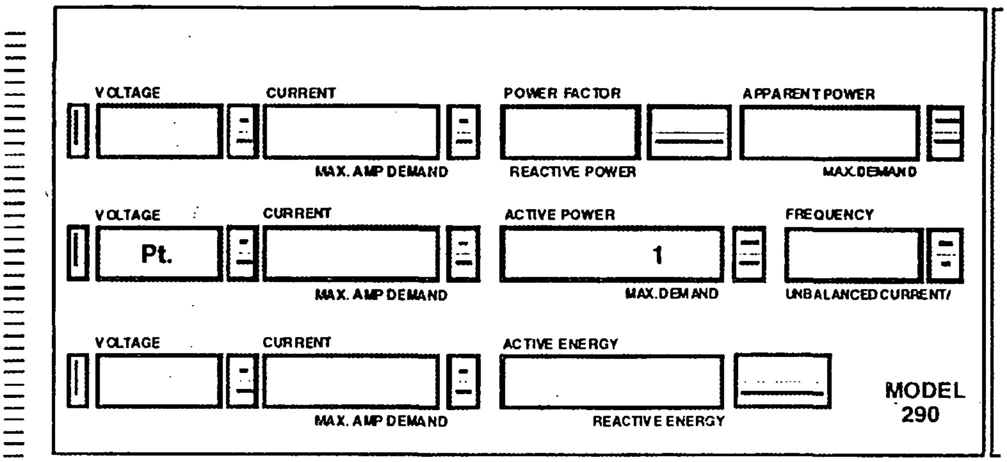
3.3 Potential Transformer Ratio: Pt

Note: Pt must be defined before relay setpoint definition.

In a direct connection, at low voltage (up to 660V), the PT must be set to 1. In the case of connection using PTs, the PT ratio must be calculated.

Example: If the primary voltage is 165kV and the secondary is 110V, the PT will be 165,000/110=1500.

- Press SELECT; the dot will disappear.
- Use the ⇑ ⇓ keys to scroll to the appropriate value (**1 - 6500**).
- Press RESET; the dot will re-appear.



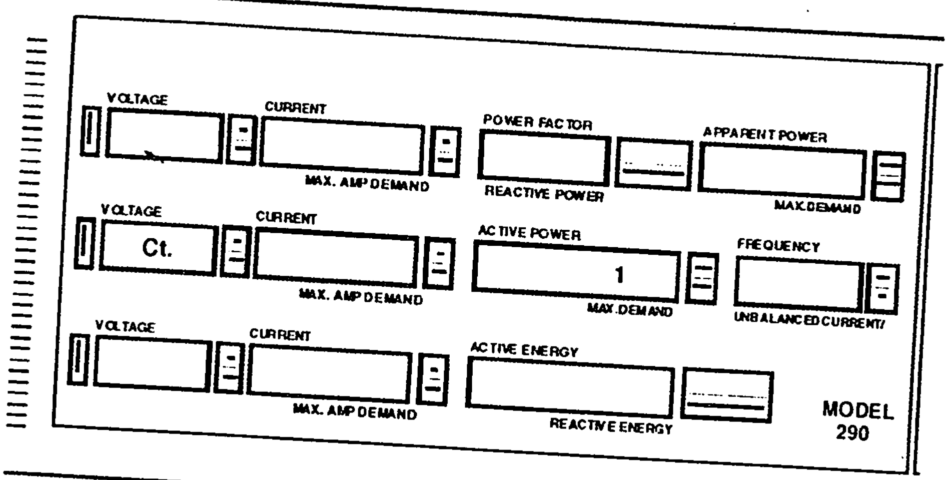
Use the ⇑ key to move to the next setup parameter.

3.4 Current Transformer Primary Current: Ct

Notes: 1) Ct must be defined before relay setpoint definition.
2) For Option L, ground leakage primary current is represented by Ct.G

This parameter defines the primary value of the Current Transformer.

- Press SELECT; the dot will disappear.
- Use the ⇑ ⇓ keys to scroll to the appropriate value (**1 - 50000** A).
- Press RESET; the dot will re-appear.

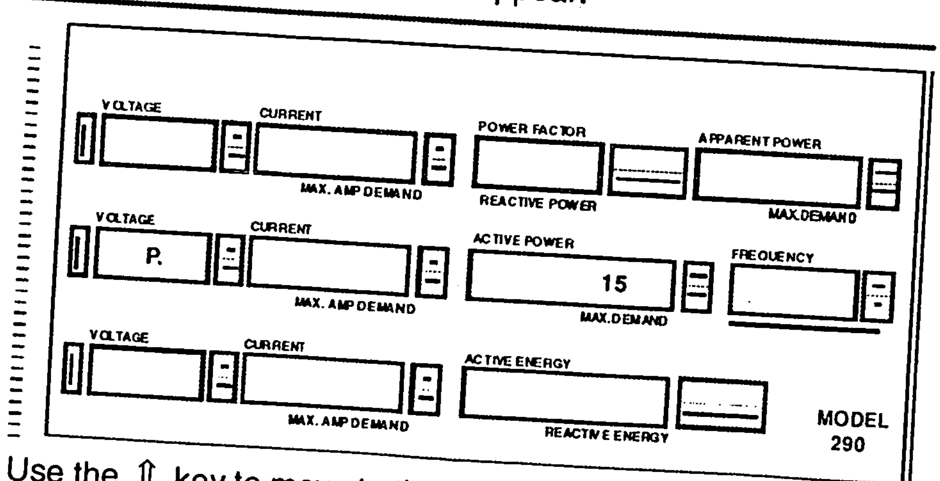


- Use the ⇑ key to move to the next setup parameter.

3.5 Power Demand Period: P

This parameter defines the time period over which average power demand is calculated.

- Press SELECT; the dot will disappear.
- Use the ⇑ ⇓ keys to scroll to the appropriate value (**1, 2, 5, 10, 15, 20, 30** or **60** minutes, or **E** for external synchronization).
- Press RESET; the dot will re-appear.

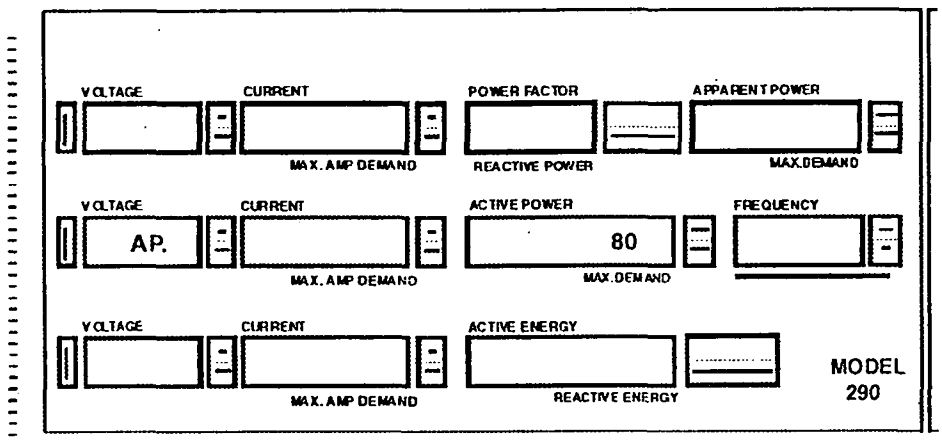


Use the ⇑ key to move to the next setup parameter.

3.6 Ampere Demand Period: AP

This parameter defines the time period over which average ampere demand is calculated.

- Press SELECT; the dot will disappear.
- Use the ⇑ ⇓ keys to scroll to the appropriate value (**0 - 1800** seconds; a '0' value means that ampere demand will be calculated each internal cycle: 0.1 second).
- Press RESET; the dot will re-appear.



Use the ⇑ key to move to the next setup parameter.

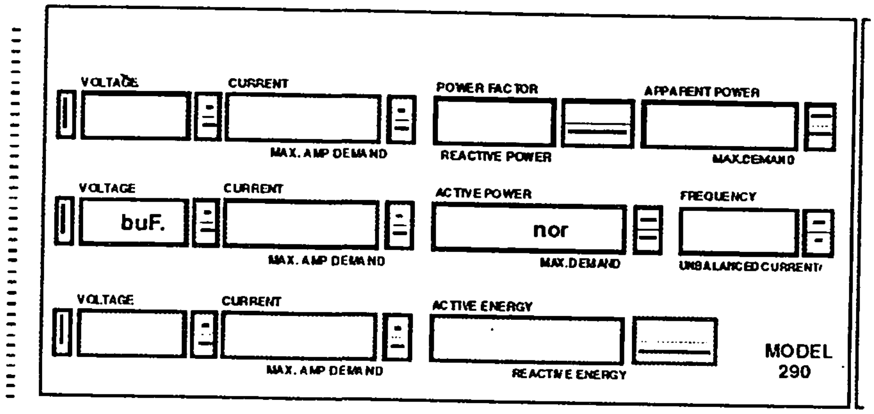
3.7 Memory Buffer: buF

This parameter defines the number of measurements which will serve as the basis for calculating average values of voltage, current and power.

- Press SELECT; the dot will disappear.
- Use the ⇑ ⇓ keys to scroll to the appropriate value:

    nor (normal) = 8 (for stable voltage and current situations)
    unSt (unstable) = 32 (for unstable voltage and current situations. Readings in this mode will be slower.).

- Press RESET; the dot will re-appear.



Use the ⇑ key to move to the next setup parameter.

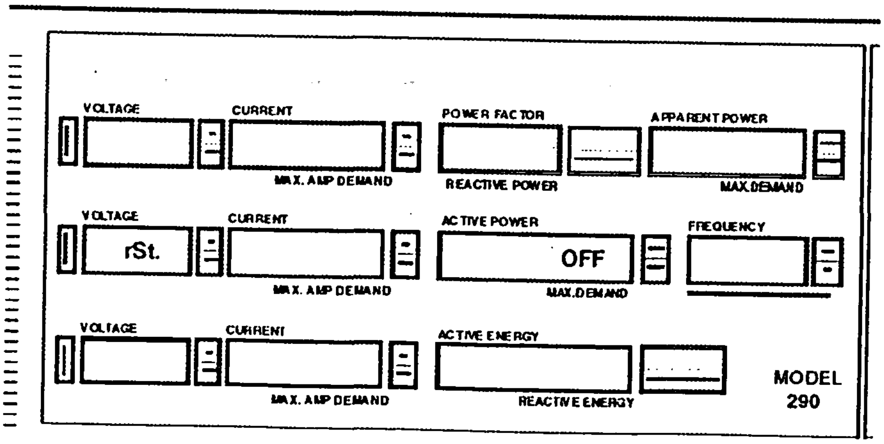
3.8 Reset: rSt

This parameter enables/disables the reset of energies and demands.

- Press SELECT; the dot will disappear.
- Use the ⇑ ⇓ keys to scroll to the appropriate value:

    ON = reset function enabled; **OFF** = reset function disabled

- Press RESET; the dot will re-appear.



Use the ⇑ key to move to the next setup parameter.

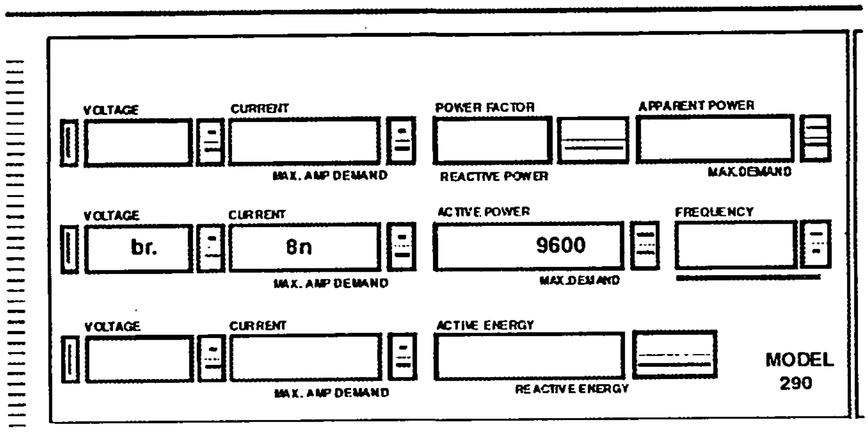
3.9 Baud Rate: br

This parameter defines the communication speed. Here, 3 display windows are used.

- Press SELECT; the dot will disappear.
- Use the ⇑ ⇓ keys to scroll to the appropriate values:

  middle window: number of bits and parity - **7E, 8n, 8E**
  right window: bits per second - **110, 300, 600, 1200, 2400, 4800, 9600**

  Both values (windows) change simultaneously.
- Press RESET; the dot will re-appear.



Use the ⇑ key to move to the next setup parameter.

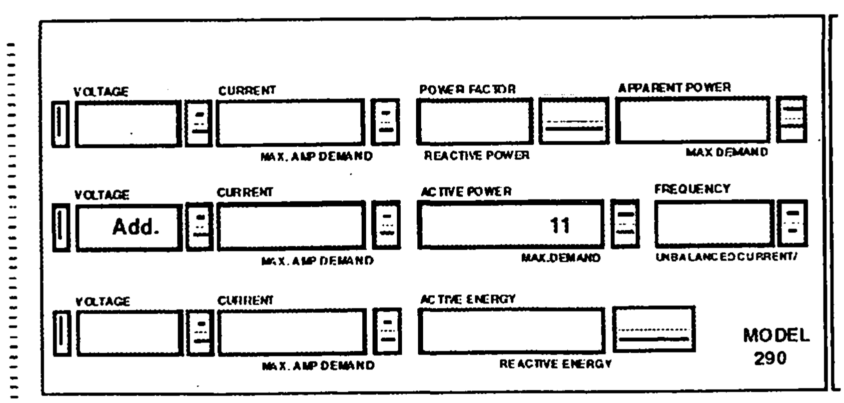
3.10 Communication Address: Add

Each Powermeter on the network must have a unique address, according to the communication protocol used (see Section 3.12).

- Press SELECT; the dot will disappear.
- Use the ⇑ ⇓ keys to scroll to the appropriate value:

  ASCII protocol: **0 - 32** Modbus protocol: **1* - 247**
- Press RESET; the dot will re-appear.

*The *PM290* will accept a value of '0' but the Modbus protocol will not recognize it.

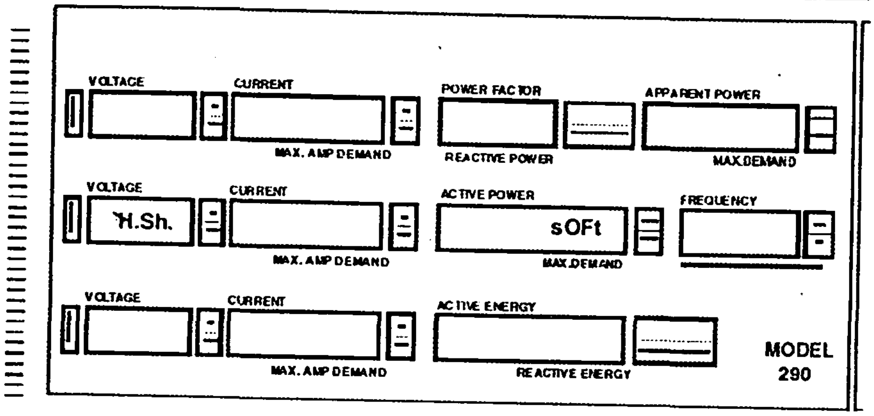


Use the ⇑ key to move to the next setup parameter.

3.11 Handshake Mode: H.Sh

Handshaking refers to a signal from the receiving device indicating its readiness to receive data. Handshaking is achieved by means of either hardware signals or software commands.

- Press SELECT; the dot will disappear.
- Use the ⇑ ⇓ keys to scroll to the appropriate value: **sOFt** or **Hard**
- Press RESET; the dot will re-appear.



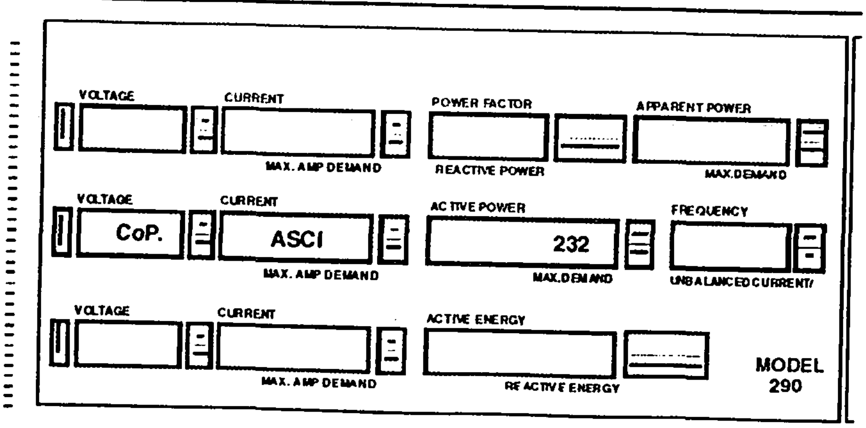
Use the ⇑ key to move to the next setup parameter.

3.12 Communication Protocol: CoP

Here, 3 display windows are used.

- Press SELECT; the dot will disappear.
- Use the ⇑ ⇓ keys to scroll to the appropriate values:

  middle window: protocol - ASCII **(ASCI)**, Modbus (**bin**) or printer **(Prnt)**
  right window: serial line - RS-232 **(232)**, RS-422 (**422**) or RS-485 **(485)**
  Both values (windows) change simultaneously.
- Press RESET; the dot will re-appear.



Use the ⇑ key to move to the next setup parameter.

3.13 Relays

There are 4 relays in the instrument which can be associated with up to 8 setpoints. Three of the relays may also be used for pulsing (see following page). The setpoint values appear in the following windows (each window has its number marked above it in the illustration below):

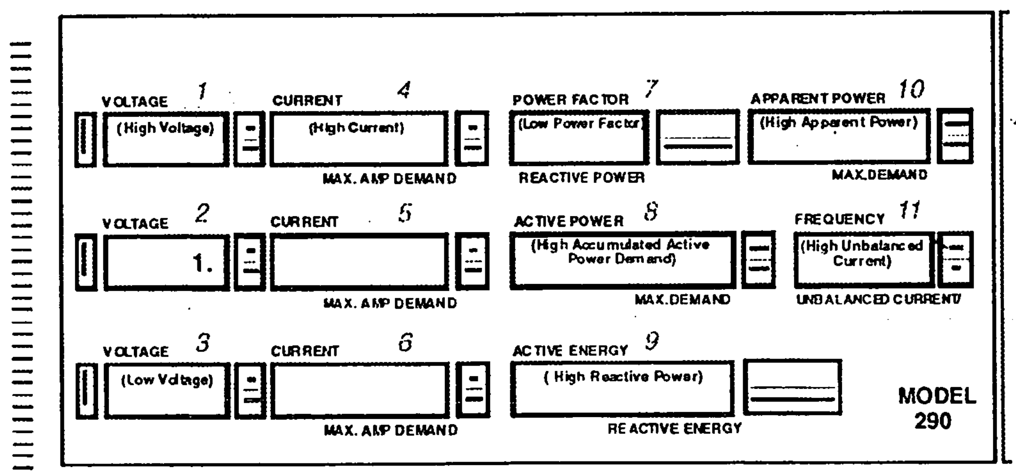
Window	*Setpoint*	*Unit*	*Range*
1	High voltage	V	0 - Vmax
3	Low voltage	V	0 - Vmax
4	High current	A	0 - Imax
7	Low total power factor lag		0 - 1.000
8	High accumulated power demand	kW	
9	High total reactive power import	kvar	0 - Pmax
10	High total apparent power	kVA	0 - Pmax
11 - standard	High unbalanced current	A	0 - Imax
11 - Option L	High ground leakage current	A	0 - GLImax

Notes:

Parameter limits:

Vmax (660V input) = (400 x k)V, where k=1 if no PT, or k=PT ratio if PT used
Imax (20% overrange) = 1.2 x CT primary current A
Pmax = (Imax x Vmax x 3)/1000 kW @ wiring mode 4L-n
Pmax = (Imax x Vmax x 2)/1000 kW @ wiring mode 4L-L, 3OP, 3dir
GLImax = 1.2 x ground leakage CT primary current mA

Wiring mode 4L-n: line-to-neutral voltages
Other wiring modes: line-to-line voltages



- Use the ⇑ ⇓ keys to scroll to the desired relay number: **1, 2, 3** or **4.** Assigned setpoint values will appear in their respective windows; dots will appear if a setpoint value has not yet been defined.

- Press SELECT; the dot after the relay number will disappear. Window 5 will display **'on'**. This allows the user to set or change the value at which the setpoint is activated. The 'High Voltage' setpoint value (or dots) will appear in window 1; the other windows will be empty.
  - Use the ⇑ ⇓ keys to set the 'ON' value for the HIgh Voltage setpoint.
  - Press SELECT; window 5 will display **'on.d'**, indicating the time delay until setpoint operation. This may take a value from 0.1 to 99.9 seconds.
  - Use the ⇑ ⇓ keys to define the delay to operation.
- Press SELECT; window 5 will display **'OFF'**.
  - Use the ⇑ ⇓ keys to scroll to the value at which the displayed setpoint will be released.
  - Press SELECT; window 5 will display **'OFF.d'**, indicating the time delay until setpoint release. This may take a value from 1 to 999 seconds.
- Press either: SELECT to move to another setpoint parameter, or RESET to exit this relay and move to another relay/parameter.
- Press RESET to exit the relay after all desired setpoint values are defined; the dot will re-appear, and ON setpoint values will be displayed.
- Press RESET again to exit the parameter.

Use the ⇑ key to move to the next setup parameter.

NOTE

It is possible to cancel both ON and OFF setpoints by pressing the ⇑ and ⇓ keys simultaneously. A canceled setpoint can be re-instated by pressing either the ⇑ or ⇓ key.

Pulses

Pulses may be defined for relays 1, 2 and 4. When one of these relays is displayed, the pulsing value in Window 9 can be set, from 1 to 200 units per pulse.

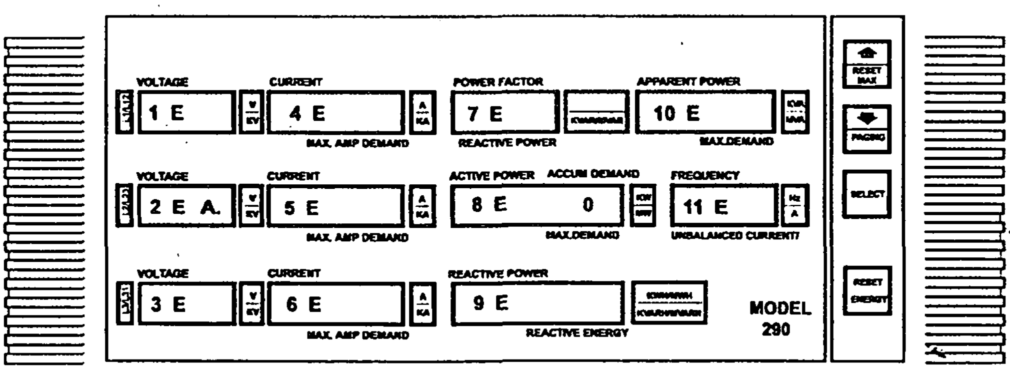
Pulse Name	*Description*	*Units*
Pul1 Ac.En	Pulse 1 - Active Energy	kWh
Pul2 rE.En	Pulse 2 - Reactive Energy	kvarh
Pul4 rEt.E	Pulse 4 - Returned Energy	kWh

3.14 Analog Output: A *(optional)*

Up to 12 parameters may be assigned an analog output:

Window	*Parameter Name*	*Description*
1	*U.1*	Voltage L1 / L12
2	*U.2*	Voltage L2 / L23
3	*U.3*	Voltage L3 / L31
4	*c.1*	Current L1
5	*c.2*	Current L2
6	*c.3*	Current L3
7	*PF*	Power Factor
8 (right)	*Ac.d*	Active Power Accumulated Demand
8 (left)	*Ac.P*	Active Power
9	*rE.P*	Reactive Power
10	*AP.P*	Apparent Power
11	*Fr*	Frequency

'**A**' is the overall code for Analog Output. A parameter allocated to analog output is indicated by a number (e.g., '**1 E**' or '**3 E**') displayed in that parameter's window. Where there is no allocation, a row of dots will appear in the window.



- Use the ⇑ ⇓ keys to choose the parameter from the list above.
- Press SELECT; the dot will disappear from the '**A**'.
- Use the ⇑ ⇓ keys to scroll to the appropriate values:

  0 (internal analog output), or
  1E - 12E (if 1 or 2 AX-8 analog expanders are connected).

- Press RESET; the dot will re-appear.

To cancel an allocation of a specific parameter to Analog Output, press SELECT and then press the up and down arrows simultaneously. A row of dots will appear in the place of the number.

Note: If you are not using an AX-8 Analog Expander, cancel all analog output assignments so as not to disrupt communication.

The following table gives the range of values of the output parameters:

Parameter	***Value***	***4-20mA***	***0-20mA***	***Note***
Voltage No PT	0V 660V	4 mA 20mA	0 mA 20mA	
Voltage via PT	0V (144V * K) V	4 mA 20mA	0 mA 20mA	K = PT ratio
Current	0V 1.2 * I(p)	4 mA 20mA	0 mA 20mA	I(p) = rated primary current of CT
Power factor	-0.00 -0.50 1.00 0.50 0.00	4 mA 8 mA 12 mA 16 mA 20mA	0 mA 5 mA 10 mA 15 mA 20mA	
Frequency	45 Hz 65 Hz	4 mA 20mA	0 mA 20mA	
Active power kW	-V * I * n kW 0 kW V * I * n kW	4 mA 12 mA 20mA	0 mA 10 mA 20mA	**
Reactive power kvar	as for Active Power			
Apparent power kVA	0 kVA V * I * n kVA	4 mA 20 mA	0 mA 20 mA	**
Accumulated active power demand	as for Apparent Power			

** V, I are defined according to PT ratio and CT primary current.
For line-to-neutral voltage measurement, n=3; in all other cases, n=2.

Parameters measured by the PM290 are calculated based on the analog output current (I_{Analog}), as per the following table:

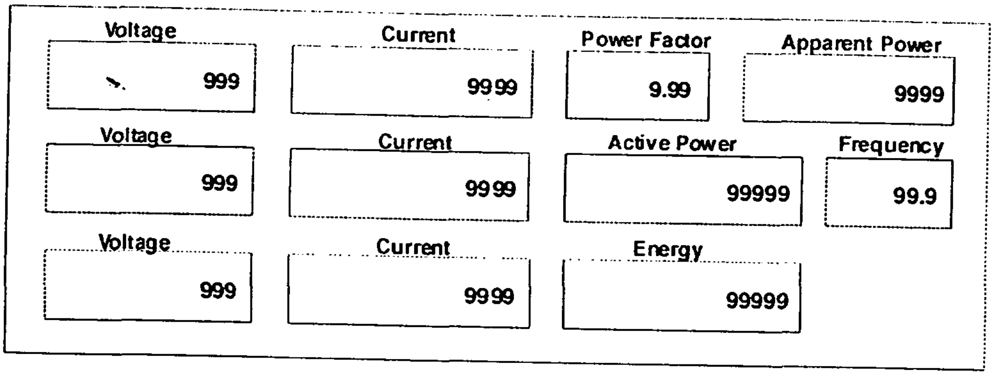
Measured Parameter	***Output 4-20mA***	***Output 0-20mA***
Voltage, V	$V = \frac{(I_{Analog}-4) \cdot V_{Full\ Scale}}{16}$	$V = \frac{I_{Analog} \cdot V_{Full\ Scale}}{20}$
Current for any CT, I	$I = \frac{(I_{Analog}-4) \cdot I_{Full\ Scale}}{16}$	$I = \frac{I_{Analog} \cdot I_{Full\ Scale}}{20}$
Power factor, PF	PF(positive) = $(20-I_{Analog}) / 8$ PF(negative) = $(4-I_{Analog}) / 8$	PF(pos.) = $(20-I_{Analog}) / 10$ PF(neg.) = $(4-I_{Analog}) / 10$
Frequency, Hz	$f = (I_{Analog}+32) / 0.8$	$f = (I_{Analog}+45)$
Active power, kW	$P = \frac{(I_{Analog}-12) \cdot P_{Full\ Scale}}{8}$	$P = \frac{(I_{Analog}-10) \cdot P_{Full\ Scale}}{10}$
Reactive power, kvar	$Q = \frac{(I_{Analog}-12) \cdot Q_{Full\ Scale}}{8}$	$Q = \frac{(I_{Analog}-10) \cdot Q_{Full\ Scale}}{10}$
Apparent power, kVA	$S = \frac{(I_{Analog}-4) \cdot S_{Full\ Scale}}{16}$	$S = \frac{I_{Analog} \cdot S_{Full\ Scale}}{20}$
Accumulated active power demand, kW	$P = \frac{(I_{Analog}-4) \cdot P_{Full\ Scale}}{16}$	$P = \frac{I_{Analog} \cdot P_{Full\ Scale}}{20}$

4 Data Display

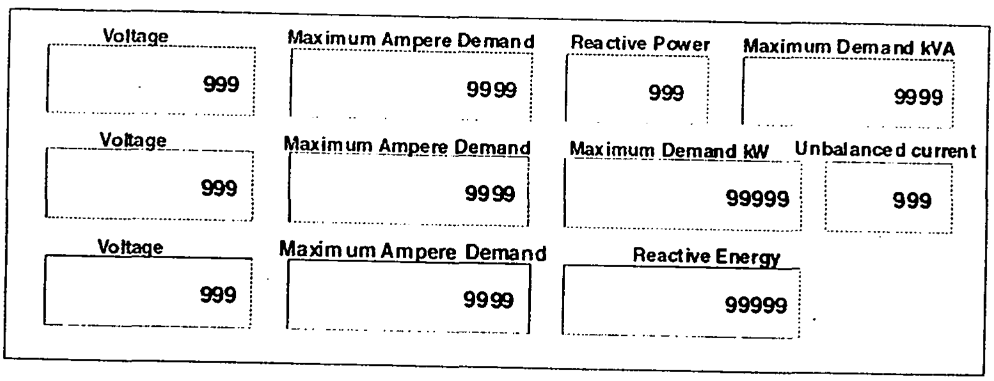
In the monitoring mode, values are displayed on 3 pages. Use the ⇓ key to scroll through the pages. The display will return to page 1 after 30 seconds. For resolution and parameter ranges, see *Appendix A, Measurement Specifications.*

4.1 Display Pages

Page 1

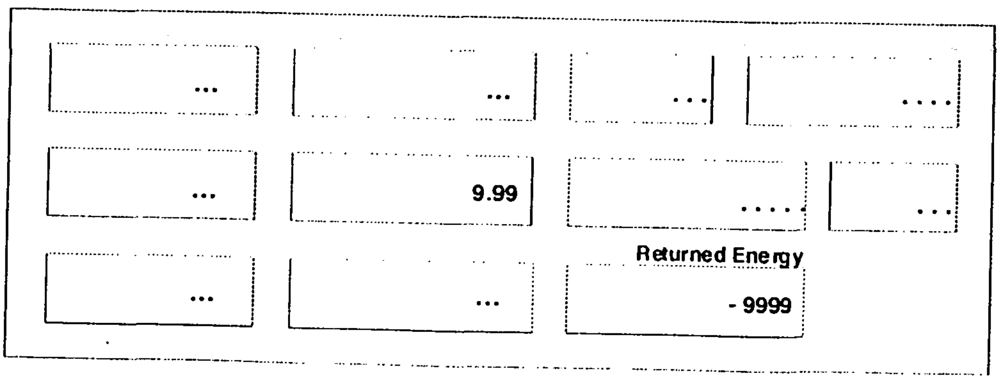


Page 2



Note: For Option L, ground leakage current is displayed instead of unbalanced current

Page 3



4.2 Self-Test Diagnostics

The *PM290* periodically perform self-test diagnostics. If the instrument fails the self-test diagnostics, it discards the last measurement results, and an error code (from *1* to 7) is displayed for 2 seconds on all LEDs. Code *8* represents Power Down (Normal).

If the instrument resets itself continuously, contact your local distributor.

If the Powermeter malfunctions, it is recommended to switch it off for one minute and then to turn it on again.

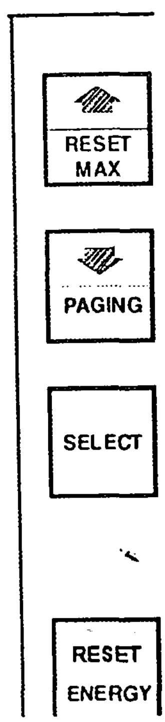
4.3 RESET

In the monitoring mode, press the RESET button (towards the bottom of the front panel) continuously for more than 5 seconds to reset the following parameters to zero:

Energy kWH
Returned energy kWH
Reactive energy kVARH

Press the RESET MAX button (at the top of the front panel) continuously for more than 5 seconds to reset the following parameters to zero:

Ampere max. demand per phase
Active power max. demand
Apparent power max. demand



To prevent unauthorized resetting, disable the reset function (see Section 3.8).

Appendix A: Technical Specifications

Input and Output Ratings

3 galvanically isolated voltage inputs	120 V (Option U)	INPUT USING PT (up to 120+20% V line-to-line voltage) Burden: < 0.015 VA
	660 V	DIRECT INPUT (up to 660 V line-to-line voltage or up to 550 V line-to-neutral voltage) Burden: < 0.3 VA
3 galvanically isolated current inputs	1 A	INPUT via CT with 1 A secondary output Burden: < 0.15 VA Measurement up to 1.2 A RMS, 1.76A amplitude Overload withstand: 2 A RMS continuous, 30 A RMS for 1 second
	5 A	INPUT via CT with 5 A secondary output Burden: < 0.15 VA Measurement up to 6 A RMS, 8.8A amplitude Overload withstand: 10 A RMS continuous, 150A RMS for 1 second
1 galvanically isolated ground current input (Option L)	5mA input via CT with 5mA secondary output Burden: < 0.1 mVA Overload withstand: 30mA RMS continuous, 400mA RMS for 1 second	
External synchronization input	Optically isolated, dry contact sensing input (voltage-free)	
Relay outputs	3 relays rated at 5A, 250 VAC, 2 contacts (SPST Form A) 1 relay rated at 5A, 250 VAC, 3 contacts (SPDT Form C)	
Analog output	Range CMV Isolation Offset Temperature Non-Linearity Accuracy Offset Maximum Load Power Supply	0-20 mA/4-20 mA (upon order) 1500 V RMS ±300 nA/°C ±0.02% 0.06% FS ±100 μA 510 Ω 15 - 30 VDC, external

Input and Output Ratings

Communication	One serial port, EIA RS-232 or RS-422/RS-485 (optically isolated) standards Connector: 9-pin female D-type
Display	High-brightness seven-segment digital LEDs, 11 windows. A total of 3 pages with simultaneous display of up to 11 parameters.
Voltage and current input terminals	Standard 9.52 mm pitch (UL recognized) Screw M 3 Maximum wire diameter 2.591 mm (10 AWG)
Service terminals	Standard 5 mm pitch (UL recognized XCFR2) Screw M2.6 Maximum wire diameter 2 mm (12 AWG)
Power supply	95-135V AC, 185-250VAC, 50/60 Hz, 20 VA 10-20V DC 20-38VDC 15 W 38-72VDC 80-160VDC 160-290VDC

Environmental Conditions

Operating temperature	-20°C to 60°C (-4°F to 140°F)
Storage temperature	-25°C to 80°C (-13°F to 176°F)
Humidity	0 to 95% non-condensing

Construction

Instrument body	CASE ENCLOSURE: plastic ABS (UL recognized QMFZ2) FRONT PANEL: plastic polycarbonate
Instrument weight	2.65 kg (5.83 lbs.)

Standards

UL File #E129258(N)
CE-EMC: 89/336/EEC as amended by 92/31/EEC and 93/68/EEC
CE-LVD: 73/23/EEC as amended by 93/68/EEC and 93/465/EEC

Measurement Specifications

Parameter, units	Full scale		Accuracy, %			Range	Resolution @ range	
			Rdg	FS	Conditions		Front panel display	Comm.
Voltage, V	120V×PT @ 120V **or** 380V×PT @ 660V	For Ln reading and for 3OP wiring mode		0.25	10% to 120% FS	0 to 999,000	1 V @ 1 to 999 V ≤1% @ 1,000 to 999,000 V	1 V
	208V×PT @ 120V **or** 660V×PT @ 660V	For LL reading except 3OP wiring mode						
Line current, A	CT primary current			0.25	2% to 120%FS	0 to 60,000	1 A @ 1 to 9,999 A ≤0.1% @ 10,000 to 65,000A	1 A
Active power, kW	0.36×PT×CT @ 120V input 1.14×PT×CT @ 660V input			0.5	|PF| ≥ 0.5 ①	0 to ± 2,147,000	1 kW @ 1 to 9,999/-9.999 ≤0.1% @ 10 to 2,000 MW ≤0.1% @ -10 to -2,000 MW	1 kW
Reactive power, kvar (minus sign not displayed)	0.36×PT×CT @ 120V input 1.14×PT×CT @ 660V input			0.5	|PF| ≤ 0.9 ①	0 to ± 999,000	1 kvar @ 1 to 999 kvar ≤ 1% @ 1 to 999 Mvar	1 kvar
Apparent power, kVA	0.36×PT×CT @ 120V input 1.14×PT×CT @ 660V input			0.5	|PF| ≥ 0.5 ①	0 to 2,147,000	1 kVA @ 1 to 9,999 ≤0.1% @ 10 to 2,147 MVA	1 kVA

Measurement Specifications

Parameter, units	Full scale	Accuracy, %			Range	Resolution @ range	
		Rdg	FS	Conditions		Front panel display	Comm.
Power factor	1	2		|PF| ≥ 0.5	-0.99 to +1.00	0.01	0.01
Unbalanced (neutral) current, A	CT primary current		0.5	2% to 120% FS	0 to 60,000	1 A @ 1 to 999 A ≤1% @ 1,000 to 60,000 A	1A
Ground leakage current, mA	Ground leakage primary current		0.5		2% to 120% FS	1mA @ 1 to 9,999 mA ≤0.1% @ 10,000 to 60,000 mA	1mA
Frequency, Hz		0.1			45.0 to 65.0	0.1 Hz	0.1 Hz
Ampere demand, A	As for current						
kW demand, kW	As for kW						
kVA demand, kVA	As for kVA						
Active energy (import), kWh		1 typical			0 to 99,999 MWh	1 kWh @ 0 to 99,999 kWh 10kWh @ 100 to 999.99 MWh 0.1MWh @ 1000 to 9999.9 MWh 1MWh@10,000 to 99,999MWh	1 kWh
Reactive energy, kvarh		1 typical			-9,999 to 99,999 Mvarh	as Active and Returned energy	1 kvarh
Returned energy, kWh		1 typical			0 to -9,999 kWh	1 kWh @ 0 to -9999 kWh 10 kWh @ -10 to -99.99 MWh 100kWh@ -100 to -999.9 MWh 1MWh @ -1000 to -9999 MWh	1 kWh

Key:

PT - external potential transformer ratio
CT, CT primary current - the primary current rating of the external current transformer

① @ 10% to 120 % of voltage full scale and 2% to 120 % of current full scale

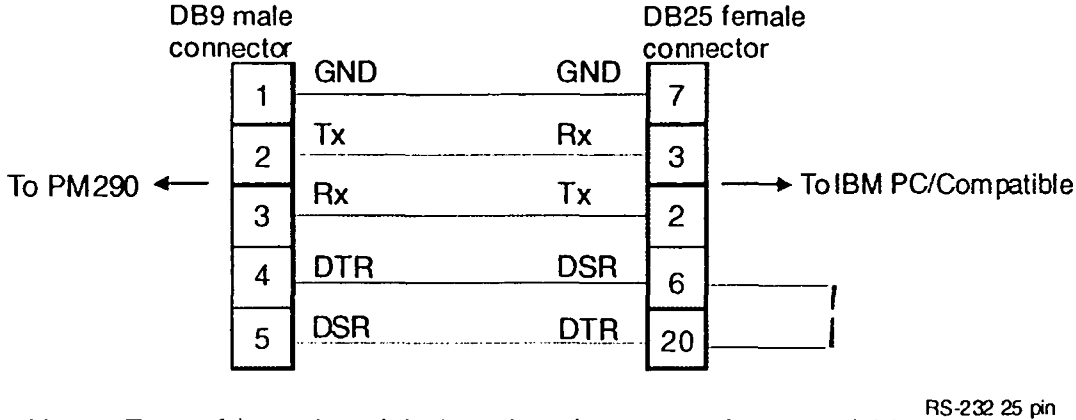
NOTES

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.
2. These specifications assume voltage and current waveforms with THD ≤ 5 % (except harmonic measurements) and an operating temperature of 20 to 26 °C.

Appendix B: Communication Cable Drawings

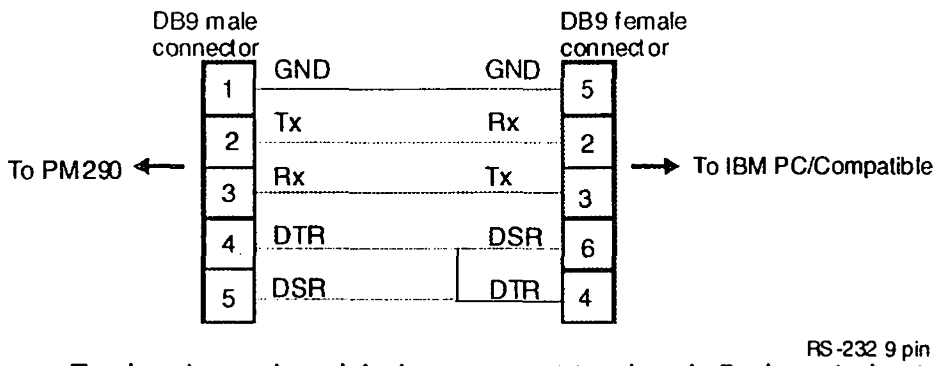
RS-232

25-pin Computer Connector, Hardware Handshake



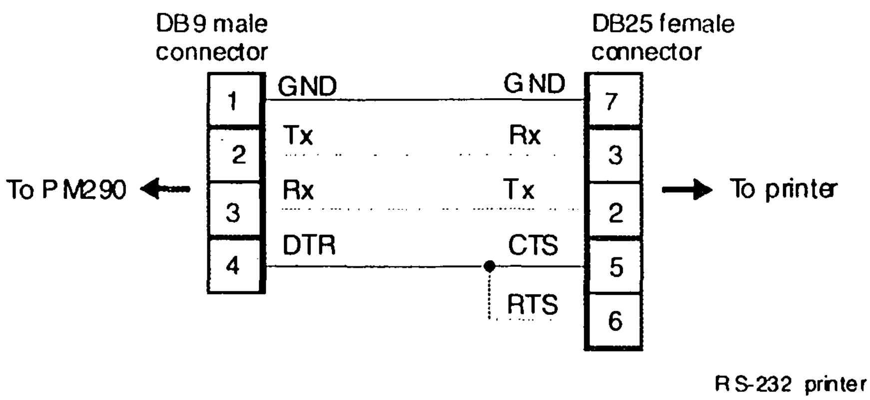
Note: For software handshake, short between pins 6 and 20; do not connect to pins 4, 5.

9-pin Computer Connector, Software Handshake



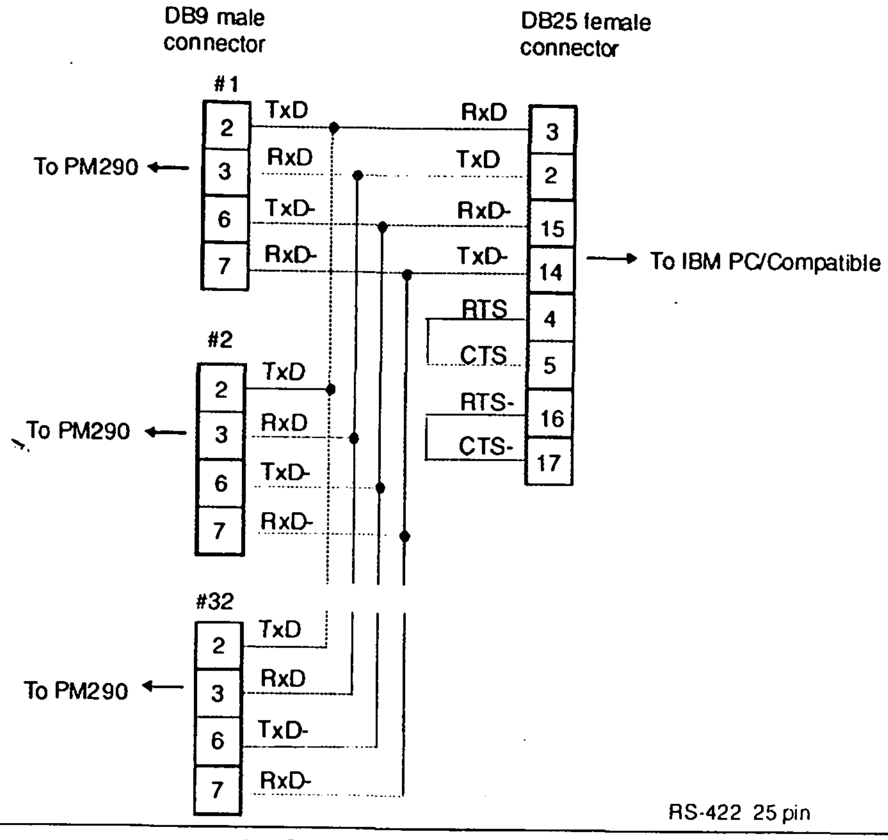
Note: For hardware handshake, connect to pins 4, 5; do not short between pins 6 and 4.

Printer Connector - Example

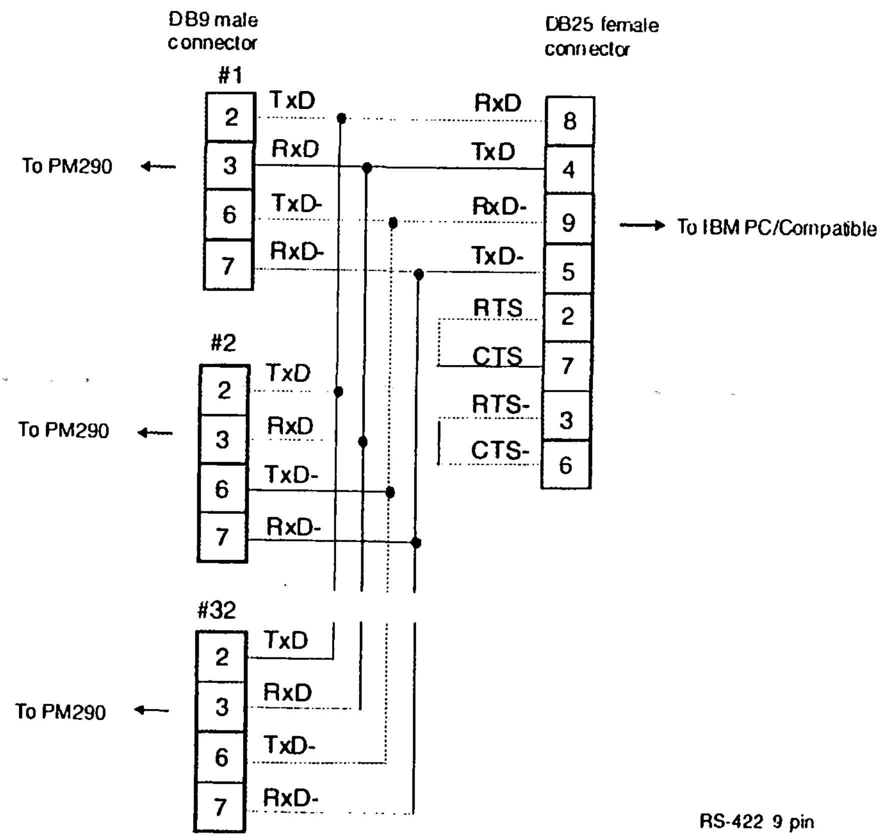


RS-422

25-pin Computer Connector

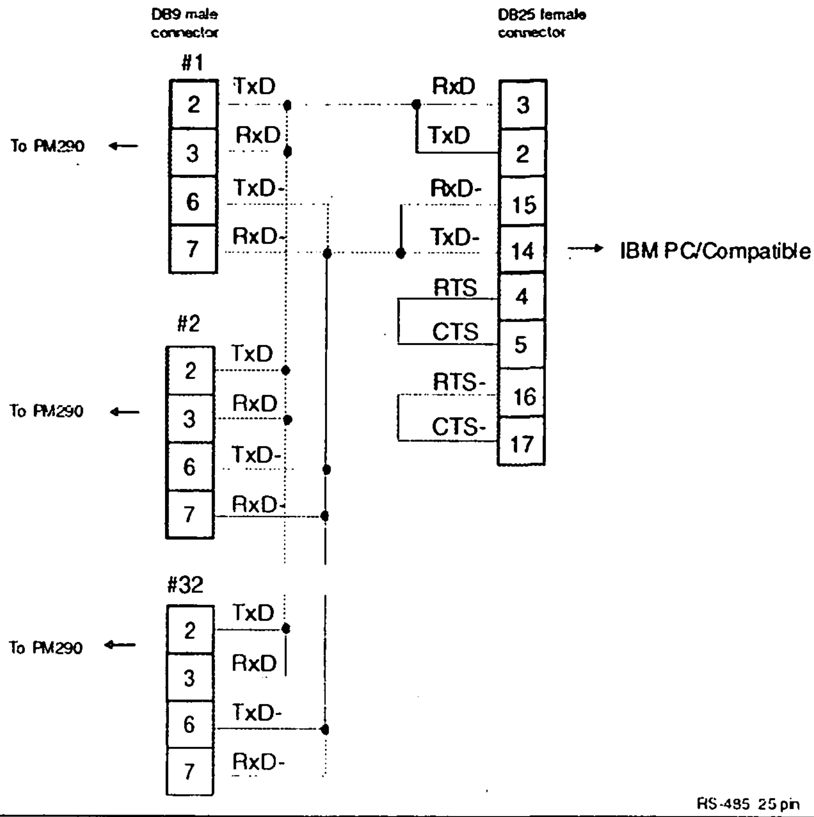


9-pin Computer Connector

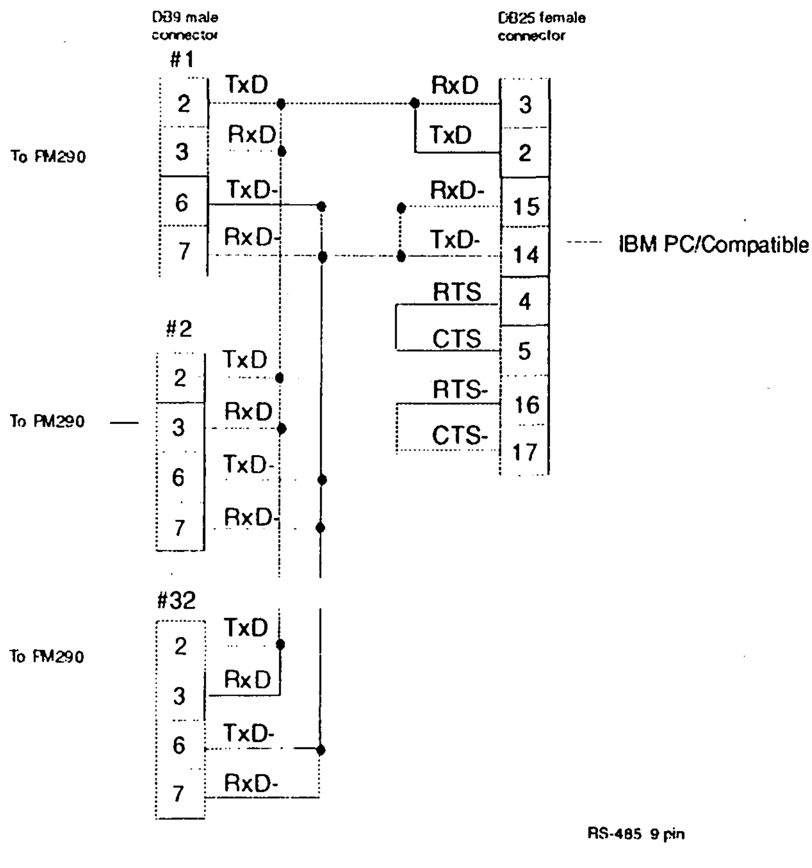


RS-485

25-pin Computer Connector



9-pin Computer Connector



■ Contents

Introduction to HVAC

Installation

Programming

All about VLT 6000 HVAC

175ZA691.10

VLT 6000 HVAC

Operating instructions
Software version: 2.2x

These operating instructions can be used for all VLT 6000 HVAC frequency converters with software version 2.2x. The software version number can be seen from parameter 624.

The voltage of the frequency converter is dangerous whenever the equipment is connected to mains. Incorrect installation of the motor or the frequency converter may cause damage to the equipment, serious personal injury or death.
Consequently, the instructions in this manual, as well as national and local rules and safety regulations, must be complied with.

Safety regulations

1. The VLT frequency converter must be disconnected from mains if repair work is to be carried out.
   Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
2. The [OFF/STOP] key on the control panel of the VLT frequency converter does not disconnect the equipment from mains and is thus not to be used as a safety switch.
3. Correct protective earthing of the equipment must be established, the user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The earth leakage currents are higher than 3.5 mA.
5. Protection against motor overload is included in the factory setting. Parameter 117, *Motor thermal protection*, default value is ETR trip 1.

NB!
The function is initialised at 1.0 x rated motor current and rated motor frequency (see parameter 117, *Motor thermal protection*).
For the North American market: The ETR functions ensure overload protection of the motor, Class 20, in accordance with NEC.

6. Do not remove the plugs for the motor and mains supply while the VLT frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
7. Reliable galvanic isolation (PELV) is not complied with if the RFI switch is placed in OFF position. This means that all control in- and outputs can only be considered low-voltage terminals with basic galvanic isolation.
8. Please note that the VLT frequency converter has more voltage inputs than L1, L2, L3 when the DC-bus terminals are used.
   Check that all voltage inputs have been disconnected and that the necessary time has passed before repair work is commenced.

Warning against unintended start

1. The motor can be brought to a stop by means of digital commands, bus commands, references or a local stop, while the frequency converter is connected to mains.
   If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.
2. While parameters are being changed, the motor may start. Consequently, the stop key [OFF/STOP] must always be activated, following which data can be modified.
3. A stopped motor may start if a fault occurs in the electronics of the VLT frequency converter, or if a temporary overload or a fault in the supply mains or the motor connection ceases.

Warning:

Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.
Using VLT 6002-6005: wait at least 4 minutes
Using VLT 6006-6550: wait at least 15 minutes

■ Introduction to Operating Instructions

These Operating Instructions are intended as a tool for you as the person who is going to install, operate and program the VLT 6000 HVAC.

A VLT 6000 HVAC comes with *Operating Instructions* as well as a *Quick Setup Guide*. In addition, a *Design Guide* can be ordered for use when designing installations that will include a VLT 6000 HVAC. See *Available literature*.

Operating Instructions:	These are instructions in how to ensure optimum mechanical and electrical installation, commissioning and service. The Operating Instructions also include a description of the software parameters, thereby enabling easy adaptation of the VLT 6000 HVAC to your application.
Quick Setup Guide:	Helps you to quickly install and commission the VLT 6000 HVAC.
Design Guide:	Used when designing installations that include a VLT 6000 HVAC. The *Design Guide* gives detailed information about VLT 6000 HVAC and HVAC installations, including a selection tool to enable you to choose the right VLT 6000 HVAC with its relevant options and modules. The *Design Guide* also contains examples of the most common HVAC applications. Furthermore, the *Design Guide* has all information relating to serial communication.

These Operating Instructions are divided into four sections with information about VLT 6000 HVAC.

Introduction to HVAC:	This section tells you the advantages you can obtain by using a VLT 6000 HVAC - such as AEO, Automatic Energy Optimization, RFI filters and other HVAC-relevant functions. This section also contains examples of application as well as information about Danfoss and CE-labelling.
Installation:	This section tells you how to carry out mechanically correct installation of the VLT 6000 HVAC. In addition, this section includes a description of how to ensure that the installation of your VLT 6000 HVAC is EMC-correct. Furthermore, a list is given of mains and motor connections, together with a description of the control card terminals.
Programming:	This section describes the control unit and the software parameters for the VLT 6000 HVAC. Also included is a guide to the Quick Setup menu, which allows you to get started on your application very quickly.
All about VLT 6000 HVAC:	This section gives information about status, warning and error messages from the VLT 6000 HVAC. Additionally, information is given on technical data, service, factory settings and special conditions.

Indicates something to be noted by the reader.

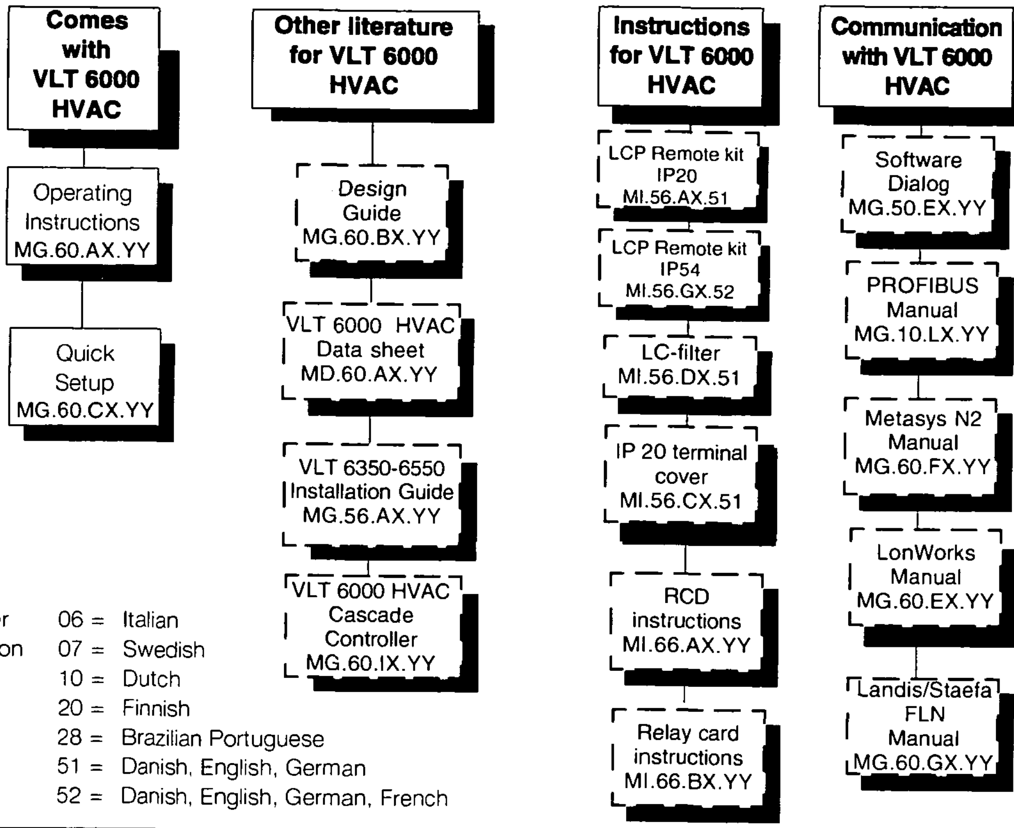
Indicates a general warning.

Indicates a high-voltage warning.

Introduction to HVAC

■ **Available literature**

The chart below gives an overview of the literature available for the VLT 6000 HVAC.
Please note that variations may occur from one country to the next



X =	version number	06 =	Italian
yy =	language version	07 =	Swedish
01 =	Danish	10 =	Dutch
02 =	English	20 =	Finnish
03 =	German	28 =	Brazilian Portuguese
04 =	French	51 =	Danish, English, German
05 =	Spanish	52 =	Danish, English, German, French

■ **VLT 6000 advantages in a HVAC installation**

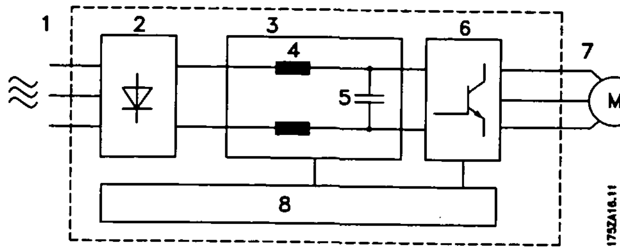
One advantage involved in using a VLT 6000 HVAC is that this unit has been designed to regulate the speed of fans and rotary pumps while consuming the smallest possible amount of energy. Consequently, if a VLT 6000 HVAC is used in a HVAC installation, optimum energy savings are guaranteed, since less energy is used with a VLT frequency converter than with the traditional HVAC regulation principles.
Another advantage in using the VLT 6000 HVAC is that regulation is improved and can easily adapt to a new flow or pressure requirement in an installation.
The use of a VLT 6000 HVAC offers the following additional advantages:

- VLT 6000 HVAC has been designed for HVAC applications.
- A wide power range - from 1.1-250 kW, with a unique design.
- IP 20 and IP 54 enclosures that can be mounted side by side. For power sizes ≥ 55 kW (≥ 30kW for 200 V) IP 00 is also available.
- All unit types are available with an integral RFI filter, complying with EN 55011 class 1-A in the case of a 150 m screened/armoured motor cable and EN 55011 class 1-B in the case of a screened/ armoured motor cable up to 50 m long.
- User-friendly design, which makes VLT 6000 HVAC easy to install, both mechanically and electrically.
- Detachable LCP control panel with Hand-Off-Auto buttons and a graphics display of local speed.
- High starting torque owing to Automatic Energy Optimization (AEO).
- Automatic Motor Adaptation (AMA) ensures optimum motor utilisation.
- Integral PID regulator with option of connecting two feedback signals (in connection with zoning), as well as setting of two set-points.
- Sleep mode, which automatically turns the motor off, e.g. when there is no need for more pressure or flow in a system.
- The "flying start" function enables the unit to catch a rotating fan.
- Automatic ramp up/down to ensure that the VLT 6000 HVAC will not trip during acceleration or deceleration.
- All standard units have three integral, serial protocols - RS 485 FC protocol, Johnson's Metasys N2 and Landis/Staefa FLN. Communication option cards that can be connected are LonWorks, Profibus for the VLT 6000 HVAC.

Control principle

A frequency converter rectifies AC voltage from mains into DC voltage, after which this DC voltage is converted into an AC current with a variable amplitude and frequency.

The motor is thus supplied with variable voltage and frequency, which enables infinitely variable speed regulation of three-phased, standard AC motors.



1. Mains voltage
   3 x 200 - 240 V AC, 50 / 60 Hz
   3 x 380 - 460 V AC, 50 / 60 Hz.

2. Rectifier
   A three-phase rectifier bridge that rectifies AC current into DC current.

3. Intermediate circuit
   DC voltage = $\sqrt{2}$ x mains voltage [V].

4. Intermediate circuit coils
   Even out the intermediate circuit voltage and reduce the harmonic current feedback to the mains supply.

5. Intermediate circuit capacitors
   Even out the intermediate circuit voltage.

6. Inverter
   Converts DC voltage into variable AC voltage with a variable frequency.

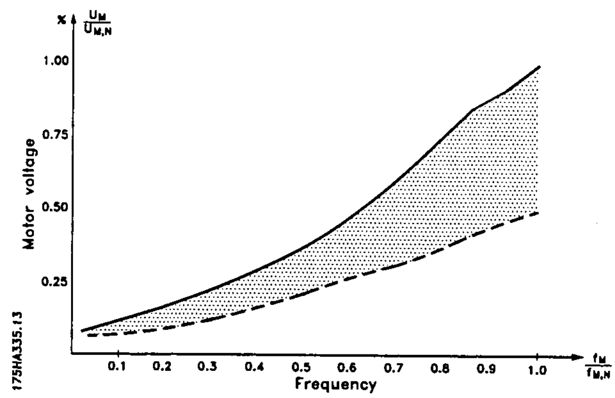
7. Motor voltage
   Variable AC voltage, 10-100% of mains supply voltage.

8. Control card
   This is where to find the computer that controls the inverter which generates the pulse pattern by which the DC voltage is converted into variable AC voltage with a variable frequency.

AEO - Automatic Energy Optimization

Normally, the U/f characteristics have to be set on the basis of the expected load at different frequencies. However, knowing the load at a given frequency in an installation is often a problem. This problem can be solved by using a VLT 6000 HVAC with its integral Automatic Energy Optimization (AEO), which ensures optimum energy utilization. All VLT 6000 HVAC units feature this function as a factory setting, i.e. it is not necessary to adjust the frequency converter U/f ratio in order to obtain maximum energy savings. In other frequency converters, the given load and voltage/ frequency ratio (U/f) must be assessed to carry out correct setting of the frequency converter.
Using Automatic Energy Optimization (AEO), you no longer need to calculate or assess the system characteristics of the installation, since Danfoss VLT 6000 HVAC units guarantee optimum, load-dependent energy consumption by the motor at all times.

The figure on the right illustrates the working range of the AEO function, within which energy optimization is enabled.



If the AEO function has been selected in parameter 101, *Torque characteristics*, this function will be constantly active. If there is a major deviation from the optimum U/f ratio, the VLT frequency converter will quickly adjust itself.

Advantages of the AEO function

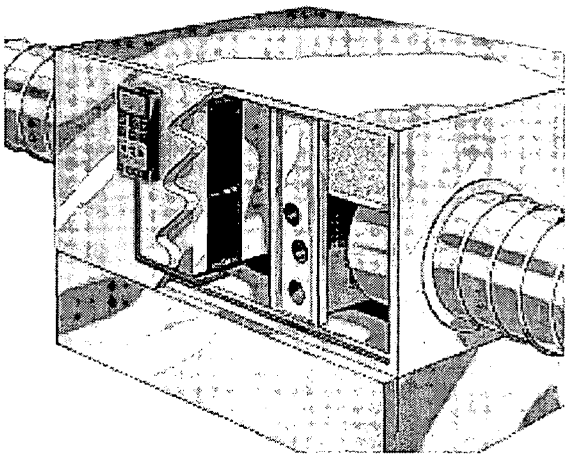
- Automatic energy optimization
- Compensation if an oversize motor is used
- AEO matches operations to daily or seasonal fluctuations
- Energy savings in a constant air volume system
- Compensation in the oversynchronous working range
- Reduces acoustic motor noise

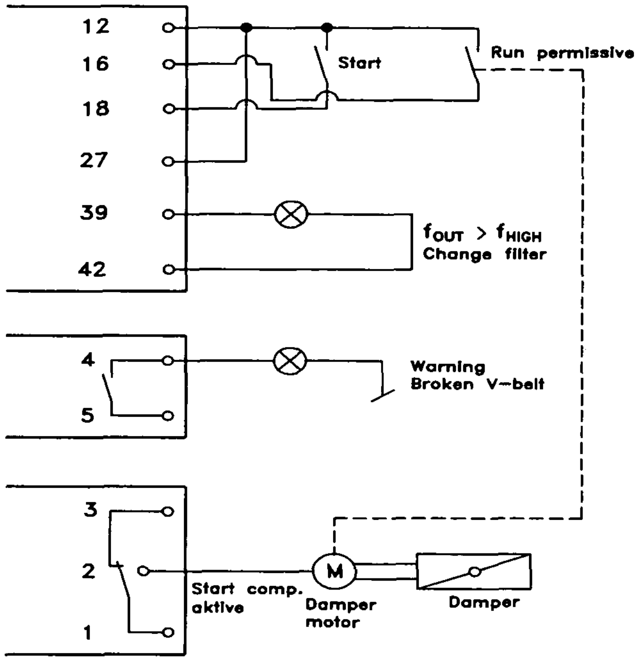
Introduction to HVAC

■ Example of application - Speed control of fan in ventilation system

The AHU installation is able to distribute air throughout the building or to one or several parts of a building.
Normally, an AHU installation consists of a fan and a motor that supply air, a fan scroll and a duct system with filters. If centralised air distribution is applied, the efficiency of the installation will increase and major energy savings can be made.
A VLT 6000 HVAC enables excellent control and monitoring, thereby ensuring perfect conditions in the building at all times.

This example shows an application with *Run permissive*, warning against no load and warning for filter change.
The *Run permissive* function ensures that the VLT frequency converter will not start the motor until the discharge damper has opened. If the V-belt to the fan breaks and if the filter is to be changed, this application will also give a warning on an output.





Set the following parameters:

Par. 100	Configuration	Open loop [0]
Par. 221	Warning: Low current, I_{LOW}	Depends on unit
Par. 224	Warning: High frequency, f_{HIGH}	
Par. 300	Terminal 16 Digital inputs	Run permissive [8]
Par. 302	Terminal 18 Digital inputs	Start [1]
Par. 308	Terminal 53, analogue input voltage	Reference [1]
Par. 309	Terminal 53, min. scaling	0 V
Par. 310	Terminal 53, max. scaling	10 V
Par. 319	Output	Output frequency greater than f_{HIGH} par. 224
Par. 323	Relay 1	Start command active [27]
Par. 326	Relay 2	Alarm or warning [12]
Par. 409	Function at no load	Warning [1]

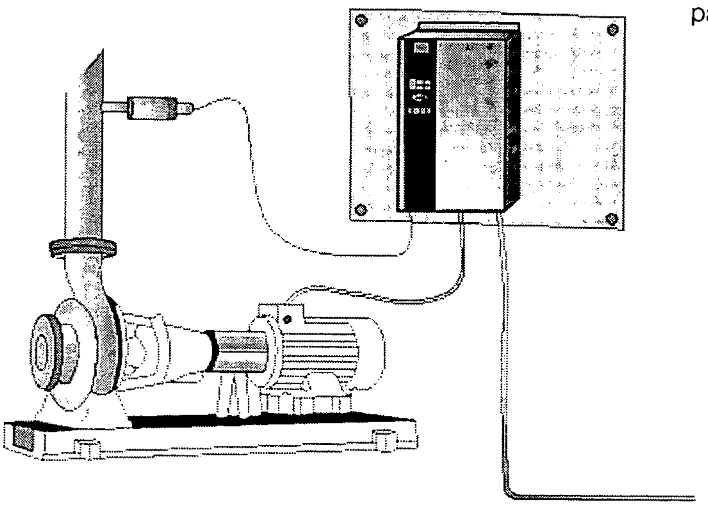
Example of application - Constant pressure regulation in water supply system

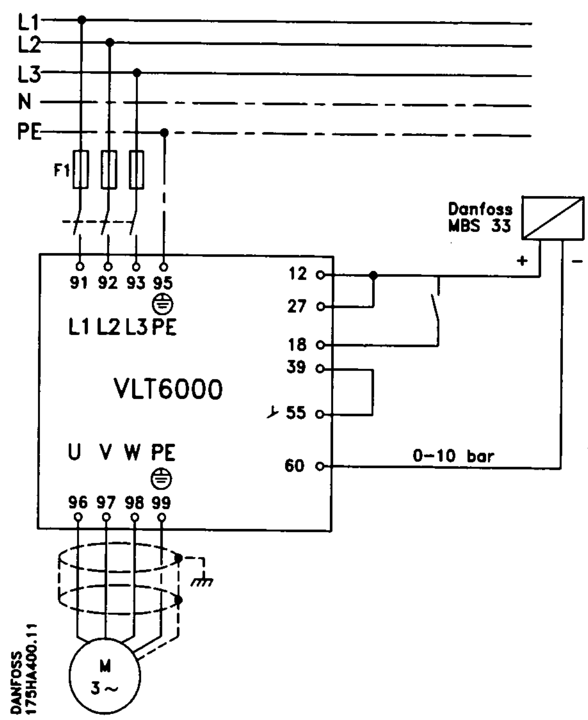
The demand for water from waterworks varies considerably over the 24 hours of a day. In the night, practically no water is used, while in the morning and in the evening the consumption is high. In order to maintain a suitable pressure in the water supply lines in relation to the current demand, the water supply pumps are equipped with speed control. The use of frequency converters enables the energy consumed by the pumps to be kept at a minimum, while optimizing the water supply to consumers.

A VLT 6000 HVAC with its integral PID controller ensures simple and quick installation. For example, an IP 54 unit can be mounted close to the pump on the wall and the existing mains cables can be used as mains supply to the frequency converter.

A Danfoss MBS 33 0-10 bar can be fitted a couple of metres from the joint outlet point from the waterworks to obtain closed loop regulation. Danfoss MBS 33 is a two-wire transmitter (4-20 mA) that can be powered directly from a VLT 6000 HVAC.

The required setpoint (e.g. 5 bar) can be set locally in parameter 418 *Setpoint 1*.





Set the following parameters:

Par. 100	Configuration	Closed loop [1]
Par. 205	Maximum reference	5 Hz
Par. 302	Terminal 18 Digital inputs	Start [1]
Par. 314	Terminal 60, analogue input current	Feedback signal [2]
Par. 315	Terminal 60, min. scaling	4 mA
Par. 316	Terminal 60, max. scaling	20 mA
Par. 403	Sleep mode timer	10 sec.
Par. 404	Sleep frequency	15 Hz
Par. 405	Wake-up frequency	20 Hz
Par. 406	Boost setpoint	125%
Par. 414	Maximum feedback	10
Par. 415	Process units	Bar [16]
Par. 418	Setpoint 1	5 bar
Par. 423	PID Proportional gain	0.6
Par. 424	PID integration time	10

CE-labelling

What is CE-labelling ?

The purpose of CE-labelling is to avoid technical obstacles to trade within EFTA and the EU. The EU has introduced the CE-label as a simple way of showing whether a product complies with the relevant EU directives. The CE-label says nothing about the quality or specifications of a product. Three EU directives relate to frequency converters:

- **The machine directive (89/392/EEC)**
  All machines with critical, moving parts are comprised by the machine directive which came into force on 1 January 1995. Since a frequency converter is largely electrical by function, it does not fall under the machine directive. However, if a frequency converter is supplied for use in a machine, we provide information about the safety aspects relating to the frequency converter. We do that by means of a manufacturer's declaration.

- **The low voltage directive (73/23/EEC)**
  Frequency converters must be CE-labelled in accordance with the low voltage directive which came into force on 1 January 1997. This directive applies to all electrical equipment and units used in the 50-1000 V AC and 75-1500 V DC voltage ranges. Danfoss provides its units with CE-labels in accordance with the directive and issues declarations of conformity upon request.

- **The EMC directive (89/336/EEC)**
  EMC is short for electromagnetic compatibility. The presence of electromagnetic compatibility means that the mutual interference between different components/appliances is so small that the functioning of the appliances is not affected. The EMC directive came into force on 1 January 1996. In accordance with the directive, Danfoss CE-labels its products and issues a declaration of conformity upon request.

To help ensure that your installation is EMC-correct, the manual provides detailed instructions for installation. Furthermore, we specify which norms that are complied with by which of our products. We offer the filters that can be seen from the specifications and gladly provide other types of assistance that can help you obtain the best possible EMC result.

In most cases the VLT frequency converter is used by professionals of the trade as a complex component forming part of a larger appliance, system or installation. It must be noted that the responsibility for the final EMC properties of the appliance, system or installation rests with the installer.

PC software and serial communication

Danfoss offers a number of serial communication options. Serial communication allows monitoring, programming and controlling one or several units from a centrally placed computer.
All VLT 6000 HVAC units have a RS 485 port as standard with a choice of three protocols. The three protocols selectable in parameter 500 *Protocols* are:

- FC protocol
- Johnson Controls Metasys N2
- Landis/Stefa FLN

A bus option card allows higher transmission speed than RS 485. In addition, a higher number of units can be linked to the bus and alternative transmission media can be used. Danfoss offers the following option cards for communication:

- Profibus
- LonWorks

Software Dialogue

Using the RS 485 port enables communication, e.g. with a PC. A Windows™ program, called *Software Dialog*, is available for this purpose. It can be used to monitor, program and control one or several VLT 6000 HVAC units.

Modules

Information on the installation of various modules is not included in this manual. See the Design Guide for VLT 6000 HVAC or contact Danfoss.

500-566 Serial communication

NB!
Information on the use of RS-485 serial interface is not included in this manual. Please contact Danfoss and ask for the Design Guide.

Unpacking and ordering a VLT frequency converter

Are you are in doubt as to which VLT frequency converter you have received and which options it contains? Use the following table to find out. The table can also be used for ordering a VLT 6000 HVAC.

Type code ordering number string

On the basis of your order, the VLT frequency converter is given an ordering number that can be seen from the nameplate on the unit. The number may look as follows:

VLT-**6008**-H-**T4**-**B20**-**R3**-**DL**-**F10**-A10

This means that the frequency converter ordered is a VLT 6008 for three-phase mains voltage of 380-460 V (**T4**) in Bookstyle enclosure IP 20 (**B20**). The hardware variant is with integral RFI filter, classes A & B (**R3**). The frequency converter features a control unit (**DL**) with a PROFIBUS option card (**F10**). Character no. 8 (H) indicates the application range of the unit: H = HVAC.

Bookstyle IP 20

	Mains voltage, rated:	
Motor power	200-240 V	380-460 V
1.1 kW	VLT 6002	VLT 6002
1.5 kW	VLT 6003	VLT 6003
2.2 kW	VLT 6004	VLT 6004
3.0 kW	VLT 6005	VLT 6005
4.0 kW		VLT 6006
5.5 kW		VLT 6008
7.5 kW		VLT 6011

Mains voltage, rated:		
Motor power	200-240 V	380-460 V
1.1 kW	VLT 6002	VLT 6002
1.5 kW	VLT 6003	VLT 6003
2.2 kW	VLT 6004	VLT 6004
3.0 kW	VLT 6005	VLT 6005
4.0 kW	VLT 6006	VLT 6006
5.5 kW	VLT 6008	VLT 6008
7.5 kW	VLT 6011	VLT 6011
11 kW	VLT 6016	VLT 6016
15 kW	VLT 6022	VLT 6022
18.5 kW	VLT 6027	VLT 6027
22 kW	VLT 6032	VLT 6032
30 kW	VLT 6042	VLT 6042
37 kW	VLT 6052	VLT 6052
45 kW	VLT 6062	VLT 6062

Units in the range of 1.1-45 kW come with enclosure IP 20, IP 54.

	Mains voltage, rated:	
Motor power	400 V [1]	460 V [1]
55 kW	VLT 6072	-
75 kW	VLT 6100	VLT 6072
90 kW	VLT 6125	VLT 6100
110 kW	VLT 6150	VLT 6125
132 kW	VLT 6175	VLT 6150
160 kW	VLT 6225	VLT 6175
200 kW	VLT 6275	VLT 6225
250 kW	VLT 6350	VLT 6275
315 kW	VLT 6400	VLT 6350
355 kW	VLT 6500	VLT 6400
400 kW	VLT 6550	VLT 6500
450 kW	-	VLT 6550

Units in the range of 55-450 kW come with enclosure IP 00, IP 20 or IP 54.

[1] The max. output depends on the mains voltage connected to the unit.

Hardware variants

All units in the programme are available in the following hardware variants:

ST: Standard unit with or without control unit.

EX: Extended unit for VLT type 6350 - 6550 with control unit, connection of external 24 V DC supply for back-up of control PCB.

DX: Extended unit for VLT type 6350 - 6550 with control unit, built-in mains fuses and disconnector, connection of external 24 V DC supply for back-up of control PCB.

RFI-filter

Bookstyle units always come *with* an integral RFI filter that complies with EN 55011-1B with 20 m screened /armoured motor cable and EN 55011-1A with 150 m screened/armoured motor cable.

Units for a mains voltage of 240 V and a motor power of up to and including 3.0 kW (VLT 6005) and units for a mains voltage of 380-460 V and a motor power of up to 7.5 kW (VLT 6011) are always supplied with an integral class 1A & 1B filter.

Units for higher motor power than these (3.0 and 7.5 kW, respectively) can be ordered either with or without an RFI filter.

Control unit (keypad and display)

All types of units in the programme, except for IP 54 units, can be ordered either with or without the control unit. IP 54 units always come *with* a control unit.

Conformal Coating

All types of units in the programme are available with or without conformal coating of the PCB.

Introduction to HVAC

■ Ordering form VLT 6000 HVAC

VLT [6][ ][ ]-[H]-[T][ ]-[ ][ ][ ]-[ ][ ]-[R][ ]-[D][ ]-[ ][ ][ ]-[ ][ ]

Power sizes e.g. 6008

3x200–240V:

6002	1.1kW
6003	1.5kW
6004	2.2kW
6005	3.0kW
6006	4.0kW
6008	5.5kW
6011	7.5kW
6016	11kW
6022	15kW
6027	18.5kW
6032	22kW
6042	30kW
6052	37kW
6062	45kW

3x380–460V:

6002	1.1kW
6003	1.5kW
6004	2.2kW
6005	3.0kW
6006	4.0kW
6008	5.5kW
6011	7.5kW
6016	11kW
6022	15kW
6027	18.5kW
6032	22kW
6042	30kW
6052	37kW
6062	45kW
6072	55kW
6100	75/90kW
6125	90/110kW
6150	110/132kW
6175	132/160kW
6225	160/200kW
6275	200/250kW
6350	250/315kW
6400	315/355kW
6500	355/400kW
6550	400/450kW

Application range
HVAC [H]

Mains voltage
3x200–240V [T2]
3x380–460V [T4]

Enclosure

Bookstyle IP 20 [B20]
6002–6005 200–240V
6002–6011 380–460V

IP 00 [C00]
6042–6062 200–240V
6075–6550 380–460V

IP 20 [C20]
6002–6062 200–240V
6002–6550 380–460V

IP 54 [C54]
6002–6062 200–240V
6002–6550 380–460V

Standard [ST]

Extended with external 24 VDC. Available only in VLT 6350–6550 380–500V [EX]

Hardware variant
Same as EX with built-in main fuses and disconnector [DX]

RFI filter

Available w/o filter in the range [R0]
6006–6062 200–240V
6016–6275 380–460V

With integral 1A filter (only 6350–6550) [R1]

With integral 1A + 1B filter [R3]

Display unit (LCP)
Without LCP (not an option with [D0]

With LCP [DL]

Fieldbus option card
No option [F00]
Profibus [F10]
LonWorks free Topology Process [F40]
LonWorks 78 KBPS [F41]
LonWorks 1.25 MBPS [F42]

Application option card
With relay card (not with fieldbus option) [A31]
Cascade controller option [A32]

Conformal coating
Without coating [C0]
With coating (standard w/ VLT 6350–6550) [C1]

No. units of this type [ ][ ][ ]

Required delivery date [ ][ ][ ][ ][ ][ ]

Ordered by:

Date:

Take a copy of the ordering forms. Fill them in and send or fax your order to the nearest office of the Danfoss sales organisation

175ZA520.11

General technical data

Mains supply (L1, L2, L3):

Supply voltage 200-240 V units	3 x 200/208/220/230/240 V ±10%
Supply voltage 380-460 V units	3 x 380/400/415/440/460 V ±10%
Supply frequency	50/60 Hz ±1%
Max. imbalance of supply voltage:	
VLT 6002 - 6011 / 380 - 460 V and VLT 6002 - 6005 / 200 - 240 V	±2.0% of rated supply voltage
VLT 6016 - 6072 / 380 - 460 V and VLT 6006 - 6032 / 200 - 240 V	±1.5% of rated supply voltage
VLT 6075 - 6550 / 380 - 460 V and VLT 6042 - 6062 / 200 - 240 V	±3.0% of rated supply voltage
True Power Factor (λ)	0.90 nominal at rated load
Displacement Power Factor (cos. φ)	near unity (>0.98)
No. of switches on supply input L1, L2, L3	approx. 1 time/min.
Max. short-circuit current	100.000 A

VLT output data (U, V, W):

Output voltage	0-100% of supply voltage
Output frequency	0 - 120 Hz, 0 - 1000 Hz
Rated motor voltage, 200-240 V units	200/208/220/230/240 V
Rated motor voltage, 380-460 V units	380/400/415/440/460/500 V
Rated motor frequency	50/60 Hz
Switching on output	Unlimited
Ramp times	1 - 3600 sec.

Torque characteristics:

Starting torque	110% for 1 min.
Starting torque (parameter 110 *High break-away torque*)	Max. torque: 160% for 0.5 sec.
Acceleration torque	100%
Overload torque	110%

Control card, digital inputs:

Number of programmable digital inputs	8
Terminal nos.	16, 17, 18, 19, 27, 29, 32, 33
Voltage level	0-24 V DC (PNP positive logics)
Voltage level, logical '0'	< 5 V DC
Voltage level, logical '1'	> 10 V DC
Maximum voltage on input	28 V DC
Input resistance, R_i	2 kΩ
Scanning time per input	3 msec.

Reliable galvanic isolation: All digital inputs are galvanically isolated from the supply voltage (PELV). In addition, the digital inputs can be isolated from the other terminals on the control card by connecting an external 24 V DC supply and opening switch 4. See Switches 1-4.

Control card, analogue inputs:

No. of programmable analogue voltage inputs/thermistor inputs	2
Terminal nos.	53, 54
Voltage level	0 - 10 V DC (scalable)
Input resistance, R_i	approx. 10 kΩ
No. of programmable analogue current inputs	1
Terminal no. ground	55
Current range	0/4 - 20 mA (scalable)
Input resistance, R_i	200 Ω
Resolution	10 bit + sign
Accuracy on input	Max. error 1% of full scale
Scanning time per input	3 msec.

Reliable galvanic isolation: All analogue inputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

■ General technical data

Control card, pulse input:

No. of programmable pulse inputs	3
Terminal nos.	17, 29, 33
Max. frequency on terminal 17	5 kHz
Max. frequency on terminals 29, 33	20 kHz (PNP open collector)
Max. frequency on terminals 29, 33	65 kHz (Push-pull)
Voltage level	0-24 V DC (PNP positive logics)
Voltage level, logic '0'	< 5 V DC
Voltage level, logic '1'	> 10 V DC
Maximum voltage on input	28 V DC
Input resistance, R_i	2 kΩ
Scanning time per input	3 msec.
Resolution	10 bit + sign
Accuracy (100-1 kHz), terminals 17, 29, 33	Max. error: 0.5% of full scale
Accuracy (1-5 kHz), terminal 17	Max. error: 0.1% of full scale
Accuracy (1-65 kHz), terminals 29, 33	Max. error: 0.1% of full scale

Reliable galvanic isolation: All pulse inputs are galvanically isolated from the supply voltage (PELV). In addition, pulse inputs can be isolated from the other terminals on the control card by connecting an external 24 V DC supply and opening switch 4. See Switches 1-4.

Control card, digital/pulse and analogue outputs:

No. of programmable digital and analogue outputs	2
Terminal nos.	42, 45
Voltage level at digital/pulse output	0 - 24 V DC
Minimum load to ground (terminal 39) at digital/pulse output	600 Ω
Frequency ranges (digital output used as pulse output)	0-32 kHz
Current range at analogue output	0/4 - 20 mA
Maximum load to ground (terminal 39) at analogue output	500 Ω
Accuracy of analogue output	Max. error: 1.5% of full scale
Resolution on analogue output.	8 bit

Reliable galvanic isolation: All digital and analogue outputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control card, 24 V DC supply:

Terminal nos.	12, 13
Max. load	200 mA
Terminal nos. ground	20, 39

Reliable galvanic isolation: The 24 V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analogue outputs.

Control card, RS 485 serial communication:

Terminal nos.	68 (TX+, RX+), 69 (TX-, RX-)

Reliable galvanic isolation: Full galvanic isolation (PELV).

Relay outputs:

No. of programmable relay outputs	2
Terminal nos., control card	4-5 (make)
Max. terminal load on 4-5, control card	50 V AC, 1 A, 60 VA, 75 V DC, 1 A, 30 W
Max. terminal load on 4-5, control card for UL/cUL applications	30 V AC, 1 A / 42.5 V DC, 1A
Terminal nos., power card and relay card	1-3 (break), 1-2 (make)
Max. terminal load on 1-3, 1-2, power card and relay card	240 V AC, 2 A, 60 VA
Max. terminal load on 1-3, 1-2, power card	50 V DC, 2 A

Installation

General technical data

External 24 Volt DC supply: (only available with VLT 6350 - 6550):

Terminal nos. 35, 36
Voltage range .... 24 V DC ±15% (max. 37 V DC for 10 sec.)
Max. voltage ripple .... 2 V DC
Power consumption .... 15 W - 50 W (50 W for start-up, 20 msec.)
Min. pre-fuse .... 6 Amp
Reliable galvanic isolation: Full galvanic isolation if the external 24 V DC supply is also of the PELV type.

Cable lengths and cross-sections:

Max. motor cable length, screened cable .... 150 m
Max. motor cable length, unscreened cable .... 300 m
Max. motor cable length, screened cable VLT 6011 380-460 V .... 100 m
Max. DC-bus cable length, screened cable .... 25 m from frequency converter to DC bar.
Max. cable cross-section to motor, see next section
Max. cross-section for control cables .... 1.5 mm²/16 AWG
Max. cross-section for serial communication .... 1.5 mm²/16 AWG
If UL/cUL is to complied with, cable with temperature class 60/75 °C must be used (VLT 6002 - 6072 380 - 500 V)
If UL/cUL is to complied with, cable with temperature class 75 °C must be used (VLT 6042 - 6062 200 - 240 V, VLT 6072 - 6550 380 - 500 V)

Control characteristics:

Frequency range 0 - 1000 Hz
Resolution on output frequency .... ±0.003 Hz
System response time .... 3 msec.
Speed, control range (open loop) .... 1:100 of synchro. speed
Speed, accuracy (open loop) .... < 1500 rpm: max. error ± 7.5 rpm
> 1500 rpm: max. error of 0.5% of actual speed
Process, accuracy (closed loop) .... < 1500 rpm: max. error ± 1.5 rpm
> 1500 rpm: max. error of 0.1% of actual speed
All control characteristics are based on a 4-pole asynchronous motor

Accuracy of Display readout (parameters 009-012 *Display readout*):

Motor current [5], 0 - 140% load .... Max. error: ±2.0% of rated output current
Power kW [6], Power HP [7], 0 - 90% load .... Max. error: ±5.0% of rated output power

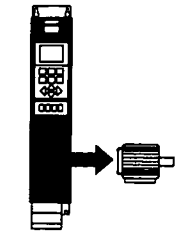
Externals:

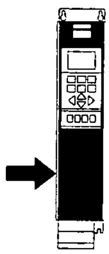
Enclosure .... IP 00, IP 20, IP 54
Vibration test .... 0.7 g RMS 18-1000 Hz random. 3 directions for 2 hours (IEC 68-2-34/35/36)
Max. relative humidity .... 93 % +2 %, -3 % (IEC 68-2-3) for storage/transport
Max. relative humidity .... 95% non condensing (IEC 721-3-3; class 3K3) for operation
Ambient temperature ....
VLT 6002-6005 200-240V, 6002-6011 380-460V, Bookstyle, IP 20 .... Max. 45°C (24-hour average max. 40°C)
VLT 6006-6062 200-240V, 6016-6550 380-460V, IP 00, IP 20 .... Max. 40°C (24-hour average max. 35°C)
VLT 6002-6062 200-240V, 6002-6550 380-460V, IP 54 .... Max. 40°C (24-hour average max. 35°C)
See *Derating for high ambient temperature*
Min. ambient temperature in full operation .... 0°C
Min. ambient temperature at reduced performance .... -10°C
Temperature during storage/transport .... -25 - +65/70°C
Max. altitude above sea level .... 1000 m
See *Derating for high air pressure*
EMC standards applied,
Emission EN 50081-1/2, EN 61800-3, EN 55011, EN 55014
Immunity EN 50082-2, EN 61000-4-2, IEC 1000-4-3, EN 61000-4-4
EN 61000-4-5, ENV 50204, EN 61000-4-6, VDE 0160/1990.12

VLT 6000 HVAC protection:

- Electronic motor thermal protection against overload.
- Temperature monitoring of heat-sink ensures that the VLT frequency converter cuts out if the temperature reaches 90°C for IP 00 and IP 20. For IP 54, the cut-out temperature is 80°C. An overtemperature can only be reset when the temperature of the heat-sink has fallen below 60°C.
- The VLT frequency converter is protected against short-circuiting on motor terminals U, V, W.
- The VLT frequency converter is protected against earth fault on motor terminals U, V, W.
- Monitoring of the intermediate circuit voltage ensures that the VLT frequency converter cuts out if the intermediate circuit voltage gets too high or too low.
- If a motor phase is missing, the VLT frequency converter cuts out.
- If there is a mains fault, the VLT frequency converter is able to carry out a controlled deramping.
- If a mains phase is missing, the VLT frequency converter will cut out when a load is placed on the motor.

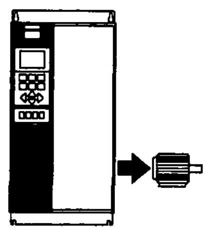
■ Technical data, mains supply 3 x 200 - 240 V

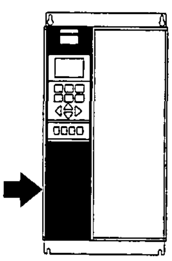




According to international requirements	VLT type	6002	6003	6004	6005	6006	6008	6011
Output current [4]	$I_{VLT,N}$ [A]	6.6	7.5	10.6	12.5	16.7	24.2	30.8
	$I_{VLT,MAX}$ (60 s) [A]	7.3	8.3	11.7	13.8	18.4	26.6	33.9
Output power (240 V)	$S_{VLT,N}$ [kVA]	2.7	3.1	4.4	5.2	6.9	10.1	12.8
Typical shaft output	$P_{VLT,N}$ [kW]	1.1	1.5	2.2	3.0	4.0	5.5	7.5
Typical shaft output	$P_{VLT,N}$ [HP]	1.5	2	3	4	5	7.5	10
Max. cable cross-section to motor and DC-bus	[mm²/AWG]	4/10	4/10	4/10	4/10	4/10	16/6	16/6
Max. input current (200 V) (RMS)	$I_{L,N}$ [A] 6.0	7.0	10.0	12.0	16.0	23.0	30.0	
Max. cable cross-section power [mm²]/[AWG] [2]		4/10	4/10	4/10	4/10	4/10	16/6	16/6
Max. pre-fuses	[A]/UL [1] [A]	16/10	16/15	25/20	25/25	35/30	50	60
Mains contactor	[Danfoss type]	CI 6	CI 6	CI 6	CI 6	CI 6	CI 9	CI 16
Efficiency [3]		0.95						
Weight IP 20	[kg]	7	7	9	9	23	23	23
Weight IP 54	[kg]	11.5	11.5	13.5	13.5	35	35	38
Power loss at max. load. [W]	Total	76	95	126	172	194	426	545
Enclosure	VLT type	Bookstyle IP 20/Compact IP 20/IP 54						
		(Bookstyle IP 20 is available in power range VLT 6002-6005).						

■ Mains supply 3 x 200 - 240 V

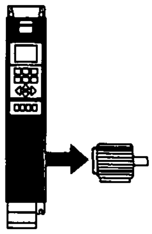


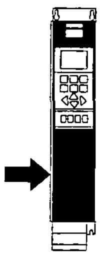


According to international requirements	VLT type	6016	6022	6027	6032	6042	6052	6062
Output current	$I_{VLT,N}$ [A] (200-230 V)	46.2	59.4	74.8	88.0	115	143	170
	$I_{VLT,MAX}$ (60 s) [A] (200-230 V)	50.6	65.3	82.3	96.8	127	158	187
	$I_{VLT,N}$ [A] (240 V)	46.0	59.4	74.8	88.0	104	130	154
	$I_{VLT,MAX}$ (60 s) [A] (240 V)	50.6	65.3	82.3	96.8	115	143	170
Output power	$S_{VLT,N}$ [kVA] (240 V)	19.1	24.7	31.1	36.6	41.0	52.0	61.0
Typical shaft output	$P_{VLT,N}$ [kW]	11	15	18.5	22	30	37	45
Typical shaft output	$P_{VLT,N}$ [HP]	15	20	25	30	40	50	60
Max. cable cross-section to motor and DC-bus [mm²/AWG]	copper	16/6	35/2	35/2	50/0	70/1/0	95/3/0	120/4/0
	aluminium	16/6	35/2	35/2	50/0	95/3/0 [5]	90/250mcm [5]	120/300mcm [5]
Min. cable cross-section to motor and DC-bus	[mm²/AWG]	10/8	10/8	10/8	16/6	10/8	10/8	10/8
Max. input current (200 V) (RMS)	$I_{L,N}$ [A]	46.0	59.2	74.8	88.0	101.3	126.6	149.9
Max. cable, cross-section power [mm²/AWG]	copper	16/6	35/2	35/2	50/0	70/1/0	95/3/0	120/4/0
	aluminium	16/6	35/2	35/2	50/0	95/3/0 [5]	90/250mcm [5]	120/300mcm [5]
Max. pre-fuses	[A]/UL [1] [A]	60	80	125	125	150	200	250
Mains contactor	[Danfoss type]	CI 32	CI 32	CI 37	CI 61	CI85	CI85	CI141
	[AC value]	AC-1	AC-1	AC-1	AC-1			
Efficiency [3]		0.95						
Weight IP 00	[kg]	-	-	-	-	90	90	90
Weight IP 20	[kg]	23	30	30	48	101	101	101
Weight IP 54	[kg]	38	49	50	55	104	104	104
Power loss at max. load:	[W]	545	783	1042	1243	1089	1361	1613
Enclosure		IP 20+NEMA 1 kit, IP 54/NEMA 12						

1. If UL/cUL is to be complied with, pre-fuses type Bussmann KTN-R, or Ferraz Shawmut type ATMR must be used. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Amps ms (symmetrical), 500 V maximum.
2. American Wire Gauge.
3. Measured using 30 m screened motor cable at rated load and rated frequency.
4. Current ratings fulfill UL requirements for 208-240 V
5. Connection stud 1 x M8 / 2 x M8.

■ Technical data, mains supply 3 x 380 - 460 V

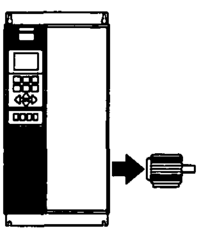


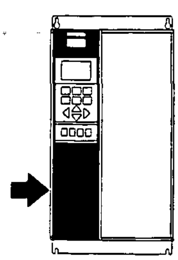


According to international requirements	VLT type	6002	6003	6004	6005	6006	6008	6011
Output current	$I_{VLT,N}$ [A] (380-440 V)	3.0	4.1	5.6	7.2	10.0	13.0	16.0
	$I_{VLT,MAX}$ (60 s) [A] (380-440 V)	3.3	4.5	6.2	7.9	11.0	14.3	17.6
	$I_{VLT,N}$ [A] (441-460 V)	3.0	3.4	4.8	6.3	8.2	11.0	14.0
	$I_{VLT,MAX}$ (60 s) [A] (441-460 V)	3.3	3.7	5.3	6.9	9.0	12.1	15.4
Output power	$S_{VLT,N}$ [kVA] (400 V)	2.2	2.9	4.0	5.2	7.2	9.3	11.5
	$S_{VLT,N}$ [kVA] (460 V)	2.4	2.7	3.8	5.0	6.5	8.8	11.2
Typical shaft output	$P_{VLT,N}$ [kW]	1.1	1.5	2.2	3.0	4.0	5.5	7.5
Typical shaft output	$P_{VLT,N}$ [HP]	1.5	2	3	-	5	7.5	10
Max. cable cross-section to motor	[mm²/AWG]	4/10	4/10	4/10	4/10	4/10	4/10	4/10
Max. input current (RMS)	$I_{L,N}$ [A] (380 V)	2.8	3.8	5.3	7.0	9.1	12.2	15.0
	$I_{L,N}$ [A] (460 V)	2.5	3.4	4.8	6.0	8.3	10.6	14.0
Max. cable cross-section, power	[mm²]/[AWG] [2]	4/10	4/10	4/10	4/10	4/10	4/10	4/10
Max. pre-fuses	[A]/UL [1] [A]	16/6	16/10	16/10	16/15	25/20	25/25	35/30
Mains contactor	[Danfoss type]	CI 6	CI 6	CI 6	CI 6	CI 6	CI 6	CI 6
Efficiency [3]		0.96						
Weight IP 20	[kg]	8	8	8,5	8,5	10,5	10,5	10,5
Weight IP 54	[kg]	11.5	11.5	12	12	14	14	14
Power loss at max. load. [W]	Total	67	92	110	139	198	250	295
Enclosure	VLT type	Bookstyle IP 20/Compact IP 20/IP 54						

(Bookstyle IP 20 is available in the VLT 6002-6011 power range)

■ Mains supply 3 x 380 - 460 V

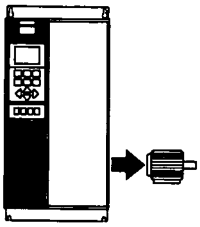


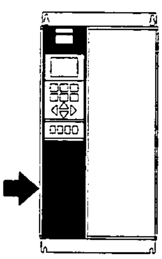


According to international requirements	VLT type	6016	6022	6027	6032	6042	6052	6062	6072
Output current	$I_{VLT,N}$ [A] (380-440 V)	24.0	32.0	37.5	44.0	61.0	73.0	90.0	106
	$I_{VLT,MAX}$ (60 s) [A] (380-440 V)	26.4	35.2	41.3	48.4	67.1	80.3	99.0	117
	$I_{VLT,N}$ [A] (441-460 V)	21.0	27.0	34.0	40.0	52.0	65.0	77.0	106
	$I_{VLT,MAX}$ (60 s) [A] (441-460 V)	23.1	29.7	37.4	44.0	57.2	71.5	84.7	117
Output power	$S_{VLT,N}$ [kVA] (400 V)	17.3	23.0	27.0	31.6	43.8	52.5	64.7	73.4
	$S_{VLT,N}$ [kVA] (460 V)	16.7	21.5	27.1	31.9	41.4	51.8	61.3	84.5
Typical shaft output	$P_{VLT,N}$ [kW]	11	15	18.5	22	30	37	45	55
Typical shaft output	$P_{VLT,N}$ [HP]	15	20	25	30	40	50	60	75
Max. cable cross-section to motor and DC-bus	[mm²/AWG]	16/6	16/6	16/6	16/6	35/2	35/2	50/0	50/0
Min. cable cross-section to motor and DC-bus [4]	[mm²/AWG]	10/8	10/8	10/8	10/8	10/8	10/8	16/6	16/6
Max. input current (RMS)	$I_{L,N}$ [A] (380 V)	24.0	32.0	37.5	44.0	60.0	72.0	89.0	104
	$I_{L,N}$ [A] (460 V)	21.0	27.6	34.0	41.0	53.0	64.0	77.0	104
Max. cable cross-section, power	[mm²]/[AWG]	16/6	16/6	16/6	16/6	35/2	35/2	50/0	
Max. pre-fuses	[A]/UL [1] [A]	63/40	63/40	63/50	63/60	80/80	100/100	125/125	150/150
Mains contactor	[Danfoss type]	CI 9	CI 16	CI 16	CI 32	CI 32	CI 37	CI 61	CI 85
Efficiency at rated frequency		0.96							
Weight IP 20	[kg]	?	21	22	27	28	41	42	43
Weight IP 54	[kg]	?	41	42	42	54	56	56	60
Power loss at max. load.	[W]	419	559	655	768	1065	1275	1571	1851
Enclosure		IP 20/IP 54							

1. To comply with UL/cUL, use pre-fuses type Bussmann KTS-R or Ferraz Shawmut type ATMR. Place the fuses to protect a circuit capable of supplying max. 100,000 amps rms (symmetrical), 500 V max.
2. American Wire Gauge.
3. Measured using 30 m screened motor cable at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.

■ Technical data, mains supply 3 x 380 - 460 V

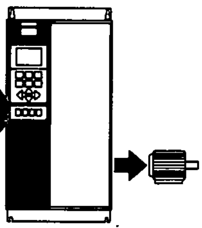




According to international requirements	VLT type	6075[6]	6100	6125	6150	6175	6225	6275
Output current	$I_{VLT,N}$ [A] (380-440 V)	106	147	177	212	260	315	368
	$I_{VLT,MAX}$ (60 s) [A] (380-440 V)	117	162	195	233	286	347	405
	$I_{VLT,N}$ [A] (441-460 V)	106	130	160	190	240	302	361
	$I_{VLT,MAX}$ (60 s) [A] (441-460 V)	117	143	176	209	264	332	397
Output power	$S_{VLT,N}$ [kVA] (400 V)	73	102	123	147	180	218	255
	$S_{VLT,N}$ [kVA] (460 V)	84.5	104	127	151	191	241	288
Typical shaft output (380-440 V)	$P_{VLT,N}$ [kW]	55	75	90	110	132	160	200
Typical shaft output (441-460 V)	$P_{VLT,N}$ [HP]	75	100	125	150	200	250	300
Max. cross-section of copper cable to motor and DC-bus (380-440 V)	[mm²][5]	70	95	120	2x70	2x70	2x95	2x120
Max. cross-section of copper cable to motor and DC-bus (441-460 V)	[mm²][5]	70	70	95	2x70	2x70	2x95	2x120
Max. cross-section of aluminium cable to motor and DC-bus (380-440 V)	[mm²][5]	95	90	120	2x70	2x95	2x120	2x150
Max. cross-section of aluminium cable to motor and DC-bus (441-460 V)	[mm²][5]	70	120	150	2x70	2x120	2x120	2x150
Max. cross-section of copper cable to motor and DC-bus (380-440 V)	[AWG][5]	1/0	3/0	4/0	2x1/0	2x2/0	2x3/0	2x250mcm
Max. cross-section of copper cable to motor and DC-bus (441-460 V)	[AWG][5]	1/0	2/0	3/0	2x1/0	2x1/0	2x3/0	2x4/0
Max. cross-section of aluminium cable to motor and DC-bus (380-440 V)	[AWG][5]	3/0	250mcm	300mcm	2x2/0	2x4/0	2x250mcm	2x350mcm
Max. cross-section of aluminium cable to motor and DC-bus (441-460 V)	[AWG][5]	3/0	4/0	250mcm	2x2/0	2x3/0	2x250mcm	2x300mcm
Max. cross-section of cable to motor, and DC-bus[4]	[mm²/AWG][5]	10/8	10/8	10/8	10/8	10/8	16/6	16/6
Max. input current (RMS)	$I_{L,N}$ [A] (380 V)	103	145	174	206	256	317	366
	$I_{L,N}$ [A] (460 V)	103	128	158	185	236	304	356
Max. cross-section of copper cable to power (380-440 V)	[mm²][5]	70	95	120	2x70	2x70	2x95	2x120
Max. cross-section of copper cable to power (441-460 V)	[mm²][5]	70	70	95	2x70	2x70	2x95	2x120
Max. cross-section of aluminium cable to power (380-440 V)	[mm²][5]	95	90	120	2x70	2x95	2x120	2x150
Max. cross-section of aluminium cable to power (441-460 V)	[mm²][5]	70	120	150	2x70	2x120	2x120	2x150
Max. cross-section of copper cable to power (380-440 V)	[AWG][5]	1/0	3/0	4/0	2x1/0	2x2/0	2x3/0	2x250mcm
Max. cross-section of copper cable to power (441-460 V)	[AWG][5]	1/0	2/0	3/0	2x1/0	2x1/0	2x3/0	2x4/0
Max. cross-section of aluminium cable to power (380-440 V)	[AWG][5]	3/0	250mcm	300mcm	2x2/0	2x4/0	2x250mcm	2x350mcm
Max. cross-section of aluminium cable to power (441-460 V)	[AWG][5]	3/0	4/0	250mcm	2x2/0	2x3/0	2x250mcm	2x300mcm
Min. cable cross-section to motor, and DC-bus[4]	[mm²/AWG][5]	10/8	10/8	10/8	10/8	10/8	16/6	
Max. pre-fuses	[A]/UL[1] [A]	150/150	250/220	250/250	300/300	350/350	450/400	500/500
Integral pre-fuses	[A]/UL[1] [A]	15/15	15/15	15/15	30/30	30/30	30/30	30/30
Mains contactor	[Danfoss Type]	CI 85	CI 85	CI 141	CI 141	CI 250EL	CI 250EL	CI 300EL
Pre-fuses SMPS	[A]/UL[1] [A]	5.0/5.0						
Weight IP 00	[kg]	109	109	109	146	146	146	146
Weight IP 20	[kg]	121	121	121	161	161	161	161
Weight IP 54	[kg]	124	124	124	177	177	177	177
Efficiency at rated frequency		0.96-0.97						
Power loss at max. load	[W]	1430	1970	2380	2860	3810	4770	5720
Enclosure		IP 00 / IP 20/ IP 54						

1. To comply with UL/cUL, use pre-fuses type Bussmann KTN-R, or Ferraz Shawmut type ATMR. The fuses protect a circuit capable of supplying max. 100,000 amps rms (symmetrical), 500 V max.
2. American Wire Gauge.
3. Measured using 30 m screened motor cable at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Connection stud 1 x M8 / 2 x M8.
6. Not for new designs. For new designs, use VLT 6072

■ Technical data, mains supply 3 x 380 - 460 V

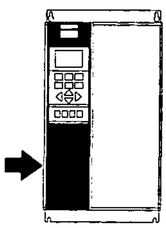


According to international requirements	VLT type	6350	6400	6500	6550
Output current	$I_{VLT,N}$ [A] (380-440 V)	480	600	658	745
	$I_{VLT,MAX}$ (60 s) [A] (380-440 V)	528	660	724	820
	$I_{VLT,N}$ [A] (441-460 V)	443	540	590	678
	$I_{VLT,MAX}$ (60 s) [A] (441-460 V)	487	594	649	746
Output power	$S_{VLT,N}$ [kVA] (440 V)	345	431	473	536
	$S_{VLT,N}$ [kVA] (460 V)	353	430	470	540
Typical shaft output (380-440 V)	$P_{VLT,N}$ [kW]	250	315	355	400
Typical shaft output (441-500 V)	$P_{VLT,N}$ [HP]	350	450	500	600
Max. cross-section of copper cable to motor and loadsharing (380-440 V)	[mm²]5)	2 x 150 3 x 70	2 x 185 3 x 95	2 x 240 3 x 120	2 x 300 3 x 150
Max. cross-section of copper cable to motor and loadsharing (441-460 V)	[mm²]5)	2 x 120 3 x 70	2 x 150 3 x 95	2 x 185 3 x 95	2 x 300 3 x 120
Max. cross-section of aluminium cable to motor and loadsharing (380-440 V)	[mm²]5)	2 x 185 3 x 120	2 x 240 3 x 150	2 x 300 3 x 185	3 x 185
Max. cross-section of aluminium cable to motor and loadsharing (441-460 V)	[mm²]5)	2 x 150 3 x 95	2 x 185 3 x 120	2 x 240 3 x 150	3 x 185
Max. cross-section of copper cable to motor and loadsharing (380-440 V)	[AWG]2) 5)	2 x 250mcm 3 x 2/0	2 x 350mcm 3 x 3/0	2 x 400mcm 3 x 4/0	2 x 500mcm 3 x 250mcm
Max. cross-section of copper cable to motor and loadsharing (441-460 V)	[AWG]2) 5)	2 x 4/0 3 1/0	2 x 300mcm 3 x 3/0	2 x 350mcm 3 x 3/0	2 x 500mcm 3 x 4/0
Max. cross-section of aluminium cable to motor and loadsharing (380-440 V)	[AWG]2) 5)	2 x 350mcm 3 x 4/0	2 x 500mcm 3 x 250mcm	2 x 600mcm 3 x 300mcm	2 x 700mcm 3 x 350mcm
Max. cross-section of aluminium cable to motor and loadsharing (441-460 V)	[AWG]2) 5)	2 x 300mcm 3 x 3/0	2 x 400mcm 3 x 4/0	2 x 500mcm 3 x 250mcm	2 x 600mcm 3 x 300mcm

1. If UL/cUL is to be complied with, pre-fuses type Bussmann KTN-R, KTS-R must be used. The fuses must be placed to protect a circuit capable of supplying max. 100,000 amps rms (symmetrical), 500 V maximum.
2. American Wire Gauge.
3. Measured using 30 m screened motor cable at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Connection stud 1 x M8 / 2 x M8.

■ Technical data, mains supply 3 x 380 - 460 V

According to international requirements



	VLT type	6350	6400	6500	6550
Max. input current	$I_{L,MAX}$ [A] (380 V)	389	467	584	648
(RMS)	$I_{L,MAX}$ [A] (460 V)	356	431	526	581
Max. cross-section of copper cable to power (380-440 V)	[mm^2][5]	2 x 150 3 x 70	2 x 185 3 x 95	2 x 240 3 x 120	2 x 300 3 x 150
Max. cross-section of copper cable to power (441-460 V)	[mm^2][5]	2 x 120 3 x 70	2 x 150 3 x 95	2 x 185 3 x 95	2 x 300 3 x 120
Max. cross-section of aluminium cable to power (380-440 V)	[mm^2][5]	2 x 185 3 x 120	2 x 240 3 x 150	2 x 300 3 x 185	3 x 185
Max. cross-section of aluminium cable to power (441-460 V)	[mm^2][5]	2 x 150 3 x 95	2 x 185 3 x 120	2 x 240 3 x 150	3 x 185
Max. cross-section of copper cable to power (380-440 V)	[AWG][2][5]	2 x 250mcm 3 x 2/0	2 x 350mcm 3 x 3/0	2 x 400mcm 3 x 4/0	2 x 500mcm 3 x 250mcm
Max. cross-section of copper cable to power (441-460 V)	[AWG][2][5]	2 x 4/0 3 1/0	2 x 300mcm 3 x 3/0	2 x 350mcm 3 x 3/0	2 x 500mcm 3 x 4/0
Max. cross-section of aluminium cable to power (380-440 V)	[AWG][2][5]	2 x 350mcm 3 x 4/0	2 x 500mcm 3 x 250mcm	2 x 600mcm 3 x 300mcm	2 x 700mcm 3 x 350mcm
Max. cross-section of aluminium cable to power (441-460 V)	[AWG][2][5]	2 x 300mcm 3 x 3/0	2 x 400mcm 3 x 4/0	2 x 500mcm 3 x 250mcm	2 x 600mcm 3 x 300mcm
Max. pre-fuses (mains)	[-]/UL [1] [A]	630/600	700/700	800/800	800/800
Integral pre-fuses (softcharge circuit)	[-]/UL [1] [A]	15/15	15/15	15/15	30/30
Integral pre-fuses (softcharge resistors)	[-]/UL [1] [A]	12/12	12/12	12/12	12/12
Integral pre-fuses (SMPS)	[-]/UL [1] [A]	5.0/5.0			
Efficiency		0.97			
Mains contactor	[Danfoss type]	CI 300EL	CI 300EL	-	-
Weight IP 00	[kg]	480	515	560	585
Weight IP 20	[kg]	595	630	675	700
Weight IP 54	[kg]	605	640	685	710
Power loss at max. load	[W]	7500	9450	10650	12000
Enclosure		IP 00 / IP 20/ IP 54			

1. If UL/cUL is to be complied with, pre-fuses type Bussmann KTN-R, KTS-R must be used. The fuses must be placed to protect a circuit capable of supplying max. 100,000 amps rms (symmetrical), 500 V maximum.
2. American Wire Gauge.
3. Measured using 30 m screened motor cable at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Connection stud 1 x M8 / 2 x M8.

■ Mechanical dimensions

All measurements in mm.

VLT type	A	B	C	a	b	aa/bb	Type
Bookstyle IP 20 200-240 V							
6002 - 6003	395	90	260	384	70	100	A
6004 - 6005	395	130	260	384	70	100	A
Bookstyle IP 20 380-460 V							
6002 - 6005	395	90	260	384	70	100	A
6006 - 6011	395	130	260	384	70	100	A
IP 00 200-240 V							
6042 - 6062	800	370	335	780	270	225	B
IP 00 380-460 V							
6075 - 6125	800	370	335	780	270	225	B
6150 - 6275	1400	420	400	1380	350	225	B
6350 - 6550	1896	1099	490	-	-	400 (aa)	H
IP 20 200-240 V							
6002 - 6003	395	220	160	384	200	100	C
6004 - 6005	395	220	200	384	200	100	C
6006 - 6011	560	242	260	540	200	200	D
6016 - 6022	700	242	260	680	200	200	D
6027 - 6032	800	308	296	780	270	200	D
6042 - 6062	954	370	335	780	270	225	E
IP 20 380-460 V							
6002 - 6005	395	220	160	384	200	100	C
6006 - 6011	395	220	200	384	200	100	C
6016 - 6027	560	242	260	540	200	200	D
6032 - 6042	700	242	260	680	200	200	D
6052 - 6072	800	308	296	780	270	200	D
6075 - 6125	954	370	335	780	270	225	E
6150 - 6275	1554	420	400	1380	350	225	E
6350 - 6550	2010	1200	600	-	-	400 (aa)	H

VLT type	A	B	C	D	a	b	a/b	Type
IP 54 200-240 V								
6002 - 6003	460	282	195	85	260	258	100	F
6004 - 6005	530	282	195	85	330	258	100	F
6006 - 6011	810	355	280	70	560	330	200	F
6016 - 6032	940	400	280	70	690	375	200	F
6042 - 6062	937	495	421	-	830	374	225	G
IP 54 380-460 V								
6002 - 6005	460	282	195	85	260	258	100	F
6006 - 6011	530	282	195	85	330	258	100	F
6016 - 6032	810	355	280	70	560	330	200	F
6042 - 6072	940	400	280	70	690	375	200	F
6075 - 6125	937	495	421	-	830	374	225	G
6150 - 6275	1572	495	425	-	1465	445	225	G
6350 - 6550	2010	1200	600	-	-	-	400 (aa)	H

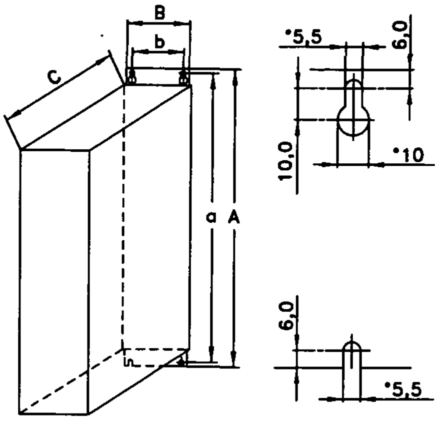
Option for IP 00 VLT 6075-6275	A1	B1	C1
IP 20 bottom cover			
6075 - 6125	175	370	335
6150 - 6275	175	420	400

aa: Min. air above enclosure

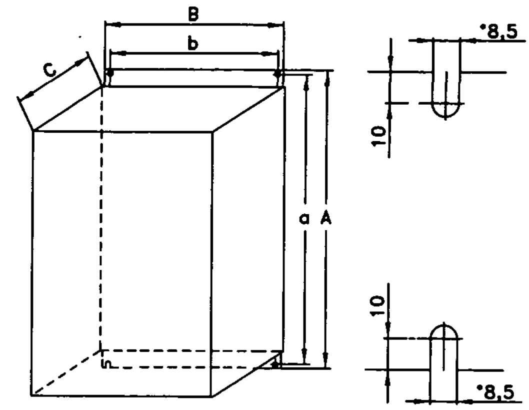
ab: Min. air below enclosure

Installation

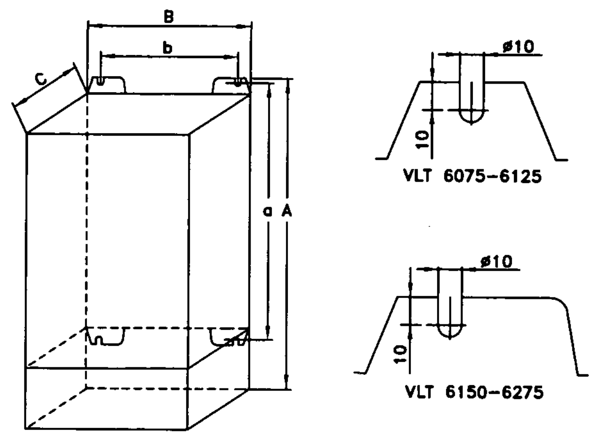
■ Mechanical dimensions



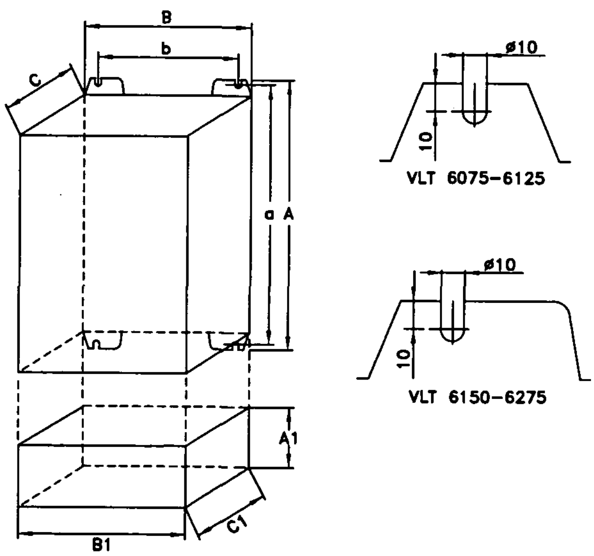
Type A, IP20



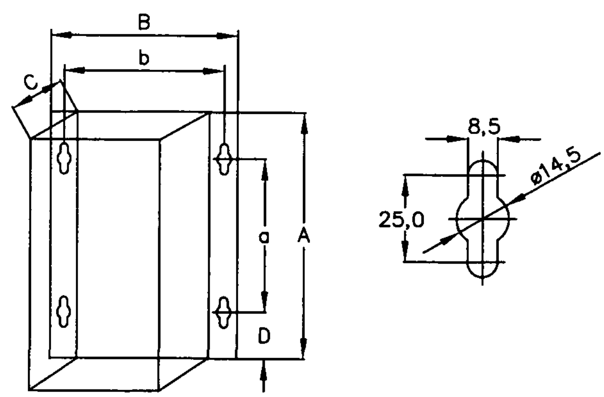
Type D, IP20



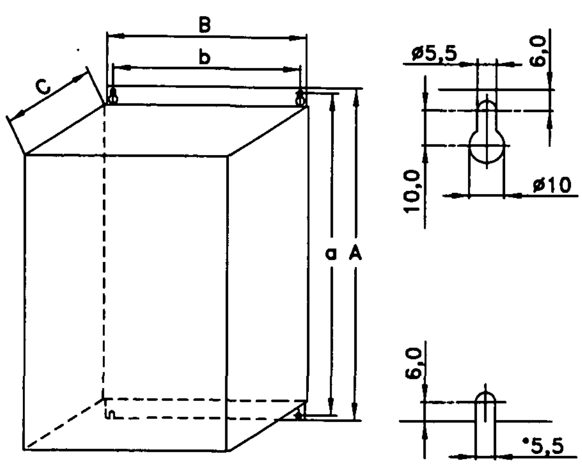
Type E, IP20



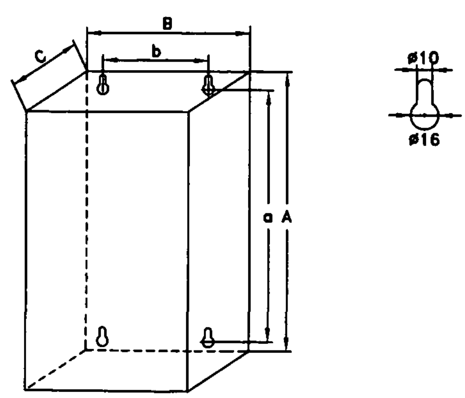
Type B, IP00
With option and enclosure IP20



Type F, IP54

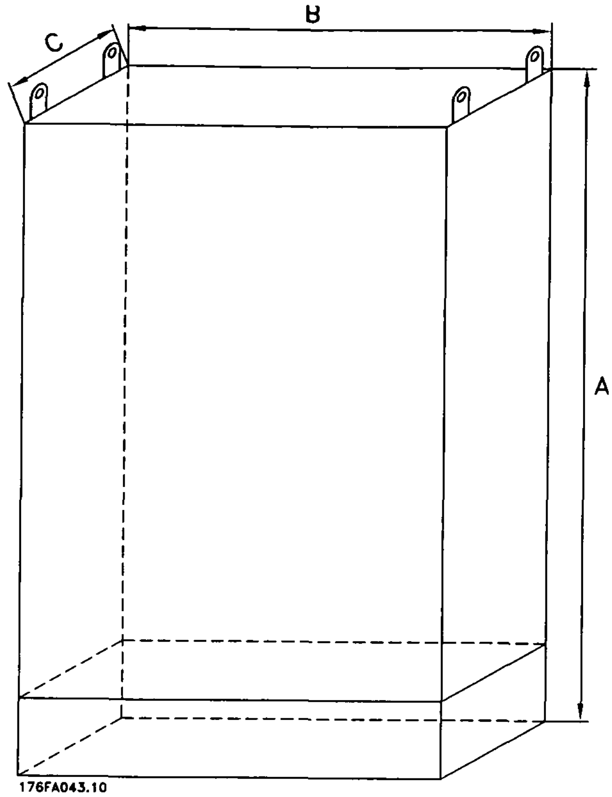


Type C, IP20



Type G, IP54

■ **Mechanical dimensions (cont.)**



Type H, IP 00, IP 20, IP 54

Mechanical installation

Please pay attention to the requirements that apply to integration and field mounting kit, see the below list. The information given in the list must be observed to avoid serious damage or injury, especially when installing large units.

The VLT frequency converter *must* be installed vertically.

The VLT frequency converter is cooled by means of air circulation. For the unit to be able to release its cooling air, the *minimum* distance over and below the unit must be as shown in the illustration below.
To protect the unit from overheating, it must be ensured that the ambient temperature *does not rise above the max. temperature stated for the VLT frequency converter* and that the 24-hour average temperature *is not exceeded.* The max. temperature and 24-hour average can be seen from the *General Technical Data.*
If the ambient temperature is in the range of 45°C - 55°C, derating of the VLT frequency converter will become relevant, see *Derating for ambient temperature.*
The service life of the VLT frequency converter will be reduced if derating for ambient temperature is not taken into account.

Enclosure protection

	IP 00	IP 20	IP 54
Bookstyle	-	OK	-
VLT 6002-6032 200-240 V	-	OK	OK
VLT 6002-6550 380-460 V	OK	OK	OK

Field-mounting

	IP 00	IP 20	IP 54
Bookstyle	-	No	-
VLT 6002-6032 200-240 V	-	No	OK
VLT 6002-6550 380-460 V	No	No	OK

IP 20 with 4x top cover

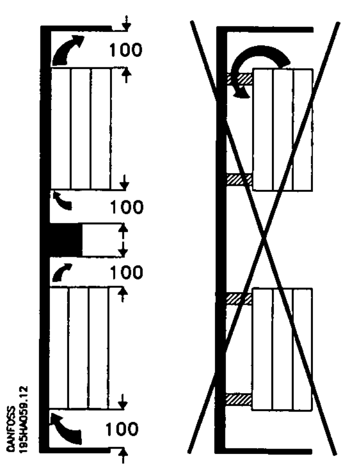
VLT 6002-6005 200-240 V	-	OK	OK
VLT 6002-6016 380-460 V	-	OK	OK

IP 20 terminal cover

VLT 6006-6032 200-240 V	-	OK	OK
VLT 6022-6072 380-460 V	-	OK	OK

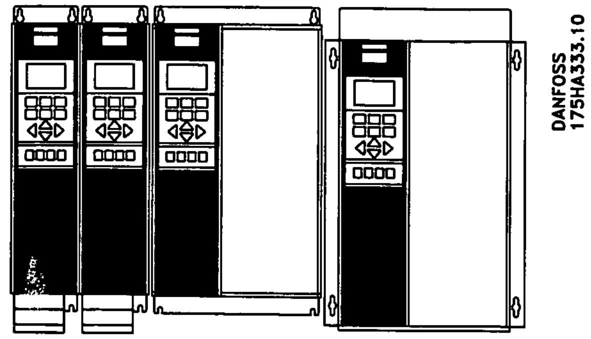
Spacing when installing of VLT 6002-6005 200-240 V, VLT 6002-6011 380-460 V Bookstyle IP 00, IP 20 and IP 54.

Cooling



All the above-mentioned units require a minimum space of 100 mm above and below the enclosure.

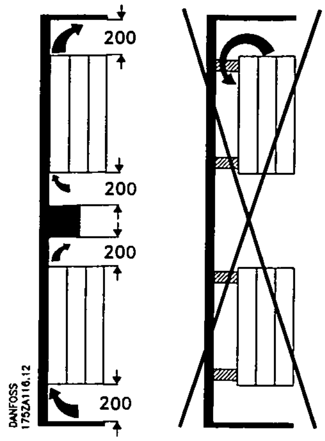
Side-by-side



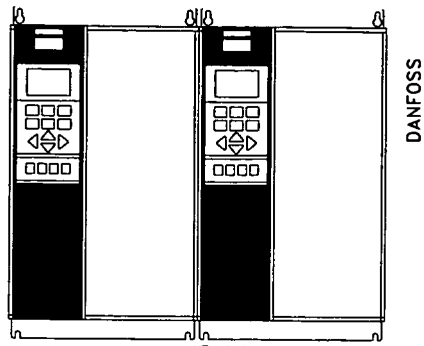
All the above-mentioned units can be installed side by side without any space, since these units do not require any cooling on the sides.

■ Installation of VLT 6006-6032 200-240 V, VLT 6016-6072 380-460 V IP 20 and IP 54

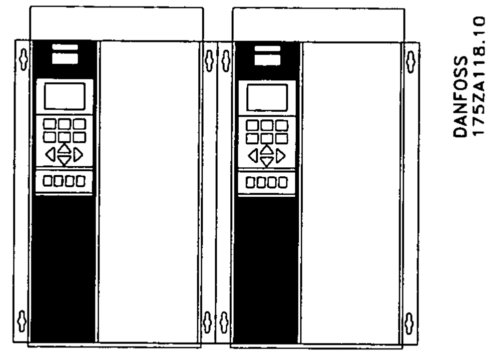
Cooling



Side-by-side



IP 20



IP 54 (flange-by-flange)

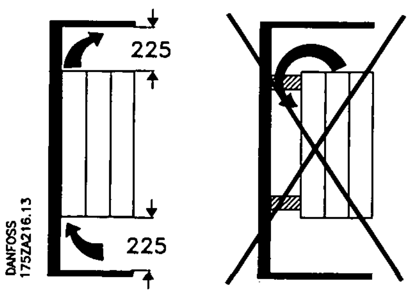
All units in the above-mentioned series require a minimum space of 200 mm above and below the enclosure and must be installed on a plane, vertical surface (no spacers). This applies both to IP 20 and IP 54 units.

These units can be installed side by side without any spacing, since they do not require any cooling on the sides.

Installation

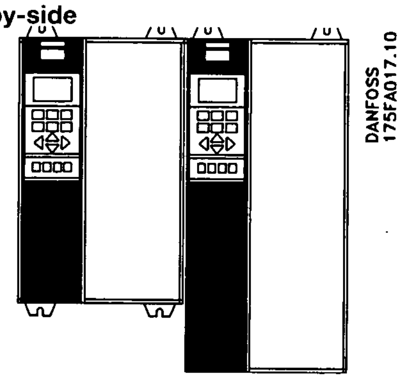
■ Installation of VLT 6042-6062 200-240 V, VLT 6075-6275 380-460 V IP 00, IP 20 and IP 54

Cooling

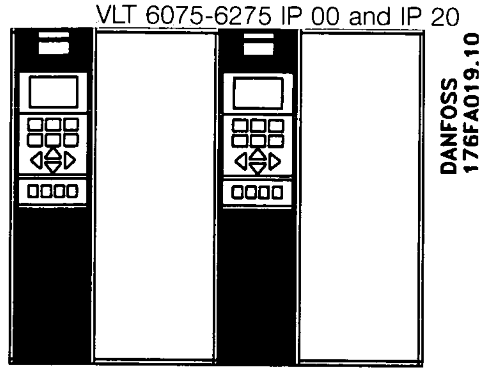


VLT 6075-6275

Side-by-side



VLT 6075-6275 IP 00 and IP 20



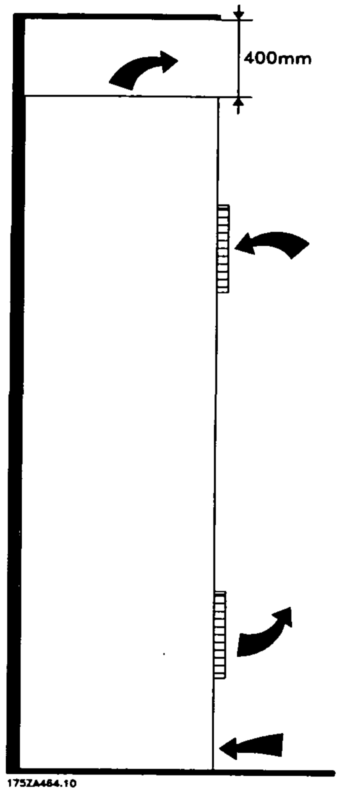
VLT 6075-6275 IP 54

All units require a minimum space of 225 mm above and below the enclosure and must be installed on a plane, vertical surface (no spacers). This applies to IP 00, IP 20 and IP 54 units alike.

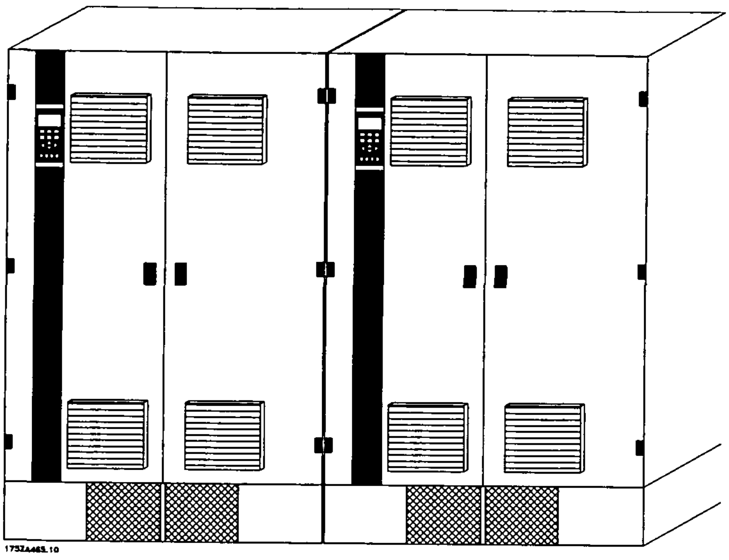
All IP 00 and IP 20 units in the above-mentioned series can be installed side by side without any spacing.

Installation of VLT 6350-6550 380-500 V Compact IP 00, IP 20 and IP 54

Cooling



Side-by-side



All units in the above-mentioned series require a minimum space of 400 mm above the enclosure and must be installed on a plane floor. This applies to both IP 00, IP 20 and IP 54 units.
Gaining access to VLT 6350-6550 requires a minimum space of 605 mm in front of the VLT frequency converter.

Compact IP 00, IP 20 and IP 54
All IP 00, IP 20 and IP 54 units in the above-mentioned series can be installed side by side without any space between them, since these units do not require cooling on the sides.

IP 00 VLT 6350-6550 380-460 V

The IP 00 unit is designed for installation in a cabinet when installed according to the instructions in the VLT 6350-6550 Installation Guide MG.56.AX.YY.
Please note, that the same conditions as for NEMA 1/ IP20 and NEMA 12/ IP54 must be fulfilled.

■ General information about electrical installation

■ High voltage warning

The voltage of the frequency converter is dangerous whenever the equipment is connected to mains. Incorrect installation of the motor or the frequency converter may cause damage to the equipment, serious personal injury or death.
Consequently, the instructions in this Design Guide, as well as national and local safety regulations, must be complied with.
Touching the electrical parts may be fatal - even after disconnection from mains:
Using VLT 6002-6005 wait at least 4 minutes and using VLT 6006-6550 wait at least 15 minutes.

NB!
It is the user's or certified electrician's responsibility to ensure correct earthing and protection in accordance with applicable national and local norms and standards.

■ Earthing

The following basic issues need to be considered when installing a frequency converter, so as to obtain electromagnetic compatibility (EMC).

- **Safety earthing:** Please note that the frequency converter has a high leakage current and must be earthed appropriately for safety reasons. Apply local safety regulations.
- **High-frequency earthing:** Keep the earth wire connections as short as possible.

Connect the different earth systems at the lowest possible conductor impedance. The lowest possible conductor impedance is obtained by keeping the conductor as short as possible and by using the greatest possible surface area. A flat conductor, for example, has a lower HF impedance than a round conductor for the same conductor cross-section C_{VESS}.
If more than one device is installed in cabinets, the cabinet rear plate, which must be made of metal, should be used as a common earth reference plate. The metal cabinets of the different devices are mounted on the cabinet rear plate using the lowest possible HF impedance. This avoids having different HF voltages for the individual devices and avoids the risk of radio interference currents running in connection cables that may be used between the devices. The radio interference will have been reduced.
In order to obtain a low HF impedance, use the fastening bolts of the devices as HF connection to the rear plate. It is necessary to remove insulating paint or similar from the fastening points.

■ Cables

Control cables and the filtered mains cable should be installed separate from the motor cables so as to avoid interference overcoupling. Normally, a distance of 20 cm will be sufficient, but it is recommended to keep the greatest possible distance wherever possible, especially where cables are installed in parallel over a substantial distance.

With respect to sensitive signal cables, such as telephone cables and data cables, the greatest possible distance is recommended with a minimum of 1 m per 5 m of power cable (mains and motor cable). It must be pointed out that the necessary distance depends on the sensitivity of the installation and the signal cables, and that therefore no precise values can be stated.

If cable jaws are used, sensitive signal cables are not to be placed in the same cable jaws as the motor cable or brake cable.
If signal cables are to cross power cables, this should be done at an angle of 90 degrees.
Remember that all interference-filled in- or outgoing cables to/from a cabinet should be screened/armoured or filtered.
See also *EMC-correct electrical installation.*

■ Screened/armoured cables

The screen must be a low HF-impedance screen. This is ensured by using a braided screen of copper, aluminium or iron. Screen armour intended for mechanical protection, for example, is not suitable for an EMC-correct installation.
See also *Use of EMC-correct cables*.

■ Extra protection with regard to indirect contact

ELCB relays, multiple protective earthing or earthing can be used as extra protection, provided that local safety regulations are complied with.
In the case of an earth fault, a DC content may develop in the faulty current.
Never use ELCB relays, type A, since such relays are not suitable for DC fault currents. If ELCB relays are used, this must be done in accordance with local regulations.

If ELCB relays are used, they must be:
- Suitable for protecting equipment with a direct current content (DC) in the faulty current (3-phase bridge rectifier)
- Suitable for power-up with short charging current to earth
- Suitable for a high leakage current.

Installation

■ RFI switch

Mains supply isolated from earth:

When the VLT frequency converter is supplied from an isolated mains source (IT mains), the RFI switch must be closed (OFF). In the OFF position, the internal RFI capacitors (filter capacitors) between the chassis and the intermediate circuit are cut out so as to avoid damaging the intermediate circuit and to reduce the earth leakage currents (see IEC 1800-3). The position of the RFI switch can be seen from in *VLT 6000 enclosures*.

NB!
When the RFI switch is set to OFF parameter 407 Switching frequency max is only allowed to be set to factory setting.

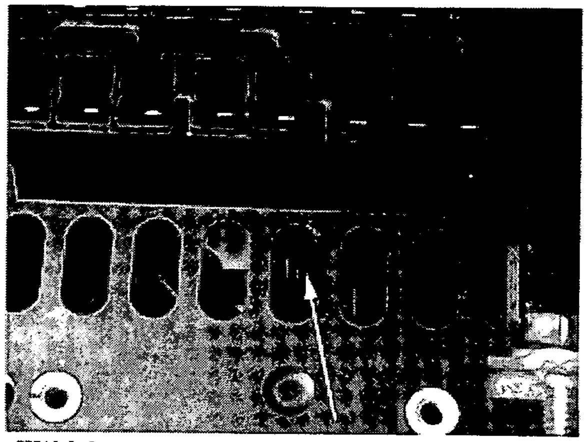
NB!
The RFI switch is not to be operated with mains supply connected to the unit. Check that the mains supply has been disconnected before operating the RFI switch.

NB!
The RFI switch disconnects the capacitors galvanically; however, transients higher than approx. 1,000 V will be bypassed by a spark gap.

Reliable galvanic isolation (PELV) is lost if the RFI switch is placed in the OFF position. This means that all control in- and outputs can only be considered low-voltage terminals with basic galvanic isolation. In addition, the VLT 6000 HVAC EMC performance will be reduced if the RFI switch is placed in the OFF position.

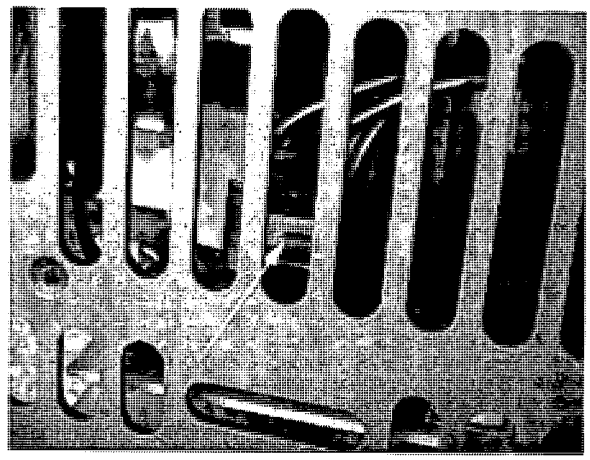
Mains supply connected to earth:

The RFI switch must be ON for all installations on earthed mains supplies.



175ZA649.10

Bookstyle IP 20
VLT 6002 - 6011 380 - 460 V
VLT 6002 - 6005 200 - 240 V



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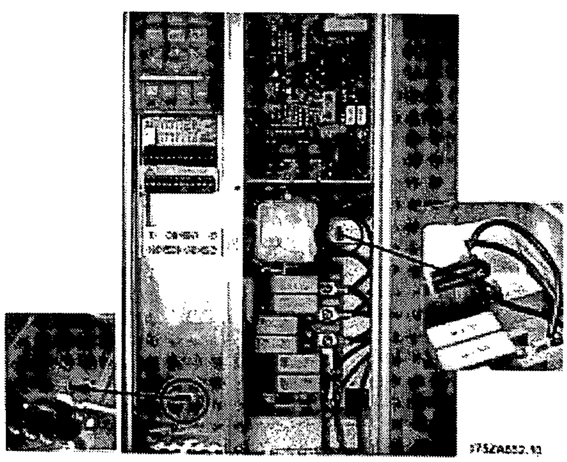
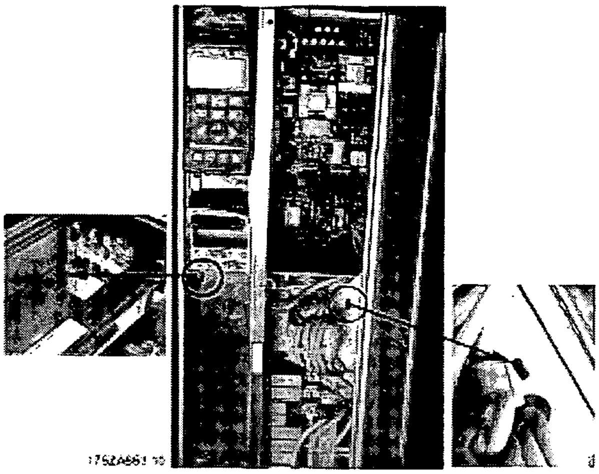
Compact IP 20
VLT 6002 - 6011 380 - 460 V
VLT 6002 - 6005 200 - 240 V

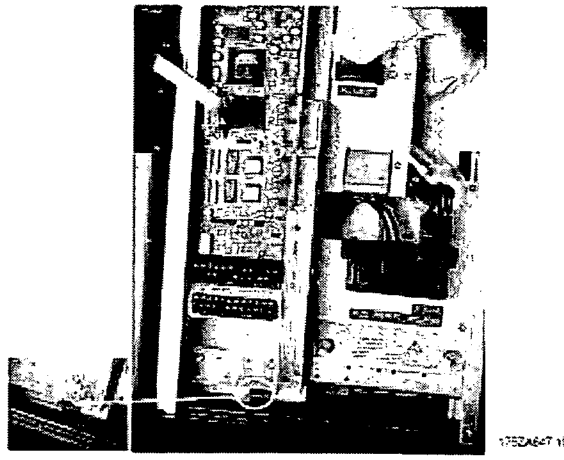


175ZA652.10

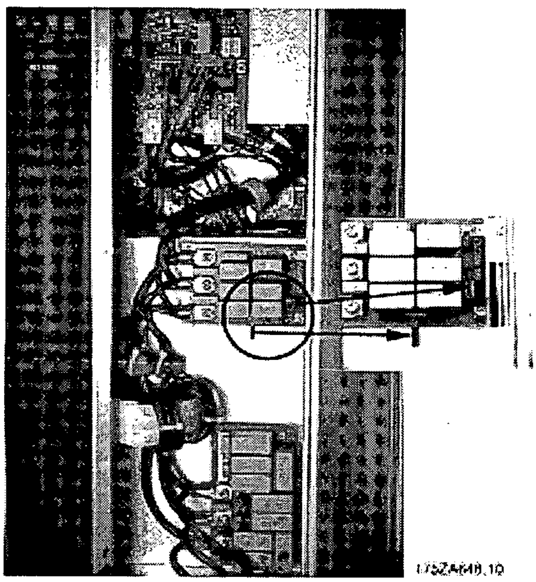
Compact IP 20
VLT 6016 - 6027 380 - 460 V
VLT 6006 - 6011 200 - 240 V



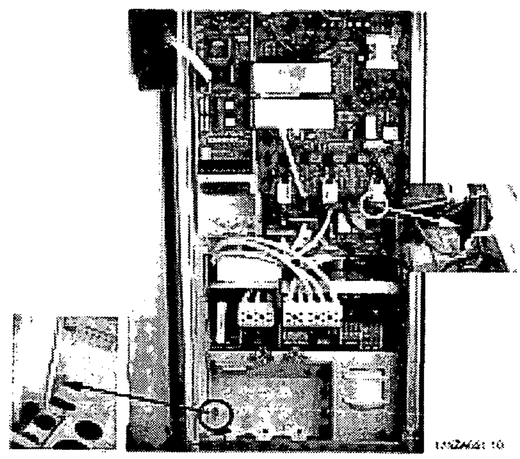
Compact IP 20
VLT 6032 - 6042 380 - 460 V
VLT 6016 - 6022 200 - 240 V



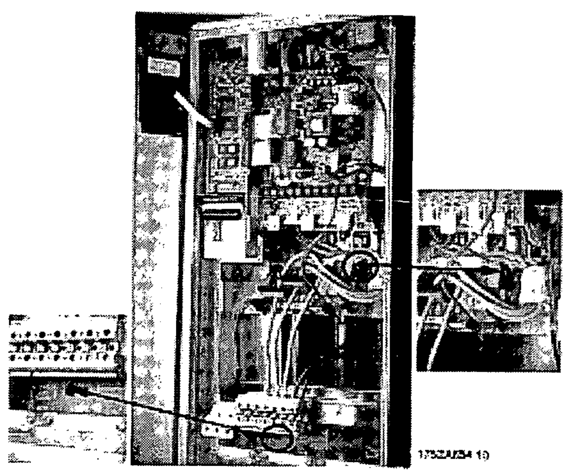
Compact IP 54
VLT 6002 - 6011 380 - 460 V
VLT 6002 - 6005 200 - 240 V



Compact IP 20
VLT 6052 - 6072 380 - 460 V
VLT 6027 - 6032 200 - 240 V



Compact IP 54
VLT 6016 - 6032 380 - 460 V
VLT 6006 - 6011 200 - 240 V



Compact IP 54
VLT 6042 - 6072 380 - 460 V
VLT 6016 - 6032 200 - 240 V

High voltage test

A high voltage test can be carried out by short-circuiting terminals U, V, W, L_1, L_2 and L_3 and energizing by max. 2.5 kV DC for one second between this short-circuit and the chassis.

NB!
The RFI switch must be closed (position ON) when high voltage tests are carried out. The mains and motor connection must be interrupted in the case of high voltage tests of the total installation if the leakage currents are too high.

Heat emission from VLT 6000 HVAC

The tables in *General technical data* show the power loss P_{Φ}(W) from VLT 6000 HVAC. The maximum cooling air temperature $t_{IN,\ MAX}$ is 40° at 100% load (of rated value).

Ventilation of integrated VLT 6000 HVAC

The quantity of air required for cooling frequency converters can be calculated as follows:

1. Add up the values of P_{Φ} for all the frequency converters to be integrated in the same panel. The highest cooling air temperature (t_{IN}) present must be lower than $t_{IN,\ MAX}$ (40°C). The day/night average must be 5°C lower (VDE 160). The outlet temperature of the cooling air must not exceed: $t_{OUT.\ MAX}$ (45° C).
2. Calculate the permissible difference between the temperature of the cooling air (t_{IN}) and its outlet temperature (t_{OUT}): Δt= 45° C-t_{IN}.
3. Calculate the required

$$\text{quantity of air} = \frac{\Sigma P_{\varphi} \times 3.1}{\Delta t} \quad m^3/h$$

Insert Δt in Kelvin

The outlet from the ventilation must be placed above the highest-mounted frequency converter. Allowance must be made for the pressure loss across the filters and for the fact that the pressure is going to drop as the filters are choked.

EMC-correct electrical installation

Following these guidelines is advised, where compliance with EN 50081, EN 55011 or EN 61800-3 *First environment* is required.
If the installation is in EN 61800-3 *Second environment*, then it is acceptable to deviate from these guidelines. It is however not recommended. See also *CE labelling, Emission* and *EMC test results* under special conditions in the Design Guide for further details.

Good engineering practice to ensure EMC-correct electrical installation:

- Use only braided screened/armoured motor cables and control cables.
  The screen should provide a minimum coverage of 80%.The screen material must be metal, not limited to but typically copper, aluminium, steel or lead. There are no special requirements for the mains cable.

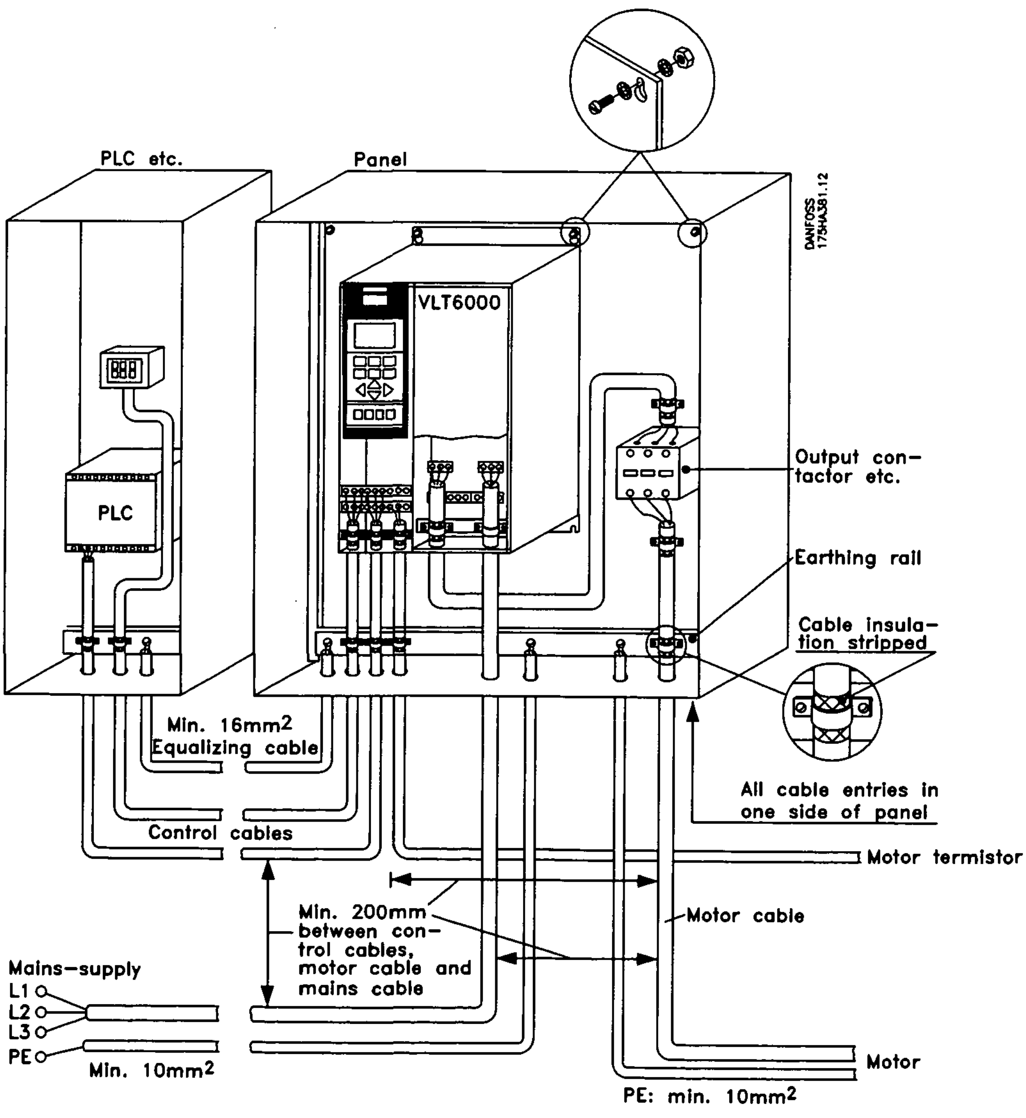
- Installations using rigid metal conduits are not required to use screened cable, but the motor cable must be installed in conduit separate from the control and mains cables. Full connection of the conduit from the drive to the motor is required. The EMC performance of flexible conduits varies a lot and information from the manufacturer must be obtained.

- Connect the screen/armour/conduit to earth at both ends for motor cables and control cables. See also *Earthing of braided screened/ armoured control cables.*

- Avoid terminating the screen/armour with twisted ends (pigtails). Such a termination increases the high frequency impedance of the screen, which reduces its effectiveness at high frequencies. Use low impedance cable clamps or glands instead.

- Ensure good electrical contact between the mounting plate and the metal chassis of the VLT frequency converter. This does not apply to IP54/NEMA 12 units as they are designed for wall mounting and VLT6075-6550, 380-460 VAC and VLT6042-6062, 200-240 VAC in IP20/NEMA1 enclosure.
- Use starwashers and galvanically conductive installation plates to secure good electrical connections for IP00 and IP20 installations.
- Avoid using unscreened/unarmoured motor or control cables inside cabinets housing the drive(s), where possible.
- An uninterrupted high frequency connection between the VLT frequency converter and the motor units is required for IP54/NEMA 12 units.

The illustration below shows an example of an EMC-correct electrical installation of an IP 20 VLT frequency converter. The VLT frequency converter has been fitted in an installation cabinet with an output contactor and connected to a PLC, which in this example is installed in a separate cabinet. Other ways of making the installation may have as good an EMC performance, provided the above guidelines to engineering practice are followed.Please note that when unscreened cables and control wires are used, some emission requirements are not complied with, although the immunity requirements are fulfilled.
See the section EMC test results for further details.



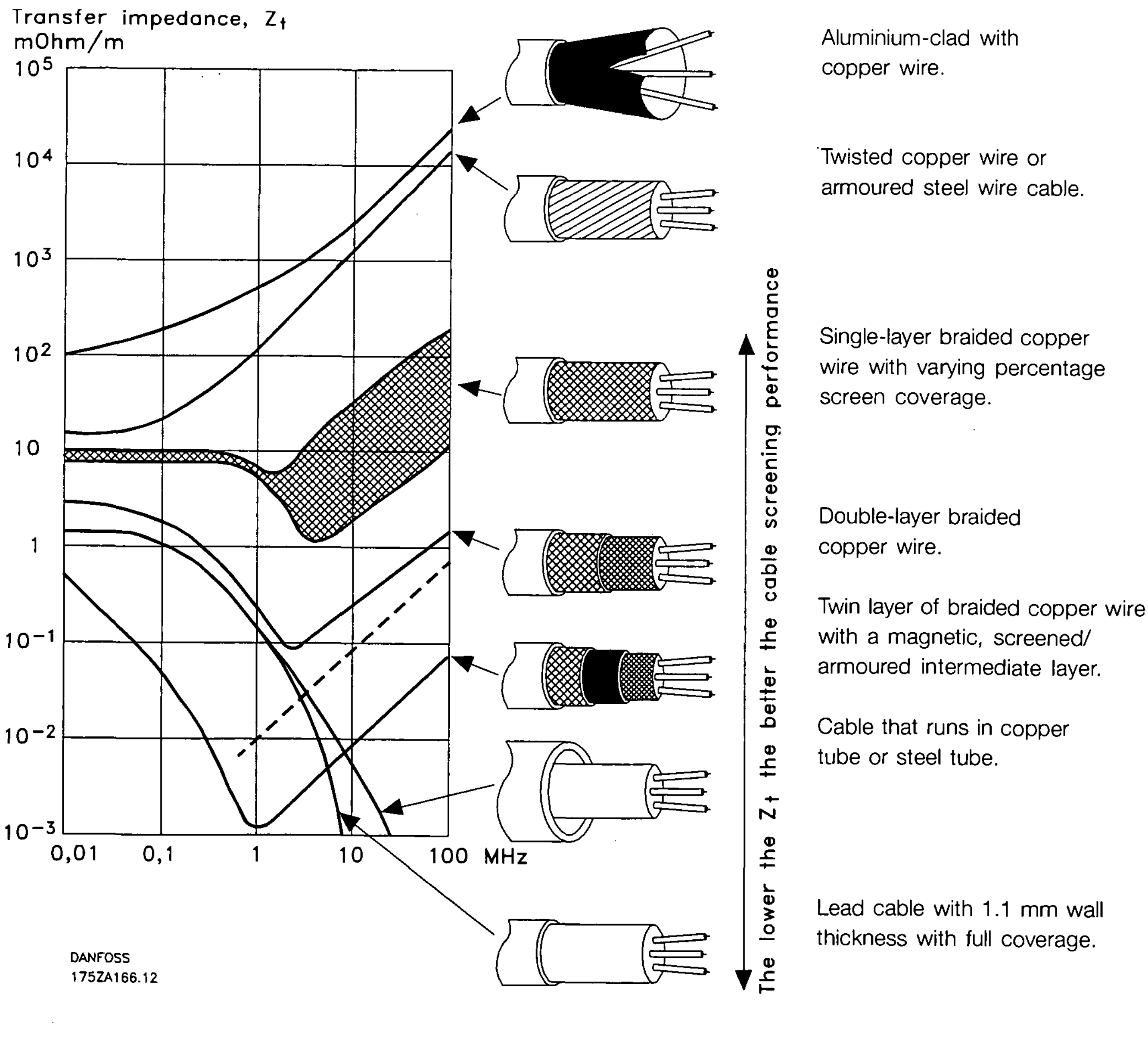
■ Use of EMC-correct cables

Braided screened/armoured cables are recommended to optimise EMC immunity of the control cables and the EMC emission from the motor cables.

The ability of a cable to reduce the in- and outgoing radiation of electric noise depends on the switching impedance (Z_T). The screen of a cable is normally designed to reduce the transfer of electric noise; however, a screen with a lower Z_T value is more effective than a screen with a higher Z_T. Z_T is rarely stated by cable manufacturers, but it is possible to estimate Z_T by looking at the cable and assessing its physical design.

Z_T can be assessed on the basis of the following factors:

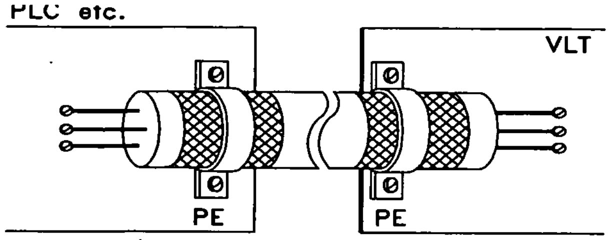
- The contact resistance between the individual screen conductors.
- The screen coverage, i.e. the physical area of the cable covered by the screen - often stated as a percentage value. Should be min. 85%.
- The screen type, i.e. braided or twisted pattern. A braided pattern or a closed tube is recommended.



Earthing of screened/armoured control cables

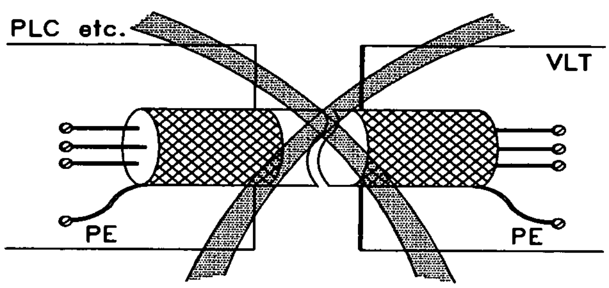
Generally speaking, control cables must be screened/armoured and the screen must be connected by means of a cable clamp at both ends to the metal cabinet of the unit.

The drawing below indicates how correct earthing is carried out and what to be done if in doubt.



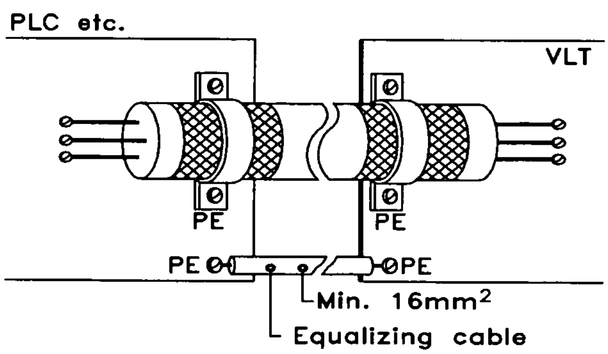
Correct earthing

Control cables and cables for serial communication must be fitted with cable clamps at both ends to ensure the best possible electrical contact.



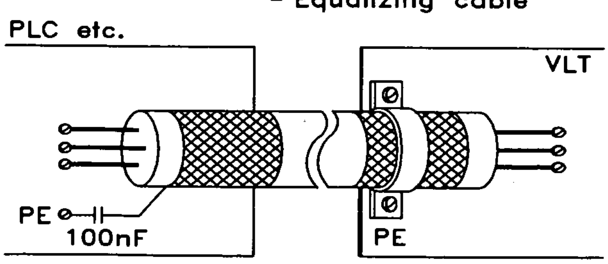
Wrong earthing

Do not use twisted cable ends (pigtails), since these increase the screen impedance at high frequencies.



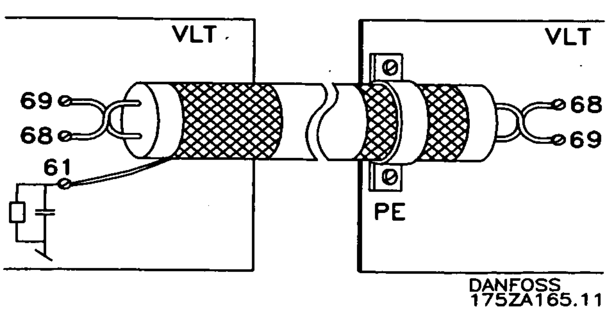
Protection with respect to earth potential between PLC and VLT

If the earth potential between the VLT frequency converter and the PLC (etc.) is different, electric noise may occur that will disturb the whole system. This problem can be solved by fitting an equalizing cable, to be placed next to the control cable. Minimum cable cross-section: 16 mm² .



For 50/60 Hz earth loops

If very long control cables are used, 50/60 Hz earth loops may occur that will disturb the whole system. This problem can be solved by connecting one end of the screen to earth via a 100nF condenser (keeping leads short).

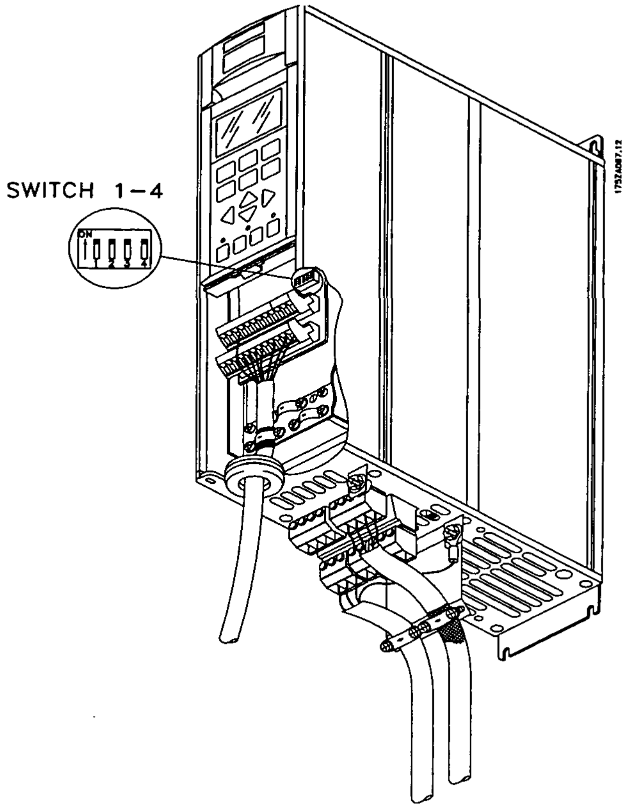


Cables for serial communication

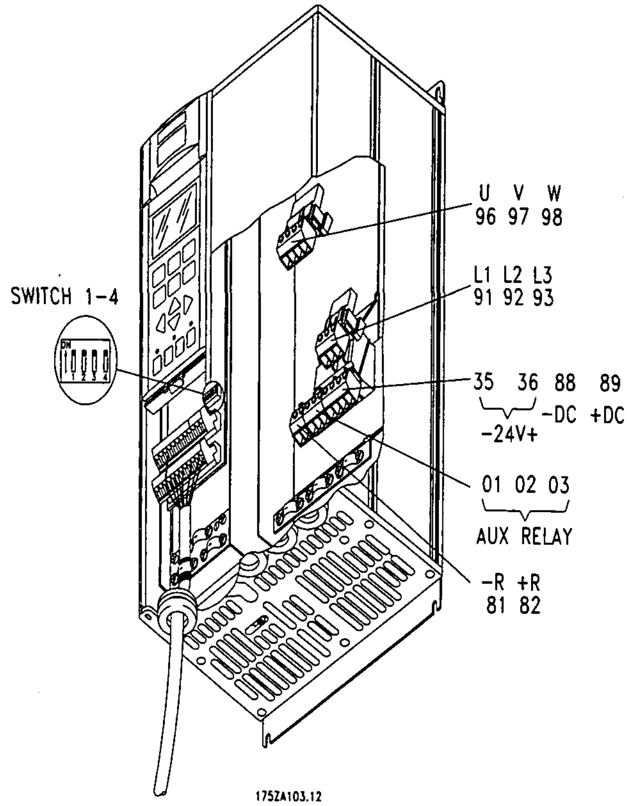
Low-frequency noise currents between two VLT frequency converters can be eliminated by connecting one end of the screen to terminal 61. This terminal is connected to earth via an internal RC link. It is recommended to use twisted-pair cables to reduce the differential mode interference between the conductors.

Installation

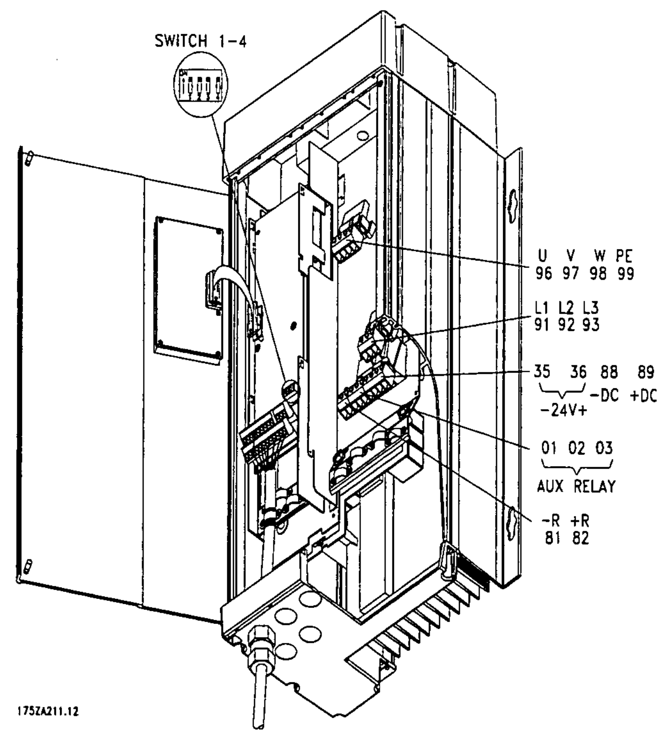
■ **VLT 6000 HVAC enclosures**



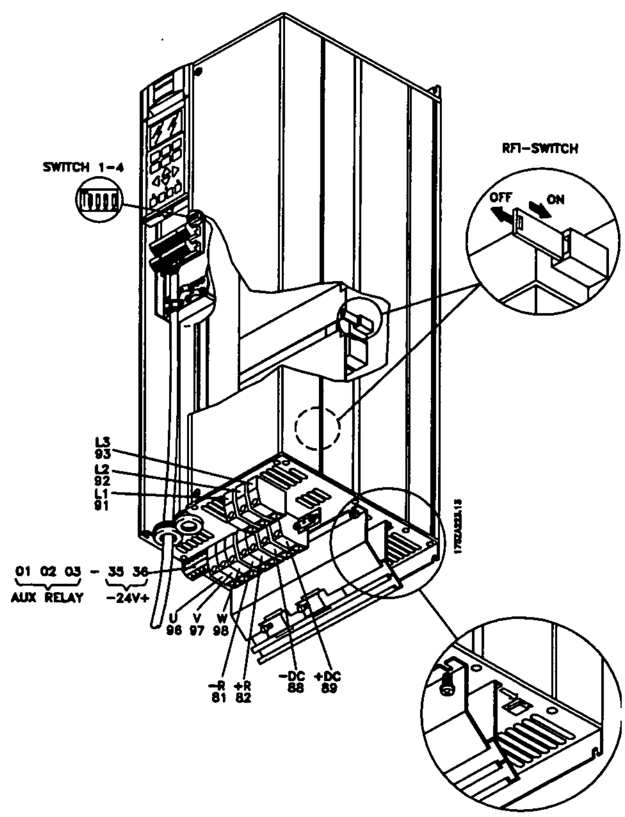
Bookstyle IP 20
VLT 6002-6005, 200-240 V
VLT 6002-6011, 380-460 V



Compact IP 20
VLT 6002-6005, 200-240 V
VLT 6002-6011, 380-460 V

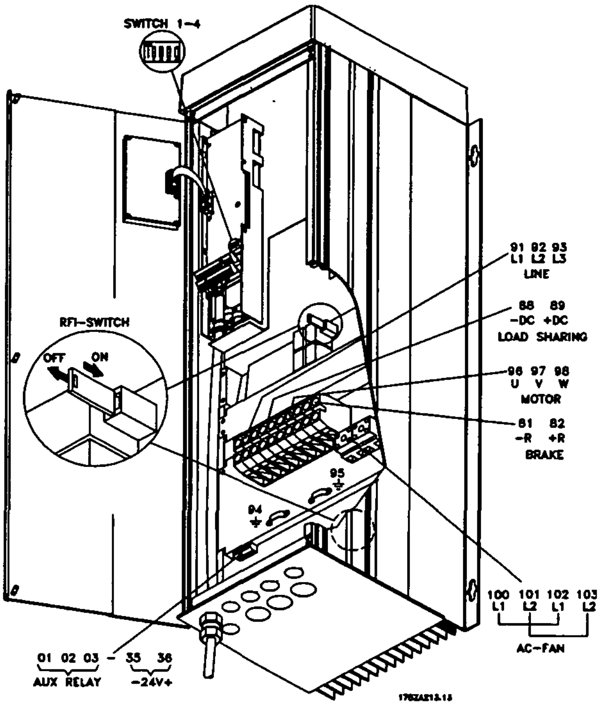


Compact IP 54
VLT 6002-6005, 200-240 V
VLT 6002-6011, 380-460 V

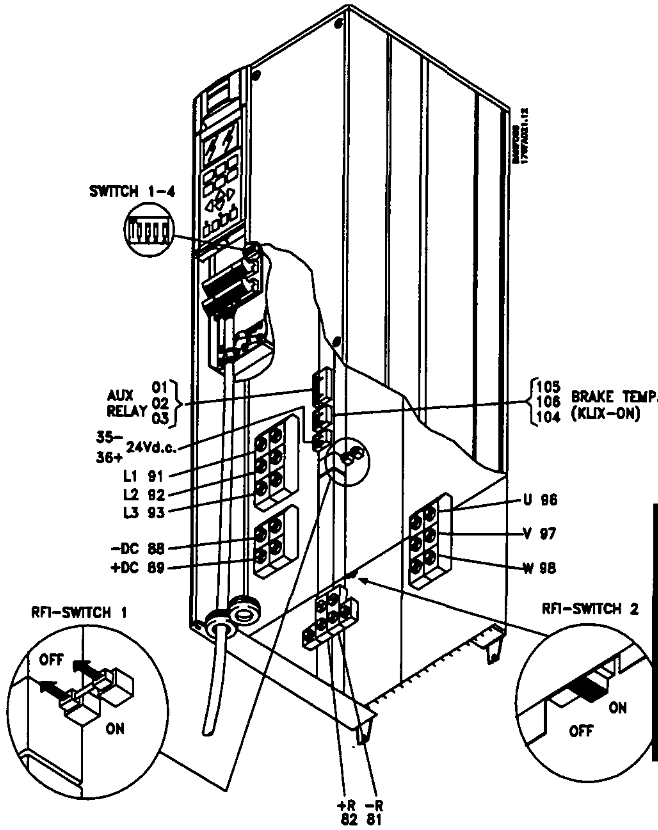


IP 20
VLT 6006-6032, 200-240 V
VLT 6016-6072, 380-460 V

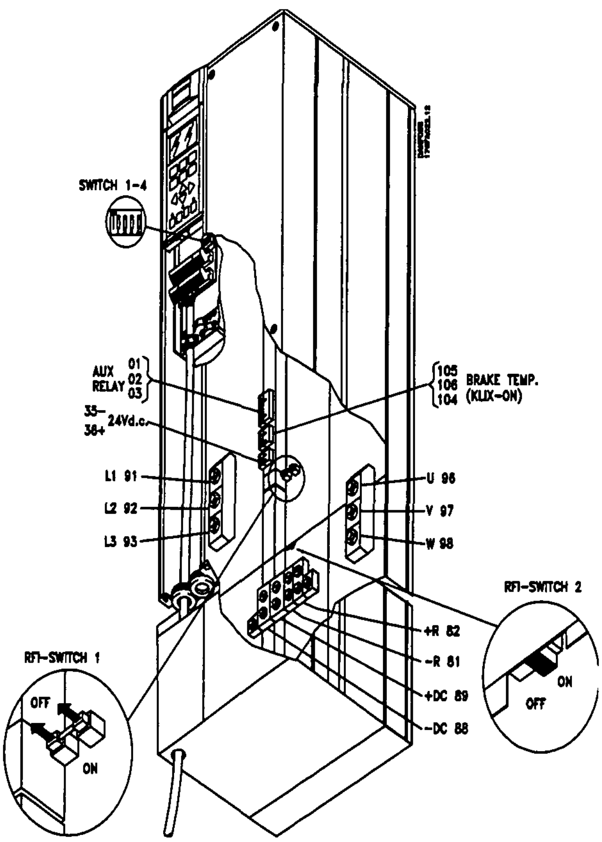
■ VLT 6000 HVAC enclosures



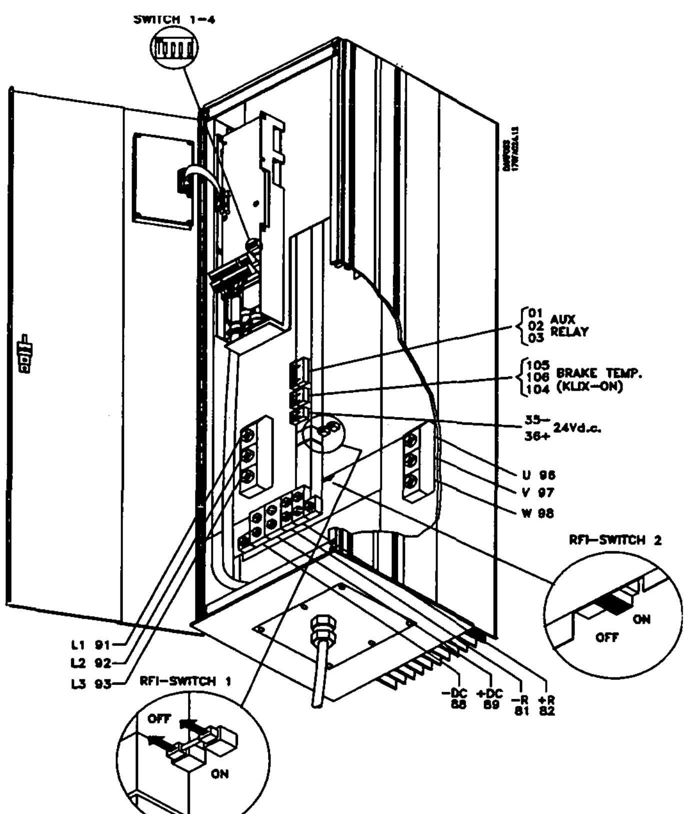
IP 54
VLT 6006-6032, 200-240 V
VLT 6016-6062, 380-460 V



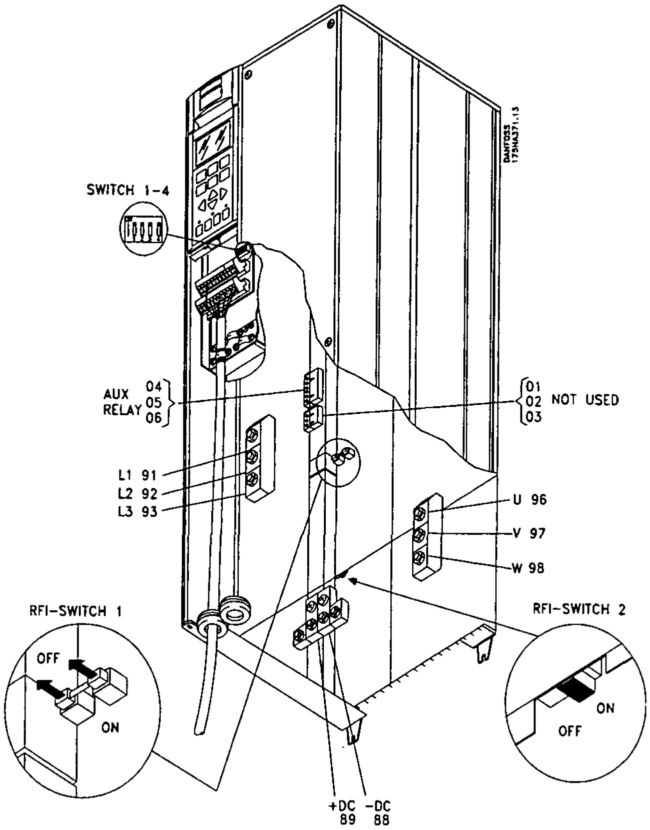
IP 00
VLT 6042-6062, 200-240 V
VLT 6075-6125, 380-460 V



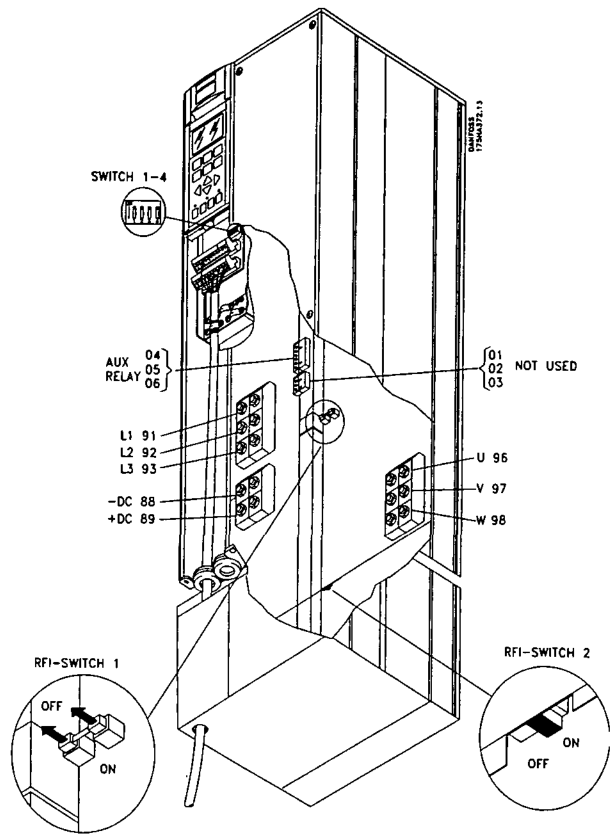
IP 20
VLT 6042-6062, 200-240 V
VLT 6075-6125, 380-460 V



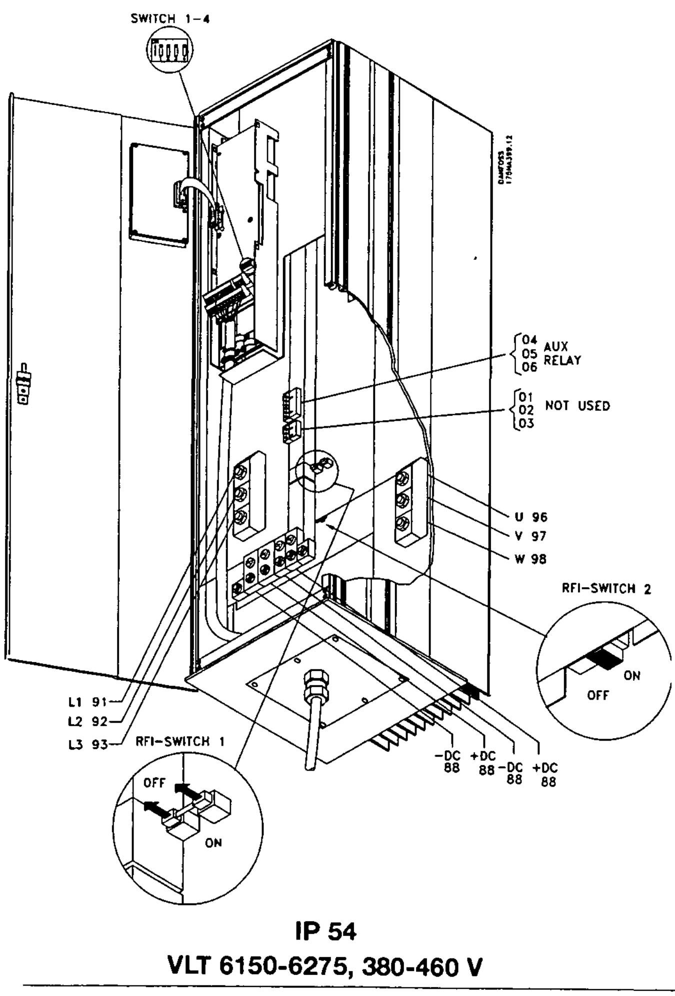
IP 54
VLT 6042-6062, 200-240 V
VLT 6075-6125, 380-460 V



IP 00
VLT 6150-6275, 380-460 V

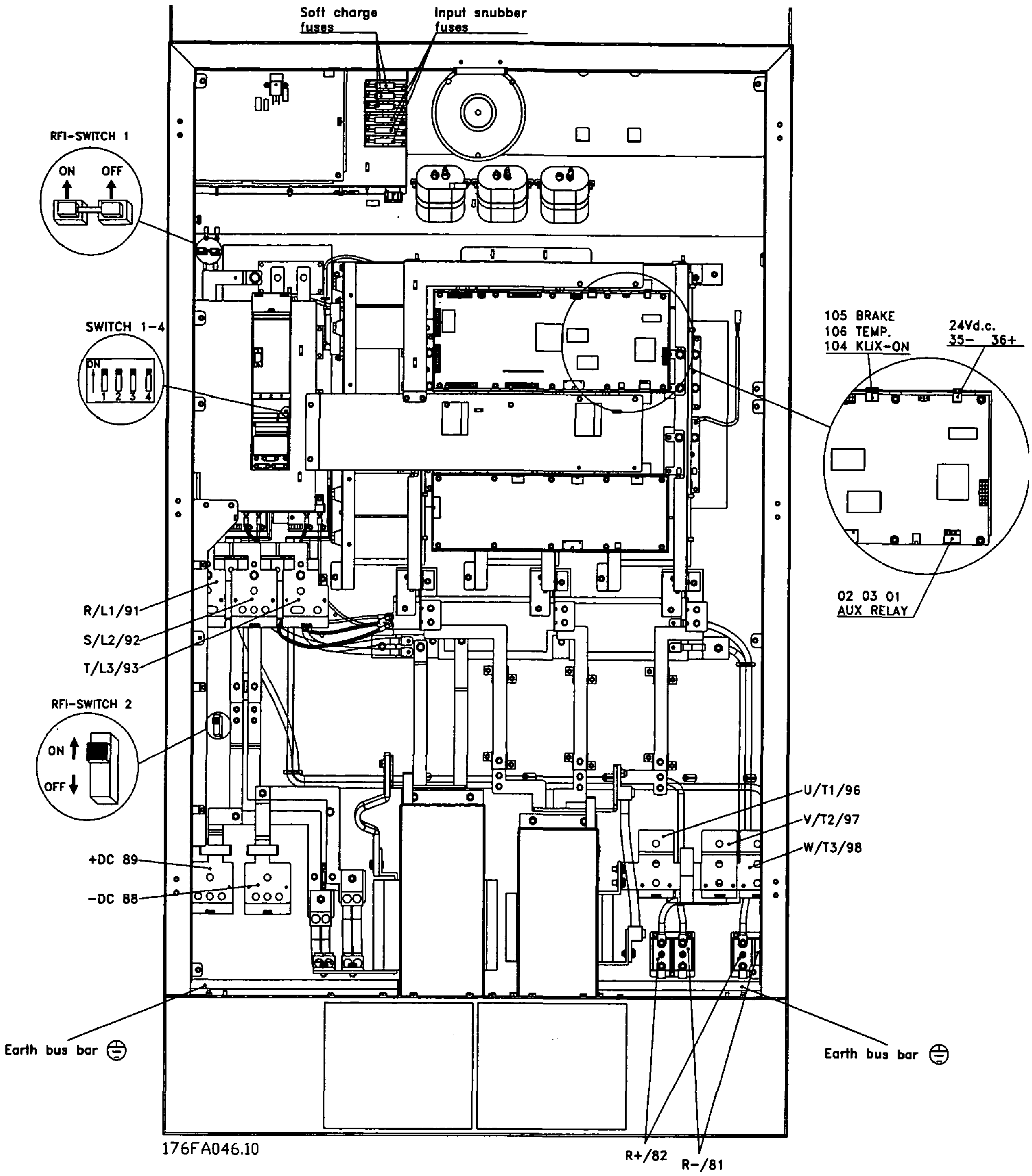


IP 20
VLT 6150-6275, 380-460 V



IP 54
VLT 6150-6275, 380-460 V

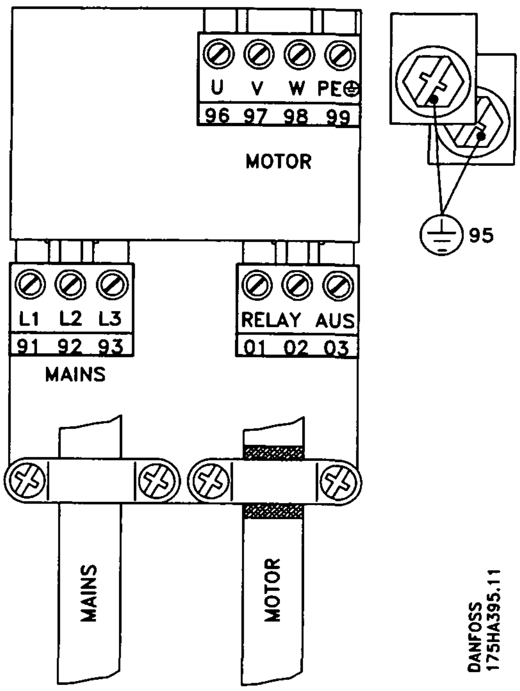
■ Electrical installation, enclosures



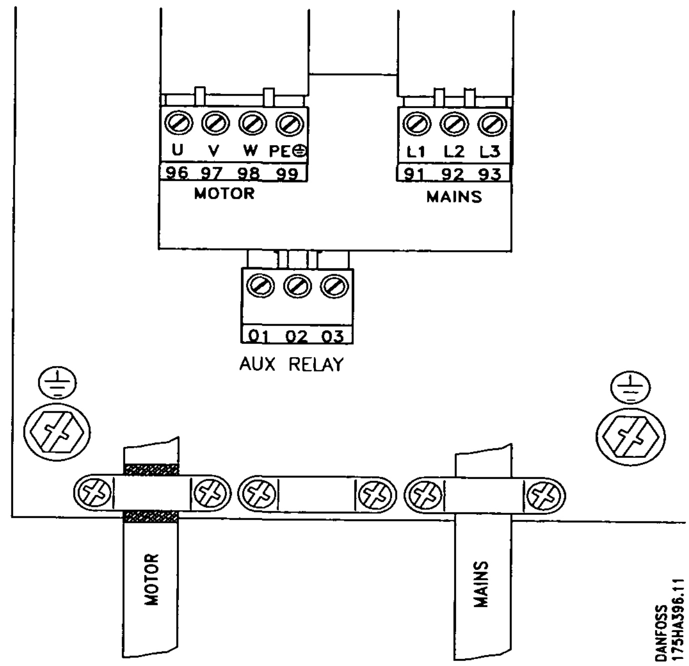
Compact IP 20 / IP 54
VLT 6350-6550, 380-500 V

Installation

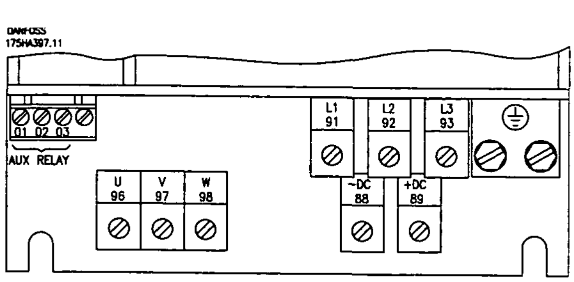
■ Electrical installation, power cables



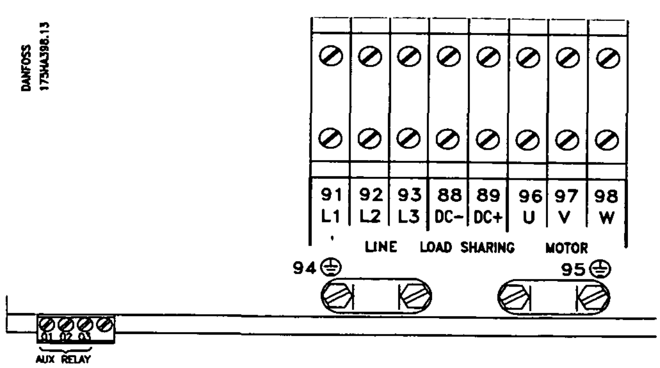
Bookstyle IP 20
VLT 6002-6005, 200-240 V
VLT 6002-6011, 380-460 V



Compact IP 20/IP 54
VLT 6002-6005, 200-240 V
VLT 6002-6011, 380-460 V

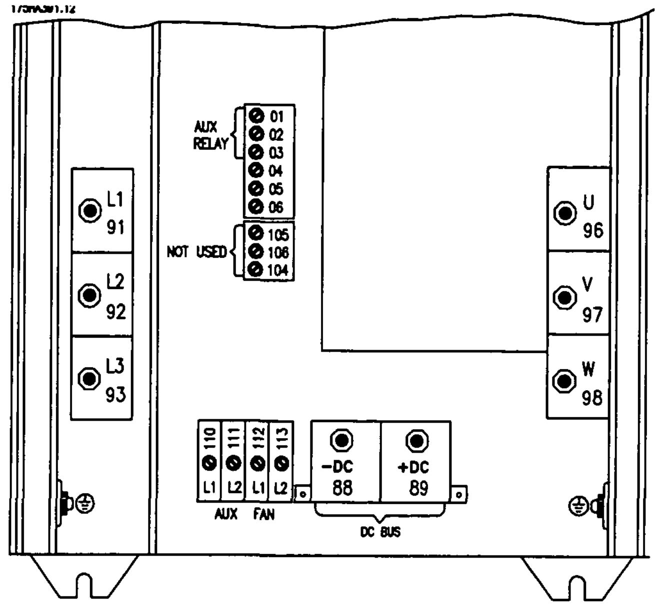


IP 20
VLT 6006-6032, 200-240 V
VLT 6016-6072, 380-460 V

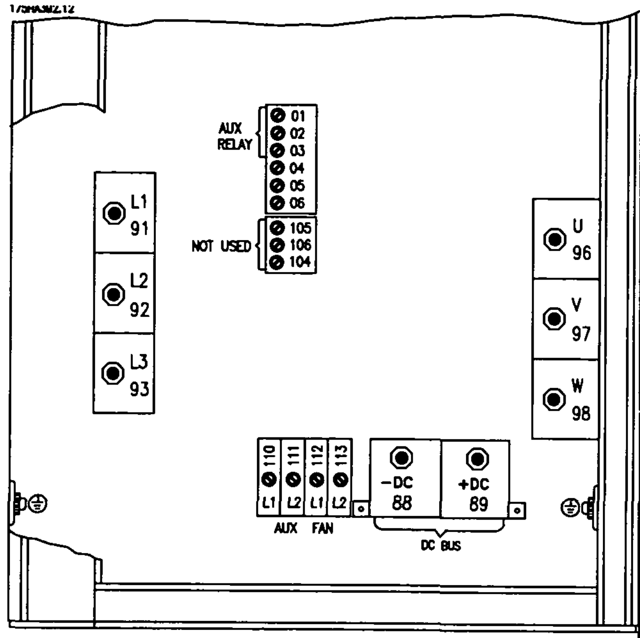


IP 54
VLT 6006-6032, 200-240 V
VLT 6016-6072, 380-460 V

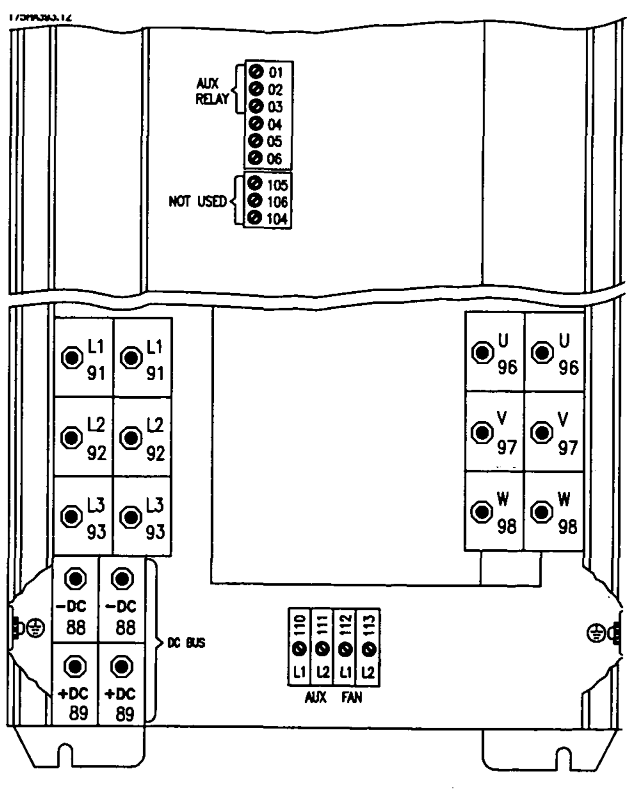
■ Electrical installation, power cables



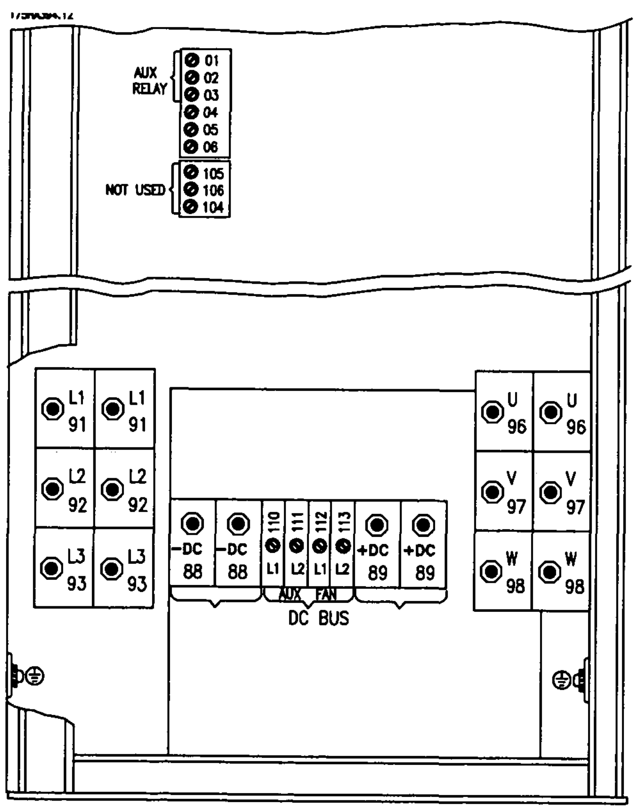
IP 00/20
VLT 6042-6062, 200-240 V
VLT 6075-6125, 380-460 V



IP 54
VLT 6042-6062, 200-240 V
VLT 6075-6125, 380-460 V



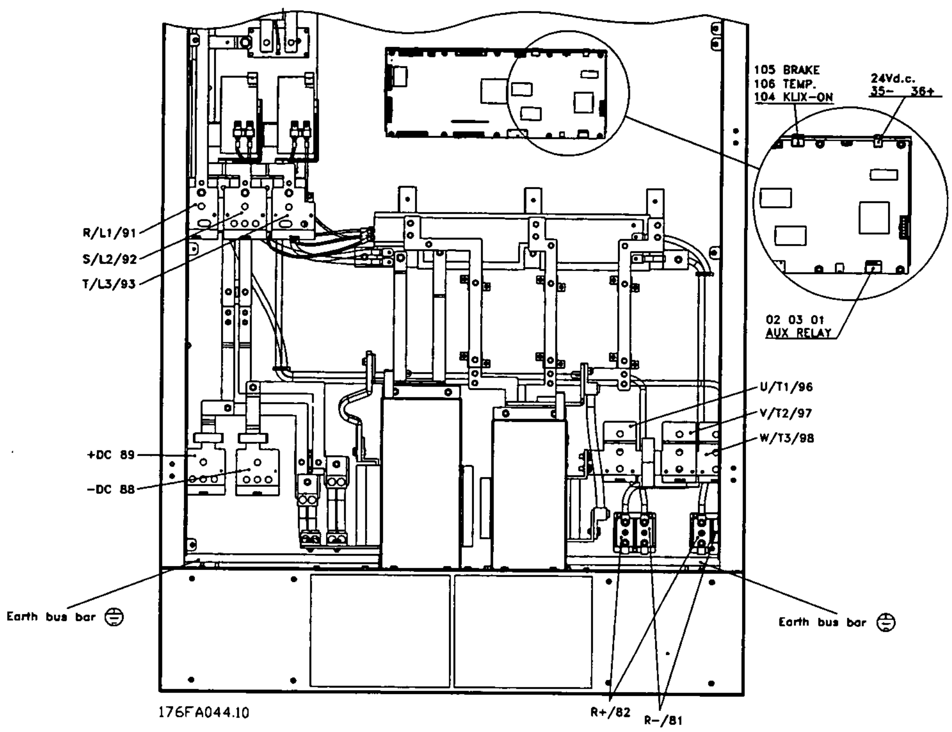
IP 00/20
VLT 6150-6275, 380-460 V



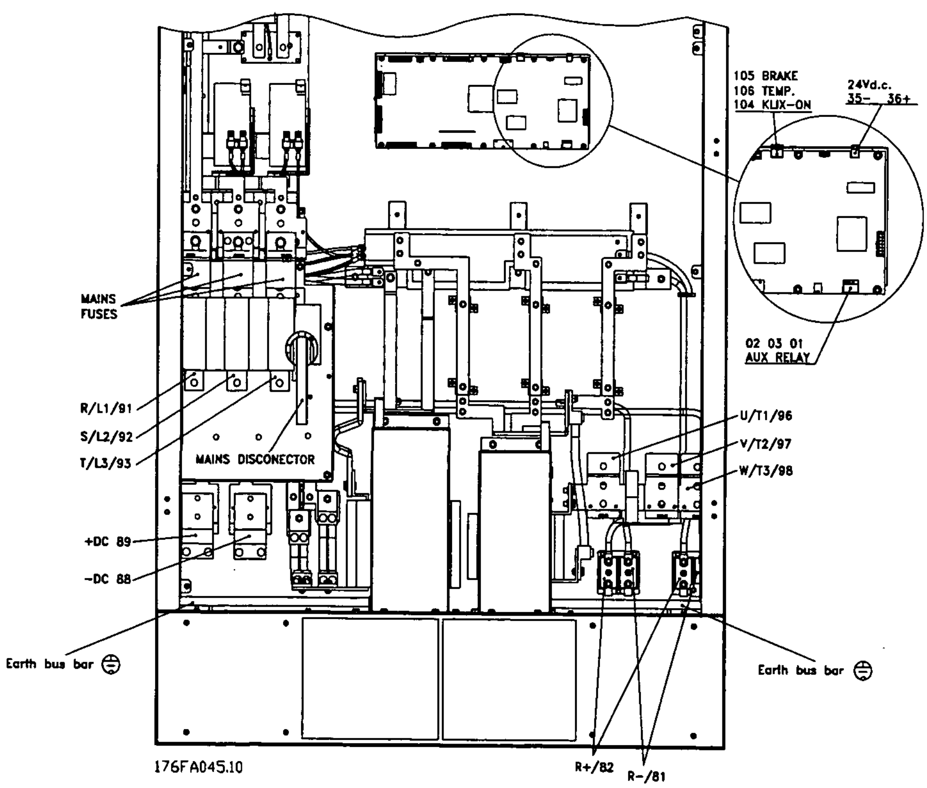
IP 54
VLT 6150-6275, 380-460 V

Installation

■ Electrical installation, power cables



Compact IP 20/IP 54
without disconnectors and mains fuses



Compact IP 20/IP 54
with disconnectors and mains fuses

■ Tightening-up torque and screw sizes

The table shows the torque required when fitting terminals to the VLT frequency converter. For VLT 6002-6032, 200 -240 V, VLT 6002-6072, 380-460 V, the cables must be fastened with screws. For VLT 6042-6062, 200-240 V and for VLT 6075-6550, the cables must be fastened with bolts.
These figures apply to the following terminals:

Mains terminals	**Nos. 91, 92, 93** **L1, L2, L3**
Motor terminals	**Nos. 96, 97, 98** **U, V, W**
Earth terminal	**No. 99**

VLT type 3 x 200-240 V	Tightening-up torque	Screw size
VLT 6002-6005	0.5 - 0.6 Nm	M3
VLT 6006-6011	1.8 Nm	M4
VLT 6016-6027	3.0 Nm	M5
VLT 6032	4.0 Nm	M6

VLT type 3 x 200-240 V	Tightening-up torque	Bolt size
VLT 6042-6062	11.3 Nm	M8

VLT type 3 x 380-460 V	Tightening-up torque	Screw size
VLT 6002-6011	0.5 - 0.6 Nm	M3
VLT 6016-6027	1.8 Nm	M4
VLT 6032-6072	3.0 Nm	M5

VLT type 3 x 380-460 V	Tightening-up torque	Bolt size
VLT 6075-6125	11.3 Nm	M8
VLT 6150-6275	11.3 Nm	M8
VLT 6350-6550	42.0 Nm	M12

■ Mains connection

Mains must be connected to terminals 91, 92, 93.

Nos. 91, 92, 93	Mains voltage 3 x 200-240 V
L1, L2, L3	Mains voltage 3 x 380-460 V

NB!
Check that the mains voltage fits the mains voltage of the VLT frequency converter, which can be seen from the nameplate.

See *Technical data* for correct sizing of cable cross-sections.

■ Pre-fuses

See *Technical data* for correct sizing of pre-fuses.

■ Motor connection

The motor must be connected to terminals 96, 97, 98. Earth to terminal 94/95/99.

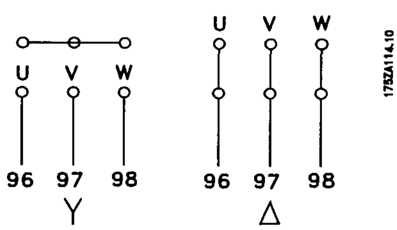
Nos. 96, 97, 98 **U, V, W**	Motor voltage 0-100% of mains voltage.
No.	Earth connection.

See *Technical data* for correct sizing of cable cross-sections.

All types of three-phase asynchronous standard motors can be used with a VLT 6000 HVAC unit.

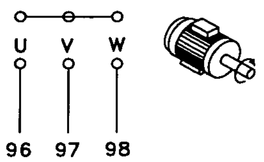
Small-size motors are normally star-connected. (220/380 V, Δ/Y). Large-size motors are delta-connected (380/660 V, Δ/Y).
The correct connection and voltage can be read from the motor nameplate.

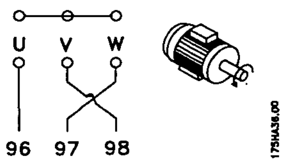
NB!
In older motors without phase coil insulation, a LC filter should be fitted to the VLT frequency converter output. See the Design Guide or contact Danfoss.



Installation

■ Direction of motor rotation



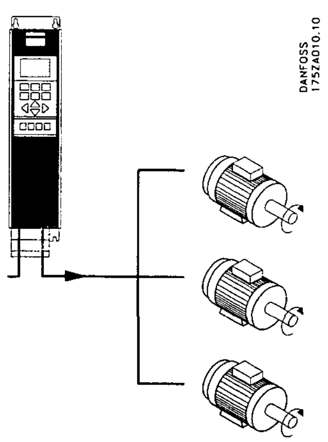


The factory setting is for clockwise rotation with the VLT frequency transformer output connected as follows.

Terminal 96 connected to U-phase
Terminal 97 connected to V-phase
Terminal 98 connected to W-phase

The direction of rotation can be changed by switching two phases in the motor cable.

■ Parallel coupling of motors



VLT 6000 HVAC is able to control several motors connected in parallel. If the motors are to have different rpm values, the motors must have different rated rpm values. Motor rpm is changed simultaneously, which means that the ratio between the rated rpm values is maintained across the range.

The total current consumption of the motors is not to exceed the maximum rated output current $I_{VLT,N}$ for the VLT frequency converter.

Problems may arise at the start and at low rpm values if the motor sizes are widely different. This is because the relatively high ohmic resistance in small motors calls for a higher voltage at the start and at low rpm values.

In systems with motors connected in parallel, the electronic thermal relay (ETR) of the VLT frequency converter cannot be used as motor protection for the individual motor. Consequently, additional motor protection is required, such as thermistors in each motor (or individual thermal relays).

NB!
Parameter 107 *Automatic Motor Adaptation, AMA* and *Automatic Energy Optimization, AEO* in parameter 101 *Torque characteristics* cannot be used if motors are connected in parallel.

■ Motor cables

See *Technical data* for correct sizing of motor cable cross-section and length.
Always comply with national and local regulations on cable cross-sections.

NB!
If an unscreened cable is used, some EMC requirements are not complied with, see *EMC test results*.

If the EMC specifications regarding emission are to be complied with, the motor cable must be screened, unless otherwise stated for the RFI filter in question. It is important to keep the motor cable as short as possible so as to reduce the noise level and leakage currents to a minimum.
The motor cable screen must be connected to the metal cabinet of the frequency converter and to the metal cabinet of the motor. The screen connections are to be made with the biggest possible surface (cable clamp). This is enabled by different installation devices in the different VLT frequency converters. Mounting with twisted screen ends (pigtails) is to be avoided, since these spoil the screening effect at higher frequencies.
If it is necessary to break the screen to install a motor isolator or motor contactor, the screen must be continued at the lowest possible HF impedance.

Motor thermal protection

The electronic thermal relay in UL-approved VLT frequency converters has received UL-approval for single motor protection, as long as parameter 117 *Motor thermal protection* has been set to ETR Trip and parameter 105 *Motor current,* $I_{VLT,N}$ has been programmed for the rated motor current (can be read from the motor nameplate).

Earth connection

Since the leakage currents to earth may be higher than 3.5 mA, the VLT frequency converter must always be earthed in accordance with applicable national and local regulations. In order to ensure good mechanical connection of the earth cable, its cable cross-section must be at least 10 mm². For added security, an RCD (Residual Current Device) may be installed. This ensures that the VLT frequency converter will cut out if the leakage currents get too high. See RCD instructions MI.66.AX.02.

Installation of 24 Volt external DC supply:

Torque: 0.5 - 0.6 Nm
Screw size: M3

No.	Function
35 (-), 36 (+)	24 V external DC supply

(Available with VLT 6350-6550 only)

24 V external DC supply can be used as low-voltage supply to the control card and any option cards installed. This enables full operation of the LCP (incl. parameter setting) without connection to mains. Please note that a warning of low voltage will be given when 24 V DC has been connected; however, there will be no tripping. If 24 V external DC supply is connected or switched on at the same time as the mains supply, a time of min. 200 msec. must be set in parameter 111, *Start delay*.
A pre-fuse of min. 6 Amp, slow-blow, can be fitted to protect the external 24 V DC supply. The power consumption is 15-50 W, depending on the load on the control card.

NB!
Use 24 V DC supply of type PELV to ensure correct galvanic isolation (type PELV) on the control terminals of the VLT frequency converter.

DC bus connection

The DC bus terminal is used for DC back-up, with the intermediate circuit being supplied from an external DC source. In addition, a 12-pulse option can be connected to reduce the total harmonic distortion.

Terminal nos. **Nos. 88, 89**

Contact Danfoss if you require further information.

High-voltage relay

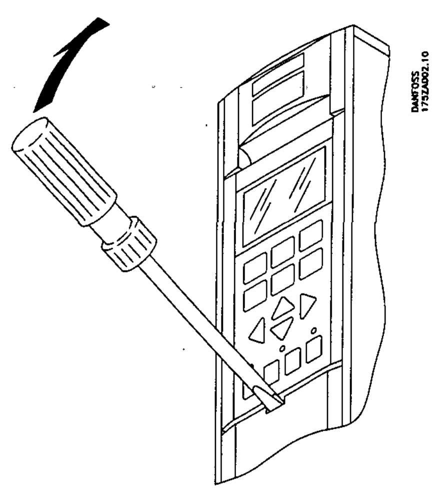
The cable for the high-voltage relay must be connected to terminals 01, 02, 03. The high-voltage relay is programmed in parameter 323, *Relay 1, output*.

No. 1 Relay output 1
1+3 break, 1+2 make.
Max. 240 V AC, 2 Amp.
Min. 24 V DC, 10 mA or
24 V AC, 100 mA.

Max. cross-section:	4 mm²/10 AWG.
Torque:	0.5 - 0.6 Nm.
Screw size:	M3.

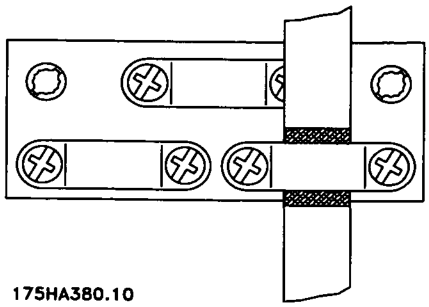
Control card

All terminals for the control cables are located under the protective cover of the VLT frequency converter. The protective cover (see drawing below) can be removed by means of a pointed object - a screwdriver or similar.



Installation

■ Electrical installation, control cables



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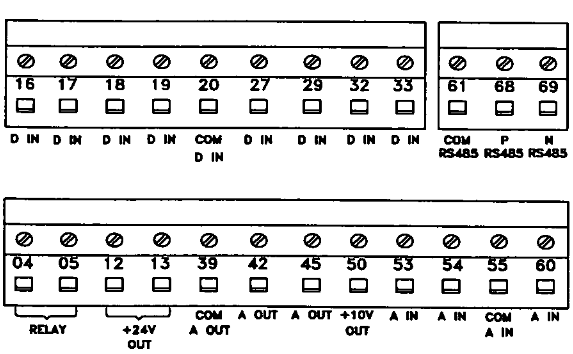
Torque: 0.5 - 0.6 Nm.
Screw size: M3.

Generally speaking, control cables must be screened/ armoured and the screen must be connected by means of a cable clamp at both ends to the metal cabinet of the unit (see *Earthing of screened/ armoured control cables*). Normally, the screen must also be connected to the body of the controlling unit (follow the instructions for installation given for the unit in question).
If very long control cables are used, 50/60 Hz earth loops may occur that will disturb the whole system. This problem can be solved by connecting one end of the screen to earth via a 100nF condenser (keeping leads short).

■ Electrical installation, control cables

Max. control cable cross section: 1.5 mm²/16 AWG
Torque: 0.5-0.6 Nm
Screw size: M3
See *Earthing of screened/armoured control cables* for correct termination of control cables.



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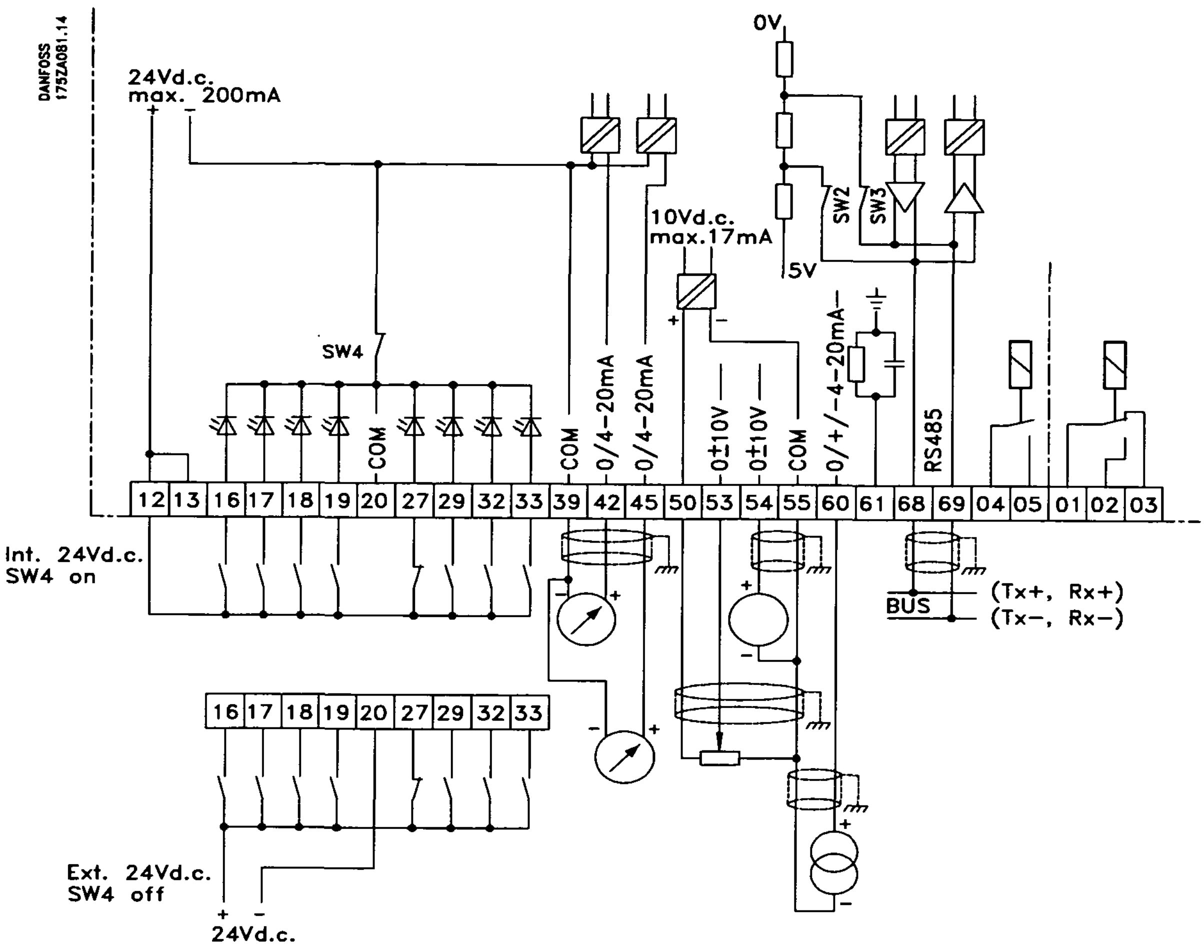
No.	Function
04, 05	Relay output 1 can be used for indicating status and warnings.
12, 13	Voltage supply to digital inputs. For the 24 V DC to be used for digital inputs, switch 4 on the control card must be closed, position "on".
16-33	Digital inputs. See parameters 300-307 *Digital inputs*.
20	Ground for digital inputs.
39	Ground for analogue/digital outputs. Must be connected to terminal 55 by means of a three-wire transmitter. See *Examples of connection*.
42, 45	Analogue/digital outputs for indicating frequency, reference, current and torque. See parameters 319-322 *Analogue/digital outputs*.
50	Supply voltage to potentiometer and thermistor 10 V DC.
53, 54	Analogue voltage input, 0 - 10 V DC.
55	Ground for analogue voltage inputs.
60	Analogue current input 0/4-20 mA. See parameters 314-316 *Terminal 60*.
61	Termination of serial communication. See *Earthing of screened/armoured control cables*. This terminal is not normally to be used.
68, 69	RS 485 interface, serial communication. Where the VLT frequency converter is connected to a bus, switches 2 and 3 (switches 1- 4 - see next page) must be closed on the first and the last VLT frequency converter. On the remaining VLT frequency converters, switches 2 and 3 must be open. The factory setting is closed (position on).

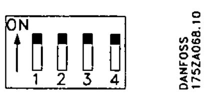


■ **Switches 1-4**

The dipswitch is located on the control card.

It is used for serial communication and external DC supply.

The switching position shown is the factory setting.



Switch 1 has no function.

Switches 2 and 3 are used for terminating an RS-485 interface to the serial communication bus

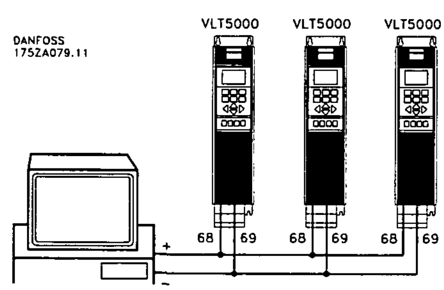
NB!
When the VLT is the first or last device on the serial communication bus, switches 2 and 3 must be ON in that designated VLT. Any other VLTs on the serial communication bus must have switches 2 and 3 set to OFF.

NB!
Please note that when Switch 4 is in position "OFF," the external 24 V DC supply is galvanically isolated from the VLT frequency converter.

■ Bus connection

The serial bus connection in accordance with the RS 485 (2-conductor) norm is connected to terminals 68/69 of the frequency converter (signals P and N). Signal P is the positive potential (TX+,RX+), while signal N is the negative potential (TX-,RX-).

If more than one frequency converter is to be connected to a given master, use parallel connections.



In order to avoid potential equalizing currents in the screen, the cable screen can be earthed via terminal 61, which is connected to the frame via an RC-link.

■ Connection example, VLT 6000 HVAC

The diagram below gives an example of a typical VLT 6000 HVAC installation.

The mains supply is connected to terminals 91 (L1), 92 (L2) and 93 (L3), while the motor is connected to 96 (U), 97 (V) and 98 (W). These numbers can also be seen from the terminals of the VLT frequency converter.

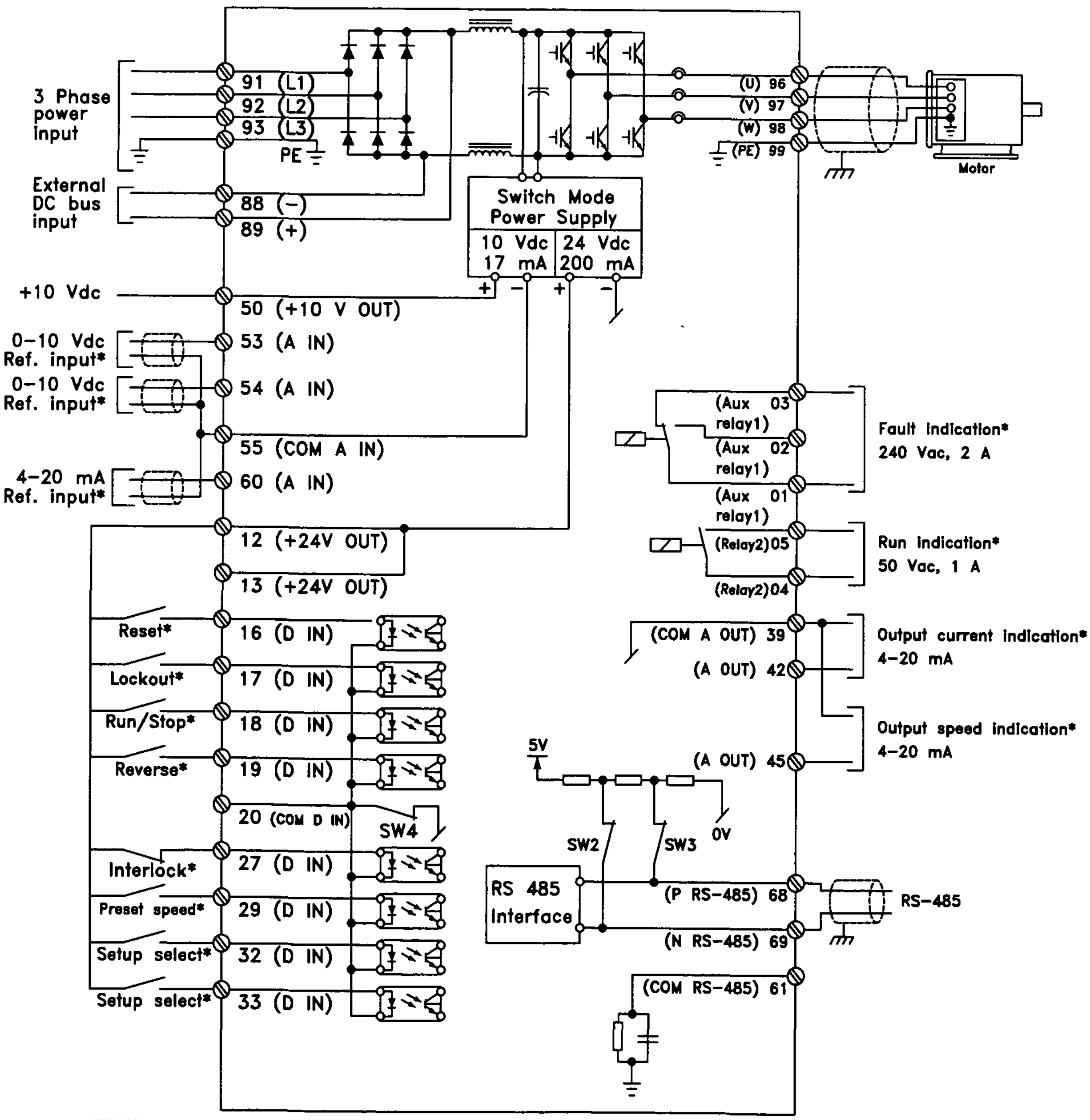
An external DC supply or a 12-pulse option can be connected to terminals 88 and 89. Please ask Danfoss for a Design Guide to learn more.

Analogue inputs can be connected to terminals 53 [V], 54 [V] and 60 [mA]. These inputs can be programmed for either reference, feedback or thermistor. See *Analogue inputs* in parameter group 300.

There are 8 digital inputs, which can be connected to terminals 16-19, 27, 29, 32, 33. These inputs can be programmed in accordance with the table in *Inputs and outputs 300-328*.

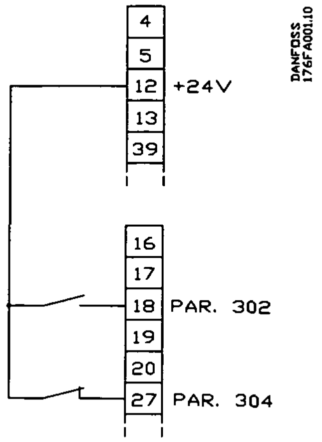
There are two analogue/digital outputs (terminals 42 and 45), which can be programmed to show the present status or a process value, such as 0-f_{MAX}. Relay outputs 1 and 2 can be used for giving the present status or a warning.

On terminals 68 (P+) and 69 (N-) RS 485 interface, the VLT frequency converter can be controlled and monitored via serial communication.



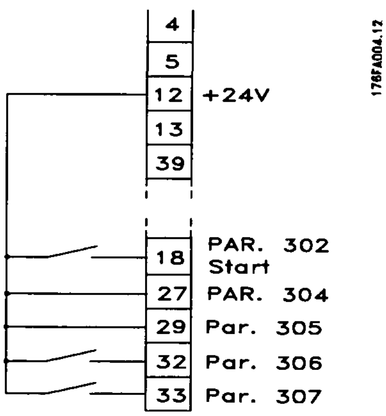
* These terminals can be programmed for other functions.

■ Connection examples
Single-pole start/stop



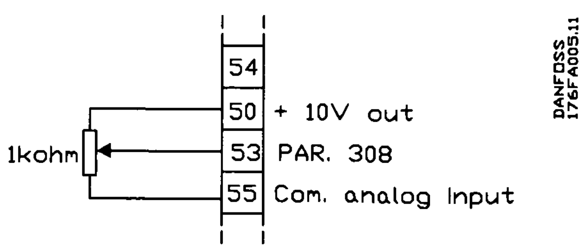
- Start/stop using terminal 18.
  Parameter 302 = *Start* [1]
- Quick-stop using terminal 27.
  Parameter 304 = *Coasting stop, inverse* [0]

Digital speed up/down



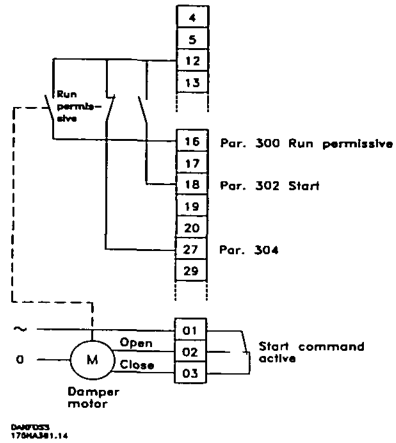
- Speed up and down using terminals 32 and 33.
  Parameter 306 = *Speed up* [7]
  Parameter 307 = *Speed down* [7]
  Parameter 305 = *Freeze reference* [2]

Potentiometer reference



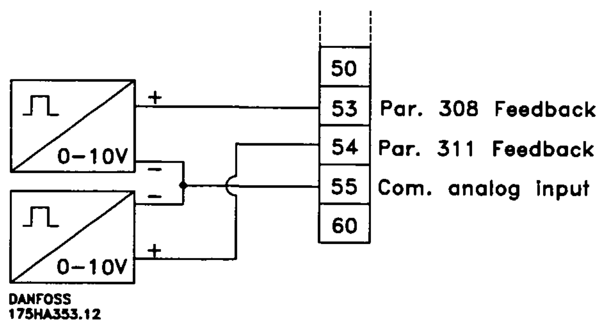
- Parameter 308 = *Reference* [1]
  Parameter 309 = *Terminal 53, min. scaling*
  Parameter 310 = *Terminal 53, max. scaling*

Run permissive



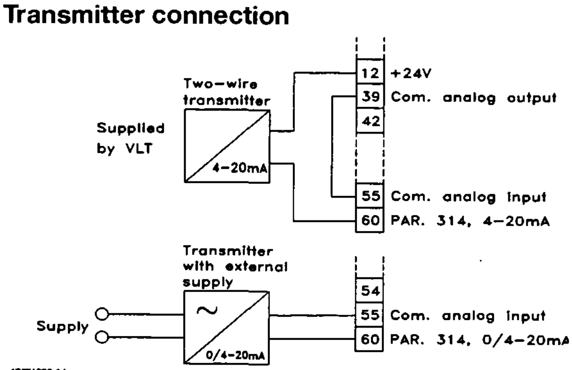
- Start permitted with terminal 16.
  Parameter 300 = *Start enabled* [8].
- Start/stop with terminal 18.
  Parameter 302 = *Start* [1].
- Quickstop with terminal 27.
  Parameter 304 = *Coasting stop, inverse* [0].
- Activated damper (motor)
  Parameter 323 = *Start command active* [13].

2-zone regulation



- Parameter 308 = *Feedback* [2].
- Parameter 311 = *Feedback* [2].

Transmitter connection



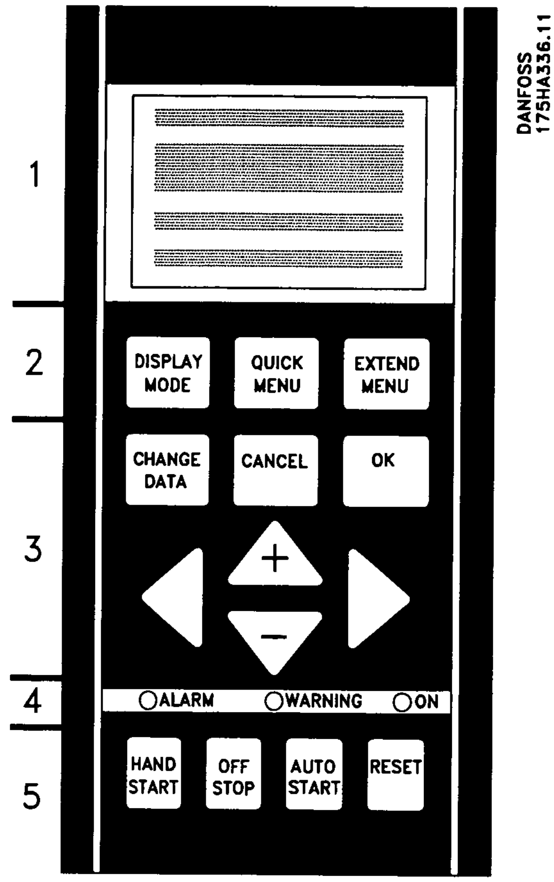
- Parameter 314 = *Reference* [1]
- Parameter 315 = *Terminal 60, min. scaling*
- Parameter 316 = *Terminal 60, max. scaling*

Control unit LCP

The front of the VLT frequency converter features a control panel - LCP (Local Control Panel). This is a complete interface for operation and programming of the VLT 6000 HVAC.
The control panel is detachable and can - as an alternative - be installed up to 3 metres away from the VLT frequency converter, e.g. on the front panel, by means of a mounting kit option.
The functions of the control panel can be divided into five groups:

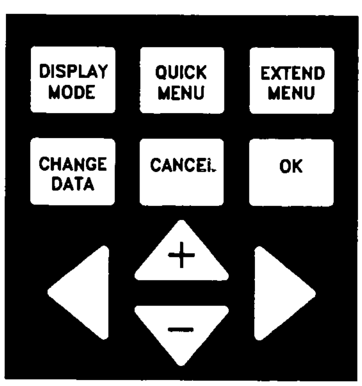
1. Display
2. Keys for changing display mode
3. Keys for changing program parameters
4. Indicator lamps
5. Keys for local operation.

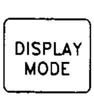
All data are indicated by means of a 4-line alphanumeric display, which, in normal operation, is able to show 4 operating data values and 3 operating condition values continuously. During programming, all the information required for quick, effective parameter Setup of the VLT frequency converter will be displayed. As a supplement to the display, there are three indicator lamps for voltage (ON), warning (WARNING) and alarm (ALARM), respectively.
All VLT frequency converter parameter Setups can be changed immediately via the control panel, unless this function has been programmed to be *Locked* [1] via parameter 016 *Lock for data change* or via a digital input, parameters 300-307 *Lock for data change*.



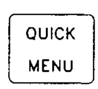
Control keys for parameter Setup

The control keys are divided into functions. This means that the keys between display and indicator lamps are used for parameter Setup, including selecting the display indication during normal operation.





[DISPLAY / STATUS] is used for selecting the indication mode of the display or when returning to the Display mode from either the Quick menu or the Extend menu mode.

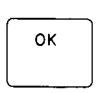


[QUICK MENU] gives access to the parameters used for the Quick menu. It is possible to switch between the Quick menu and the Extend menu modes.

[EXTEND MENU] gives access to all parameters. It is possible to switch between the Extend menu and the Quick menu modes.

[CHANGE DATA] is used for changing a setting selected either in the Extend menu or the Quick menu mode.

[CANCEL] is used if a change of the selected parameter is not to be carried out.



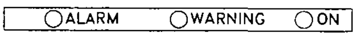
[OK] is used for confirming a change of the parameter selected.

[+/-] is used for selecting parameters and for changing a chosen parameter. These keys are also used to change the local reference.
In addition, the keys are used in Display mode to switch between operation variable readouts.

[<>] is used when selecting a parameter group and for moving the cursor when changing numerical values.

Indicator lamps

At the bottom of the control panel is a red alarm lamp and a yellow warning lamp, as well as a green voltage LED.



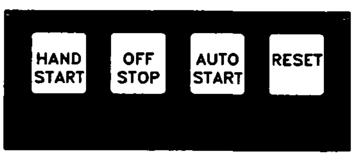
red yellow green

If certain threshold values are exceeded, the alarm and/or warning lamp is activated, and a status or alarm text is displayed.

NB!
The voltage indicator lamp is activated when the VLT frequency converter receives voltage.

Local control

Underneath the indicator lamps are keys for local control.



[HAND START] is used if the VLT frequency converter is to be controlled via the control unit. The VLT frequency converter will start the motor, since a start command is given by means of [HAND START].
On the control terminals, the following control signals will still be active when [HAND START] is activated:

- Hand start - Off stop - Auto start
- Safety Interlock
- Reset
- Coasting stop inverse
- Reversing
- Setup select lsb - Setup select msb
- Jog
- Run permissive
- Lock for data change
- Stop command from serial communication

NB!
If parameter 201 *Output frequency low limit f_{MIN}* is set to an output frequency greater than 0 Hz, the motor will start and ramp up to this frequency when [HAND START] is activated.

[OFF/STOP] is used for stopping the connected motor. Can be selected as Enable [1] or Disable [0] via parameter 013. If the stop function is activated, line 2 will flash.

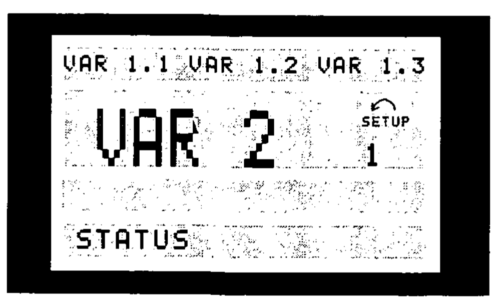
[AUTO START] is used if the VLT frequency converter is to be controlled via the control terminals and/or serial communication. When a start signal is active on the control terminals and/or the bus, the VLT frequency converter will start.

NB!
An active HAND-OFF-AUTO signal via the digital inputs will have higher priority than the control keys [HAND START]-[AUTO START].

[RESET] is used for resetting the VLT frequency converter after an alarm (trip). Can be selected as *Enable* [1] or *Disable* [0] via parameter 015 *Reset on LCP*.

Display mode

In normal operation, any 4 different operating variables can be indicated continuously: 1.1 and 1.2 and 1.3 and 2. The present operating status or alarms and warnings that have arisen are shown in line 2 in the form of a number. In the case of alarms, the alarm in question will be shown in lines 3 and 4, accompanied by an explanatory note. Warnings will flash in line 2, with an explanatory note in line 1. In addition, the display shows the active Setup.
The arrow indicates the direction of rotation; here the VLT frequency converter has an active reversing signal. The arrow body disappears if a stop command is given or if the output frequency falls below 0.01 Hz.
The bottom line gives the status of the VLT frequency converter. See next page.
The scroll list on the next page gives the operating data that can be shown for variable 2 in display mode. Changes are made via the [+/-] keys.



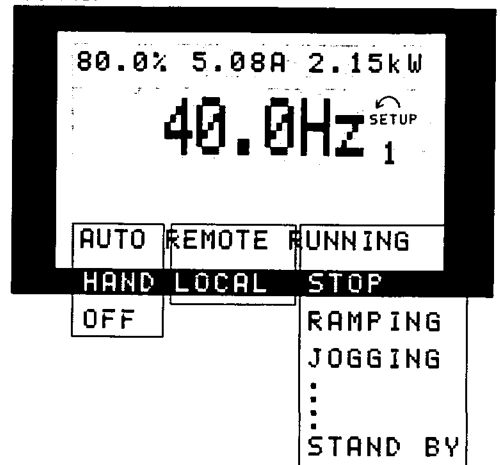
■ Display mode, cont.

The table below gives the operating data options for the first and second line of the display.

Scroll-list:	Unit:
Resulting reference, %	[%]
Resulting reference, unit	[unit]
Frequency	[Hz]
Frequency	[%]
Motor current	[A]
Power	[kW]
Power	[HP]
Output energy	[kWh]
Hours run	[h]
Used-defined readout	[unit]
Setpoint 1	[unit]
Setpoint 2	[unit]
Feedback 1	[unit]
Feedback 2	[unit]
Feedback	[unit]
Motor voltage	[V]
DC voltage	[V]
Thermal motor load	[%]
Thermal drive load	[%]
Digital input	[BIN]
Analogue input 53	[V]
Analogue input 54	[V]
Analogue input 60	[mA]
Pulse reference	[Hz]
Ext. reference	[%]
Heat sink temp.	[°C]
Free Prog Array	[-]
Comm Opt Warn	[HEX]

Three operating data values can be shown in the first display line, while one operating variable can be shown in the second display line. To be programmed via parameters 007, 008, 009 and 010 *Display readout*.

- Status line:

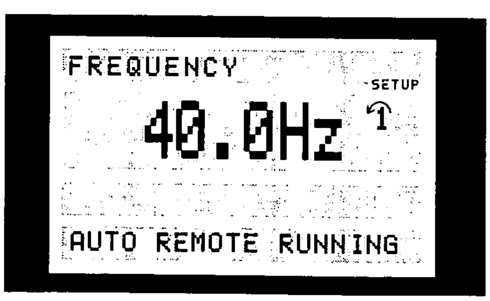


The left part of the status line indicates the control element of the VLT frequency converter that is active. AUTO means that control is via the control terminals, while HAND indicates that control is via the local keys on the control unit.
OFF means that the VLT frequency converter ignores all control commands and stops the motor.
The centre part of the status line indicates the reference element that is active. REMOTE means that the reference from the control terminals is active, while LOCAL indicates that the reference is determined via the [+/-] keys on the control panel.

The last part of the status line indicates the current status, for example "Running", "Stop" or "Alarm".

■ Display mode I:

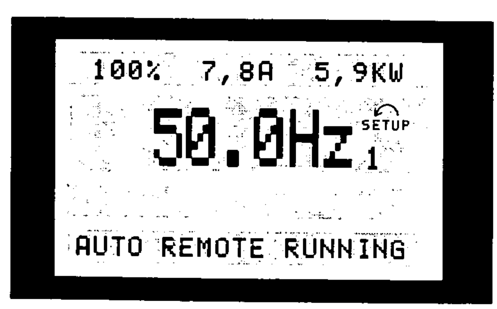
VLT 6000 HVAC offers different display modes depending on the mode selected for the VLT frequency converter. The figure on the next page shows the way to navigate between different display modes.
Below is a display mode, in which the VLT frequency converter is in Auto mode with remote reference at an output frequency of 40 Hz.
In this display mode, reference and control are determined via the control terminals.
The text in line 1 gives the operating variable shown in line 2.



Line 2 gives the current output frequency and the active Setup.
Line 4 says that the VLT frequency converter is in Auto mode with remote reference, and that the motor is running.

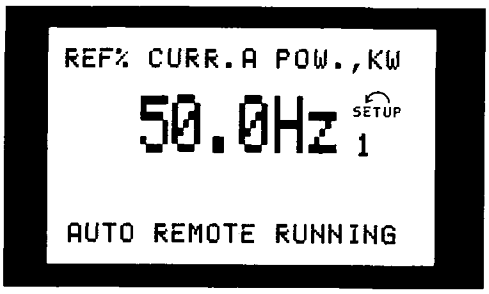
■ Display mode II:

This display mode makes it possible to have three operating data values displayed at the same time in line 1.
The operating data values are determined in parameters 007-010 *Display readout*.



■ **Display mode III:**

This display mode can be generated as long as the [DISPLAY MODE] key is kept depressed. In the first line, operating data names and units of operating data are displayed. In the second line, operating data 2 remains unchanged. When the key is released, the different operating data values are shown.



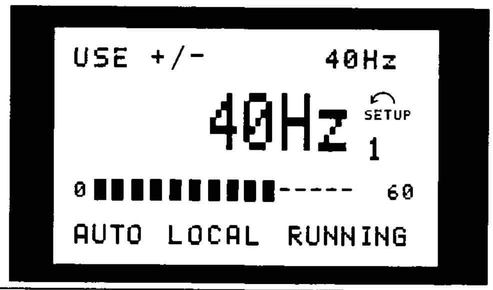
■ **Display mode IV:**

This display mode is only generated in connection with local reference, see also *Reference handling*.

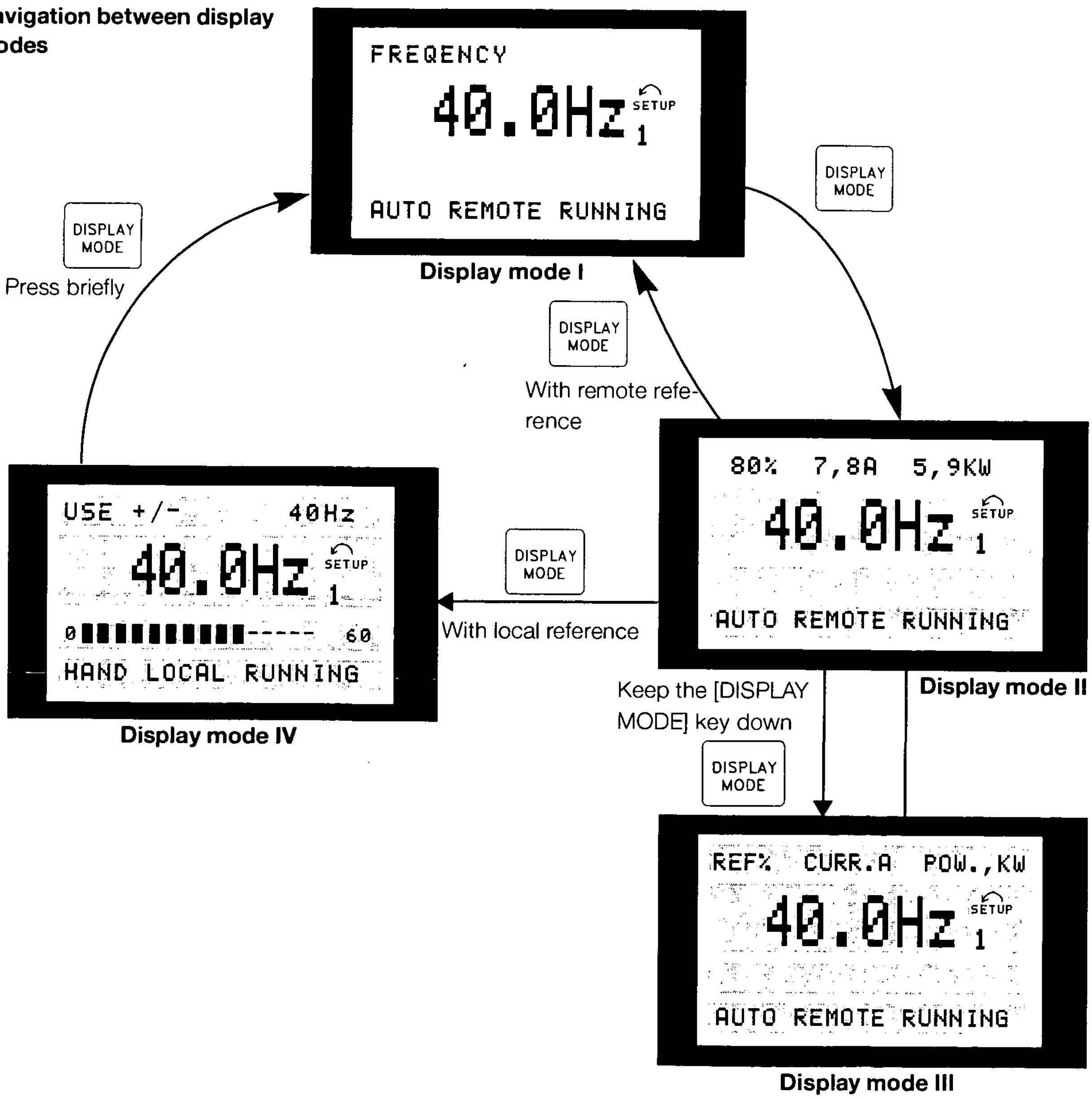
In this display mode, the reference is determined via the [+/-] keys and control is carried out by means of the keys underneath the indicator lamps.

The first line indicates the required reference.

The third line gives the relative value of the present output frequency at any given time in relation to the maximum frequency. The display is in the form of a bar graph.



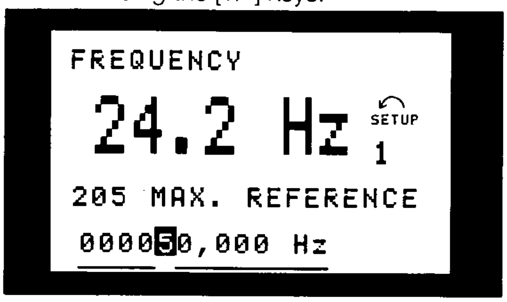
■ **Navigation between display modes**



Programming

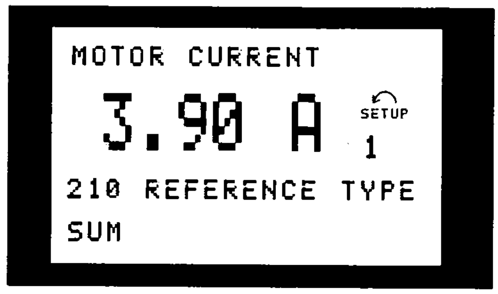
■ Changing data

Regardless of whether a parameter has been selected under the Quick menu or the Extend menu, the procedure for changing data is the same.
Pressing the [CHANGE DATA] key gives access to changing the selected parameter, following which the underlining in line 4 will flash on the display.
The procedure for changing data depends on whether the selected parameter represents a numerical data value or a functional value.
If the chosen parameter represents a numeric data value, the first digit can be changed by means of the [+/-] keys. If the second digit is to be changed, first move the cursor by using the [<>] keys, then change the data value using the [+/-] keys.



The selected digit is indicated by a flashing cursor. The bottom display line gives the data value that will be entered (saved) when signing off by pressing the [OK] button. Use [CANCEL] to cancel the change.

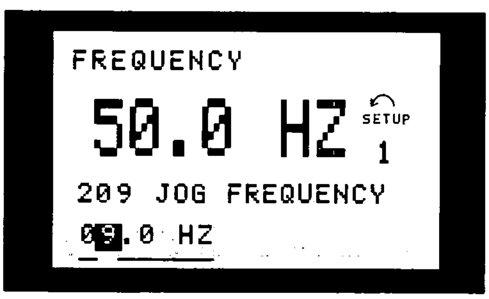
If the selected parameter is a functional value, the selected text value can be changed by means of the [+/-] keys.



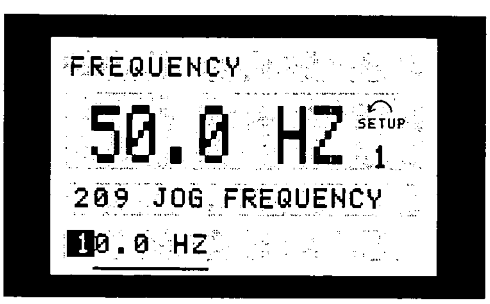
The functional value flashes until signing off by pressing the [OK] button. The functional value has now been selected. Use [CANCEL] to cancel the change.

■ Infinitely variable change of numeric data value

If the chosen parameter represents a numeric data value, a digit is first selected by means of the [<>] keys.



Then the chosen digit is changed infinitely variably by means of the [+/-] keys:



The chosen digit is indicated by the digit flashing. The bottom display line shows the data value that will be entered (saved) when signing off with [OK].

■ Changing of data value, step-by-step

Certain parameters can be changed both step by step and infinitely variably. This applies to *Motor power* (parameter 102), *Motor voltage* (parameter 103) and *Motor frequency* (parameter 104).
This means that the parameters are changed both as a group of numeric data values and as numeric data values infinitely variably.

■ Manual initialisation

Disconnect from mains and hold the [DISPLAY/STATUS] + [CHANGE DATA] + [OK] keys down while at the same time reconnecting the mains supply. Release the keys; the VLT frequency converter has now been programmed for the factory setting.

The following parameters are not zeroed by means of manual initialisation:

parameter 500, *Protocol*
600, *Operating hours*
601, *Hours run*
602, *kWh counter*
603, *Number of power-ups*
604, *Number of overtemperatures*
605, *Number of overvoltages*

It is also possible to carry out initialisation via parameter 620 *Operating mode*.

Quick Menu

The QUICK MENU key gives access to 12 of the most important setup parameters of the drive. After programming, the drive will, in many cases, be ready for operation. The 12 Quick Menu parameters are shown in the table below. A complete description of the function is given in the parameter sections of this manual.

Quick Menu Item Number	Parameter Name	Description
1	001 Language	Selects language used for all displays.
2	102 Motor Power	Sets output characteristics of drive based on kW size of motor.
3	103 Motor Voltage	Sets output characteristics of drive based on voltage ofmotor.
4	104 Motor Frequency	Sets output characteristics of drive based on nominal frequency of motor. This is typically equal to line frequency.
5	105 Motor Current	Sets output characteristics of drive based on nominal current in amps of motor.
6	106 Motor Nominal Speed	Sets output characteristics of drive based on nominal full load speed of motor.
7	201 Minimum Frequency	Sets minimum controlled frequency at which motor will run.
8	202 Maximum Frequency	Sets maximum controlled frequency at which motor will run.
9	206 Ramp Up Time	Sets time to accelerate motor from 0 Hz to nominal motor frequency set in Quick Menu Item 4.
10	207 Ramp Down Time	Sets time to decelerate motor from nominal motor frequency set in Quick Menu Item 4 to 0 Hz.
11	323 Relay 1 Function	Sets function of high voltage Form C relay.
12	326 Relay 2 Function	Sets function of low voltage Form A relay.

Parameter Data

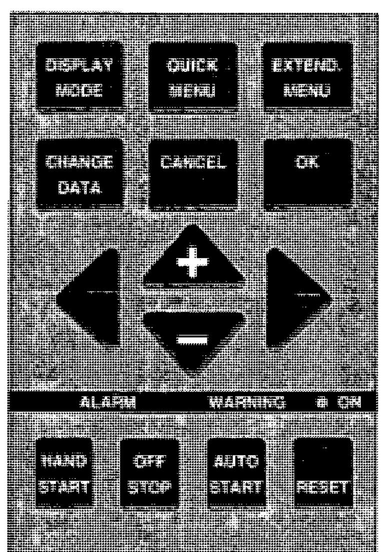
Enter or change parameter data or settings in accordance with the following procedure.

1. Press Quick Menu key.
2. Use '+' and '-' keys to find parameter you choose to edit.
3. Press Change Data key.
4. Use '+' and '-' keys to select correct parameter setting. To move to a different digit within parameter, use ◀and ▶arrows. *Flashing cursor indicates digit selected to change.*
5. Press Cancel key to disregard change, or press OK key to accept change and enter new setting.

Example of Changing Parameter Data

Assume parameter 206, *Ramp Up Time,* is set at 60 seconds. Change the ramp up time to 100 seconds in accordance with the following procedure.

1. Press Quick Menu key.
2. Press '+' key until you reach Parameter 206, *Ramp Up Time*.
3. Press Change Data key.
4. Press ◀ key twice – hundreds digit will flash.
5. Press '+' key once to change hundreds digit to '1.'
6. Press ▶ key to change to tens digit.
7. Press '-' key until '6' counts down to '0' and setting for *Ramp Up Time* reads '100 s.'
8. Press OK key to enter new value into drive controller.



NB!
Programming of extended parameters functions available through EXTENDED MENU key is done in accordance with same procedure as described for Quick Menu functions.

Programming

Programming

EXTEND MENU

Using the [EXTEND MENU] key, it is possible to have access to all the parameters for the VLT frequency converter.

Operation and Display 000-017

This parameter group makes it possible to set up the control unit, e.g. with respect to language, display readout and the possibility of making the function keys on the control unit inactive.

001 Language (LANGUAGE)

Value:

★ English (ENGLISH)	[0]
German (DEUTSCH)	[1]
French (FRANCAIS)	[2]
Danish (DANSK)	[3]
Spanish (ESPAÑOL)	[4]
Italian (ITALIANO)	[5]
Swedish (SVENSKA)	[6]
Dutch (NEDERLANDS)	[7]
Portuguese (PORTUGUESA)	[8]

State when delivered may vary from factory setting.

Function:

The choice in this parameter defines the language to be used on the display.

Description of choice:

There is a choice of the languages indicated.

The Setup configuration

VLT 6000 HVAC has four Setups (parameter Setups) that can be programmed independently of each other. The active Setup can be selected in parameter 002 *Active Setup*. The active Setup number will be shown in the display under "Setup".

It is also possible to set the VLT frequency converter to *Multi-Setup* to allow switching of Setups with the digital inputs or serial communication.

Setup shifts can be used in systems where, e.g., one Setup is used during the day and another at night.

Parameter 003 *Copying of Setups* enables copying from one Setup to another.

By means of parameter 004 *LCP copy*, all Setups can be transferred from one VLT frequency converter to another by moving the control panel. First all parameter values are copied to the control panel. This can then be moved to another VLT frequency converter, where all parameter values can be copied from the control unit to the VLT frequency converter.

002 Active Setup (ACTIVE SETUP)

Value:

Factory Setup (FACTORY SETUP)	[0]
★ Setup 1 (SETUP 1)	[1]
Setup 2 (SETUP 2)	[2]
Setup 3 (SETUP 3)	[3]
Setup 4 (SETUP 4)	[4]
MultiSetup (MULTI SETUP)	[5]

Function:

The choice in this parameter defines the Setup number you want to control the functions of the VLT frequency converter.

All parameters can be programmed in four individual parameter Setups, Setup 1 - Setup 4.

In addition, a pre-programmed Setup called the Factory Setup exists. This only allows specific parameters to be changed.

Description of choice:

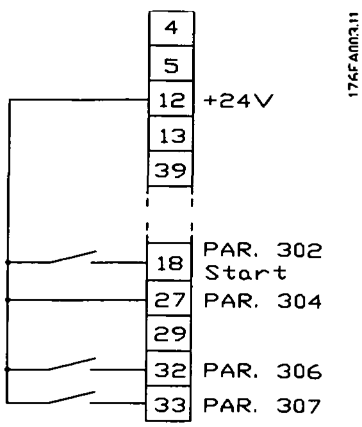
Factory Setup [0] contains the parameter values preset at the factory. Can be used as a data source if the other Setups are to be returned to a known state. In this case Factory Setup is selected as the active Setup.

Setups 1-4 [1]-[4] are four individual Setups that can be selected as required.

MultiSetup [5] is used if remote switching between different Setups is required. Terminals 16/17/29/32/33 and the serial communication port can be used for switching between Setups.

★ = factory setting. () = display text [] = value for use in communication via serial communication port

Connection examples
Setup change



- Selection of Setup using terminals 32 and 33.
  Parameter 306 = *Selection of Setup, lsb* [4]
  Parameter 307 = *Selection of Setup, msb* [4]
  Parameter 004 = *MultiSetup* [5].

---

003 Copying of Setups (SETUP COPY)

Value:

★ No copying (NO COPY)	[0]
Copy active Setup to Setup 1 (COPY TO SETUP 1)	[1]
Copy active Setup to Setup 2 (COPY TO SETUP 2)	[2]
Copy active Setup to Setup 3 (COPY TO SETUP 3)	[3]
Copy active Setup to Setup 4 (COPY TO SETUP 4)	[4]
Copy active Setup to all (COPY TO ALL)	[5]

Function:

A copy is made from the active Setup selected in parameter 002 Active Setup to the Setup or Setups selected in parameter 003 Copying of Setups.

NB!
Copying is only possible in Stop mode (motor stopped on a Stop command).

Description of choice:

The copying starts when the required copying function has been selected and the [OK] key has been pressed.
The display indicates when copying is in progress.

---

004 LCP copy (LCP COPY)

Value:

★ No copying (NO COPY)	[0]
Upload all parameters (UPLOAD ALL PARAMET.)	[1]
Download all parameters (DOWNLOAD ALL PARAM.)	[2]
Download power-independent par. (DOWNLOAD SIZE INDEP.)	[3]

Function:

Parameter 004 *LCP copy* is used if the integrated copying function of the control panel is to be used. This function is used if all parameter Setups are to be copied from one VLT frequency converter to another by moving the control panel.

Description of choice:

Select *Upload all parameters* [1] if all parameter values are to be transmitted to the control panel.
Select *Download all parameters* [2] if all transmitted parameter values are to be copied to the VLT frequency converter on which the control panel has been mounted.
Select *Download power-independent par.* [3] if only the power-independent parameters are to be downloaded. This is used if downloading to a VLT frequency converter that has a different rated power than the one from where the parameter Setup originates.

NB!
Uploading/Downloading can only be carried out in Stop mode.

■ Setup of user-defined readout

Parameter 005 *Max. value of user-defined readout* and 006 *Unit for user-defined readout* allow users to design their own readout which can be seen if user-defined readout has been selected under display readout. The range is set in parameter 005 *Max. value of user-defined readout* and the unit is determined in parameter 006 *Unit for user-defined readout*. The choice of unit decides whether the ratio between the output frequency and the readout is a linear, square or cubed ratio.

Programming

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

005 Max. value of user-defined readout (CUSTOM READOUT)

Value:

0.01 - 999,999.99 ★100.00

Function:

This parameter allows a choice of the max. value of the user-defined readout. The value is calculated on the basis of the present motor frequency and the unit selected in parameter 006 *Unit for user-defined readout*. The programmed value is reached when the output frequency in parameter 202 *Output frequency high limit, f_{MAX}* is reached. The unit also decides whether the ratio between output frequency and readout is linear, square or cubed.

Description of choice:

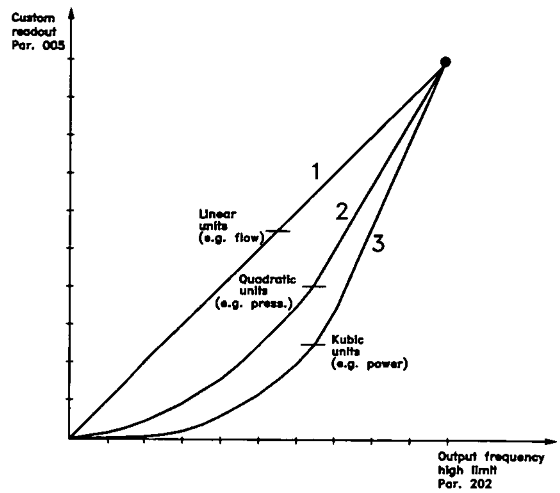
Set the required value for max. output frequency.

006 Unit for user-defined readout (CUST. READ. UNIT)

Value:

Unit	Value	Unit	Value
★ No unit [1]	[0]	GPM [1]	[21]
% [1]	[1]	gal/s [1]	[22]
rpm [1]	[2]	gal/min [1]	[23]
ppm [1]	[3]	gal/h [1]	[24]
pulse/s [1]	[4]	lb/s [1]	[25]
l/s [1]	[5]	lb/min [1]	[26]
l/min [1]	[6]	lb/h [1]	[27]
l/h [1]	[7]	CFM [1]	[28]
kg/s [1]	[8]	ft^3/s [1]	[29]
kg/min [1]	[9]	ft^3/min [1]	[30]
kg/h [1]	[10]	ft^3/h [1]	[31]
m^3/s [1]	[11]	ft^3/min [1]	[32]
m^3/min [1]	[12]	ft/s [1]	[33]
m^3/h [1]	[13]	in wg [2]	[34]
m/s [1]	[14]	ft wg [2]	[35]
mbar [2]	[15]	PSI [2]	[36]
bar [2]	[16]	lb/in^2	[37]
Pa [2]	[17]	HP [3]	[38]
kPa [2]	[18]		
MWG [2]	[19]		
kW [3]	[20]		

Flow and speed units are marked with 1. Pressure units with 2, and power units with 3. See figure in next column.



Function:

Select a unit to be shown in the display in connection with parameter 005 *Max. value of user-defined readout*.

If units such as flow or speed units are selected, the ratio between readout and output frequency will be a linear one.

If pressure units are selected (bar, Pa, MWG, PSI, etc.), the ratio will be square.

If power units (kW, HP) are selected, the ratio will be cubed.

The value and the unit are shown in display mode whenever *User-defined readout* [10] has been selected in one of parameters 007-010 *Display readout*.

Description of choice:

Select the required unit for *User-defined readout*.

007 Large display readout (LARGE READOUT)

Value:

Resulting reference [%] (REFERENCE [%])	[1]
Resulting reference [unit] (REFERENCE [UNIT])	[2]
★Frequency [Hz] (FREQUENCY [HZ])	[3]
% of maximum output frequency [%] (FREQUENCY [%])	[4]
Motor current [A] (MOTOR CURRENT [A])	[5]
Power [kW] (POWER [KW])	[6]
Power [HP] (POWER [HP])	[7]
Output energy [kWh] (ENERGI [UNIT])	[8]
Hours run [Hours] (HOURS RUN [h])	[9]
User-defined readout [-] (CUSTOM READ.[UNITS])	[10]
Setpoint 1 [unit] (SETPOINT 1 [UNITS])	[11]

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

Setpoint 2 [unit] (SETPOINT 2 [UNITS])	[12]
Feedback 1 (FEEDBACK 1 [UNITS])	[13]
Feedback 2 (FEEDBACK 2 [UNITS])	[14]
Feedback [unit] (FEEDBACK [UNITS])	[15]
Motor voltage [V] (MOTOR VOLTAGE [V])	[16]
DC link voltage [V] (DC VOLTAGE [V])	[17]
Thermal load, motor [%] (THERM.MOTOR LOAD [%])	[18]
Thermal load, VLT [%] (THERM.DRIVE LOAD [%])	[19]
Digital input [Binary code] (DIGITAL INPUT [BIN])	[20]
Analogue input 53 [V] (ANALOG INPUT 53 [V])	[21]
Analogue input 54 [V] (ANALOG INPUT 54 [V])	[22]
Analogue input 60 [mA] (ANALOG INPUT 60 [mA])	[23]
Relay status [binary code] (RELAY STATUS)	[24]
Pulse reference [Hz] (PULSE REFERENCE [HZ])	[25]
External reference [%] (EXT. REFERENCE [%])	[26]
Heat sink temp. [°C] (HEATSINK TEMP [°C])	[27]
Communication option card warning (COMM OPT WARN [HEX])	[28]
LCP display text (FREE PROG.ARRAY)	[29]

Function:

This parameter allows a choice of the data value to be shown in the display, line 2, when the VLT frequency converter is turned on. The data values will also be included in the display mode scroll-list. Parameters 008-010 *Small display readout* allow a choice of another three data values, shown in line 1.
See the description of the *control unit*.

Description of choice:

No readout can only be selected in parameters 008-010 Small display readout.
Resulting reference [%] gives a percentage for the resulting reference in the range from *Minimum reference, Ref_{MIN}* to *Maximum reference, Ref_{MAX}*. See also *reference handling*.
Reference [unit] gives the resulting reference in Hz in *Open loop*. In *Closed loop*, the reference unit is selected in parameter 415 *Process units.*
Frequency [Hz] gives the output frequency from the VLT frequency converter.
% of maximum output frequency [%] is the present output frequency as a percentage value of parameter 202 *Output frequency high limit, f_{MAX}*.
Motor current [A] states the phase current of the motor measured as effective value.
Power [kW] states the actual power consumed by the motor in kW.
Power [HP] states the actual power consumed by the motor in HP.
Output energy [kWh] states the energy consumed by the motor since the latest reset was made in parameter 618 *Reset of kWh counter*.
Hours run [Hours] states the number of hours that the motor has run since the latest reset in parameter 619 *Reset of hours-run counter.*
User-defined readout [-] is a user-defined value, calculated on the basis of the present output frequency and unit, as well as the scaling in parameter 005 *Max. value of user-defined readout*. Select unit in parameter 006 *Unit for user-defined readout*.
Setpoint 1 [unit] is the programmed setpoint value in parameter 418 *Setpoint 1*. The unit is decided in parameter 415 *Process units*. See also *Feedback handling*.
Setpoint 2 [unit] is the programmed setpoint value in parameter 419 *Setpoint 2*. The unit is decided in parameter 415 *Process units.*
Feedback 1 [unit] gives the signal value of the resulting feedback 1 (Term. 53). The unit is decided in parameter 415 *Process units*. See also *Feedback handling*.
Feedback 2 [unit] gives the signal value of the resulting feedback 2 (Term. 53). The unit is decided in parameter 415 *Process units.*
Feedback [unit] gives the resulting signal value using the unit/scaling selected in parameter 413 *Minimum feedback, FB_{MIN}*, 414 *Maximum feedback, FB_{MAX}* and 415 *Process units*.
Motor voltage [V] states the voltage supplied to the motor.
DC link voltage [V] states the intermediate circuit voltage in the VLT frequency converter.
Thermal load, motor [%] states the calculated/ estimated thermal load on the motor. 100% is the cut-out limit. See also parameter 117 *Motor thermal protection*.
Thermal load, VLT [%] states the calculated/ estimated thermal load on the VLT frequency converter. 100% is the cut-out limit.
Digital input [Binary code] states the signal status from the 8 digital inputs (16, 17, 18, 19, 27, 29, 32 and 33). Terminal 16 corresponds to the bit at the far left. '0' = no signal, '1' = connected signal.
Analogue input 53 [V] states the voltage value on terminal 53.
Analogue input 54 [V] states the voltage value on terminal 54.
Analogue input 60 [mA] states the voltage value on terminal 60.

Programming

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Relay status [binary code] indicates the status of each relay. The left (most significant) bit indicates relay 1 followed by 2 and 6 through 9. A "1" indicates the relay is active, a "0" indicates inactive. Paramater 007 uses an 8-bit word with the last two positions not used. Relays 6-9 are provided with the cascade controller and four relay option cards
Pulse reference [Hz] states a pulse frequency in Hz connected to terminal 17 or terminal 29.
External reference [%] gives the sum of the external references as a percentage (the sum of analogue/ pulse/serial communication) in the range from *Minimum reference, Ref_{MIN}* to *Maximum reference, Ref_{MAX}*.
Heat sink temp. [°C] states the present heat sink temperature of the VLT frequency converter. The cut-out limit is 90 ± 5°C; cutting back in occurs at 60 ± 5°C.
Communication option card warning [Hex] gives a warning word if there is a fault on the communication bus. This is only active if communication options have been installed. Without communication options, 0 Hex is displayed.
LCD display text shows the text programmed in parameter 533 *Display text 1* and 534 *Display text 2* via the serial communication port.

---

008 Small display readout 1.1
(SMALL READOUT 1)

Value:

See parameter 007 *Large display readout*

★ Reference [Unit] [2]

Function:

This parameter enables a choice of the first of three data values to be shown on the display, line 1, position 1.
This is a useful function, i.a. when setting the PID regulator, in order to see how the process reacts to a change of reference.
For display read-outs, press the [DISPLAY/STATUS] button. Data option *LCP display text* [27] cannot be selected with *Small display readout*.

Description of choice:

There is a choice of 26 different data values, see parameter 007 *Large display readout*.

---

009 Small display readout 1.2
(SMALL READOUT 2)

Value:

See parameter 007 *Large display readout*

★ Motorcurrent [A] [5]

Function:

See the functional description for parameter 008 *Small display readout*.

Description of choice:

There is a choice of 26 different data values, see parameter 007 *Large display readout*.

---

010 Small display readout 1.3
(SMALL READOUT 3)

Value:

Se parameter 007 *Large display readout*

★ Power [kW] [6]

Function:

See the functional description for parameter 008 *Small data readout*.

Description of choice:

There is a choice of 26 different data values, see parameter 007 *Large display readout*.

---

011 Unit of local reference
(UNIT OF LOC REF)

Value:

★ Hz (HZ) [0]

% of output frequency range (%) (% OF FMAX) [1]

Function:

This parameter decides the local reference unit.

Description of choice:

Choose the required unit for local reference.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

012 Hand start on LCP (HAND START BTTN)

Value:

Disable (DISABLE)	[0]
★ Enable (ENABLE)	[1]

Function:
This parameter allows selection/deselection of the Hand start key on the control panel.

Description of choice:
If *Disable* [0] is selected in this parameter, the [HAND START] key will be inactive.

013 OFF/STOP on LCP (STOP BUTTON)

Value:

Disable (DISABLE)	[0]
★ Enable (ENABLE)	[1]

Function:
This parameter allows selection/deselection of the local stop key on the control panel.

Description of choice:
If *Disable* [0] is selected in this parameter, the [OFF/STOP] key will be inactive.

NB!
If Disable is selected, the motor cannot be stopped by means of the [OFF/STOP] key.

014 Auto start on LCP (AUTO START BTTN)

Value:

Disable (DISABLE)	[0]
★ Enable (ENABLE)	[1]

Function:
This parameter allows selection/deselection of the auto start key on the control panel.

Description of choice:
If *Disable* [0] is selected in this parameter, the [AUTO START] key will be inactive.

015 Reset on LCP (RESET BUTTON)

Value:

Disable (DISABLE)	[0]
★ Enable (ENABLE)	[1]

Function:
This parameter allows selection/deselection of the reset key on the control panel.

Description of choice:
If *Disable* [0] is selected in this parameter, the [RESET] key will be inactive.

NB!
Only select Disable [0] if an external reset signal has been connected via the digital inputs.

016 Lock for data change (DATA CHANGE LOCK)

Value:

★ Not locked (NOT LOCKED)	[0]
Locked (LOCKED)	[1]

Function:
This parameter allows the control panel to be 'locked', which means that it is not possible to carry out data modifications via the control unit.

Description of choice:
If *Locked* [1] is selected, data modifications in the parameters cannot be made, although it will still be possible to carry out data modifications via the bus. Parameters 007-010 *Display readout* can be changed via the control panel.
It is also possible to lock for data modifications in these parameters by means of a digital input, see parameters 300-307 *Digital inputs*.

Programming

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

017 Operating state at power up, local control (POWER UP ACTION)

Value:

★ Auto restart (AUTO RESTART)	[0]
OFF/Stop (OFF/STOP)	[1]

Function:

Setting of the desired operating mode when the mains voltage is reconnected.

Description of choice:

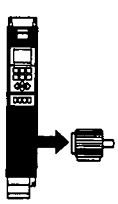
Auto restart [0] is selected if the VLT frequency converter is to start up in the same start/stop condition as immediately before power to the converter is cut off.

OFF/Stop [1] is selected if the VLT frequency converter is to remain stopped when the mains voltage is connected, until a start command is active. To restart, activate the key [HAND START] or [AUTO START] by using the control panel.

NB!

If [HAND START] or [AUTO START] cannot be activated by the keys on the control panel (see parameter 012/014 Hand/Auto start on *LCP*) the motor will not be able to restart if OFF/Stop [1] is selected. If Handstart or Autostart has been programmed for activation via the digital inputs, the motor will not be able to restart if OFF/Stop [1] is selected.

■ Load and Motor 100-117



This parameter group allows the configuration of regulation parameters and the choice of torque characteristics to which the VLT frequency converter is to be adapted.

The motor nameplate data must be set and automatic motor adaptation can be carried out. In addition, DC brake parameters can be set and the motor thermal protection can be activated.

■ Configuration

The selection of configuration and torque characteristics influences the parameters that can be seen in the display. If *Open loop* [0] is selected, all parameters relating to PID regulation will be hidden.

Consequently, the user is only able to see the parameters that are of significance for a given application.

100 Configuration (CONFIG. MODE)

Value:

★ Open loop (OPEN LOOP)	[0]
Closed loop (CLOSED LOOP)	[1]

Function:

This parameter is used for selecting the configuration to which the VLT frequency converter is to be adapted.

Description of choice:

If *Open loop* [0] is selected, normal speed control is obtained (without feedback signal), i.e. if the reference is changed, the motor speed will change.

If *Closed loop* [1] is selected, the internal process regulator is activated to enable accurate regulation in relation to a given process signal.

The reference (setpoint) and the process signal (feedback) can be set to a process unit as programmed in parameter 415 *Process units*.

See *Feedback handling*.

101 Torque characteristics (VT CHARACT)

Value:

★ Automatic Energy Optimisation (AEO FUNCTION)	[0]
Parallel motors (MULTIPLE MOTORS)	[1]

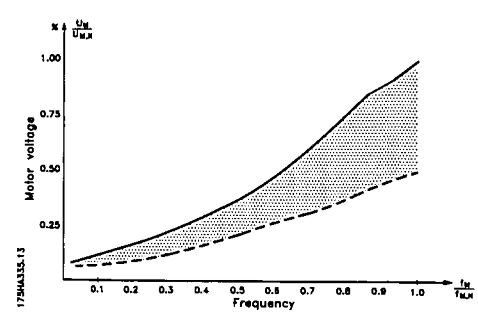
Function:

This parameter allows a choice of whether the VLT frequency converter has one or several motors connected to it.

Description of choice:

If *Automatic Energy Optimisation* [0] has been selected, only one motor may be connected to the VLT frequency converter. The AEO function ensures that the motor obtains its maximum efficiency and minimises motor interference.

Select *Parallel motors* [1] if more than one motor is connected to the output in parallel. See the description under parameter 108 *Start voltage of parallel motors* regarding the setting of parallel motor start voltages.



★ = factory setting. () = display text [] = value for use in communication via serial communication port

NB!
It is important that the values set in parameters 102-106 *Nameplate data* correspond to the nameplate data of the motor with respect to either star coupling Y or delta coupling Δ.

102 Motor power, $P_{M,N}$ (MOTOR POWER)

Value:

0.25 kW (0.25 KW)	[25]
0.37 kW (0.37 KW)	[37]
0.55 kW (0.55 KW)	[55]
0.75 kW (0.75 KW)	[75]
1.1 kW (1.10 KW)	[110]
1.5 kW (1.50 KW)	[150]
2.2 kW (2.20 KW)	[220]
3 kW (3.00 KW)	[300]
4 kW (4.00 KW)	[400]
5,5 kW (5.50 KW)	[550]
7,5 kW (7.50 KW)	[750]
11 kW (11.00 KW)	[1100]
15 kW (15.00 KW)	[1500]
18.5 kW (18.50 KW)	[1850]
22 kW (22.00 KW)	[2200]
30 kW (30.00 KW)	[3000]
37 kW (37.00 KW)	[3700]
45 kW (45.00 KW)	[4500]
55 kW (55.00 KW)	[5500]
75 kW (75.00 KW)	[7500]
90 kW (90.00 KW)	[9000]
110 kW (110.00 KW)	[11000]
132 kW (132.00 KW)	[13200]
160 kW (160.00 KW)	[16000]
200 kW (200.00 KW)	[20000]
250 kW (250.00 KW)	[25000]
300 kW (300.00 KW)	[30000]
315 kW (315.00 KW)	[31500]
355 kW (355.00 KW)	[35500]
400 kW (400.00 KW)	[40000]
450 kW (450.00 KW)	[45000]
500 kW (500.00 KW)	[50000]

★ Depends on the unit

Function:
This is where to select the kW value $P_{M,N}$ that corresponds to the rated power of the motor. At the works, a rated kW value $P_{M,N}$ has been selected that depends on the type of unit.

Description of choice:
Select a value that equals the nameplate data on the motor. There are 4 possible undersizes or 1 oversize in comparison with the factory setting. Also, alternatively it is possible to set the value for motor power as an infinitely variable value, see the procedure for *Infinitely variable change of numeric data value*.

103 Motor voltage, $U_{M,N}$ (MOTOR VOLTAGE)

Value:

200 V	[200]
208 V	[208]
220 V	[220]
230 V	[230]
240 V	[240]
380 V	[380]
400 V	[400]
415 V	[415]
440 V	[440]
460 V	[460]
480 V	[480]
500 V	[500]

★ Depends on the unit

Function:
This is where the rated motor voltage $U_{M,N}$ is set for either star Y or delta Δ.

Description of choice:
Select a value that equals the nameplate data on the motor, regardless of the mains voltage of the VLT frequency converter.
Furthermore, alternatively it is possible to set the value of the motor voltage infinitely variable, see also the procedure for *Infinitely variable change of numeric data value*.

NB!
Changing parameters 102, 103 or 104 will automatically reset parameters 105 and 106 to default values. If changes are made to parameters 102, 103 or 104, go back and reset parameters 105 and 106 to correct values.

Programming

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

104 Motor frequency, $f_{M,N}$ (MOTOR FREQUENCY)

Value:

★ 50 Hz (50 Hz)	[50]
60 Hz (60 Hz)	[60]

Function:

This is where the rated motor frequency $f_{M,N}$ is selected.

Description of choice:

Select a value that equals the nameplate data on the motor.
Furthermore, it is also possible to set the value for motor frequency infinitely variably in the 24-1000 Hz range.

105 Motor current, $I_{M,N}$ (MOTOR CURRENT)

Value:

0.01 - $I_{VLT,MAX}$ A ★Depends on the unit

Function:

The rated motor current $I_{M,N}$ forms part of the VLT frequency converter calculations i.a. of torque and motor thermal protection. Set the motor current $I_{VLT,N}$, taking into account the star Y or delta Δ connected motor.

Description of choice:

Set a value that equals the nameplate data on the motor.

NB!
It is important to enter the correct value, since this forms part of the VVC+ control feature.

106 Rated motor speed, $n_{M,N}$ (MOTOR NOM. SPEED)

Value:

100 - $f_{M,N}$ x 60 (max. 60000 rpm)
★ Depends on parameter 102 *Motor power, $P_{M,N}$*.

Function:

This is where the value is set that corresponds to the rated motor speed $n_{M,N}$, which can be seen from the nameplate data.

Description of choice:

Choose a value that corresponds to the motor nameplate data.

NB!
It is important to set the correct value, since this forms part of the VVC+ control feature.
The max. value equals $f_{M,N}$ x 60.
$f_{M,N}$ is set in parameter 104 *Motor frequency, $f_{M,N}$*.

107 Automatic motor adaptation, AMA (AUTO MOTOR ADAPT)

Value:

★ Optimisation disable (NO AMA)	[0]
Automatic adaptation (RUN AMA)	[1]
Automatic adaptation with LC-filter (RUN AMA WITH LC-FILT)	[2]

Function:

Automatic motor adaptation is a test algorithm that measures the electrical motor parameters at motor standstill. This means that AMA itself does not supply any torque.
AMA is useful when commissioning systems, where the user wants to optimise the adjustment of the VLT frequency converter to the motor applied. This feature is used in particular where the factory setting does not adequately cover the motor in question.

For the best adjustment of the VLT frequency converter, it is recommended to carry out AMA on a cold motor.
It must be noted that repeated AMA runs may lead to a heating of the motor that will result in an increase of the stator resistance R_S. However, this is not normally critical.

NB!
It is important to run AMA with any motors ≥ 55 kW/ 75 HP

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

It is possible via parameter 107 *Automatic motor adaptation, AMA* to choose whether a complete automatic motor adaptation *Automatic adaptation* [1] is to be carried out, or whether reduced automatic motor adaptation *Automatic adaptation with LC-filter* [2] is to be made.
It is only possible to carry out the reduced test if a LC-filter has been placed between the VLT frequency converter and the motor. If a total setting is required, the LC-filter can be removed and, after completion of the AMA, it can be reinstalled. In *Automatic optimisation with LC-filter* [2] there is no test of motor symmetry and of whether all motor phases have been connected. The following must be noted when the AMA function is used:

- For AMA to be able to determine the motor parameters optimally, the correct nameplate data for the motor connected to the VLT frequency converter must be entered in parameters 102 to 106.
- The duration of a total automatic motor adaptation varies from a few minutes to approx. 10 minutes for small motors, depending on the rating of the motor used (the time for a 7.5 kW motor, for example, is approx. 4 minutes).
- Alarms and warnings will be shown in the display if faults occur during motor adaptation.
- AMA can only be carried out if the rated motor current of the motor is min. 35% of the rated output current of the VLT frequency converter.
- If automatic motor adaptation is to be discontinued, press the [OFF/STOP] key.

NB!
AMA is not allowed on motors connected in parallel.

Description of choice:
Select *Automatic adaptation* [1] if the VLT frequency converter is to carry out a complete automatic motor adaptation.
Select *Automatic adaptation with LC-filter* [2] if a LC-filter has been placed between the VLT frequency converter and the motor.

Procedure for automatic motor adaptation:

1. Set the motor parameters in accordance with the motor nameplate data given in parameters 102-106 *Nameplate data.*
2. Connect 24 V DC (possibly from terminal 12) to terminal 27 on the control card.
3. Select Automatic adaptation [1] or Automatic adaptation with LC-filter [2] in parameter 107 *Automatic motor adaptation, AMA.*
4. Start up the VLT frequency converter or connect terminal 18 (start) to 24 V DC (possibly from terminal 12).
5. After a normal sequence, the display reads: AMA STOP. After a reset, the VLT frequency converter will be ready to start operation again.

If the automatic motor adaptation is to be stopped:

1. Press the [OFF/STOP] key.

If there is a fault, the display reads: ALARM 22

1. Press the [Reset] key.
2. Check for possible causes of the fault in accordance with the alarm message. See *List of warnings and alarms*.

If there is a warning, the display reads: WARNING 39-42

1. Check for possible causes of the fault in accordance with the warning. See *List of warnings and alarms*.
2. Press the [CHANGE DATA] key and select "Continue" if AMA is to continue despite the warning, or press the [OFF/STOP] key to stop the automatic motor adaptation.

108 Start voltage of parallel motors (MULTIM.START VOLT)

Value:
0.0 - parameter 103 *Motor voltage,* $U_{M,N}$
★ Depends on par. 103 *Motor voltage,* $U_{M,N}$

Function:
This parameter specifies the start-up voltage of the permanent VT characteristics at 0 Hz for motors connected in parallel.
The start-up voltage represents a supplementary voltage input to the motor. By increasing the start-up voltage, motors connected in parallel receive a higher start-up torque. This is used especially for small motors (< 4.0 kW) connected in parallel, as they have a higher stator resistance than motors above 5.5 kW.
This function is only active if *Parallel motors* [1] has been selected in parameter 101 *Torque characteristics*.

Description of choice:
Set the start-up voltage at 0 Hz. The maximum voltage depends on parameter 103 *Motor voltage,* $U_{M,N}$.

★ = factory setting. () = display text [] = value for use in communication via serial communication port

109 Resonance damping (RESONANCE DAMP.)

Value:

0 - 500 % ★100 %

Function:

High-frequency electric resonance problems between the VLT frequency converter and the motor can be eliminated by adjusting the resonance damping.

Description of choice:

Adjust the damping percentage until the motor resonance has disappeared.

110 High break-away torque (HIGH START TORQ.)

Value:

0.0 (OFF) - 0.5 sec. ★ OFF

Function:

In order to secure a high starting torque, the maximum torque for max. 0.5 sec. is allowed. However, the current is limited by the protection limit of the VLT frequency converter (inverter).
0 sec. corresponds to no high break-away torque.

Description of choice:

Set the necessary time in which a high starting torque is desired.

111 Start delay (START DELAY)

Value:

0.0 - 120.0 sec. ★ 0.0 sec.

Function:

This parameter enables a delay of the starting time after the conditions for start have been fulfilled. When the time has passed, the output frequency will start by ramping up to the reference.

Description of choice:

Set the desired time until acceleration is to begin.

112 Motor preheater (MOTOR PREHEAT)

Value:

★ Disable (DISABLE) [0]
Enable (ENABLE) [1]

Function:

The motor preheater ensures that no condensate develops in the motor at stop. This function can also be used to evaporate condensed water in the motor. The motor preheater is only active during stop.

Description of choice:

Select *Disable* [0] if this function is not required. Select *Enable* [1] to activate motor preheating. The DC current is set in parameter 113 *Motor preheater DC current*.

113 Motor preheater DC current (PREHEAT DC-CURR.)

Value:

0 - 100 % ★ 50 %

The maximum value depends on the rated motor current, parameter 105 *Motor current*, $I_{M,N}$.

Function:

The motor can be preheated at stop by means of a DC current to prevent moisture from entering the motor.

Description of choice:

The motor can be preheated by means of a DC current. At 0%, the function is inactive; at a value higher than 0%, a DC current will be supplied to the motor at stop (0 Hz). In fans that rotate because of the air flow when they are not in operation (windmilling), this function can also be used to generate a holding torque.

⚠ If too high a DC current is supplied for too long, the motor can be damaged.

DC braking

In DC braking, the motor receives a DC current that brings the shaft to a halt. Parameter 114 *DC braking current*, decides the DC braking current as a percentage of the rated motor current $I_{M,N}$.
In parameter 115 *DC braking time*, the DC braking time is selected, and in parameter 116 *DC brake cut-in frequency*, the frequency is selected at which DC braking becomes active.
If terminal 19 or 27 (parameter 303/304 *Digital input)* has been programmed to *DC braking inverse* and shifts from logic '1' to logic '0', the DC braking will be activated.
When the start signal on terminal 18 changes from logic '1' to logic '0', the DC braking will be activated when the output frequency becomes lower than the brake coupling frequency.

NB!
The DC brake is not to be used if the inertia of the motor shaft is more than 20 times the inertia of the motor itself.

114 DC braking current (DC BRAKE CURRENT)

Value:

$0 - \frac{I_{VLT.MAX}}{I_{M,N}} x\ 100\ [\%]$ ★ 50 %

The maximum value depends on the rated motor current. If the DC braking current is active, the VLT frequency converter has a switching frequency of 4 kHz.

Function:

This parameter is used for setting the DC braking current that is activated upon a stop when the DC brake frequency set in parameter 116 *DC brake cut-in frequency* has been reached, or if DC brake inverse is active via terminal 27 or via the serial communication port. The DC braking current will be active for the duration of the DC braking time set in parameter 115 *DC braking time.*

Description of choice:

To be set as a percentage value of the rated motor current $I_{M,N}$ set in parameter 105 *Motor current,* $_{VLT,N}$.
100% DC braking current corresponds to $I_{M,N}$.

Make sure not to supply too high abraking current for too long, since otherwise the motor will be damaged because of mechanical overload or the heat generated in the motor.

115 DC braking time (DC BRAKE TIME)

Value:

0.0 - 60.0 sec. ★ OFF

Function:

This parameter is for setting the DC braking time for which the DC braking current (parameter 113) is to be active.

Description of choice:

Set the desired time.

116 DC brake cut-in frequency (DC BRAKE CUT-IN)

Value:

0.0 (OFF) - par. 202 *Output frequency high limit,* f_{MAX} ★ OFF

Function:

This parameter is used for setting the DC brake cut-in frequency at which DC braking is to be activated in connection with a stop command.

Description of choice:

Set the desired frequency.

Programming

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

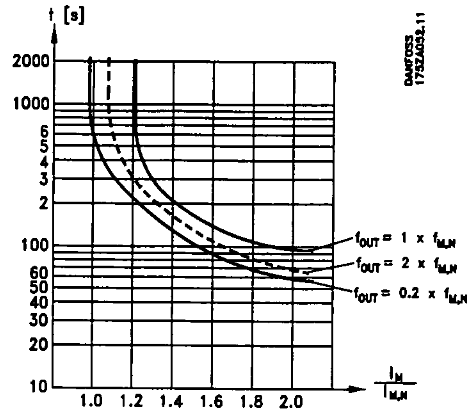
117 Motor thermal protection
(MOT. THERM PROTEC)

Value:

No protection (NO PROTECTION)	[0]
Thermistor warning (THERMISTOR WARNING)	[1]
Thermistor trip (THERMISTOR FAULT)	[2]
ETR Warning 1 (ETR WARNING 1)	[3]
★ETR Trip 1 (ETR TRIP 1)	[4]
ETR Warning 2 (ETR WARNING 2)	[5]
ETR Trip 2 (ETR TRIP 2)	[6]
ETR Warning 3 (ETR WARNING 3)	[7]
ETR Trip 3 (ETR TRIP 3)	[8]
ETR Warning 4 (ETR WARNING 4)	[9]
ETR Trip 4 (ETR TRIP 4)	[10]

Function:
The VLT frequency converter is able to monitor the motor temperature in two different ways:
- Via a thermistor sensor fitted to the motor. The thermistor is connected to one of the analogue input terminals 53 and 54.
- Calculation of the thermal load (ETR - Electronic Thermal Relay), based on the current load and the time. This is compared with the rated motor current $I_{M,N}$ and the rated motor frequency $f_{M,N}$. The calculations made take into account the need for a lower load at lower speeds because of less cooling in the motor itself.

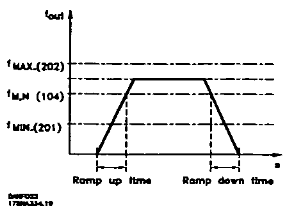
ETR functions 1-4 do not start calculating the load until there is a switch-over to the Setup in which they were selected. This enables the use of the ETR function, even where two or several motors alternate.



Description of choice:
Select *No protection* [0] if no warning or tripping is required when the motor is overloaded.
Select *Thermistor warning* [1] if a warning is desired when the connected thermistor gets too hot.
Select *Thermistor trip* [2] if cutting out (trip) is desired when the connected thermistor overheats.
Select *ETR Warning 1-4*, if a warning is to come up on the display when the motor is overloaded according to the calculations.
The VLT frequency converter can also be programmed to give off a warning signal via one of the digital outputs.
Select *ETR Trip 1-4* if tripping is desired when the motor is overloaded according to the calculations.

★ = factory setting. () = display text [] = value for use in communication via serial communication port

■ References & Limits 200 - 228



In this parameter group, the frequency and reference range of the VLT frequency converter are established.

This parameter group also includes:
- Setting of ramp times
- Choice of four preset references
- Possibility of programming four bypass frequencies.
- Setting of maximum current to motor.
- Setting of warning limits for current, frequency, reference and feedback.

---

200 Output frequency range
(FREQUENCY RANGE)

Value:

★ 0 - 120 Hz (0 - 120 HZ)	[0]
0 - 1000 Hz (0 - 1000 HZ)	[1]

Function:
This is where to select the maximum output frequency range to be set in parameter 202 *Output frequency high limit, f_{MAX}*.

Description of choice:
Select the required output frequency range.

---

201 Output frequency low limit, f_{MIN}
(MIN. FREQUENCY)

Value:
0.0 - f_{MAX} ★ 0.0 Hz

Function:
This is where to select the minimum output frequency.

Description of choice:
A value from 0.0 Hz to the *Output frequency high limit, f_{MAX}* frequency set in parameter 202 can be selected.

---

202 Output frequency high limit, f_{MAX}
(MAX. FREQUENCY)

Value:
f_{MIN} - 120/1000 Hz
(par. 200 *Output frequency range*) ★ 50 Hz

Function:
In this parameter, a maximum output frequency can be selected that corresponds to the highest speed at which the motor can be.

NB!
The output frequency of the VLT frequency converter can never assume a value higher than 1/10 of the switching frequency (parameter 407 *Switching frequency*).

Description of choice:
A value from f_{MIN} to the choice made in parameter 200 *Output frequency range* can be selected.

Programming

★ = factory setting. () = display text [] = value for use in communication via serial communication port

Reference handling

Reference handling is shown in the block diagram underneath.
The block diagram shows how a change in a parameter can affect the resulting reference.

Parameters 203 to 205 *Reference handling, minimum and maximum reference* and parameter 210 *Reference type* define the way reference handling can be carried out. The mentioned parameters are active both in a closed and in an open loop.

Remote references are defined as:

- External references, such as analogue inputs 53, 54 and 60, pulse reference via terminal 17/29 and reference from serial communication.
- Preset references.

The resulting reference can be shown in the display by selecting *Reference* [%] in parameters 007-010 *Display readout* and in the form of a unit by selecting *Resulting reference [unit]*.
See the section on *Feedback handling* in connection with a closed loop.

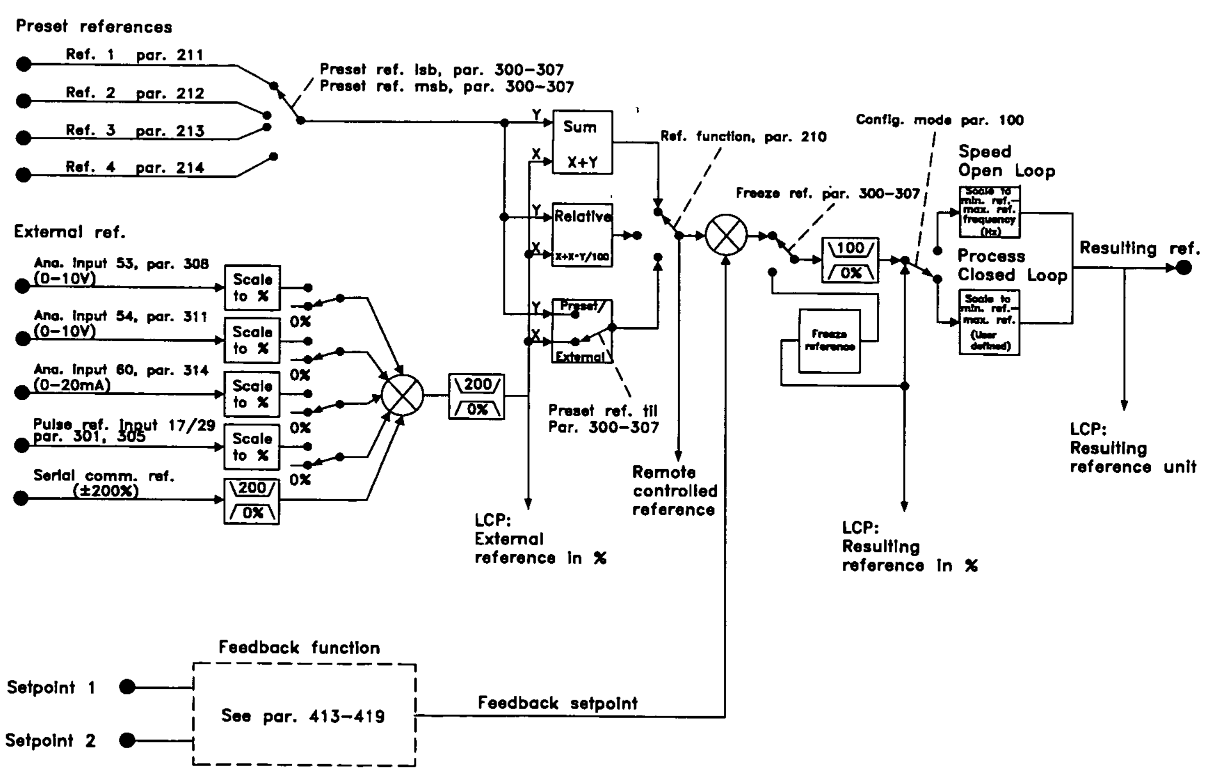
The sum of the external references can be shown in the display as a percentage of the range from *Minimum reference, Ref_{MIN}* to *Maximum reference, Ref_{MAX}*. Select *External reference, %* [25] in parameters 007-010 *Display readout* if a readout is required.

It is possible to have both preset references and external references at the same time. In parameter 210 *Reference type* a choice is made of how the preset references are to be added to the external references.

Furthermore, an independent local reference exists, where the resulting reference is set by means of the [+/-] keys. If local reference has been selected, the output frequency range is limited by parameter 201 *Output frequency low limit, f_{MIN}* and parameter 202 *Output frequency high limit, f_{MAX}*.

NB!
If the local reference is active, the VLT frequency converter will always be in *Open loop* [0], regardless of the choice made in parameter 100 *Configuration*.

The unit of the local reference can be set either as Hz or as a percentage of the output frequency range. The unit is selected in parameter 011 *Unit of local reference*.



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203 Reference site
(REFERENCE SITE)

Value:

★ Hand/Auto linked reference
(LINKED TO HAND/AUTO)) [0]
Remote reference (REMOTE) [1]
Local reference (LOCAL) [2]

Function:

This parameter decides which resulting reference is to be active. If *Hand/Auto linked reference* [0] is selected, the resulting reference will depend on whether the VLT frequency converter is in Hand or Auto mode.
The table shows which references are active when *Hand/Auto linked reference* [0], *Remote reference* [1] or *Local reference* [2] has been selected. The Hand mode or Auto mode can be selected via the control keys or via a digital input, parameters 300-307 *Digital inputs.*

Reference handling	Hand mode	Auto mode
Hand/Auto [0]	Local ref. active	Remote ref. active
Remote [1]	Remote ref. active	Remote ref. active
Local [2]	Local ref. active	Local ref. active

Description of choice:

If *Hand/Auto linked reference* [0] is chosen, the motor speed in Hand mode will be decided by the local reference, while in Auto mode it depends on remote references and any setpoints selected.
If *Remote reference* [1] is selected, the motor speed will depend on remote references, regardless of whether Hand mode or Auto mode has been chosen.
If *Local reference* [2] is selected, the motor speed will only depend on the local reference set via the control panel, regardless of whether Hand mode or Auto mode has been selected.

204 Minimum reference, Ref_{MIN}
(MIN. REFERENCE)

Value:

Parameter 100 *Configuration* = *Open loop* [0].
0.000 - parameter 205 Ref_{MAX} ★ 0.000 Hz

Parameter 100 *Configuration* = *Closed loop* [1].
-Par. 413 *Minimum feedback*
- par. 205 Ref_{MAX} ★ 0.000

Function:

The *Minimum reference* gives the minimum value that can be assumed by the sum of all references. If *Closed loop* has been selected in parameter 100 *Configuration*, the minimum reference is limited by parameter 413 *Minimum feedback*.
Minimum reference is ignored when the local reference is active (parameter 203 *Reference site*).
The unit for the reference can be seen from the following table:

	Unit
Par. 100 *Configuration* = *Open loop*	Hz
Par. 100 *Configuration* = *Closed loop*	Par. 415

Description of choice:

Minimum reference is set if the motor is to run at a minimum speed, regardless of whether the resulting reference is 0.

205 Maximum reference, Ref_{MAX}
(MAX. REFERENCE)

Value:

Parameter 100 *Configuration* = *Open loop* [0]
Parameter 204 Ref_{MIN} - 1000.000 Hz★ 50.000 Hz

Parameter 100 *Configuration* = *Closed loop* [1]
Par. 204 Ref_{MIN}
- par. 414 *Maximum feedback* ★ 50.000 Hz

Function:

The *Maximum reference* gives the maximum value that can be assumed by the sum of all references. If *Closed loop* [1] has been selected in parameter 100 *Configuration*, the maximum reference cannot be set above parameter 414 *Maximum feedback.* The *Maximum reference* is ignored when the local reference is active (parameter 203 *Reference site).*

Programming

Function, cont.:

The reference unit can be determined on the basis of the following table:

	Unit
Par. 100 *Configuration = Open loop*	Hz
Par. 100 *Configuration = Closed loop*	Par. 415

Description of choice:

Maximum reference is set if the motor speed is not to exceed the set value, regardless of whether the resulting reference is higher than *Maximum reference.*

---

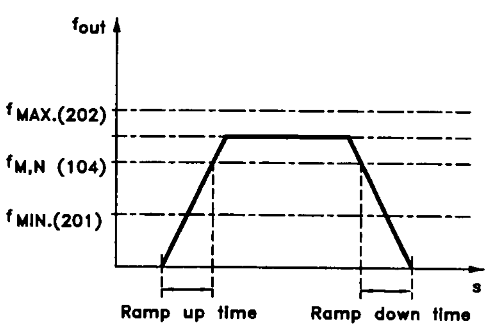
206 Ramp-up time (RAMP UP TIME)

Value:

1 - 3600 sec. ★ Depends on the unit

Function:

The ramp-up time is the acceleration time from 0 Hz to the rated motor frequency $f_{M,N}$ (parameter 104 *Motor frequency, $f_{M,N}$*). It is assumed that the output current does not reach the current limit (set in parameter 215 *Current limit I_{LIM}*).



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Description of choice:

Program the desired ramp-up time.

---

207 Ramp-down time (RAMP DOWN TIME)

Value:

1 - 3600 sec. ★ Depends on the unit

Function:

The ramp-down time is the deceleration time from the rated motor frequency $f_{M,N}$ (parameter 104 *Motor frequency, $f_{M,N}$*) to 0 Hz, provided there is no overvoltage in the inverter because of the motor acting as a generator.

Description of choice:

Program the desired ramp-down time.

---

208 Automatic ramp-down (AUTO RAMPING)

Value:

Disable (DISABLE) [0]

★ Enable (ENABLE) [1]

Function:

This function ensures that the VLT frequency converter does not trip during deceleration if the ramp-down time set is too short. If, during deceleration, the VLT frequency converter registers that the intermediate circuit voltage is higher than the max. value (see *List of warnings and alarms*), the VLT frequency converter automatically extends the ramp-down time.

NB!

If the function is chosen as *Enable* [1], the ramp time may be considerably extended in relation to the time set in parameter 207, *Ramp-down time*.

Description of choice:

Program this function as *Enable* [1] if the VLT frequency converter periodically trips during ramp-down. If a quick ramp-down time has been programmed that may lead to a trip under special conditions, the function can be set to *Enable* [1] to avoid trips.

---

209 Jog frequency (JOG FREQUENCY)

Value:

Par. 201 *Output frequency Low limit* - par. 202 *Output frequency high limit* ★ 10.0 Hz

Function:

The jog frequency f_{JOG} is the fixed output frequency at which the VLT frequency converter is running when the jog function is activated.

Jog can be activated via the digital inputs.

Description of choice:

Set the desired frequency.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

■ Reference type

The example shows how the resulting reference is calculated when Preset references are used together with Sum and Relative in parameter 210, *Reference type*. See *Calculation of resulting reference*.
See also the drawing in *Reference handling*.

The following parameters have been set:	
Par. 204 *Minimum reference:*	10 Hz
Par. 205 *Maximum reference:*	50 Hz
Par. 211 *Preset reference:*	15%
Par. 308 *Terminal 53, analogue input:*	Reference [1]
Par. 309 *Terminal 53, min. scaling:*	0 V
Par. 310 *Terminal 53, max. scaling:*	10 V

When parameter 210 *Reference type* is set to Sum [0], one of the adjusted *Preset references* (par. 211-214) will be added to the external references as a percentage of the reference range. If terminal 53 is energized by an analogue input voltage of 4 V, the resulting reference will be as follows:

Par. 210 *Reference type* = *Sum* [0]

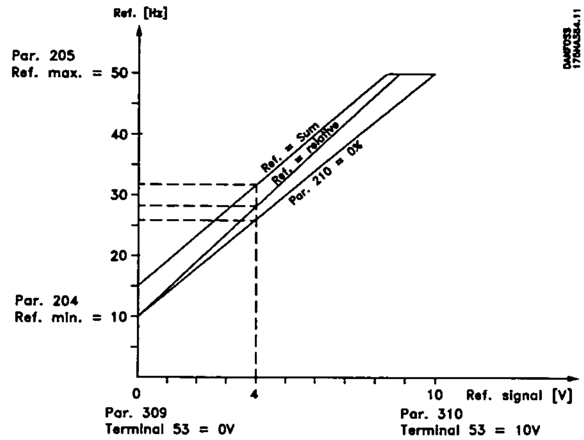
Par. 204 *Minimum reference*	= 10.0 Hz
Reference contribution at 4 V	= 16.0 Hz
Par. 211 *Preset reference*	= 6.0 Hz
Resulting reference	= 32.0 Hz

If parameter 210 *Reference type* is set to *Relative* [1], one of the adjusted *Preset references* (par. 211-214) will be totaled as a percentage of the sum of the present external references. If terminal 53 is energized by an analogue input voltage of 4 V, the resulting reference will be as follows:

Par. 210 *Reference type* = *Relative* [1]

Par. 204 *Minimum reference*	= 10.0 Hz
Reference contribution at 4 V	= 16.0 Hz
Par. 211 *Preset reference*	= 2.4 Hz
Resulting reference	= 28.4 Hz

The graph in the next column shows the resulting reference in relation to the external reference varied from 0-10 V.
Parameter 210 *Reference type* has been programmed for *Sum* [0] and *Relative* [1], respectively. In addition, a graph is shown in which parameter 211 *Preset reference 1* is programmed for 0%.



210 Reference type
(REF. FUNCTION)

Value:

★	Sum (SUM)	[0]
	Relative (RELATIVE)	[1]
	External/preset (EXTERNAL/PRESET)	[2]

Function:

It is possible to define how the preset references are to be added to the other references. For this purpose, *Sum* or *Relative* is used. It is also possible - by using the *External/preset* function - to select whether a shift between external references and preset references is wanted.
See *Reference handling*.

Description of choice:

If *Sum* [0] is selected, one of the adjusted preset references (parameters 211-214 *Preset reference*) is added to the other external references as a percentage of the reference range (Ref_{MIN}-Ref_{MAX}).
If *Relative* [1] is selected, one of the adjusted preset references (parameters 211-214 *Preset reference*) is totaled as a percentage of the sum of the present external references.
If *External/preset* [2] is selected, it is possible to shift between external references and preset references via terminal 16, 17, 29, 32 or 33 (parameter 300, 301, 305, 306 or 307 *Digital inputs*). Preset references will be a percentage value of the reference range.
External reference is the sum of the analogue references, pulse references and any references from serial communication.

NB!
If *Sum* or *Relative* is selected, one of the preset references will always be active. If the preset references are to be without influence, they should be set to 0% (as in the factory setting) via the serial communication port.

Programming

★ = factory setting. () = display text [] = value for use in communication via serial communication port

211 Preset reference 1 (PRESET REF. 1)
212 Preset reference 2 (PRESET REF. 2)
213 Preset reference 3 (PRESET REF. 3)
214 Preset reference 4 (PRESET REF. 4)

Value:

-100.00 % - +100.00 % ★ 0.00%
of the reference range/external reference

Function:

Four different preset references can be programmed in parameters 211-214 *Preset reference*. The preset reference is stated as a percentage value of the reference range (Ref_{MIN} - Ref_{MAX}) or as a percentage of the other external references, depending on the choice made in parameter 210 *Reference type*.
The choice between the preset references can be made by activating terminal 16, 17, 29, 32 or 33, cf. the table below.

Terminal 17/29/33 preset ref. msb	Terminal 16/29/32 preset ref. lsb	
0	0	Preset ref. 1
0	1	Preset ref. 2
1	0	Preset ref. 3
1	1	Preset ref. 4

Description of choice:

Set the required preset reference(s) that is/are to be the options.

215 Current limit, I_{LIM}
(CURRENT LIMIT)

Value:

0.1 - 1.1 x $I_{VLT,N}$ ★ 1.1 x $I_{VLT,N}$ [A]

Function:

This is where the maximum output current I_{LIM} is set. The factory setting corresponds to the rated output current. Current limit should not be used for motor protection; parameter 117 is for motor protection. Current limit is for protection of the VLT frequency converter. If the current limit is set within the range of 1.0-1.1 x $I_{VLT,N}$ (the rated output current of the VLT frequency converter), the VLT frequency converter can only handle a load intermittently, i.e. for short periods at a time. After the load has been higher than $I_{VLT,N}$, it must be ensured that for a period the load is lower than $I_{VLT,N}$.
Please note that if the current limit is set to less than $I_{VLT,N}$, the acceleration torque will be reduced correspondingly.

Description of choice:

Set the required maximum output current I_{LIM}.

216 Frequency bypass, bandwidth
(FREQUENCY BYPASS B.W.)

Value:

0 (OFF) - 100 Hz ★ Disable

Function:

Some systems call for some output frequencies to be avoided because of mechanical resonance problems.
The frequencies to avoid can be programmed in parameters 217-220 *Frequency bypass*.
In this parameter (216 *Frequency bypass, bandwidth*), a definition can be given of a bandwidth around each of these frequencies.

Description of choice:

The bypass bandwidth is equal to the programmed bandwidth frequency. This bandwidth will be centered around each bypass frequency.

217 Frequency bypass 1
(BYPASS FREQ. 1)
218 Frequency bypass 2
(BYPASS FREQ. 2)
219 Frequency bypass 3
(BYPASS FREQ. 3)
220 Frequency bypass 4
(BYPASS FREQ. 4)

Value:

0 - 120/1000 Hz ★ 120.0 Hz
The frequency range depends on the selection made in parameter 200 *Output frequency range*.

Function:

Some systems call for some output frequencies to be avoided because of mechanical resonance problems in the system.

Description of choice:

Enter the frequencies to be avoided.
See also parameter 216 *Frequency bypass, bandwidth*.

221 Warning: Low current, I_{LOW}
(WARN. LOW CURR.)

Value:

0.0 - par. 222 *Warning: High current, I_{HIGH}* ★0.0A

Function:

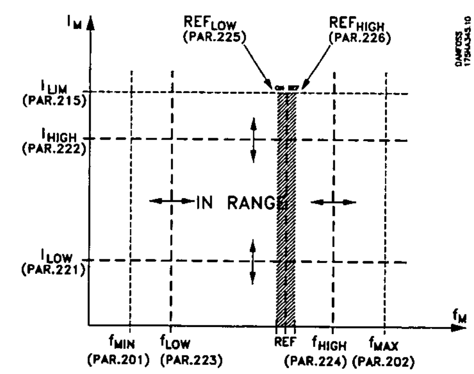
When the motor current is below the limit, I_{LOW}, programmed in this parameter, the display shows a flashing CURRENT LOW, provided *Warning* [1] has been selected in parameter 409 *Function in case of no load*. The VLT frequency converter will trip if parameter 409 *Function in case of no load* has been selected as *Trip* [0].

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.

The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

Description of choice:

The lower signal limit I_{LOW} must be programmed within the normal working range of the frequency converter.



222 Warning: High current, I_{HIGH}
(WARN. HIGH CURR.)

Value:

Parameter 221 - $I_{VLT,MAX}$ ★ $I_{VLT,MAX}$

Function:

If the motor current is above the limit, I_{HIGH}, programmed in this parameter, the display shows a flashing CURRENT HIGH.

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.

The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

Description of choice:

The upper signal limit of the motor frequency, f_{HIGH}, must be programmed within the normal working range of the frequency converter. See drawing at parameter 221 *Warning: Low current, I_{LOW}*.

223 Warning: Low frequency, f_{LOW}
(WARN. LOW FREQ.)

Value:

0.0 - parameter 224 ★ 0.0 Hz

Function:

If the output frequency is below the limit, f_{LOW}, programmed in this parameter, the display will show a flashing FREQUENCY LOW.

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.

The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

Description of choice:

The lower signal limit of the motor frequency, f_{LOW}, must be programmed within the normal working range of the frequency converter. See drawing at parameter 221 *Warning: Low current, I_{LOW}*.

★ = factory setting. () = display text [] = value for use in communication via serial communication port

224 Warning: High frequency, f_{HIGH}
(WARN. HIGH FREQ.)

Value:

Par. 200 *Output frequency range* = 0-120 Hz [0].
parameter 223 - 120 Hz ★ 120.0 Hz

Par. 200 *Output frequency range* = 0-1000 Hz [1].
parameter 223 - 1000 Hz ★ 120.0 Hz

Function:

If the output frequency is above the limit, f_{HIGH}, programmed in this parameter, the display will show a flashing FREQUENCY HIGH.
The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.
The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

Description of choice:

The higher signal limit of the motor frequency, f_{HIGH}, must be programmed within the normal working range of the frequency converter. See drawing at parameter 221 *Warning: Low current, I_{LOW}*.

---

225 Warning: Low reference, REF_{LOW}
(WARN. LOW REF.)

Value:

-999,999.999 - REF_{HIGH} (par.226) ★ -999,999.999

Function:

When the remote reference lies under the limit, Ref_{LOW}, programmed in this parameter, the display shows a flashing REFERENCE LOW.

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.
The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.
The reference limits in parameter 226 *Warning: High reference, Ref_{HIGH}*, and in parameter 227 *Warning: Low reference, Ref_{LOW}*, are only active when remote reference has been selected.
In *Open loop mode* the unit for the reference is Hz, while in *Closed loop mode* the unit is programmed in parameter 415 *Process units*.

Description of choice:

The lower signal limit, Ref_{LOW}, of the reference must be programmed within the normal working range of the frequency converter, provided parameter 100 *Configuration* has been programmed for *Open loop* [0]. In *Closed loop* [1] (parameter 100), Ref_{LOW} must be within the reference range programmed in parameters 204 and 205.

---

226 Warning: High reference, REF_{HIGH}
(WARN. HIGH REF.)

Value:

REF_{Low} (par. 225) - 999,999.999 ★ 999,999.999

Function:

If the resulting reference lies under the limit, Ref_{HIGH}, programmed in this parameter, the display shows a flashing REFERENCE HIGH.
The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.
The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.
The reference limits in parameter 226 *Warning: High reference, Ref_{HIGH}*, and in parameter 227 *Warning: Low reference, Ref_{LOW}*, are only active when remote reference has been selected.
In *Open loop* the unit for the reference is Hz, while in *Closed loop* the unit is programmed in parameter 415 *Process units*.

Description of choice:

The upper signal limit, Ref_{HIGH}, of the reference must be programmed within the normal working range of the frequency converter, provided parameter 100 *Configuration* has been programmed for *Open loop* [0]. In *Closed loop* [1] (parameter 100), Ref_{HIGH} must be within the reference range programmed in parameters 204 and 205.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

227 Warning: Low feedback, FB_{LOW} (WARN LOW FDBK)

Value:

-999,999.999 - FB_{HIGH} (parameter 228)

★ -999.999,999

Function:

If the feedback signal is below the limit, FB_{LOW}, programmed in this parameter, the display will show a flashing FEEDBACK LOW.

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.

The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

In *Closed loop*, the unit for the feedback is programmed in parameter 415 *Process units*.

Description of choice:

Set the required value within the feedback range (parameter 413 *Minimum feedback*, FB_{MIN}, and 414 *Maximum feedback*, FB_{MAX}).

228 Warning: High feedback, FB_{HIGH} (WARN. HIGH FDBK)

Value:

FB_{LOW} (parameter 227) - 999,999.999

★ 999.999,999

Function:

If the feedback signal is above the limit, FB_{HIGH}, programmed in this parameter, the display will show a flashing FEEDBACK HIGH.

The warning functions in parameters 221-228 are not active during ramp-up after a start command, ramp-down after a stop command or while stop-ped. The warning functions are activated when the output frequency has reached the resulting reference.

The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

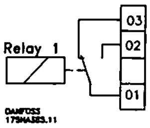
In *Closed loop*, the unit for the feedback is programmed in parameter 415 *Process units*.

Description of choice:

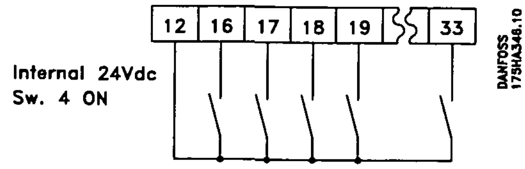
Set the required value within the feedback range (parameter 413 *Minimum feedback*, FB_{MIN}, and 414 *Maximum feedback*, FB_{MAX}).

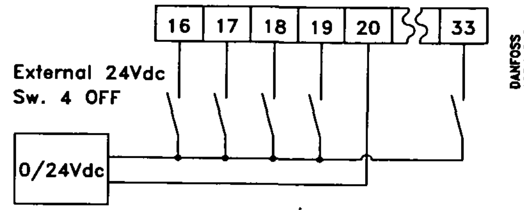
★ = factory setting. () = display text [] = value for use in communication via serial communication port

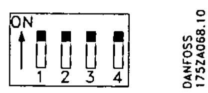
■ Inputs and outputs 300-328



In this parameter group, the functions that relate to the input and output terminals of the VLT frequency converter are defined. The digital inputs (terminals 16, 17, 18, 19, 27, 32 and 33) are programmed in parameters 300-307. The table below gives the options for programming the inputs. The digital inputs require a signal of 0 or 24 V DC. A signal lower than 5 V DC is a logic '0', while a signal higher than 10 V DC is a logic '1'.
The terminals for the digital inputs can be connected to the internal 24 V DC supply, or an external 24 V DC supply can be connected.
The drawings in the next column show one Setup using the internal 24 V DC supply and one Setup using an external 24 V DC supply.







Switch 4, which is located on the Dip switch control card, is used for separating the common potential of the internal 24 V DC supply from the common potential of the external 24 V DC supply. See *Electrical installation.*
Please note that when Switch 4 is in the OFF position, the external 24 V DC supply is galvanically isolated from the VLT frequency converter.

Digital inputs	**terminal no.**	**16**	**17**	**18**	**19**	**27**	**29**	**32**	**33**
	parameter	**300**	**301**	**302**	**303**	**304**	**305**	**306**	**307**
Value:									
No function	(NO OPERATION)	[0]	[0]	[0]	[0]		[0]	★[0]	★[0]
Reset	(RESET)	★[1]	[1]				[1]	[1]	[1]
Coasting stop, inverse	(COAST INVERSE)					★[0]			
Reset and coasting stop, inverse	(RESET & COAST INVERSE)					[1]			
Start	(START)			★[1]					
Reversing	(REVERSE)				★[1]				
Reversing and start	(START REVERSE)				[2]				
DC-braking, inverse	(DC BRAKE INVERSE)				[3]	[2]			
Safety interlock	(SAFETY INTERLOCK)					[3]			
Freeze reference	(FREEZE REFERENCE)	[2]	★[2]				[2]	[2]	[2]
Freeze output	(FREEZE OUTPUT)	[3]	[3]				[3]	[3]	[3]
Selection of Setup, lsb	(SETUP SELECT LSB)	[4]					[4]	[4]	
Selection of Setup, msb	(SETUP SELECT MSB)		[4]				[5]		[4]
Preset reference, on	(PRESET REF. ON)	[5]	[5]				[6]	[5]	[5]
Preset reference, lsb	(PRESET REF. LSB)	[6]					[7]	[6]	
Preset reference, msb	(PRESET REF. MSB)		[6]				[8]		[6]
Speed down	(SPEED DOWN)		[7]				[9]		[7]
Speed up	(SPEED UP)	[7]					[10]	[7]	
Run permissive	(RUN PERMISSIVE)	[8]	[8]				[11]	[8]	[8]
Jog	(JOG)	[9]	[9]				★[12]	[9]	[9]
Data change lock	(PROGRAMMING LOCK)	[10]	[10]				[13]	[10]	[10]
Pulse reference	(PULSE REFERENCE)		[11]				[14]		
Pulse feedback	(PULSE FEEDBACK)								[11]
Hand start	(HAND START)	[11]	[12]				[15]	[11]	[12]
Auto start	(AUTOSTART)	[12]	[13]				[16]	[12]	[13]

★ = factory setting. () = display text [] = value for use in communication via serial communication port

Function:

In parameters 300-307 *Digital inputs* it is possible to choose between the different possible functions related to the digital inputs (terminals 16-33).
The functional options are given in the table on the previous page.

Description of choice:

No function is selected if the VLT frequency converter is not to react to signals transmitted to the terminal.

Reset resets the VLT frequency converter after an alarm; however, trip locked alarms cannot be reset by cycling mains power supply. See table in *List of warnings and alarms*. Reset will occur on the rising edge of the signal.

Coasting stop, inverse is used to force the VLT frequency converter to "release" the motor immediately (the output transistors are "turned off") to make it coast freely to stop. Logic '0' implements coasting to stop.

Reset and coasting stop, inverse is used for activating coasting stop at the same time as reset. Logic '0' implements coasting stop and reset.
Reset will be activate on the falling edge of the signal.

DC braking, inverse is used for stopping the motor by energizing it with a DC voltage for a given time, see parameters 114-116 *DC brake*.
Please note that this function is only active if the value of parameters 114 *DC brake current* and 115 *DC braking time* is different from 0. Logic '0' implements DC braking. See *DC braking*.

Safety interlock has the same function as *Coasting stop, inverse*, but *Safety interlock* generates the alarm message 'external fault' on the display when terminal 27 is logic '0'. The alarm message will also be active via digital outputs 42/45 and relay outputs 1/2, if programmed for *Safety interlock*. The alarm can be reset using a digital input or the [OFF/STOP] key.

Start is selected if a start/stop command is required. Logic '1' = start, logic '0' = stop.

Reversing is used for changing the direction of rotation of the motor shaft. Logic '0' will not implement reversing. Logic '1' will implement reversing.
The reversing signal only changes the direction of rotation; it does not activate the start function.
Is not active together with *Closed loop*.

Reversing and start is used for start/stop and reversing using the same signal.
A start signal via terminal 18 at the same time is not allowed.
Is not active together with *Closed loop*.

Freeze reference freezes the present reference. The frozen reference can now only be changed by means of *Speed up* or *Speed down*. The frozen reference is saved after a stop command and in case of mains failure.

Freeze output freezes the present output frequency (in Hz). The frozen output frequency can now only be changed by means of *Speed up* or *Speed down*.

NB!
If *Freeze output* is active, the VLT frequency converter cannot be stopped via terminal 18. The VLT frequency converter can only be stopped when terminal 27 or terminal 19 has been programmed for *DC braking, inverse*.

Selection of Setup, lsb and *Selection of Setup, msb* enables a choice of one of the four Setups. However, this presupposes that parameter 002 *Active Setup* has been set at *Multi Setup* [5].

	Setup, msb	Setup, lsb
Setup 1	0	0
Setup 2	0	1
Setup 3	1	0
Setup 4	1	1

Preset reference, on is used for switching between remote reference and preset reference. This assumes that *Remote/preset* [2] has been selected in parameter 210 *Reference type*. Logic '0' = remote references active; logic '1' = one of the four preset references is active in accordance with the table below.

Preset reference, lsb and *Preset reference, msb* enables a choice of one of the four preset references, in accordance with the table below.

	Preset ref. msb	Preset ref. lsb
Preset ref. 1	0	0
Preset ref. 2	0	1
Preset ref. 3	1	0
Preset ref. 4	1	1

Programming

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

Speed up and ***Speed down*** are selected if digital control of the up/down speed is desired. This function is only active if *Freeze reference* or *Freeze output* has been selected.
As long as there is a logic '1' on the terminal selected for *Speed up*, the reference or the output frequency will increase by the *Ramp-up time* set in parameter 206.
As long as there is a logic '1' on the terminal selected for Speed down, the reference or the output frequency will increase by the *Ramp-down time* set in parameter 207.
Pulses (logic '1' minimum high for 3 ms and a minimum pause of 3 ms) will lead to a change of speed of 0.1% (reference) or 0.1 Hz (output frequency).

Example:

	Terminal (16)	Terminal (17)	Freeze ref./ Freeze output
No speed change	0	0	1
Speed down	0	1	1
Speed up	1	0	1
Speed down	1	1	1

The speed reference frozen via the control panel can be changed even if the VLT frequency converter has stopped. In addition, the frozen reference will be rememberd in case of a mains failure.

Run permissive. There must be an active start signal via the terminal, where *Run permissive* has been programmed, before a start command can be accepted. *Run permissive* has a logic 'AND' function related to Start (terminal 18, parameter 302 *Terminal 18, Digital input*), which means that in order to start the motor, both conditions must be fulfilled. If *Run permissive* is programmed on several terminals, *Run permissive* must only be logic '1' on one of the terminals for the function to be carried out. See *Example of application - Speed control of fan in ventilation system.*

Jog is used to override the output frequency to the frequency set in parameter 209 *Jog frequency* and issue a start command. If local reference is active, the VLT frequency converter will always be in *Open loop* [0], regardless of the selection made in parameter 100 *Configuration*.
Jog is not active if a stop command has been given via terminal 27.

Data change lock is selected if data changes to parameters are not to be made via the control unit; however, it will still be possible to carry out data changes via the bus.

Pulse reference is selected if a pulse sequence (frequency) is selected as a reference signal.
0 Hz corresponds to Ref_{MIN}, parameter 204 *Minimum reference,* Ref_{MIN}.
The frequency set in parameter 327 *Pulse reference, max. frequency* corresponds to parameter 205 *Maximum reference,* Ref_{MAX}.

Pulse feedback is selected if a pulse sequence (frequency) is selected as a feedback signal.
Parameter 328 *Pulse feedback, max. frequency* is where the maximum frequency for pulse feedback is set.

Hand start is selected if the VLT frequency converter is to be controlled by means of an external hand/off or H-O-A switch. A logic '1' (Hand start active) will mean that the VLT frequency converter starts the motor. A logic '0' means that the connected motor stops. The VLT frequency converter will then be in OFF/STOP mode, unless there is an active *Auto start signal*. See also the description in *Local control*.

NB!
An active *Hand* and *Auto* signal via the digital inputs will have higher priority than the [HAND START]-[AUTO START] control keys.

Auto start is selected if the VLT frequency converter is to be controlled via an external auto/off or H-O-A switch. A logic '1' will place the VLT frequency converter in auto mode allowing a start signal on the control terminals or the serial communication port. If *Auto start* and *Hand start* are active at the same time on the control terminals, *Auto start* will have the highest priority. If *Auto start* and *Hand start* are not active, the connected motor will stop and the VLT frequency converter will then be in OFF/STOP mode.

■ Analogue inputs

Two analogue inputs for voltage signals (terminals 53 and 54) are provided for reference and feedback signals. Furthermore, an analogue input is available for a current signal (terminal 60). A thermistor can be connected to voltage input 53 or 54.
The two analogue voltage inputs can be scaled in the range of 0-10 V DC; the current input in the range of 0-20 mA.

The table below gives the possibilities for programming the analogue inputs.
Parameter 317 *Time out* and 318 *Function after time out* allow activation of a time-out function on all analogue inputs. If the signal value of the reference or feedback signal connected to one of the analogue input terminals drops to below 50% of the minimum scaling, a function will be activated after the time out determined in parameter 318, *Function after time out*.

Analogue inputs	terminal no.	53(voltage)	54(voltage)	60(current)
	parameter	308	311	314
Value:				
No operation	(NO OPERATION)	[0]	[0] ★	[0]
Reference	(REFERENCE	[1] ★	[1]	[1] ★
Feedback	(FEEDBACK)	[2]	[2]	[2]
Thermistor	(THERMISTOR)	[3]	[3]	

308 Terminal 53, analogue input voltage (AI [V] 53 FUNCT.)

Function:

This parameter is used to select the required function to be linked to terminal 53.

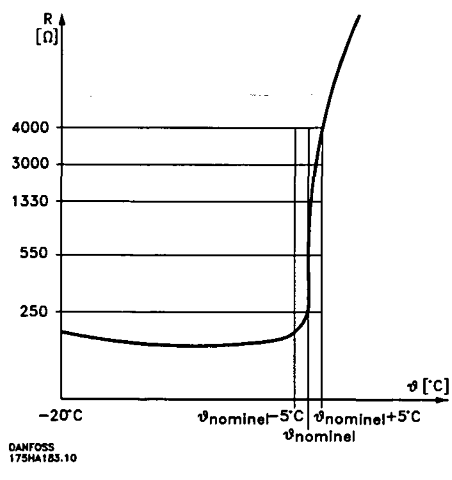
Description of choice:

No operation. Is selected if the VLT frequency converter is not to react to signals connected to the terminal.

Reference. Is selected to enable change of reference by means of an analogue reference signal.
If reference signals are connected to several inputs, these reference signals must be added up.

Feedback. If a feedback signal in connected, there is a choice of a voltage input (terminal 53 or 54) or a current input (terminal 60) as feedback. In the case of zone regulation, feedback signals must be selected as voltage inputs (terminals 53 and 54).
See *Feedback handling*.

Thermistor. Is selected if a thermistor integrated in the motor is to be able to stop the VLT frequency converter in case of motor overtemperature. The cut-out value is 3 kohm.
If a motor features a Klixon thermal switch instead, this can also be connected to the input. If motors run in parallel, the thermistors/thermal switches can be connected in series (total resistance < 3 kohm).
Parameter 117 *Motor thermal protection* must be programmed for *Thermal warning* [1] or *Thermistor trip* [2], and the thermistor must be inserted between terminal 53 or 54 (analogue voltage input) and terminal 50 (+10 V supply).



Programming

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

309 Terminal 53, min. scaling
(AI 53 SCALE LOW)

Value:

0.0 - 10.0 V ★ 0.0 V

Function:

This parameter is used for setting the signal value that has to correspond to the minimum reference or the minimum feedback, parameter 204 *Minimum reference, Ref_{MIN}*/413 *Minimum feedback, FB_{MIN}*. See *Reference handling* or *Feedback handling*.

Description of choice:

Set the required voltage value.
For reasons of accuracy, voltage losses in long signal lines can be compensated for.
If the time-out function is to be applied (parameters 317 *Time out* and 318 *Function after time out*), the value must be set to > 1 V.

310 Terminal 53, max. scaling
(AI 53 SCALE HIGH)

Value:

0.0 - 10.0 V ★ 10.0 V

Function:

This parameter is used for setting the signal value that has to correspond to the maximum reference value or the maximum feedback, parameter 205 *Maksimum reference, Ref_{MAX}*/414 *Maximum feedback, FB_{MAX}*. See *Reference handling* or *Feedback handling*.

Description of choice:

Set the required voltage value.
For reasons of accuracy, voltage losses in long signal lines can be compensated for.

311 Terminal 54, analogue input voltage
(AI [V] 54 FUNCT.)

Value:

See description of parameter 308. ★ No operation

Function:

This parameter chooses between the different functions available for the input, terminal 54.
Scaling of the input signal is effected in parameter 312 *Terminal 54, min. scaling* and in parameter 313 *Terminal 54, max. scaling*.

Description of choice:

See description of parameter 308.
For reasons of accuracy, voltage losses in long signal lines should be compensated for.

312 Terminal 54, min. scaling
(AI 54 SCALE LOW)

Value:

0.0 - 10.0 V ★ 0.0 V

Function:

This parameter is used for setting the signal value that corresponds to the minimum reference value or the minimum feedback, parameter 204 *Minimum reference, Ref_{MIN}*/413 *Minimum feedback, FB_{MIN}*. See *Reference handling* or *Feedback handling*.

Description of choice:

Set the required voltage value.
For reasons of accuracy, voltage losses in long signal lines can be compensated for.
If the time-out function is to be applied (parameters 317 *Time out* and 318 *Function after time out*), the value must be set to > 1 V.

313 Terminal 54, max. scaling
(AI 54 SCALE HIGH)

Value:

0.0 - 10.0 V ★ 10.0 V

Function:

This parameter is used for setting the signal value that corresponds to the maximum reference value or the maximum feedback, parameter 205 *Maximum reference, Ref_{MAX}*/414 *Maximum feedback, FB_{MAX}*. See *Reference handling* or *Feedback handling*.

Description of choice:

Set the required voltage value.
For reasons of accuracy, voltage losses in long signal lines can be compensated for.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

314 Terminal 60, analogue input current (AI [mA] 60 FUNCT.)

Value:

See description of parameter 308. ★ Reference

Function:

This parameter allows a choice between the different functions available for the input, terminal 60.
Scaling of the input signal is effected in parameter 315 *Terminal 60, min. scaling* and in parameter 316 *Terminal 60, max. scaling*.

Description of choice:

See description of parameter 308 *Terminal 53, analogue input voltage*.

315 Terminal 60, min. scaling (AI 60 SCALE LOW)

Value:

0.0 - 20.0 mA ★ 4.0 mA

Function:

This parameter determines the signal value that corresponds to the minimum reference or the minimum feedback, parameter 204 *Minimum reference, Ref_{MIN}*/413 *Minimum feedback, FB_{MIN}*. See *Reference handling* or *Feedback handling*.

Description of choice:

Set the required current value.
If the time-out function is to be used (parameters 317 *Time out* and 318 *Function after time out*), the value must be set to > 2 mA.

316 Terminal 60, max. scaling (AI 60 SCALE HIGH)

Value:

0.0 - 20.0 mA ★ 20.0 mA

Function:

This parameter determines the signal value that corresponds to the maximum reference value, parameter 205 *Maximum reference value, Ref_{MAX}*. See *Reference handling* or *Feedback handling*.

Description of choice:

Set the desired current value.

317 Time out (LIVE ZERO TIME)

Value:

1 - 99 sec. ★ 10 sec.

Function:

If the signal value of the reference or feedback signal connected to one of the input terminals 53, 54 or 60 drops to below 50% of the minimum scaling during a period longer than the preset time, the function selected in parameter 318 *Function after time out* will be activated.
This function will only be active if, in parameter 309 or 312, a value has been selected for *terminals 53 and 54, min. scaling* that exceeds 1 V, or if, in parameter 315 *Terminal 60, min. scaling*, a value has been selected that exceeds 2 mA.

Description of choice:

Set the desired time.

318 Function after time out (LIVE ZERO FUNCT.)

Value:

★ Off (NO FUNCTION)	[0]
Freeze output frequency (FREEZE OUTPUT FREQ.)	[1]
Stop (STOP)	[2]
Jog (JOG FREQUENCY)	[3]
Max. output frequency (MAX FREQUENCY)	[4]
Stop and trip (STOP AND TRIP)	[5]

Function:

This is where to select the function to be activated after the end of the time-out period (parameter 317 *Time out*).

If a time-out function occurs at the same time as a bus time-out function (parameter 556 *Bus time interval function*), the time-out function in parameter 318 will be activated.

Description of choice:

The output frequency of the VLT frequency converter can be:

- frozen at the present value [1]
- overruled to stop [2]
- overruled to jog frequency [3]
- overruled to max. output frequency [4]
- overruled to stop with subsequent trip [5].

Programming

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

■ Analogue/digital outputs

The two analogue/digital outputs (terminals 42 and 45) can be programmed to show the present status or a process value such as 0 - f_{MAX}.
If the VLT frequency converter is used as a digital output, it gives the present status by means of 0 or 24 V DC.
If the analogue output is used for giving a process value, there is a choice of three types of output signal: 0-20 mA, 4-20 mA or 0-32000 pulses (depending on the value set in parameter 322 *Terminal 45, output, pulse scaling*.
If the output is used as a voltage output (0-10 V), a pull-down resistor of 500 Ω should be fitted to terminal 39 (common for analogue/digital outputs). If the output is used as a current output, the resulting impedance of the connected equipment should not exceed 500 Ω.

Analogue/digital outputs terminal no.	42	45
parameter	319	321
Value:		
No function (NO FUNCTION)	[0]	[0]
Drive ready (UN. READY)	[1]	[1]
Standby (STAND BY)	[2]	[2]
Running (RUNNING)	[3]	[3]
Running at ref. value (RUNNING AT REFERENCE)	[4]	[4]
Running, no warning (RUNNING NO WARNING)	[5]	[5]
Local reference active (DRIVE IN LOCAL REF.)	[6]	[6]
Remote references active (DRIVE IN REMOTE REF.)	[7]	[7]
Alarm (ALARM)	[8]	[8]
Alarm or warning (ALARM OR WARNING)	[9]	[9]
No alarm (NO ALARM)	[10]	[10]
Current limit (CURRENT LIMIT)	[11]	[11]
Safety interlock (SAFETY INTERLOCK)	[12]	[12]
Start command active (START SIGNAL APPLIED)	[13]	[13]
Reversing (RUNNING IN REVERSE)	[14]	[14]
Thermal warning (THERMAL WARNING)	[15]	[15]
Hand mode active (DRIVE IN HAND MODE)	[16]	[16]
Auto mode active (DRIVE IN AUTO MODE)	[17]	[17]
Sleep mode (SLEEP MODE)	[18]	[18]
Output frequency lower than f_{LOW} parameter 223 (F OUT < F LOW)	[19]	[19]
Output frequency higher than f_{HIGH} parameter 223 (F OUT > F HIGH)	[20]	[20]
Out of frequency range (FREQ. RANGE WARN.)	[21]	[21]
Output current lower than I_{LOW} parameter 221 (I OUT < I LOW)	[22]	[22]
Output current higher than I_{HIGH} parameter 222 (I OUT > I HIGH)	[23]	[23]
Out of current range (CURRENT RANGE WARN)	[24]	[24]
Out of feedback range (FEEDBACK RANGE WARN.)	[25]	[25]
Out of reference range (REFERENCE RANGE WARN)	[26]	[26]
Relay 123 (RELAY 123)	[27]	[27]
Mains imbalance (MAINS IMBALANCE)	[28]	[28]
Output frequency, 0 - f_{MAX} ⇒ 0-20 mA (OUT. FREQ. 0-20 mA)	[29]	★ [29]
Output frequency, 0 - f_{MAX} ⇒ 4-20 mA (OUT. FREQ. 4-20 mA)	[30]	[30]
Output frequency (pulse sequence), 0 - f_{MAX} ⇒ 0-32000 p (OUT. FREQ. PULSE)	[31]	[31]
External reference, Ref_{MIN} - Ref_{MAX} ⇒ 0-20 mA (EXT. REF. 0-20 mA)	[32]	[32]
External reference, Ref_{MIN} - Ref_{MAX} ⇒ 4-20 mA (EXTERNAL REF. 4-20 mA)	[33]	[33]
External reference (pulse sequence), Ref_{MIN} - Ref_{MAX} ⇒ 0-32000 p (EXTERNAL REF. PULSE)	[34]	[34]
Feedback, FB_{MIN} - FB_{MAX} ⇒ 0-20 mA (FEEDBACK 0-20 mA)	[35]	[35]
Feedback, FB_{MIN} - FB_{MAX} ⇒ 4-20 mA (FEEDBACK 4-20 mA)	[36]	[36]
Feedback (pulse sequence), FB_{MIN} - FB_{MAX} ⇒ 0 - 32000 p (FEEDBACK PULSE)	[37]	[37]
Output current, 0 - I_{MAX} ⇒ 0-20 mA (MOTOR CUR. 0- 20 mA)	★ [38]	[38]
Output current, 0 - I_{MAX} ⇒ 4-20 mA (MOTOR CUR. 4- 20 mA)	[39]	[39]
Output current (pulse sequence), 0 - I_{MAX} ⇒ 0 - 32000 p (MOTOR CUR. PULSE)	[40]	[40]
Output power, 0 - P_{NOM} ⇒ 0-20 mA (MOTOR POWER 0-20 mA)	[41]	[41]
Output power, 0 - P_{NOM} ⇒ 4-20 mA (MOTOR POWER 4-20 mA)	[42]	[42]
Output power (pulse sequence), 0 - P_{NOM} ⇒ 0- 32000 p (MOTOR POWER PULSE)	[43]	[43]

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Function:

This output can act both as a digital or an analogue output. If used as a digital output (data value [0]-[59]), a 0/24 V DC signal is transmitted; if used as an analogue output, either a 0-20 mA signal, a 4-20 mA signal or a pulse sequence of 0-32000 pulses is transmitted.

Description of choice:

No function. Selected if the VLT frequency converter is not to react to signals.

Drive ready. The VLT frequency converter control card receives a supply voltage and the frequency converter is ready for operation.

Stand by. The VLT frequency converter is ready for operation, but no start command has been given. No warning.

Running. A start command has been given.

Running at ref. value. Speed according to reference.

Running, no warning. A start command has been given. No warning.

Local reference active. The output is active when the motor is controlled by means of the local reference via the control unit.

Remote references active. The output is active when the VLT frequency converter is controlled by means of the remote references.

Alarm. The output is activated by an alarm.

Alarm or warning. The output is activated by an alarm or a warning.

No alarm. The output is active when there is no alarm.

Current limit. The output current is greater than the value programmed in parameter 215 *Current limit* I_{LIM}.

Safety interlock. The output is active when terminal 27 is a logic '1' and *Safety interlock* has been selected on the input.

Start command active. Is active when there is a start command or the output frequency is above 0.1 Hz.

Reversing. There is 24 V DC on the output when the motor rotates anti-clockwise. When the motor rotates clockwise, the value is 0 V DC.

Thermal warning. The temperature limit in either the motor, the VLT frequency converter or a thermistor connected to an analogue input has been exceeded.

Hand mode active. The output is active when the VLT frequency converter is in Hand mode.

Auto mode active. The output is active when the VLT frequency converter is in Auto mode.

Sleep mode. Active when the VLT frequency converter is in Sleep mode.

Output frequency lower than f_{LOW}. The output frequency is lower than the value set in parameter 223 *Warning: Low frequency,* f_{LOW}.

Output frequency higher than f_{HIGH}. The output frequency is higher than the value set in parameter 224 *Warning: High frequency,* f_{HIGH}.

Out of frequency range. The output frequency is outside the frequency range programmed in parameter 223 *Warning: Low frequency,* f_{LOW} and 224 *Warning: High frequency,* f_{HIGH}.

Output current lower than I_{LOW}. The output current is lower than the value set in parameter 221 *Warning: Low current,* I_{LOW}.

Output current higher than I_{HIGH}. The output current is higher than the value set in parameter 222 *Warning: High current,* I_{HIGH}.

Out of current range. The output current is outside the range programmed in parameter 221 *Warning: Low current,* I_{LOW} and 222 *Warning, High current,* I_{HIGH}.

Programming

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Out of feedback range. The feedback signal is outside the range programmed in parameter 227 *Warning: Low feedback, FB_{LOW}* and 228 *Warning: High feedback, FB_{HIGH}*.

Out of reference range. The reference lies outside the range programmed in parameter 225 *Warning: Low reference, Ref_{LOW}* and 226 *Warning, High reference, Ref_{HIGH}*.

Relay 123. This function is only used when a profibus option card is installed.

Mains imbalance. This output is activated at too high mains imbalance or when a phase is missing in the mains supply. Check the mains voltage to the VLT frequency converter.

0-f_{MAX} ⇒ 0-20 mA and
0-f_{MAX} ⇒ 4-20 mA and
0-f_{MAX} ⇒ 0-32000 p, which generates an output signal proportional to the output frequency in the interval 0 - f_{MAX} (parameter 202 *Output frequency, high limit, f_{MAX}*).

External Ref_{MIN} - Ref_{MAX} ⇒ 0-20 mA and
External Ref_{MIN} - Ref_{MAX} ⇒ 4-20 mA and
External Ref_{MIN} - Ref_{MAX} ⇒ 0-32000 p, which generates an output signal proportional to the resulting reference value in the interval *Minimum reference, Ref_{MIN} - Maximum reference, Ref_{MAX}* (parameters 204/205).

FB_{MIN}-FB_{MAX} ⇒ 0-20 mA and
FB_{MIN}-FB_{MAX} ⇒ 4-20 mA and
FB_{MIN}-FB_{MAX} ⇒ 0-32000 p, an output signal proportional to the reference value in the interval *Minimum feedback, FB_{MIN} - Maximum feedback, FB_{MAX}* (parameters 413/414) is obtained.

0 - $I_{VLT, MAX}$ ⇒ 0-20 mA and
0 - $I_{VLT, MAX}$ ⇒ 4-20 mA and
0 - $I_{VLT, MAX}$ ⇒ 0-32000 p, an output signal proportional to the output current in the interval 0 - $I_{VLT,MAX}$ is obtained.

0 - P_{NOM} ⇒ 0-20 mA and
0 - P_{NOM} ⇒ 4-20 mA and
0 - P_{NOM} ⇒ 0-32000 p, which generates an output signal proportional to the present output power. 20 mA corresponds to the value set in parameter 102 *Motor power, $P_{M,N}$*.

320 Terminal 42, output, pulse scaling (AO 42 PULS SCALE)

Value:

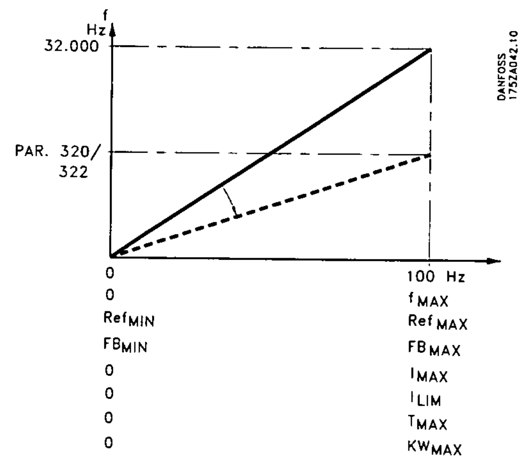
1 - 32000 Hz ★ 5000 Hz

Function:

This parameter allows scaling of the pulse output signal.

Description of choice:

Set the desired value.



321 Terminal 45, output (AO 45 FUNCTION)

Value:

See description of parameter 319 *Terminal 42, Output.*

Function:

This output can function both as a digital or an analogue output. When used as a digital output (data value [0]-[26]) it generates a 24 V (max. 40 mA) signal. For the analogue outputs (data value [27] - [41]) there is a choice of 0-20 mA, 4-20 mA or a pulse sequence.

Description of choice:

See description of parameter 319 *Terminal 42, Output.*

322 Terminal 45, output, pulse scaling (AO 45 PULS SCALE)

Value:

1 - 32000 Hz ★ 5000 Hz

Function:

This parameter allows scaling of the pulse output signal.

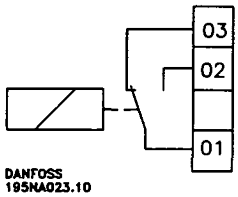
Description of choice:

Set the desired value.

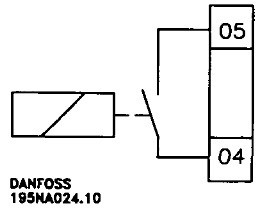
★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

Relay outputs

Relay outputs 1 and 2 can be used to give the present status or a warning.



Relay 1
1 - 3 break, 1 - 2 make
Max. 240 V AC, 2 Amp.
The relay is placed with the mains and motor terminals.



Relay 2
4 - 5 make
Max. 50 V AC, 1 A, 60 VA.
Max. 75 V DC, 1 A, 30 W.
The relay is placed on the control card, see *Electrical installation, control cables*.

Relay outputs	Relay no.	1	2
	parameter	323	326
Value:			
No function (NO FUNCTION)		[0]	[0]
Ready signal (READY)		[1]	[1]
Standby (STAND BY)		[2]	[2]
Running (RUNNING)		[3]	★ [3]
Running at ref. value (RUNNING AT REFERENCE)		[4]	[4]
Running, no warning (RUNNING NO WARNING)		[5]	[5]
Local reference active (DRIVE IN LOCAL REF)		[6]	[6]
Remote references active (DRIVE IN REMOTE REF.)		[7]	[7]
Alarm (ALARM)		★ [8]	[8]
Alarm or warning (ALARM OR WARNING)		[9]	[9]
No alarm (NO ALARM)		[10]	[10]
Current limit (CURRENT LIMIT)		[11]	[11]
Safety interlock (SAFETY INTERLOCK)		[12]	[12]
Start command active (START SIGNAL APPLIED)		[13]	[13]
Reversing (RUNNING IN REVERSE)		[14]	[14]
Thermal warning (THERMAL WARNING)		[15]	[15]
Hand mode active (DRIVE IN HAND MODE)		[16]	[16]
Auto mode active (DRIVE IN AUTO MODE)		[17]	[17]
Sleep mode (SLEEP MODE)		[18]	[18]
Output frequency lower than f_{LOW} parameter 223 (F OUT < F LOW)		[19]	[19]
Output frequency higher than f_{HIGH} parameter 224 (F OUT > F HIGH)		[20]	[20]
Out of frequency range (FREQ RANGE WARN.)		[21]	[21]
Output current lower than I_{LOW} parameter 221 (I OUT < I LOW)		[22]	[22]
Output current higher than I_{HIGH} parameter 222 (I OUT > I HIGH)		[23]	[23]
Out of current range (CURRENT RANGE WARN.)		[24]	[24]
Out of feedback range (FEEDBACK RANGE WARN.)		[25]	[25]
Out of reference range (REFERENCE RANGE WARN.)		[26]	[26]
Relay 123 (RELAY 123)		[27]	[27]
Mains imbalance (MAINS IMBALANCE)		[28]	[28]
Control word 11/12 (CONTROL WORD 11/12)		[29]	[29]

Description of choice:

See description of [0] - [28] in *Analogue/digital outputs*.

Control word bit 11/12, relay 1 and relay 2 can be activated via the serial communication. Bit 11 activates relay 1 and bit 12 activates relay 2.

If the parameter 556 *Bus time interval function* becomes active, relay 1 and relay 2 will become cut off if they are activated via the serial communication. See paragraph *Serial communication* in the Design Guide.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

Programming

323 Relay 1, output function
(RELAY1 FUNCTION)

Function:

This output activates a relay switch.
Relay switch 01 can be used for bringing status and warnings. The relay is activated when the conditions for the relevant data values have been fulfilled.
Activation/deactivation can be programmed in parameter 324 *Relay 1, ON delay* and parameter 325 *Relay 1, OFF delay*.
See *General technical data*.

Description of choice:

See data choice and connections in *Relay outputs*.

324 Relay 01, ON delay
(RELAY1 ON DELAY)

Value:

0 - 600 sec. ★ 0 sec.

Function:

This parameter allows a delay of the cut-in time of relay 1 (terminals 1-2).

Description of choice:

Enter the desired value.

325 Relay 01, OFF delay
(RELAY1 OFF DELAY)

Value:

0 - 600 sec. ★ 0 sec.

Function:

This parameter makes it possible to delay the cut-out time of relay 01 (terminals 1-2).

Description of choice:

Enter the desired value.

326 Relay 2, output function
(RELAY2 FUNCTION)

Value:

See functions of relay 2 on previous page.

Function:

This output activates a relay switch.
Relay switch 2 can be used for bringing status and warnings. The relay is activated when the conditions for the relevant data values have been fulfilled.
See *General technical data*.

Description of choice:

See data choice and connections in *Relay outputs*.

327 Pulse reference, max. frequency
(PULSE REF. MAX)

Value:

100 - 65000 Hz at terminal 29 ★ 5000 Hz
100 - 5000 Hz at terminal 17

Function:

This parameter is used to set the pulse value that must correspond to the maximum reference, parameter 205 *Maximum reference, Ref*$_{MAX}$.
The pulse reference signal can be connected via terminal 17 or 29.

Description of choice:

Set the required maximum pulse reference.

328 Pulse feedback, max. frequency
(PULSE FDBK MAX.)

Value:

100 - 65000 Hz at terminal 33 ★ 25000 Hz

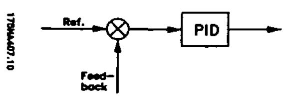
Function:

This is where the pulse value that must correspond to the maximum feedback value is set. The pulse feedback signal is connected via terminal 33.

Description of choice:

Set the desired feedback value.

■ Application functions 400-427



In this parameter group, the special functions of the VLT frequency converter are set up, e.g. PID regulation, setting of the feedback range and the Setup of the Sleep mode function.
Additionally, this parameter group includes:
- Reset function.
- Flying start.
- Option of interference reduction method.
- Setup of any function upon loss of load, e.g. because of a damaged V-belt.
- Setting of switching frequency.
- Selection of process units.

---

400 Reset function (RESET FUNCTION)

Value:

★	Manual reset (MANUAL RESET)	[0]
	Automatic reset x 1 (AUTOMATIC X 1)	[1]
	Automatic reset x 2 (AUTOMATIC X 2)	[2]
	Automatic reset x 3 (AUTOMATIC X 3)	[3]
	Automatic reset x 4 (AUTOMATIC X 4)	[4]
	Automatic reset x 5 (AUTOMATIC X 5)	[5]
	Automatic reset x 10 (AUTOMATIC X 10)	[6]
	Automatic reset x 15 (AUTOMATIC X 15)	[7]
	Automatic reset x 20 (AUTOMATIC X 20)	[8]
	Infinite automatic reset (INFINITE AUTOMATIC)	[9]

Function:

This parameter allows a choice of whether to reset and restart manually after a trip, or whether the VLT frequency converter is to be reset and restarted automatically. In addition, there is a choice of the number of times the unit is to attempt a restart. The time between each reset attempt is set in parameter 401, *Automatic restart time*.

Description of choice:

If *Manual reset* [0] is selected, resetting must be effected via the "Reset" key or via a digital input.
If the VLT frequency converter is to carry out an automatic reset and restart after a trip, select data value [1]-[9].

⚠ The motor may start without warning.

---

401 Automatic restart time (AUTORESTART TIME)

Value:

0 - 600 sec. ★ 10 sec.

Function:

This parameter allows setting of the time from tripping until the automatic reset function begins.
It is assumed that automatic reset has been selected in parameter 400 *Reset function*.

Description of choice:

Set the desired time.

---

402 Flying start (FLYING START)

Value:

	Disable (DISABLE)	[0]
★	Enable (ENABLE)	[1]
	DC brake and start (DC BRAKE AND START)	[3]

Function:

This function makes it possible for the VLT frequency converter to 'catch' a spinning motor, which - e.g. because of a mains failure - is no longer controlled by the VLT frequency converter.
This function is activated whenever a start command is active.
For the VLT frequency converter to be able to catch the spinning motor, the motor speed must be lower than the frequency that corresponds to the frequency in parameter 202 *Output frequency high limit*, f_{MAX}.

Description of choice:

Select *Disable* [0] if this function is not required.
Select *Enable* [1] if the VLT frequency converter is to be able to 'catch' and control a spinning motor.
Select *DC brake and start* [2] if the VLT frequency converter is to brake the motor by means of the DC brake first, and then start. It is assumed that parameters 114-116 *DC braking* are enabled. In the case of a substantial 'windmilling' effect (spinning motor), the VLT frequency converter is not able to 'catch' a spinning motor unless *DC brake and start* has been selected.

⚠ When parameter 402, *Flying Start*, is enabled, motor may turn in forward and backward directions a few revolutions even with no speed reference applied.

Programming

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

Sleep mode

Sleep mode makes it possible to stop the motor when it is running at low speed and thus has almost no load. If consumption in the system goes back up, the VLT frequency converter will start the motor and supply the power required.

NB!
Energy can be saved with this function, since the motor is only in operation when the system needs it.

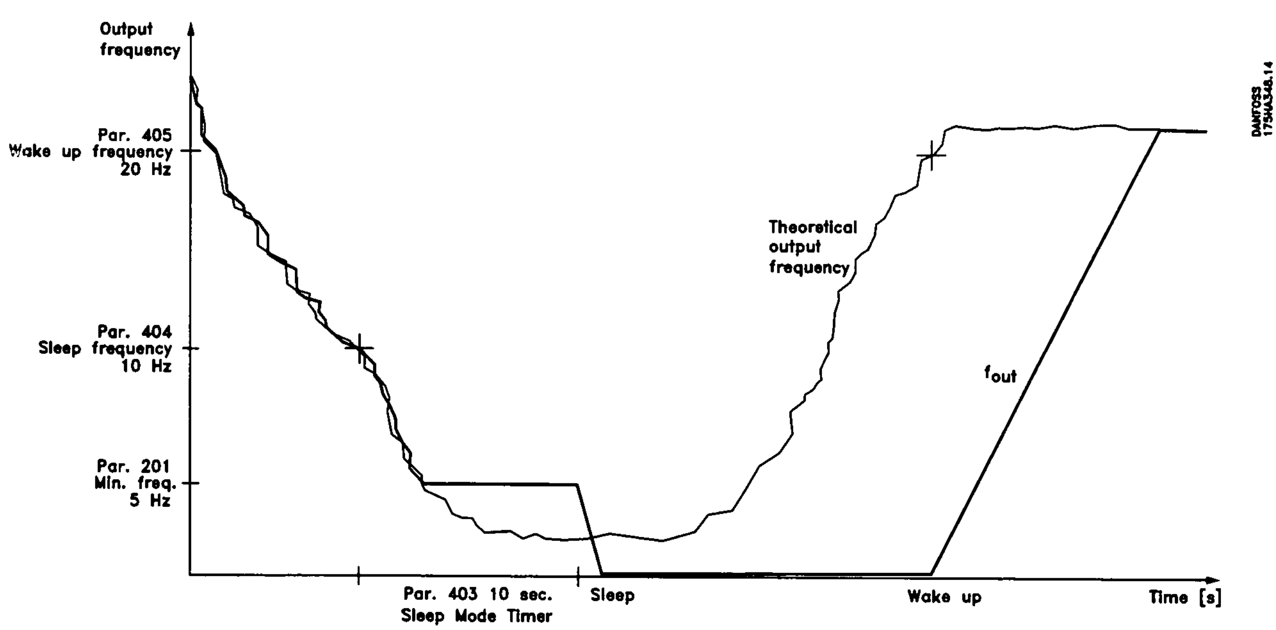
Sleep mode is not active if *Local reference* or *Jog* has been selected
The function is active in both *Open loop* and *Closed loop*.

In parameter 403 *Sleep mode timer*, the Sleep mode is activated. In parameter 403 *Sleep mode timer*, a timer is set that determines for how long the output frequency can be lower than the frequency set in parameter 404 *Sleep frequency*. When the timer runs out, the VLT frequency converter will ramp down the motor to stop via parameter 207 *Ramp-down time*. If the output frequency rises above the frequency set in parameter 404 *Sleep frequency*, the timer is reset.

While the VLT frequency converter has stopped the motor in sleep mode, a theoretical output frequency is calculated on the basis of the reference signal. When the theoretical output frequency rises above the frequency in parameter 405 *Wake up frequency*, the VLT frequency converter will restart the motor and the output frequency will ramp up to the reference.

In systems with constant pressure regulation, it is advantageous to provide extra pressure to the system before the VLT frequency converter stops the motor. This extends the time during which the VLT frequency converter has stopped the motor and helps to avoid frequent starting and stopping of the motor, e.g. in the case of system leaks.
If 25% more pressure is required before the VLT frequency converter stops the motor, parameter 406 *Boost setpoint* is set to 125%.
Parameter 406 *Boost setpoint* is only active in *Closed loop*.

NB!
In highly dynamic pumping processes, it is recommended to switch off the *Flying Start* function (parameter 402).



403 Sleep mode timer (SLEEP MODE TIMER)

Value:

0 - 300 sec. (301 sec. = OFF) ★ OFF

Function:

This parameter enables the VLT frequency converter to stop the motor if the load on the motor is minimal. The timer in parameter 403 *Sleep mode timer* starts when the output frequency drops below the frequency set in parameter 404 *Sleep frequency*.
When the time set in the timer has expired, the VLT frequency converter will turn off the motor.
The VLT frequency converter will restart the motor, when the theoretical output frequency exceeds the frequency in parameter 405 *Wake up frequency*.

Description of choice:

Select OFF if this function is not wanted.
Set the threshold value that is to activate Sleep mode after the output frequency has fallen below parameter 404 *Sleep frequency*.

404 Sleep frequency (SLEEP FREQUENCY)

Value:

000,0 - par. 405 *Wake up frequency* ★ 0.0 Hz

Function:

When the output frequency falls below the preset value, the timer will start the time count set in parameter 403 *Sleep mode*. The present output frequency will follow the theoretical output frequency until f_{MIN} is reached.

Description of choice:

Set the required frequency.

405 Wake up frequency (WAKEUP FREQUENCY)

Value:

Par 404 *Sleep frequency* - par. 202 f_{MAX} ★ 50 Hz

Function:

When the theoretical output frequency exceeds the preset value, the VLT frequency converter restarts the motor.

Description of choice:

Set the required frequency.

406 Boost setpoint (BOOST SETPOINT)

Value:

0 - 200 % ★ 100 % of setpoint

Function:

This function can only be used if *Closed loop* has been selected in parameter 100.
In systems with constant pressure regulation, it is advantageous to increase the pressure in the system before the VLT frequency converter stops the motor. This extends the time during which the VLT frequency converter stops the motor and helps to avoid frequent starting and stopping of the motor, e.g. in the case of leaks in the water supply system.

Description of choice:

Set the required *Boost setpoint* as a percentage of the resulting reference under normal operation. 100% corresponds to the reference without boost (supplement).

407 Switching frequency (SWITCHING FREQ.)

Value:

Depends on the size of the unit.

Function:

The preset value determines the switching frequency of the inverter, provided *Fixed switching frequency* [1] has been selected in parameter 408 *Interference reduction method*. If the switching frequency is changed, this may help to minimise possible acoustic noise from the motor.

NB!
The output frequency of the VLT frequency converter can never assume a value higher than 1/10 of the switching frequency.

Description of choice:

When the motor is running, the switching frequency is adjusted in parameter 407 *Switching frequency*, until the frequency has been achieved at which the motor is as quiet as possible.

NB!
Switching frequencies higher than 4.5 kHz implement automatic derating of the maximum output of the VLT frequency converter. See *Derating of high switching frequency* in this manual.

Programming

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

408 Interference reduction method (NOISE REDUCTION)

Value:

★ ASFM (ASFM) [0]
Fixed switching frequency (FIXED SWITCHING FREQ.) [1]
LC filter fitted (LC-FILTER CONNECTED) [2]

Function:

Used to select different methods for reducing the amount of acoustic interference from the motor.

Description of choice:

ASFM [0] guarantees that the maximum switching frequency, determined by parameter 407, is used at all times without derating of the VLT frequency converter. This is done by monitoring the load.
Fixed switching frequency [1] makes it possible to set a fixed high/low switching frequency. This can generate the best result, as the switching frequency can be set to lie outside the motor interference or in a less irritating area. The switching frequency is adjusted in parameter 407 *Switching frequency. LC-filter fitted* [2] is to be used if an LC-filter is fitted between the VLT frequency converter and the motor, as the VLT frequency converter will otherwise not be able to protect the LC-filter.

409 Function in case of no load (FUNCT. LOW CURR.)

Value:

Trip (TRIP) [0]
★ Warning (WARNING) [1]

Function:

This parameter can be used e.g. for monitoring the V-belt of a fan to make sure it has not snapped. This function is activated when the output current goes below parameter 221 *Warning: Low current.*

Description of choice:

In the case of a *Trip* [1], the VLT frequency converter will stop the motor.
If *Warning* [2] is selected, the VLT frequency converter will give a warning if the output current drops below the threshold value in parameter 221 *Warning: Low current, I_{LOW}.*

410 Function at mains failure (MAINS FAILURE)

Value:

★Trip (TRIP) [0]
Autoderate & warning (AUTODERATE & WARNING) [1]
Warning (WARNING) [2]

Function:

Select the function which is to be activated if the mains imbalance becomes too high or if a phase is missing.

Description:

At *Trip* [0] the VLT frequency converter will stop the motor within a few seconds (depending on drive size).
If *Autoderate & warning* [1] is selected, the drive will export a warning and reduce the output current to 30 % of $I_{VLT,N}$ to maintain operation.
At *Warning* [2] only a warning will be exported when a mains failure occurs, but in severe cases, other extreme conditions might result in a trip.

NB!
If *Warning* has been selected, the life expectancy of the drive will be reduced when the mains failure persists.

NB!
At phase loss the cooling fans of IP 54 drives cannot be powered and the VLT might trip on overheating. This applies to drive types VLT 6042-6062, 200-240 V and 6075-6550, 380-460 V.

411 Function at overtemperature (FUNCT. OVERTEMP)

Value:

★Trip (TRIP) [0]
Autoderate & warning (AUTODERATE & WARNING) [1]

Function:

Select the function which is to be activated when the VLT is exposed to an overtemperature condition.

Description:

At *Trip* [0] the VLT frequency converter will stop the motor and export an alarm.
At *Autoderate & warning* [1] the VLT will first reduce the switching frequency to minimize internal losses. If the overtemperature condition persists, the VLT will reduce the output current until the heat sink temperature stabilizes. When the function is active, a warning will be exported.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

412 Trip delay overcurrent, I_{LIM}
(OVERLOAD DELAY)

Value:

0 - 60 sec. (61=OFF) ★ 60 sec.

Function:

When the frequency converter registers that the output current has reached the current limit I_{LIM} (parameter 215 *Current limit*) and stays there for the duration selected, a cut-out will be performed.

Description of choice:

Select for how long the frequency converter is to be able to keep up with the output current at the current limit I_{LIM} before it cuts out.
In OFF mode, parameter 412 *Trip delay overcurrent, I_{LIM}* is inactive, i.e. cut-outs are not performed.

■ Feedback signals in open loop

Normally, feedback signals and thus feedback parameters are only used in *Closed loop* operation; in VLT 6000 HVAC units, however, the feedback parameters are also active in *Open loop* operation.
In *Open loop mode*, the feedback parameters can be used to show a process value in the display. If the present temperature is to be displayed, the temperature range can be scaled in parameters 413/414 *Minimum/Maximum feedback*, and the unit (°C, °F) in parameter 415 *Process units*.

---

413 Minimum feedback, FB_{MIN}
(MIN. FEEDBACK)

Value:

-999,999.999 - FB_{MAX} ★ 0.000

Function:

Parameters 413 *Minimum feedback, FB_{MIN}* and 414 *Maximum feedback, FB_{MAX}* are used to scale the display indication, thereby ensuring that it shows the feedback signal in a process unit proportionally to the signal at the input.

Description of choice:

Set the value to be shown on the display at minimum feedback signal value (par. 309, 312, 315 *Min. scaling*) on the selected feedback input (parameters 308/311/314 *Analogue inputs*).

---

414 Maximum feedback, FB_{MAX}
(MAX. FEEDBACK)

Value:

FB_{MIN} - 999,999.999 ★ 100.000

Function:

See the description of par. 413 *Minimum feedback, FB_{MIN}*.

Description of choice:

Set the value to be shown on the display when maximum feedback (par. 310, 313, 316 *Max. scaling*) has been achieved at the selected feedback input (parameters 308/311/314 *Analogue inputs*).

---

415 Units relating to closed loop
(REF. / FDBK. UNIT)

Value:

No unit	[0]	°C	[21]
★ %	[1]	GPM	[22]
rpm	[2]	gal/s	[23]
ppm	[3]	gal/min	[24]
pulse/s	[4]	gal/h	[25]
l/s	[5]	lb/s	[26]
l/min	[6]	lb/min	[27]
l/h	[7]	lb/h	[28]
kg/s	[8]	CFM	[29]
kg/min	[9]	ft^3/s	[30]
kg/h	[10]	ft^3/min	[31]
m^3/s	[11]	ft^3/h	[32]
m^3/min	[12]	ft/s	[33]
m^3/h	[13]	in wg	[34]
m/s	[14]	ft wg	[35]
mbar	[15]	PSI	[36]
bar	[16]	lb/in^2	[37]
Pa	[17]	HP	[38]
kPa	[18]	°F	[39]
mVS	[19]		
kW	[20]		

Function:

Selection of unit to be shown on the display.
This unit will be used if *Reference [unit]* [2] or *Feedback [unit]* [3] has been selected in one of the parameters 007-010, as well as in the Display mode.
In *Closed loop*, the unit is also used as a unit for *Minimum/Maximum reference* and *Minimum/Maximum feedback*, as well as *Setpoint 1* and *Setpoint 2*.

Description of choice:

Select the required unit for the reference/feedback signal.

Programming

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

PID for process control

The PID controller maintains a constant process condition (pressure, temperature, flow, etc.) and adjusts motor speed on the basis of a reference/setpoint and the feedback signal.
A transmitter supplies the PID controller with a feedback signal from the process to indicate its actual state. The feedback signal varies with the process load.
This means that deviations occur between the reference/setpoint and the actual process state. Such deviations are evened out by the PID regulator, in that it regulates the output frequency up or down in relation to the deviation between the reference/setpoint and the feedback signal.
The integral PID regulator in VLT 6000 HVAC units has been optimised for use in HVAC applications. This means that a number of specialised functions are available in VLT 6000 HVAC units.
Formerly, it was necessary to get a BMS (Building Management System) to handle these special functions by installing extra I/O modules and by programming the system.
Using the VLT 6000 HVAC, there is no need for extra modules to be installed. For example, only one required reference/setpoint and the handling of feedback need to be programmed.
There is in-built a option for connecting two feedback signals to the system, making two-zone regulation possible.

Correction for voltage losses in long signal cables can be carried out when using a transmitter with a voltage output. This is done in parameter group 300 *Min./ Max. scaling*.

Feedback

The feedback signal must be connected to a terminal on the VLT frequency converter. Use the list below to decide which terminal to use and which parameters to program.

Feedback type	Terminal	Parameters
Pulse	33	307
Voltage	53, 54	308, 309, 310 or 311, 312, 313
Current	60	314, 315, 316
Bus feedback 1	68+69	535
Bus feedback 2	68+69	536

Please note that the feedback value in parameter 535/ 536 Bus feedback 1 and 2 can only be set via serial communication (not via the control unit).

Furthermore, the minimum and maximum feedback (parameters 413 and 414) must be set to a value in the process unit that corresponds to the minimum and maximum scaling value for signals connected to the terminal. The process unit is selected in parameter 415 *Process units*.

Reference

In parameter 205 *Maximum reference, Ref$_{MAX}$*, a maximum reference that scales the sum of all references, i.e. the resulting reference, can be set. The *minimum reference* in parameter 204 indicates the smallest value that the resulting reference can assume.
The reference range cannot exceed the feedback range.
If *Preset references* are required, set these in parameters 211 to 214 *Preset reference*. See *Reference type*.
See also *Reference handling*.
If a current signal is used as a feedback signal, voltage can be used as analogue reference. Use the list below to decide which terminal to use and which parameters to program.

Reference type	Terminal	Parameters
Pulse	17 or 29	301 or 305
Voltage	53 or 54	308, 309, 310 or 311, 312, 313
Current	60	314, 315, 316
Preset reference	214	211, 212, 213,
Setpoints		418, 419
Bus reference	68+69	

Please note that the bus reference can only be set via serial communication.

NB!
Terminals that are not in use may preferably be set to *No function* [0].

■ PID for process regulation, cont.

Inverse regulation

Normal regulation means that the motor speed increases when the reference/setpoint is higher than the feedback signal. If there is a need for inverse regulation, in which the speed is reduced when the feedback signal is lower than the reference/setpoint, Inverse must be programmed in parameter 420 *PID normal/inverse control.*

Anti Windup

The process regulator is factory preset with an active anti-windup function. This function ensures that when either a frequency limit, current limit or voltage limit is reached, the integrator will be initialised for a frequency that corresponds to the present output frequency. This avoids integration on a deviation between the reference/setpoint and the actual state of the process, the controller of which is not possible by means of a speed change. This function can be disabled in parameter 421 *PID anti windup*.

Start-up conditions

In some applications, optimum setting of the process regulator will mean that it takes an excessive time for the required process state to be reached. In such applications it might be an advantage to fix an output frequency to which the VLT frequency converter is to bring the motor before the process regulator is activated. This is done by programming a *PID start-up frequency* in parameter 422.

Differentiator gain limit

If there are very quick variations in a given application with respect to the reference/setpoint signal or the feedback signal, the deviation between reference/setpoint and the actual process state will quickly change. The differentiator may thus become too dominant. This is because it reacts to the deviation between the reference/setpoint and the actual process state. The quicker the deviation changes, the stronger the resulting differentiator frequency contribution. The differentiator frequency contribution can thus be limited to allow the setting of a reasonable differentiation time for slow changes and a suitable frequency contribution for quick changes. This is done in parameter 426, *PID Differentiator gain limit*.

Lowpass filter

If there are ripple currents/voltages on the feedback signal, these can be dampened by means of a built-in lowpass filter. Set a suitable lowpass filter time constant. This time constant represents the limit frequency of the ripples occurring on the feedback signal.
If the lowpass filter has been set to 0.1s, the limit frequency will be 10 RAD/sec., corresponding to $(10/2 \times \pi) = 1.6$ Hz. This means that all currents/voltages that vary by more than 1.6 oscillations per second will be removed by the filter.
In other words, regulation will only be carried out on a feedback signal that varies by a frequency of less than 1.6 Hz. Choose a suitable time constant in parameter 427, *PID Lowpass filter time.*

Optimisation of the process regulator

The basic settings have now been made; all that remains to be done is to optimise the proportional gain, the integration time and the differentiation time (parameters 423, 424 and 425). In most processes, this can be done by following the guidelines given below.

1. Start the motor.
2. Set parameter 423 *PID proportional gain* to 0.3 and increase it until the process shows that the feedback signal is unstable. Then reduce the value until the feedback signal has stabilised. Now lower the proportional gain by 40-60%.
3. Set parameter 424 *PID integration time* to 20 s and reduce the value until the process shows that the feedback signal is unstable. Increase the integration time until the feedback signal stabilises, followed by an increase of 15-50%.
4. Parameter 425 *PID differentiation time* is only used in very fast-acting systems. The typical value is 1/4 of the value set in parameter 424 *PID Integration time*. The differentiator should only be used when the setting of the proportional gain and the integration time have been fully optimised.

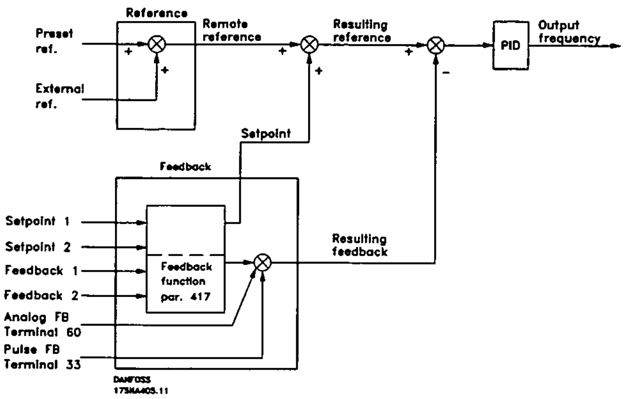
NB!
If necessary, start/stop can be activated a number of times in order to provoke an unstable feedback signal.

Programming

★ = factory setting. () = display text [] = value for use in communication via serial communication port

PID overview

The block diagram below shows reference and setpoint in relation to the feedback signal.



As can be seen, the remote reference is totalled with setpoint 1 or setpoint 2. See also *Reference handling*. Which setpoint is to be totalled with the remote reference depends on the selection made in parameter 417 *Feedback function.*

Feedback handling

The feedback handling can be seen from the block diagram on the next page.
The block diagram shows how and by which parameters the feedback handling can be affected. Options as feedback signals are: voltage, current, pulse and bus feedback signals. In zone regulation, feedback signals must be selected as voltage inputs (terminals 53 and 54). Please note that *Feedback 1* consists of bus feedback 1 (parameter 535) totalled with the feedback signal value of terminal 53. *Feedback 2* consists of bus feedback 2 (parameter 536) totalled with the feedback signal value of terminal 54.

In addition, the VLT 6000 HVAC has an integral calculator capable of converting a pressure signal into a "linear flow" feedback signal. This function is activated in parameter 416 *Feedback conversion.*

The parameters for feedback handling are active both in closed and open loop modes. In *open loop,* the present temperature can be displayed by connecting a temperature transmitter to a feedback input. In a closed loop, there are - roughly speaking - three possibilities of using the integral PID regulator and setpoint/feedback handling:

1. 1 setpoint and 1 feedback
2. 1 setpoint and 2 feedbacks
3. 2 Setpoints and 2 feedbacks

1 setpoint and 1 feedback

If only 1 setpoint and 1 feedback signal are used, parameter 418 *Setpoint 1* will be added to the remote reference. The sum of the remote reference and *Setpoint 1* becomes the resulting reference, which will then be compared with the feedback signal.

1 setpoint and 2 feedbacks

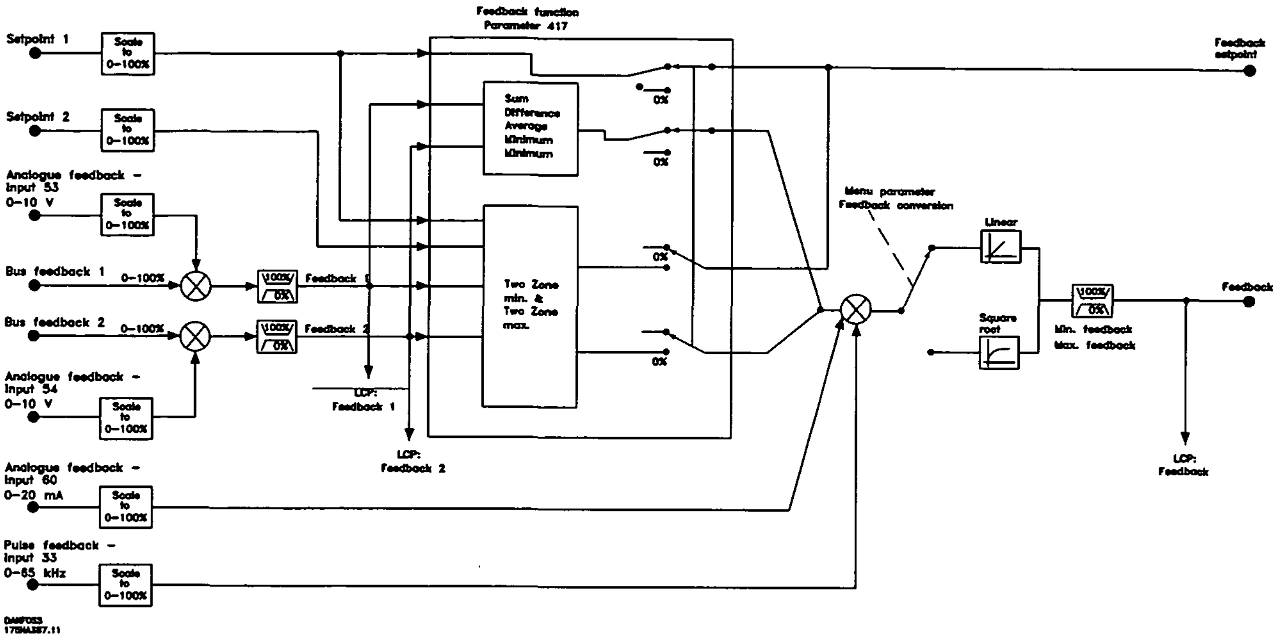
Just like in the above situation, the remote reference is added to *Setpoint 1* in parameter 418. Depending on the feedback function selected in parameter 417 *Feedback function*, a calculation will be made of the feedback signal with which the sum of the references and the setpoint is to be compared. A description of the individual feedback functions is given in parameter 417 *Feedback function.*

2 Setpoints and 2 feedbacks

Used in 2-zone regulation, where the function selected in parameter 417 *Feedback function* calculates the setpoint to be added to the remote reference.

★ = factory setting. () = display text [] = value for use in communication via serial communication port

■ Feedback handling (continued)



416 Feedback conversion (FEEDBACK CONV.)

Value:

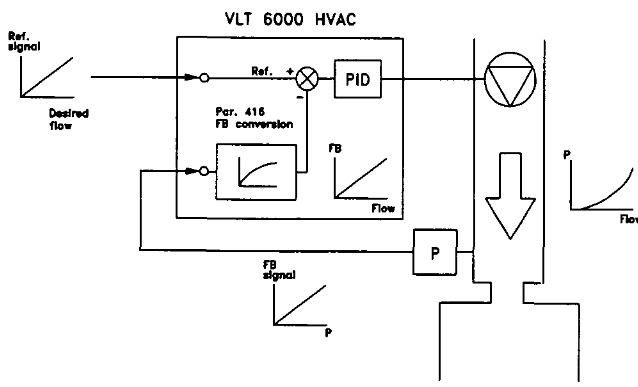
★ Linear (LINEAR)	[0]
Square root (SQUARE ROOT)	[1]

Function:

In this parameter, a function is selected which converts a connected feedback signal from the process to a feedback value that equals the square root of the connected signal.
This is used, e.g. where regulation of a flow (volume) is required on the basis of pressure as feedback signal (flow = constant x √pressure). This conversion makes it possible to set the reference in such a way that there is a linear connection between the reference and the flow required. See drawing in next column.
Feedback conversion should not be used if 2-zone regulation in parameter 417 *Feedback function* has been selected.

Description:

If *Linear* [0] is selected, the feedback signal and the feedback value will be proportional.
If *Square root* [1] is selected, the VLT frequency converter translates the feedback signal to a squared feedback value.



417 Feedback function (2 FEEDBACK, CALC.)

Value:

	Minimum (MINIMUM)	[0]
★	Maximum (MAXIMUM)	[1]
	Sum (SUM)	[2]
	Difference (DIFFERENCE)	[3]
	Average (AVERAGE)	[4]
	2-zone minimum (2 ZONE MIN)	[5]
	2-zone maximum (2 ZONE MAX)	[6]

Function:

This parameter allows a choice between different calculation methods whenever two feedback signals are used.

Description of choice:

If *Minimum* [0] is selected, the VLT frequency converter will compare *feedback 1* with *feedback 2* and regulate on the basis of the lower feedback value.
Feedback 1 = Sum of parameter 535 *Bus feedback 1* and the feedback signal value of terminal 53.
Feedback 2 = Sum of parameter 536 *Bus feedback 2* and the feedback signal value of terminal 54.

If *Maximum* [1] is selected, the VLT frequency converter will compare *feedback 1* with *feedback 2* and regulate on the basis of the higher feedback value.
If *Sum* [2] is selected, the VLT frequency converter will total *feedback 1* with *feedback 2*. Please note that the remote reference will be added to *Setpoint 1*.
If *Difference* [3] is selected, the VLT frequency converter will subtract *feedback 1* from *feedback 2*.
If *Average* [4] is selected, the VLT frequency converter will calculate the average of *feedback 1* and *feedback 2*. Please note that the remote reference will be added to the *Setpoint 1*.

If *2-zone minimum* [5] is selected, the VLT frequency converter will calculate the difference between *Setpoint 1* and *feedback 1* as well as *Setpoint 2* and *feedback 2*.
After this calculation, the VLT frequency converter will use the larger difference. A positive difference, i.e. a setpoint higher than the feedback, is always larger than a negative difference.
If the difference between *Setpoint 1* and *feedback 1* is the larger of the two, parameter 418 *Setpoint 1* will be added to the remote reference.
If the difference between *Setpoint 2* and *feedback 2* is the larger of the two, the remote reference will be added to the parameter 419 *Setpoint 2*.
If *2-zone maximum* [6] is selected, the VLT frequency converter will calculate the difference between *Setpoint 1* and *feedback 1* as well as *Setpoint 2* and *feedback 2*.
After the calculation, the VLT frequency converter will use the smaller difference. A negative difference, i.e. one where the setpoint is lower than the feedback, is always smaller than a positive difference.
If the difference between *Setpoint 1* and *feedback 1* is the smaller of the two, the remote reference will be added to the parameter 418 *Setpoint 1*.
If the difference between *Setpoint 2* and *feedback 2* is the smaller of the two, the remote reference will be added to parameter 419 *Setpoint 2*.

418 Setpoint 1 (SETPOINT 1)

Value:

Ref_{MIN} - Ref_{MAX} ★ 0.000

Function:

Setpoint 1 is used in closed loop as the reference to compare the feedback values with. See description of parameter 417 *Feedback function*.
The setpoint can be offset with digital, analog or bus references, see *Reference handling*.
Used in *Closed loop* [1] parameter 100 *Configuration*.

Description of choice:

Set the required value. The process unit is selected in parameter 415 *Process units*.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

419 Setpoint 2 (SETPOINT 2)

Value:

Ref_{MIN} - Ref_{MAX} ★ 0.000

Function:

Setpoint 2 is used in closed loop as the reference to compare the feedback values with. See description of parameter 417 *Feedbackfunction*.
The setpoint can be offset with digital, analog or bus signals, see reference handling.
Used in *Closed loop* [1] parameter 100 *Configuration* and only if 2-zone minimum/maximum is selected in parameter 417 *Feedbackfunction*.

Description of choice:

Set the required value. The process unit is selected in parameter 415 *Process units*.

420 PID normal/inverse control (PID NOR/INV. CTRL)

Value:

★ Normal (NORMAL)	[0]
Inverse (INVERSE)	[1]

Function:

It is possible to choose whether the process regulator is to increase/reduce the output frequency if there is a deviation between reference/setpoint and the actual process state.
Used in *Closed loop* [1] (parameter 100).

Description of choice:

If the VLT frequency converter is to reduce the output frequency in case the feedback signal increases, select *Normal* [0].
If the VLT frequency converter is to increase the output frequency in case the feedback signal increases, select *Inverse* [1].

421 PID anti windup (PID ANTI WINDUP)

Value:

Off (DISABLE)	[0]
★ On (ENABLE)	[1]

Function:

It is possible to choose whether the process regulator is to continue regulating on a deviation even if it is not possible to increase/reduce the output frequency.
Used in *Closed loop* [1] (parameter 100).

Description of choice:

The factory setting is *On* [1], which means that the integration link is adjusted to the actual output frequency if either the current limit, the voltage limit or the max./min. frequency has been reached. The process regulator will not be engaged again, until either the deviation is zero or its prefix has changed.
Select *Off* [0] if the integrator is to continue integrating to the deviation even if it is not possible to remove the deviation by regulation.

NB!
If *Off* [0] is selected, it will mean that when the deviation changes its prefix, the integrator will first have to integrate down from the level obtained as a result of the former error, before any change to the output frequency occurs.

422 PID start-up frequency (PID START VALUE)

Value:

f_{MIN}-f_{MAX} (parameter 201 and 202) ★ 0 Hz

Function:

When the start signal comes, the VLT frequency converter will react in the form of *Open loop* [0] following the ramp. Only when the programmed start frequency has been obtained, will it change over to *Closed loop* [1]. In addition, it is possible to set a frequency that corresponds to the speed at which the process normally runs, which will enable the required process conditions to be reached sooner.
Used in *Closed loop* [1] (parameter 100).

Description of choice:

Set the required start frequency.

Programming

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

NB!
If the VLT frequency converter is running at the current limit before the desired start frequency is obtained, the process regulator will not be activated. For the regulator to be activated anyway, the start frequency must be lowered to the required output frequency. This can be done during operation.

NB!
PID start frequency is always applied in clockwise direction.

---

423 PID proportional gain (PID PROP. GAIN)

Value:

0.00 - 10.00 ★ 0.01

Function:

The proportional gain indicates the number of times the deviation between the reference/setpoint and the feedback signal is to be applied.
Used in *Closed loop* [1] (parameter 100).

Description of choice:

Quick regulation is obtained by a high gain, but if the gain is too high, the process may become unstable.

---

424 PID integration time (PID INTEGR.TIME)

Value:

0.01 - 9999.00 sec. (OFF) ★ OFF

Function:

The integrator provides a constant change of the output frequency during constant error between the reference/setpoint and the feedback signal.
The greater the error, the quicker the integrator frequency contribution will increase. The integration time is the time needed by the integrator to reach the same gain as the proportional gain for a given deviation.
Used in *Closed loop* [1] (parameter 100).

Description of choice:

Fast regulation is obtained in connection with a short integration time. However, this time may be too short, which means that the process may be destabilised as a result of overswings.
If the integral time is long, major deviations from the required set point may occur, since the process regulator will take a long time to regulate in relation to a given error.

NB!
Some value other than OFF must be set or the PID will not function correctly.

---

425 PID differentiation time (PID DIFF. TIME)

Value:

0.00 (OFF) - 10.00 sec. ★ OFF

Function:

The differentiator does not react to a constant error. It only contributes when the error changes.
The quicker the error changes, the stronger the contribution from the differentiator will be. This influence is proportional to the speed by which the deviation changes.
Used in *Closed loop* [1] (parameter 100).

Description of choice:

Fast regulation can be obtained by means of a long differentiation time. However, this time may be too long, which means that the process may be destabilised as a result of overswings.

---

426 PID differentiator gain limit (PID DIFF. GAIN)

Value:

5.0 - 50.0 ★ 5.0

Function:

It is possible to set a limit for the differentiator gain. The differentiator gain will increase if there are fast changes, which is why it can be beneficial to limit this gain, thereby obtaining a pure differentiator gain at slow changes and a constant differentiator gain where quick changes to the deviation are made.
Used in *Closed loop* [1] (parameter 100).

Description of choice:

Select a limit to differentiator gain as required.

★ = factory setting. () = display text [] = value for use in communication via serial communication port

427 PID lowpass filter time (PID FILTER TIME)

Value:

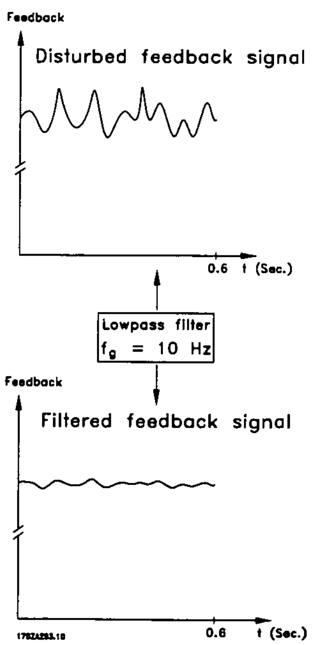
0.01 - 10.00 ★ 0.01

Function:

Oscillations on the feedback signal are dampened by the lowpass filter in order to reduce their impact on the process regulation. This can be an advantage e.g. if there is a lot of noise on the signal.
Used in *Closed loop* [1] (parameter 100).

Description of choice:

Select the desired time constant (τ). If a time constant (τ) of 0.1 s is programmed, the break frequency for the lowpass filter will be 1/0.1 = 10 RAD/sec., corresponding to (10/(2 x π)) = 1.6 Hz.
The process regulator will thus only regulate a feedback signal that varies by a frequency lower than 1.6 Hz.
If the feedback signal varies by a higher frequency than 1.6 Hz, the Process regulator will not react.



500-566 Serial communication

All information concerning the use of RS 485 serial interface is not included in this manual. Please contact Danfoss and ask for the VLT 6000 HVAC Design Guide.

Programming

■ Service functions 600-631

This parameter group contains functions such as operating data, data log and fault log.
It also has information on the nameplate data of the VLT frequency converter.

These service functions are very useful in connection with operating and fault analysis in an installation.

600-605 Operating data

Value:

Parameter No.	Description Operating data:	Display text	Unit	Range
600	Operating hours	(OPERATING HOURS)	Hours	0 - 130,000.0
601	Hours run	(RUNNING HOURS)	Hours	0 - 130,000.0
602	kWh counter	(KWH COUNTER)	kWh	-
603	No. of cut-ins	(POWER UP'S)	Nos.	0 - 9999
604	No. of overtemps.	(OVER TEMP'S)	Nos.	0 - 9999
605	No. of overvoltages	(OVER VOLT'S)	Nos.	0 - 9999

- Unit-dependent

Function:

These parameters can be read out via the serial communication port, as well as via the display in the parameters.

Description of choice:

Parameter 600 *Operating hours*:
Gives the number of hours in which the VLT frequency converter has been in operation. The value is saved every hour and when the power supply to the unit is cut off. This value cannot be reset.

Parameter 601 *Hours run*:
Gives the number of hours in which the motor has been in operation since being reset in parameter 619 *Reset of hours-run counter*. The value is saved every hour and when the power supply to the unit is cut off.

Parameter 602 *kWh counter*:
Gives the output power of the VLT frequency converter. The calculation is based on the mean value in kWh over one hour. This value can be reset using parameter 618 *Reset of kWh counter*. Range: 0 - depends on unit.

Parameter 603 *No. of cut-ins*:
Gives the number of cut-ins of supply voltage to the VLT frequency converter.

Parameter 604 *No. of overtemps*:
Gives the number of overtemperature errors on the heat-sink of the VLT frequency converter.

Parameter 605 *No. of overvoltages*:
Gives the number of overvoltages on the intermediate circuit voltage of the VLT frequency converter. The count is only taken when Alarm 7 *Overvoltage* is active.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

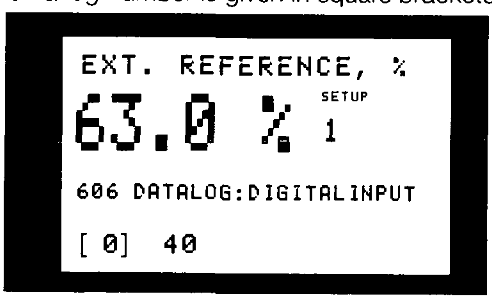
606 - 614 Data log

Value:

Parameter No.	Description Data log:	Display text	Unit	Range
606	Digital input	(LOG: DIGITAL INP)	Decimal	0 - 255
607	Control word	(LOG: BUS COMMAND)	Decimal	0 - 65535
608	Status word	(LOG: BUS STAT WD)	Decimal	0 - 65535
609	Reference	(LOG: REFERENCE)	%	0 - 100
610	Feedback	(LOG: FEEDBACK)	Par. 414	-999,999.999 - 999,999.999
611	Output frequency	(LOG: MOTOR FREQ.)	Hz	0.0 - 999.9
612	Output voltage	(LOG: MOTOR VOLT)	Volt	50 - 1000
613	Output current	(LOG: MOTOR CURR.)	Amp	0.0 - 999.9
614	DC link voltage	(LOG: DC LINK VOLT)	Volt	0.0 - 999.9

Function:

With these parameters, it is possible to see up to 20 saved values (data logs) - [1] being the most recent and [20] the oldest log. When a start command has been given, a new entry to the data log is made every 160 ms. If there is a trip or if the motor has stopped, the 20 latest data log entries will be saved and the values will be visible in the display. This is useful, e.g. in the case of service after a trip.
The data log number is given in square brackets; [1]



Data logs [1]-[20] can be read by first pressing [CHANGE DATA], followed by the [+/-] keys to change data log numbers.
Parameters 606-614 *Data log* can also be read out via the serial communication port.

Description of choice:

Parameter 606 ***Data log: Digital input*****:**
This is where the latest log data are shown in decimal code, representing the status of the digital inputs. Translated into binary code, terminal 16 corresponds to the bit to the extreme left and to decimal code 128. Terminal 33 corresponds to the bit to the extreme right and to decimal code 1.
The table can be used, e.g., for converting a decimal number into a binary code. For example, digital 40 corresponds to binary 00101000. The nearest smaller decimal number is 32, corresponding to a signal on terminal 18. 40-32 = 8, corresponds to the signal on terminal 27.

Terminal	16	17	18	19	27	29	32	33
Decimal number	128	64	32	16	8	4	2	1

Parameter 607 ***Data log: Control word*****:**
This is where the latest log data are given in decimal code for the control word of the VLT frequency converter.
The control word read can only be changed via serial communication.
The control work is read as a decimal number which is to be converted into hex.
See the control word profile under the section *Serial communication* in the Design Guide.

Parameter 608 ***Data log: Status word*****:**
This gives the latest log data in decimal code for the status word.
The status word is read as a decimal number which is to be converted into hex.
See the status word profile under the section *Serial communication* in the Design Guide.

Parameter 609 ***Data log: Reference*****:**
This gives the latest log data for the resulting reference.

Parameter 610 ***Data log: Feedback*****:**
This gives the latest log data for the feedback signal.

Parameter 611 ***Data log: Output frequency*****:**
This gives the latest log data for the output frequency.

Parameter 612 ***Data log: Output voltage*****:**
This gives the latest log data for the output voltage.

Parameter 613 ***Data log: Output current*****:**
This gives the latest log data for the output current.

Parameter 614 ***Data log: DC-link voltage*****:**
This gives the latest log data for the intermediate circuit voltage.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

615 Fault log: Error code
(F. LOG: ERROR CODE)

Value:

[Index 1-10] Error Code: 0 - 99

Function:

This parameter makes it possible to see the reason why a trip (cut-out of the VLT frequency converter) occurs.

10 [1-10] log values are stored.

The lowest log number [1] contains the latest/most recently saved data value; the highest log number [10] contains the oldest data value.

If there is a trip on the VLT 6000 HVAC, it is possible to see its cause, the time and possibly the values for output current or output voltage.

Description of choice:

Stated as an error code in which the number refers to a table in *List of warnings and alarms*.

The fault log is only reset after manual initialisation. (See *Manual initialisation*).

616 Fault log: Time
(F. LOG: TIME)

Value:

[Index 1-10] Hours: 0 - 130,000.0

Function:

This parameter makes it possible to see the total number of hours run in connection with the 10 latest trips.

10 [1-10] log values are stored.

The lowest log number [1] contains the latest/most recently saved data value, while the highest log number [10] contains the oldest data value.

Description of choice:

The fault log is only reset after manual initialisation. (See *Manual initialisation*).

617 Fault log: Value
(F. LOG: VALUE)

Value:

[Index 1 - 10] Value: 0 - 9999

Function:

This parameter makes it possible to see the value at which a trip occurred. The unit of the value depends on the alarm active in parameter 615 *Fault log: Error code*.

Description of choice:

The fault log is only reset after manual initialisation. (See *Manual initialisation*).

618 Reset of kWh counter
(RESET KWH COUNT)

Value:

★ No reset (DO NOT RESET) [0]
Reset (RESET COUNTER) [1]

Function:

Reset to zero of parameter 602 *kWh counter.*

Description of choice:

If *Reset* [1] has been selected and when the [OK] key is pressed, the kWh counter of the VLT frequency converter is reset. This parameter cannot be selected via the serial port, RS 485.

NB!
When the [OK] key has been activated, the reset has been carried out.

619 Reset of hours-run counter
(RESET RUN. HOUR)

Value:

★ No reset (DO NOT RESET) [0]
Reset (RESET COUNTER) [1]

Function:

Reset to zero of parameter 601 *Hours-run*.

Description of choice:

If *Reset* [1] has been selected and when the [OK] key is pressed, parameter 601 *Hours-run* is reset. This parameter cannot be selected via the serial port, RS 485.

NB!
When the [OK] key has been activated, the reset has been carried out.

★ = factory setting. () = display text [] = value for use in communication via serial communication port

620 Operating mode (OPERATION MODE)

Value:

★ Normal function (NORMAL OPERATION)	[0]
Function with de-activated inverter (OPER. W/INVERT.DISAB)	[1]
Control card test (CONTROL CARD TEST)	[2]
Initialisation (INITIALIZE)	[3]

Function:

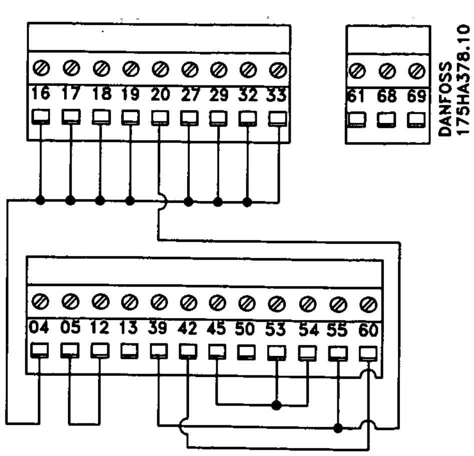
In addition to its normal function, this parameter can be used for two different tests.
Furthermore, it is possible to reset to the default factory settings for all Setups, except parameters 500 *Address*, 501 *Baud rate*, 600-605 *Operating data* and 615-617 *Fault log*.

Description of choice:

Normal function [0] is used for normal operation of the motor.
Function with de-activated inverter [1] is selected if control is desired over the influence of the control signal on the control card and its functions - without the motor shaft running.
Control card [2] is selected if control of the analogue and digital inputs, analogue and digital outputs, relay outputs and the control voltage of +10 V is desired.
A test connector with internal connections is required for this test.

The test connector for the *Control card* [2] is set up as follows:

connect 4-16-17-18-19-27-29-32-33;
connect 5-12;
connect 39-20-55;
connect 42 - 60;
connect 45-53-54.



Use the following procedure for the control card test:

1) Select *Control card test*.
2) Cut off the mains supply and wait for the light in the display to go out.
3) Insert the test plug (see preceding column).
4) Connect to mains.
5) The VLT frequency converter expects the [OK] key to be pressed (the test cannot be run without LCP).
6) The VLT frequency converter automatically tests the control card.
7) Remove the test connector and press the [OK] key when the VLT frequency converter displays "TEST COMPLETED".
8) Parameter 620 *Operating mode* is automatically set to *Normal function*.

If the control card test fails, the VLT frequency converter will display "TEST FAILED". Replace the control card.

Initialisation [3] is selected if the factory setting of the unit is to be generated without resetting parameters 500 *Address*, 501 *Baud rate*, 600-605 *Operating data* and 615-617 *Fault log*.

Procedure for initialisation:

1) Select *Initialisation*.
2) Press the [OK] key.
3) Cut off the mains supply and wait for the light in the display to go out.
4) Connect to mains.
5) Initialisation of all parameters will be carried out in all Setups with the exception of parameters 500 *Address*, 501 *Baud rate*, 600-605 *Operating data* and 615-617 *Fault log*.

Manual initialisation is another option. (See *Manual initialisation*).

★ = factory setting. () = display text [] = value for use in communication via serial communication port

621 - 631 Nameplate

Value:

Parameter No.	Description Nameplate:	Display text
621	Unit type	(DRIVE TYPE)
622	Power component	(POWER SECTION)
623	VLT ordering no.	(ORDERING NO)
624	Software version no.	(SOFTWARE VERSION)
625	LCP identification no.	(LCP ID NO.)
626	Database identification no.	(PARAM DB ID)
627	Power component identification no.	(POWER UNIT DB ID)
628	Application option type	(APPLIC. OPTION)
629	Application option ordering no.	(APPLIC. ORDER NO)
630	Communication option type	(COM. OPTION)
631	Communication option ordering no.	(COM. ORDER NO)

Function:

The main data for the unit can be read from parameters 621 to 631 *Nameplate* via the display or the serial communication port.

Description of choice:

Parameter 621 *Nameplate: Unit type*:
VLT type gives the unit size and mains voltage. Example: VLT 6008 380-460 V.

Parameter 622 *Nameplate: Power component*:
This gives the type of power card fitted to the VLT frequency converter. Example: STANDARD.

Parameter 623 *Nameplate: VLT ordering no.:*
This gives the ordering number for the VLT type in question. Example: 1757805.

Parameter 624 *Nameplate: Software version no.:*
This gives the present software version number of the unit. Example: V 1.00.

Parameter 625 *Nameplate: LCP identification no.:*
This gives the identification number of the LCP of the unit. Example: ID 1.42 2 kB.

Parameter 626 *Nameplate: Database identification no.:*
This gives the identification number of the software's database. Example: ID 1.14.

Parameter 627 *Nameplate: Power component identification no.:*
This gives the identification number of the database of the unit. Example: ID 1.15.

Parameter 628 *Nameplate: Application option type:*
This gives the type of application options fitted with the VLT frequency converter.

Parameter 629 *Nameplate: Application option ordering no.:*
This gives the ordering number for the application option.

Parameter 630 *Nameplate: Communication option type:*
This gives the type of communication options fitted with the VLT frequency converter.

Parameter 631 *Nameplate: Communication option ordering no.:*
This gives the ordering number for the communication option.

★ = factory setting. () = display text [] = value for use in communication via serial communication port

NB!
Parameters 700-711 for the relay card are only activated if a relay option card is installed in the VLT 6000 HVAC.

700 Relay 6, function (RELAY6 FUNCTION)
703 Relay 7, function (RELAY7 FUNCTION)
706 Relay 8, function (RELAY8 FUNCTION)
709 Relay 9, function (RELAY9 FUNCTION)

Function:

This output activates a relay switch.
Relay outputs 6/7/8/9 can be used for showing status and warnings. The relay is activated when the conditions for the relevant data values have been fulfilled.
Activation/deactivation can be programmed in parameters 701/704/707/710 *Relay 6/7/8/9, ON delay* and parameters 702/705/708/711 *Relay 6/7/8/9, OFF delay*.

Description of choice:

See data choice and connections in *Relay outputs*.

701 Relay 6, ON delay (RELAY6 ON DELAY)
704 Relay 7, ON delay (RELAY7 ON DELAY)
707 Relay 8, ON delay (RELAY8 ON DELAY)
710 Relay 9, ON delay (RELAY9 ON DELAY)

Value:

0 - 600 sec. ★ 0 sec.

Function:

This parameter allows a delay of the cut-in time of relays 6/7/8/9 (terminals 1-2).

Description of choice:

Enter the required value.

702 Relay 6, OFF delay (RELAY6 OFF DELAY)
705 Relay 7, OFF delay (RELAY7 OFF DELAY)
708 Relay 8, OFF delay (RELAY8 OFF DELAY)
711 Relay 9, OFF delay (RELAY9 OFF DELAY)

Value:

0 - 600 sec. ★ 0 sec.

Function:

This parameter is used to delay the cut-out time of relays 6/7/8/9 (terminals 1-2).

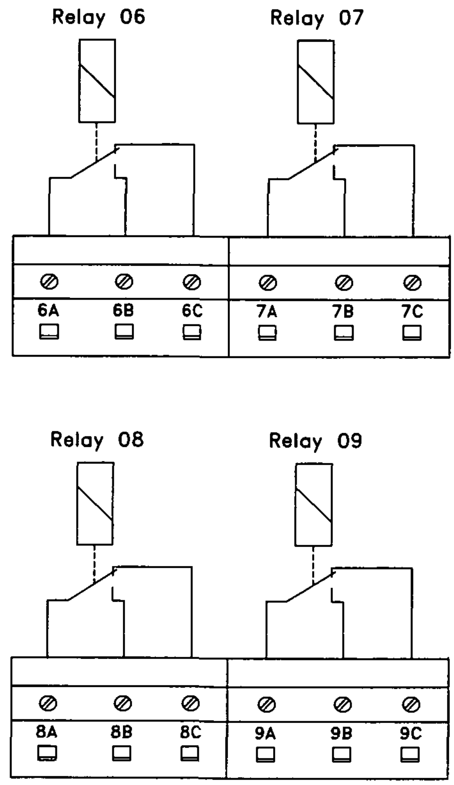
Description of choice:

Enter the required value.

■ Electrical installation of the relay card

The relays are connected as shown below.

Relay 6-9:
A-B make, A-C break
Max. 240 V AC, 2 Amp.
Max. cross-section: 1.5mm² (AWG 28-16).
Torque: 0.22 - 0.25 Nm.
Screw size: M2.



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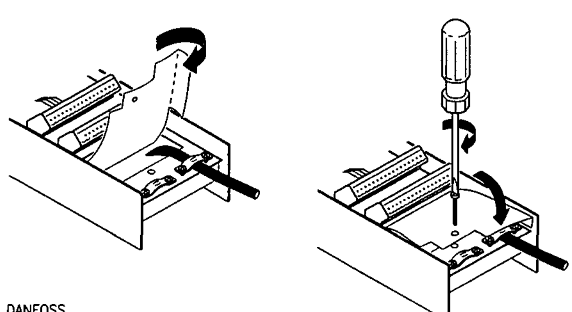
To achieve double isolation, the plastic foil must be mounted as shown in the drawing below.



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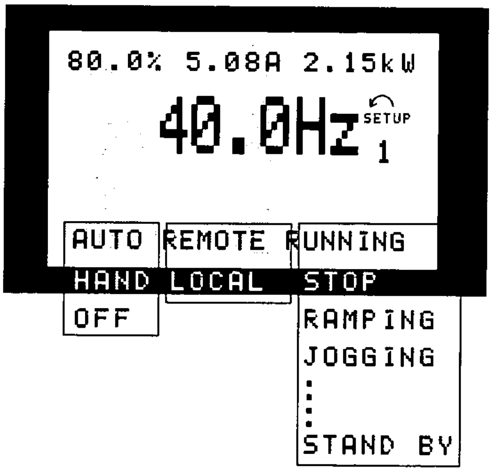
★ = factory setting. () = display text [] = value for use in communication via serial communication port

■ Status messages

Status messages appear in the 4th line of the display - see example below.
The left part of the status line indicates the active type of control of the VLT frequency converter.
The centre part of the status line indicates the active reference.
The last part of the status line gives the present status, e.g. "Running", "Stop" or "Stand by".



Auto mode (AUTO)
The VLT frequency converter is in Auto mode, i.e. control is carried out via the control terminals and/or serial communication. See also *Auto start*.

Hand mode (HAND)
The VLT frequency converter is in Hand mode, i.e. control is carried out via the control keys. See also *Hand start*.

OFF (OFF)
OFF/STOP is activated either by means of the control key, or by the digital inputs *Hand start* and *Auto start* both being a logic '0'. See also *OFF/STOP*.

Local reference (LOCAL)
If LOCAL has been selected, the reference is set via the [+/-] keys on the control panel. See also *Display modes*.

Remote reference (REM.)
If REMOTE has been selected, the reference is set via the control terminals or via serial communication. See also *Display modes*.

Running (RUNNING)
The motor speed now corresponds to the resulting reference.

Ramp operation (RAMPING)
The output frequency is now changed in accordance with the preset ramps.

Auto-ramp (AUTO RAMP)
Parameter 208 *Automatic ramp-down* is enabled, i.e. the VLT frequency converter is trying to avoid a trip from overvoltage by increasing its output frequency.

Sleep Boost (SLEEP .BST)
The boost function in parameter 406 *Boost setpoint* is enabled. This function is only possible in *Closed loop* operation.

Sleep mode (SLEEP)
The energy saving function in parameter 403 *Sleep mode timer* is enabled. This means that at present the motor has stopped, but that it will restart automatically when required.

Start delay (START DEL)
A start delay time has been programmed i parameter 111 *Start delay*. When the delay has passed, the output frequency will start by ramping up to the reference.

Run request (RUN REQ.)
A start command has been given, but the motor will be stopped until a *Run permissive* signal is received via a digital input.

Jogging (JOG)
Jog has been enabled via a digital input or via serial communication.

Jog request (JOG REQ.)
A JOG command has been given, but the motor will remain stopped until a *Run permissive* signal is received via a digital input.

Freeze output (FRZ.OUT.)
Freeze output has been enabled via a digital input.

Status messages, cont.

Freeze output request (FRZ.REQ.)
A freeze output command has been given, but the motor will remain stopped until a *Run permissive* signal is received via a digital input.

Reversing and start (START F/R)
Reversing and start [2] on terminal 19 (parameter 303 *Digital inputs*) and *Start* [1] on terminal 18 (parameter 302 *Digital inputs*) are enabled at the same time. The motor will remain stopped until one of the signals becomes a logic '0'.

Automatic Motor Adaptation running (AMA RUN)
Automatic motor adaptation has been enabled in parameter 107 *Automatic Motor Adaptation, AMA*.

Automatic Motor Adaptation completed (AMA STOP)
Automatic motor adaptation has ben completed. The VLT frequency converter is now ready for operation after the *Reset* signal has been enabled. Please note that the motor will start after the VLT frequency converter has received the *Reset* signal.

Stand by (STANDBY)
The VLT frequency converter is able to start the motor when a start command is received.
Stop (STOP)
The motor has been stopped via a stop signal from a digital input, [OFF/STOP]-buttom or serial communication.

DC stop (DC STOP)
The DC brake in parameter 114-116 has been enabled.

DRIVE ready (UN. READY)
The VLT frequency converter is ready for operation, but terminal 27 is a logic '0' and/or a *Coasting command* has been received via the serial communication.

Control ready (CTR.READY)
This status is only active when a profibus option card is installed.

Not ready (NOT READY)
The VLT frequency converter is not ready for operation, because of a trip or because OFF1, OFF2 or OFF3 is a logic '0'.

Start disabled (START IN.)
This status will only be displayed if, in parameter 599 *Statemachine*, *Profidrive* [1] has been selected and OFF2 or OFF3 is a logic '0'.

Exceptions XXXX (EXCEPTIONS XXXX)
The microprocessor of the control card has stopped and the VLT frequency converter is out of operation. The cause may be noise on the mains, motor or control cables, leading to a stop of the control card microprocessor.
Check for EMC-correct connection of these cables.

List of warnings and alarms

The table gives the different warnings and alarms and indicates whether the fault locks the VLT frequency converter. After Trip locked, the mains supply must be cut and the fault must be corrected. Reconnect the mains supply and reset the VLT frequency converter before being ready. A Trip can be reset manually in three ways

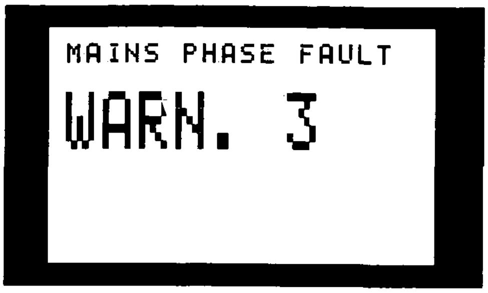
1) Via the control key [RESET]
2) Via a digital input
3) Via serial communication
   In addition, an automatic reset may be selected in parameter 400 *Reset function.*

Wherever a cross is placed under both Warning and Alarm, this can mean that a warning precedes the alarm. It can also mean that it is possible to program whether a given fault is to result in a warning or an alarm. This is possible, e.g. in parameter 117 *Motor thermal protection*. After a trip, the motor will be coasting and on the VLT frequency converter alarm and warning will flash. If the fault is removed, only the alarm will flash. After a reset, the VLT frequency converter will be ready to start operation again.

No.	Description	Warning	Alarm	Trip locked
1	10 Volts low (10 VOLT LOW)	X		
2	Live zero fault (LIVE ZERO ERROR)	X	X	
4	Mains imbalance (MAINS IMBALANCE)	X	X	X
5	Voltage warning high (DC LINK VOLTAGE HIGH)	X		
6	Voltage warning low (DC LINK VOLTAGE LOW)	X		
7	Overvoltage (DC LINK OVERVOLT)	X	X	
8	Undervoltage (DC LINK UNDERVOLT)	X	X	
9	Inverter overloaded (INVERTER TIME)	X	X	
10	Motor overloaded (MOTOR TIME)	X	X	
11	Motor thermistor (MOTOR THERMISTOR)	X	X	
12	Current limit (CURRENT LIMIT)	X	X	
13	Overcurrent (OVERCURRENT)	X	X	X
14	Earth fault (EARTH FAULT)		X	X
15	Switch mode fault (SWITCH MODE FAULT)		X	X
16	Short-circuit (CURR.SHORT CIRCUIT)		X	X
17	Serial communication timeout (STD BUSTIMEOUT)	X	X	
18	HPFB bus timeout (HPFB TIMEOUT)	X	X	
19	Fault in EEprom on power card (EE ERROR POWER)	X		
20	Fault in EEprom on control card (EE ERROR CONTROL)	X		
22	Auto-optimisation not OK (AMA FAULT)		X	
29	Heat-sink temperature too high (HEAT SINK OVERTEMP.)		X	
30	Motor phase U missing (MISSING MOT.PHASE U)		X	
31	Motor phase V missing (MISSING MOT.PHASE V)		X	
32	Motor phase W missing (MISSING MOT.PHASE W)		X	
34	HPFB communication fault (HPFB COMM. FAULT)	X	X	
37	Inverter fault (GATE DRIVE FAULT)		X	X
39	Check parameters 104 and 106 (CHECK P.104 & P.106)	X		
40	Check parameters 103 and 105 (CHECK P.103 & P.106)	X		
41	Motor too big (MOTOR TOO BIG)	X		
42	Motor too small (MOTOR TOO SMALL)	X		
60	Safety stop (EXTERNAL FAULT)		X	
61	Output frequency low (FOUT < FLOW)	X		
62	Output frequency high (FOUT > FHIGH)	X		
63	Output current low (I MOTOR < I LOW)	X	X	
64	Output current high (I MOTOR > I HIGH)	X		
65	Feedback low (FEEDBACK < FDB LOW)	X		
66	Feedback high (FEEDBACK > FDB HIGH)	X		
67	Reference low (REF. < REF. LOW)	X		
68	Reference high (REF. > REF. HIGH)	X		
69	Temperature auto derate (TEMP.AUTO DERATE)	X		
99	Unknown fault (UNKNOWN ALARM)		X	X

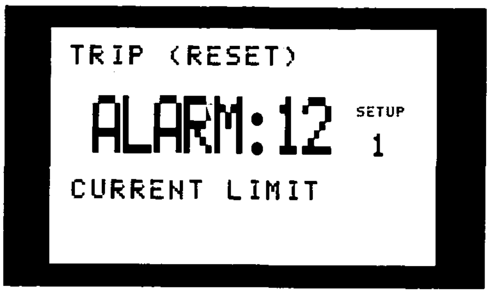
Warnings

A warning will flash in line 2, while an explanation is given in line 1.



Alarms

If an alarm is given, the present alarm number will be shown in line 2. Lines 3 and 4 of the display will offer an explanation.



WARNING 1
Under 10 V (10 VOLT LOW)
The 10 V voltage from terminal 50 on the control card is below 10 V.
Remove some of the load from terminal 50, as the 10 Volts supply is overloaded. Max. 17 mA/min. 590 Ω.

WARNING/ALARM 2
Live zero fault (LIVE ZERO ERROR)
The current or voltage signal on terminal 53, 54 or 60 is below 50% of the value preset in parameter 309, 312 and 315 *Terminal, min. scaling*.

WARNING/ALARM 4
Mains imbalance (MAINS IMBALANCE)
High imbalance or phase missing on the supply side. Check the supply voltage to the VLT frequency converter.

WARNING 5
Voltage warning high
(DC LINK VOLTAGE HIGH)
The intermediate circuit voltage (DC) is higher than *Voltage warning high*, see table below. The controls of the VLT frequency converter are still enabled.

WARNING 6
Voltage warning low (DC LINK VOLTAGE LOW)
The intermediate circuit voltage (DC) is lower than *Voltage warning low*, see table below. The controls of the VLT frequency converter are still enabled.

WARNING/ALARM 7
Overvoltage (DC LINK OVERVOLT)
If the intermediate circuit voltage (DC) is higher than the *Overvoltage limit* of the inverter (see table below), the VLT frequency converter will trip after a fixed period. The length of this period depends on the unit.

Alarm/warning limits:

VLT 6000 HVAC	3 x 200 - 240 V [VDC]	3 x 380 - 460 V [VDC]
Undervoltage	211	402
Voltage warning low	222	423
Voltage warning high	384	737
Overvoltage	425	765

The voltages stated are the intermediate circuit voltage of the VLT frequency converter with a tolerance of ± 5 %. The corresponding mains voltage is the intermediate circuit voltage divided by 1,35.

Warnings and alarms, cont.

WARNING/ALARM 8
Undervoltage (DC LINK UNDERVOLT)
If the intermediate circuit voltage (DC) drops below the *undervoltage limit* of the inverter, the VLT frequency converter will trip after a fixed period, the length of the period depending on the unit.
Furthermore, the voltage will be stated in the display. Check whether the supply voltage matches the VLT frequency converter, see *Technical data.*

WARNING/ALARM 9
Inverter overload (INVERTER TIME)
The electronic, thermal inverter protection reports that 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 gives a warning at 98% and trips at 100%, while giving an alarm. The VLT frequency converter cannot be reset until the counter is below 90%.
The fault is that the VLT frequency converter is overloaded by more than 100% for too long.

WARNING/ALARM 10
Motor overtemperature (MOTOR TIME)
According to the electronic thermal protection (ETR), the motor is too hot. Parameter 117 *Motor thermal protection* allows a choice of whether the VLT frequency converter is to give a warning or an alarm when the *Motor thermal projection* reaches 100%. The fault is that the motor is overloaded by more than 100% of the preset, rated motor current for too long. Check that the motor parameters 102-106 have been set correctly.

WARNING/ALARM 11
Motor thermistor (MOTOR THERMISTOR)
The thermistor or the thermistor connection has been disconnected. Parameter 117 *Motor thermal protection* allows a choice of whether the VLT frequency converter is to give a warning or an alarm. Check that the thermistor has been correctly connected between terminal 53 or 54 (analogue voltage input) and terminal 50 (+ 10 V supply).

WARNING/ALARM 12
Current limit (CURRENT LIMIT)
The current is higher than the value in parameter 215 *Current limit* I_{LIM} and the VLT frequency converter trips after the time set in parameter 412 *Trip delay overcurrent,* I_{LIM} has passed.

WARNING/ALARM 13
Overcurrent (OVER CURRENT)
The inverter peak current limit (approx. 200% of the rated current) has been exceeded. The warning will last approx. 1-2 seconds, following which the VLT frequency converter will trip and give off an alarm. Turn off the VLT frequency converter and check whether the motor shaft can be turned and whether the motor size matches the VLT frequency converter.

ALARM: 14
Earth fault (EARTH FAULT)
There is a discharge from the output phases to earth, either in the cable between the frequency converter and the motor or in the motor itself.
Turn off the VLT frequency converter and remove the earth fault.

ALARM: 15
Switch mode fault (SWITCH MODE FAULT)
Fault in the switch mode power supply (internal ± 15 V supply).
Contact your Danfoss supplier.

ALARM: 16
Short-circuiting (CURR. SHORT CIRCUIT)
There is short-circuiting on the motor terminals or in the motor itself.
Cut off the mains supply to the VLT frequency converter and remove the short-circuit.

WARNING/ALARM 17
Serial communication timeout (STD BUSTIMEOUT)
There is no serial communication with the VLT frequency converter.
This warning will only be enabled if parameter 556 *Bus time interval function* has been set to a value different from OFF.
If parameter 556 *Bus time interval function* has been set to *Stop and trip* [5], the VLT frequency converter will first give off an alarm, then ramp down and finally trip while giving off an alarm. It is possible to increase parameter 555 *Bus time interval.*

Warnings and alarms, cont.

WARNING/ALARM 18
HPFB bus timeout (HPFB TIMEOUT)
There is no serial communication with the communication option card of the VLT frequency converter. The warning will only be enabled if parameter 804 *Bus time interval function* has been set to anything but OFF. If parameter 804 *Bus time interval function* has been set to *Stop and trip*, the VLT frequency converter will first give off an alarm, then ramp down and finally trip while giving off an alarm.
Parameter 803 *Bus time interval* could possibly be increased.

WARNING 19
Fault in the EEprom on the power card (EE ERROR POWER)
There is a fault on the power card EEPROM. The VLT frequency converter will continue to function, but is likely to fail at the next power-up. Contact your Danfoss supplier.

WARNING 20
Fault in the EEprom on the control card (EE ERROR CONTROL)
There is a fault in the EEPROM on the control card. The VLT frequency converter will continue to function, but is likely to fail at the next power-up. Contact your Danfoss supplier.

ALARM: 22
Auto-optimisation not OK (AMA FAULT)
A fault has been found during automatic motor adaptation. The text shown in the display indicates a fault message.

NB!
AMA can only be carried out if there are no alarms during tuning.

CHECK 103, 105 **[0]**
Parameter 103 or 105 has a wrong setting. Correct the setting and start AMA all over.

LOW P.105 **[1]**
The motor is too small for AMA to be carried out. If AMA is to be enabled, the rated motor current (parameter 105) must be higher than 35% of the rated output current of the VLT frequency converter.

ASYMMETRICAL IMPEDANCE **[2]**
AMA has detected an asymmetrical impedance in the motor connected to the system. The motor could be defective.

MOTOR TOO BIG **[3]**
The motor connected to the system is too big for AMA to be carried out. The setting in parameter 102 does not match the motor used.

MOTOR TOO SMALL **[4]**
The motor connected to the system is too small for AMA to be carried out. The setting in parameter 102 does not match the motor used.

TIME OUT **[5]**
AMA fails because of noisy measuring signals. Try to start AMA all over a number of times, until AMA is carried out. Please note that repeated AMA runs may heat the motor to a level where the stator resistance R_S is increased. In most cases, however, this is not critical.

INTERRUPTED BY USER **[6]**
AMA has been interrupted by the user.

INTERNAL FAULT **[7]**
An internal fault has occurred in the VLT frequency converter. Contact your Danfoss supplier.

LIMIT VALUE FAULT **[8]**
The parameter values found for the motor are outside the acceptable range within which the VLT frequency converter is able to work.

MOTOR ROTATES **[9]**
The motor shaft rotates. Make sure that the load is not able to make the motor shaft rotate. Then start AMA all over.

Warnings and alarms, cont.

ALARM 29
Heat sink temperature too high
(HEAT SINK OVER TEMP.):
If the enclosure is IP 00 or IP 20, the cut-out temperature of the heat-sink is 90°C. If IP 54 is used, the cut-out temperature is 80°C.
The tolerance is ± 5°C. The temperature fault cannot be reset, until the temperature of the heat-sink is below 60°C.
The fault could be the following:
- Ambient temperature too high
- Too long motor cable
- Too high switching frequency.

ALARM: 30
Motor phase U missing
(MISSING MOT.PHASE U):
Motor phase U between VLT frequency converter and motor is missing.
Turn off the VLT frequency converter and check motor phase U.

ALARM: 31
Motor phase V missing
(MISSING MOT.PHASE V):
Motor phase V between VLT frequency converter and motor is missing.
Turn off the VLT frequency converter and check motor phase V.

ALARM: 32
Motor phase W missing
(MISSING MOT.PHASE U):
Motor phase W between VLT frequency converter and motor is missing.
Turn off the VLT frequency converter and check motor phase W.

WARNING/ALARM: 34
HPFB communication fault
(HPFB COMM. FAULT)
The serial communication on the communication option card is not working.

ALARM: 37
Inverter fault (GATE DRIVE FAULT):
IGBT or the power card is defective. Contact your Danfoss supplier.

Auto-optimisation warnings 39-42
Automatic motor adaptation has stopped, since some parameters have probably been set wrongly, or the motor used in too big/small for AMA to be carried out. A choice must thus be made by pressing [CHANGE DATA] and choosing 'Continue' + [OK] or 'Stop' + [OK]. If parameters need to be changed, select 'Stop'; start up AMA all over.

WARNING: 39
CHECK PAR. 104, 106
Parameters 104 *Motor frequency* $f_{M,N}$, or 106 *Rated motor speed* $n_{M,N}$, have probably not been set correctly. Check the setting and select 'Continue' or [STOP].

WARNING: 40
CHECK PAR. 103, 105
Parameter 103 *Motor voltage,* $U_{M,N}$ or 105 *Motor current,* $I_{M,N}$ has not been set correctly. Correct the setting and restart AMA.

WARNING: 41
MOTOR TOO BIG (MOTOR TOO BIG)
The motor used is probably too big for AMA to be carried out. The setting in parameter 102 *Motor power,* $P_{M,N}$ may not match the motor. Check the motor and choose 'Continue' or [STOP].

WARNING: 42
MOTOR TOO SMALL (MOTOR TOO SMALL)
The motor used is probably too small for AMA to be carried out. The setting in parameter 102 *Motor power,* $P_{M,N}$ may not match the motor. Check the motor and select 'Continue' or [STOP].

ALARM: 60
Safety stop (EXTERNAL FAULT)
Terminal 27 (parameter 304 *Digital inputs*) has been programmed for a *Safety interlock* [3] and is a logic '0'.

WARNING: 61
Output frequency low (FOUT < FLOW)
The output frequency is lower than parameter 223 *Warning: Low frequency,* f_{LOW}.

WARNING: 62
Output frequency high (FOUT > FHIGH)
The output frequency is higher than parameter 224 *Warning: High frequency, f_{HIGH}.*

WARNING/ALARM: 63
Output current low (I MOTOR < I LOW)
The output current is lower than parameter 221 *Warning: Low current, I_{LOW}.* Select the required function in parameter 409 *Function in case of no load.*

WARNING: 64
Output current high (I MOTOR > I HIGH)
The output current is higher than parameter 222 *Warning: High current, I_{HIGH}.*

WARNING: 65
Feedback low (FEEDBACK < FDB LOW)
The resulting feedback value is lower than parameter 227 *Warning: Low feedback, FB_{LOW}.*

WARNING: 66
Feedback high (FEEDBACK > FDB HIGH)
The resulting feedback value is higher than parameter 228 *Warning: High feedback, FB_{HIGH}.*

WARNING: 67
Remote reference low
(REF. < REF LOW)
The remote reference is lower than parameter 225 *Warning: Low reference, REF_{LOW}.*

WARNING: 68
Remote reference high
(REF. > REF HIGH)
The remote reference is higher than parameter 226 *Warning: High reference, REF_{HIGH}.*

WARNING: 69
Temperature auto derate
(TEMP.AUTO DERATE)
The heat sink temperature has exceeded the maximum value and the auto derating function (par. 411) is active. *Warning: Temp. Auto derate.*

WARNING: 99
Unknown fault (UNKNOWN ALARM)
An unknown fault has occurred which the software is not able to handle.
Contact your Danfoss supplier.

■ Aggressive environments

In common with all electronic equipment, a VLT frequency converter contains a large number of mechanical and electronic components, all of which are vulnerable to environmental effects to some extent.

⚠ The VLT frequency converter should not therefore be installed in environments with airborne liquids, particles or gases capable of affecting and damaging the electronic components. Failure to take the necessary protective measures increases the risk of stoppages, thus reducing the life of the VLT frequency converter.

Liquids can be carried through the air and condense in the VLT frequency converter. In addition to this, liquids may cause corrosion of components and metal parts.
Steam, oil and salt water may cause corrosion of components and metal parts.
In such environments, equipment with enclosure rating IP 54 is recommended.

Airborne particles such as dust particles may cause mechanical, electrical or thermal failure in the VLT frequency converter.
A typical indicator of excessive levels of airborne particles is dust particles around the VLT frequency converter fan.
In very dusty environments, equipment with enclosure rating IP 54 or a cabinet for IP 00/20 equipment is recommended.

In environments with high temperatures and humidity, corrosive gases such as sulphur, nitrogen and chlorine compounds will cause chemical processes on the VLT frequency converter components. Such chemical reactions will rapidly affect and damage the electronic components.

In such environments, it is recommended that equipment is mounted in a cabinet with fresh air ventilation, keeping aggressive gases away from the VLT frequency converter.

NB!
Mounting VLT frequency converters in aggressive environments will increase the risk of stoppages and furthermore considerably reduce the life of the converter.

Before the installation of the VLT frequency converter, the ambient air should be checked for liquids, particles and gases. This may be done by observing existing installations in this environment. Typical indicators of harmful airborne liquids are water or oil on metal parts, or corrosion of metal parts.
Excessive dust particle levels are often found on installation cabinets and existing electrical installations. One indicator of aggressive airborne gases is blackening of copper rails and cable ends on existing installations.

■ Calculation of resulting reference

The calculation made below gives the resulting reference when parameter 210 *Reference type* is programmed for *Sum* [0] and *Relative* [1], respectively.

External reference is the sum of references from terminals 53, 54, 60 and serial communication. The sum of these can never exceed parameter 205 *Max. reference*.

External reference can be calculated as follows:

$$\text{Ext. ref.} = \frac{(\text{Par. 205 } \textit{Max. ref.} - \text{Par. 204 } \textit{Min. ref.}) \times \text{Ana. signal } \textit{Term. 53} \text{ [V]}}{\text{Par. 310 Term. 53 Max. scaling} - \text{Par. 309 Term. 53 Min. scaling}} + \frac{(\text{Par. 205 } \textit{Max. ref.} - \text{Par. 204 } \textit{Min. ref.}) \times \text{Ana. signal } \textit{Term. 54} \text{ [V]}}{\text{Par. 313 Term. 54 Max. scaling} - \text{Par. 312 Term. 54 Min. scaling}} +$$

$$\frac{(\text{Par. 205 } \textit{Max. ref.} - \text{Par. 204 } \textit{Min. ref.}) \times \text{Par. 314 } \textit{Term. 60} \text{ [mA]}}{\text{Par. 316 Term. 60 Max. scaling} - \text{Par. 315 Term. 60 Min. scaling}} + \frac{\text{serial com. reference} \times (\text{Par. 205 } \textit{Max. ref.} - \text{Par. 204 } \textit{Min. ref.})}{16384 \text{ (4000 Hex)}}$$

Par. 210 *Reference type* is programmed = *Sum* [0].

$$\text{Res. ref.} = \frac{(\text{Par. 205 } \textit{Max. ref.} - \text{Par. 204 } \textit{Min. ref.}) \times \text{Par. 211-214 } \textit{Preset ref.}}{100} + \text{External ref.} + \text{Par. 204 } \textit{Min. ref.} + \text{Par. 418/419 Setpoint (only in closed loop)}$$

Par. 210 *Reference type* is programmed = *Relative* [1].

$$\text{Res. ref.} = \frac{\text{External reference} \times \text{Par. 211-214 } \textit{Preset ref.}}{100} + \text{Par. 204 } \textit{Min. ref.} + \text{Par. 418/419 Setpoint (only in closed loop)}$$

Galvanic isolation (PELV)

PELV offers protection by way of extra low voltage. Protection against electric shock is considered to be ensured when the electrical supply is of the PELV type and the installation is made as described in local/national regulations on PELV supplies.

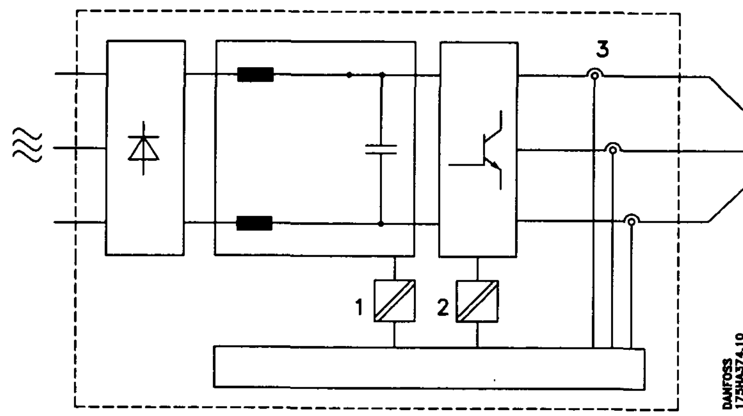
In VLT 6000 HVAC all control terminals as well as terminals 1-3 (AUX relay) are supplied from or in connection with extra low voltage (PELV).

Galvanic (ensured) isolation is obtained by fulfilling requirements concerning higher isolation and by providing the relevant creapage/clearance distances. These requirements are described in the EN 50178 standard.

For additional information on PELV see *RFI switching*.
The components that make up the electrical isolation, as described below, also comply with the requirements concerning higher isolation and the relevant test as described in EN 50178.
The galvanic isolation can be shown in three locations (see drawing below), namely:

1. Power supply (SMPS) incl. signal isolation of U_{DC},indicating the intermediate current voltage.
2. Gate drive that runs the IGTBs (trigger transformers/opto-couplers).
3. Current transducers (Hall effect current transducers).

Galvanic isolation



Earth leakage current

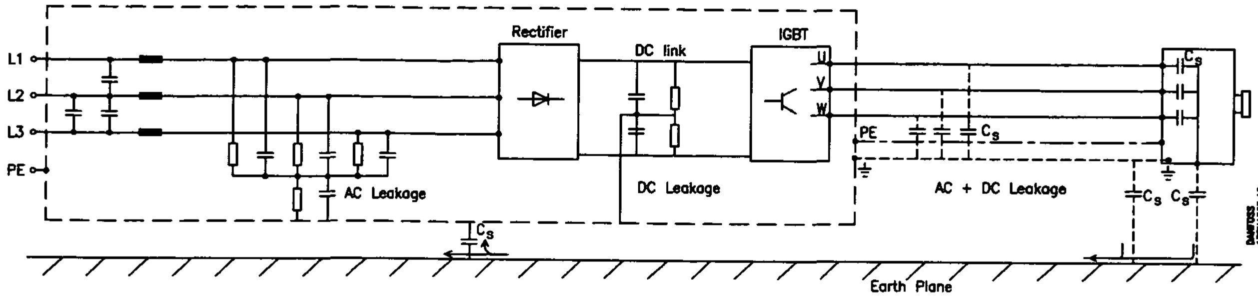
Earth leakage current is primarily caused by the capacitance between motor phases and the motor cable screen. When an RFI filter is used, this contributes additional leakage current, as the filter circuit is connected to earth through capacitors. See drawing on the following page.
The size of the leakage current to the ground depends on the following factors, in order of priority:
1. Length of motor cable
2. Motor cable with or without screen
3. Switching frequency
4. RFI filter used or not
5. Motor grounded on site or not.

The leakage current is of importance to safety during handling/operation of the frequency converter if (by mistake) the frequency converter has not been earthed.

NB!
Since the leakage current is > 3.5 mA, reinforced earthing must be established, which is required if EN 50178 is to be complied with. Never use ELCB relays (type A) that are not suitable for DC fault currents from three-phase rectifier loads.

If ELCB relays are used, they must be:
- Suitable for protecting equipment with a direct current content (DC) in the fault current (3-phase bridge rectifier)
- Suitable for power-up with short pulse-shaped charging current to earth
- Suitable for a high leakage current (300 mA).

All about VLT 6000 HVAC



Leakage currents to earth

■ Extreme running conditions

Short circuit

VLT 6000 HVAC is protected against short circuits by means of current measurement in each of the three motor phases. A short circuit between two output phases will cause an overcurrent in the inverter. However, each transistor of the inverter will be turned off individually when the short circuit current exceeds
the permitted value.

After a few microseconds the driver card turns off the inverter and the frequency converter will display a fault code, although depending on impedance and motor frequency.

Earth fault

The inverter cuts out within a few micorseconds in case of an earth fault on a motor phase, although depending on impedance and motor frequency.

Switching on the output

Switching on the output between the motor and the frequency converter is fully permitted. It is not possible to damage VLT 6000 HVAC in any way by switching on the output. However, fault messages may appear.

Motor-generated overvoltage

The voltage in the intermediate circuit is increased when the motor acts as a generator. This occurs in two cases:

1. The load drives the motor (at constant output frequency from the frequency converter), i.e. the load generates energy.
2. During deceleration ("ramp-down") if the moment of inertia is high, the load is low and the ramp-down time is too short for the energy to be dissipated as a loss in the VLT frequency converter, the motor and the installation.

The control unit attempts to correct the ramp if possible.
The inverter turns off to protect the transistors and the intermediate circuit capacitors when a certain voltage level is reached.

Mains drop-out

During a mains drop-out, VLT 6000 HVAC continues until the intermediate circuit voltage drops below the minimum stop level, which is typically 15% below VLT 6000 HVAC's lowest rated supply voltage.

The time before the inverter stops depends on the mains voltage before the drop-out and on the motor load.

Static overload

When VLT 6000 HVAC is overloaded (the current limit in parameter 215 *Current limit,* I_{LIM} has been reached), the controls will reduce the output frequency in an attempt to reduce the load.
If the overload is excessive, a current may occur that makes the VLT frequency converter cut out after approx. 1.5 sec.

Operation within the current limit can be limited in time (0-60 s) in parameter 412 *Trip delay overcurrent,* I_{LIM}.

■ Peak voltage on motor

When a transistor in the inverter is opened, the voltage across the motor increases by a dV/dt ratio that depends on:

- the motor cable (type, cross-section, length screened/armoured or unscreened/unarmoured)
- inductance

The natural induction causes an overshot U_{PEAK} in the motor voltage before it stabilises itself at a level which depends on the voltage in the intermediate circuit. The rise time and the peak voltage U_{PEAK} affect the service life of the motor. If the peak voltage is too high, motors without phase coil insulation are the ones that will primarily be affected. If the motor cable is short (a few meters), the rise time and peak voltage are lower.
If the motor cable is long (100 m), the rise time and peak voltage will increase.

If very small motors are used without phase coil insulation, it is recommended to fit a LC filter after the frequency converter.
Typical values for the rise time and peak voltage U_{PEAK} measured on the motor terminals between two phases:

VLT 6002-6006 200 V, VLT 6002-6011 400 V

Cable length	Mains voltage	du/dt	Peak voltage
50 metres	380 V	0.3 µsec.	850 V
50 metres	460 V	0.4 µsec.	950 V
150 metres	380 V	1.2 µsec.	1000 V
150 metres	460 V	1.3 µsec.	1300 V

VLT 6008-6027 200 V, VLT 6016-6072 400 V

Cable length	Mains voltage	du/dt	Peak voltage
50 metres	380 V	0.1 µsec.	900 V
150 metres	380 V	0.2 µsec.	1000 V

VLT 6075-6275 380-460 V, 6042-6062 200-240 V

Cable length	Mains voltage	du/dt	Peak voltage
13 metres	460 V	670 V/µsec.	815 V
20 metres	460 V	620 V/µsec.	915 V

VLT 6350-6550 380-460 V

Cable length	Mains voltage	du/dt	Peak voltage
20 metres	460 V	415 V/µsec.	760 V

■ Switching on the input

Switching on the input depends on the mains voltage in question.
The table below states the waiting time between cut-ins.

Mains voltage	380 V	415 V	460 V
Waiting time	48 s	65 s	89 s

■ Acoustic noise

The acoustic interference from the frequency converter comes from two sources:
1. DC intermediate circuit coils
2. Integral fan.

Below are the typical values measured at a distanceof 1 m from the unit at full load and are nominal maximum values:

VLT 6002-6006 200 V, VLT 6002-6011 400 V

IP 20 units:	50 dB(A)
IP 54 units:	62 dB(A)

VLT 6008-6027 200 V, VLT 6016-6062 400 V

IP 20 units:	61 dB(A)
IP 54 units:	66 dB(A)

VLT 6042-6062 200-240 V

IP 00/20 units:	70 dB(A)
IP 54 units:	65 dB(A)

VLT 6072 380-460 V

IP 20 units:	67 dB(A)
IP 54 units:	66 dB(A)

VLT 6075-6275 380-460 V

IP 00/20 units:	70 dB(A)
IP 54 units:	75 dB(A)

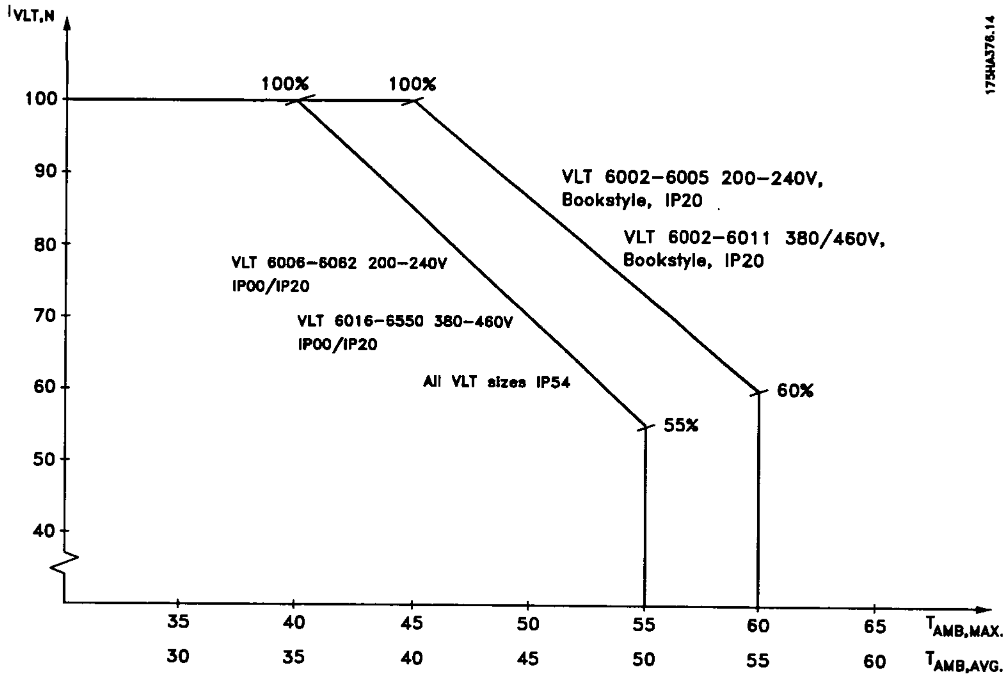
VLT 6350-6550 380-460 V

IP 00 units:	71 dB(A)
IP 20/54 units:	82 dB(A)

Derating for ambient temperature

The ambient temperature ($T_{AMB,MAX}$) is the maximum temperature allowed. The average ($T_{AMB,AVG}$) measured over 24 hours must be at least 5°C lower.

If VLT 6000 HVAC is operated at temperatures above 45 °C, a derating of the continuous output current is necessary.

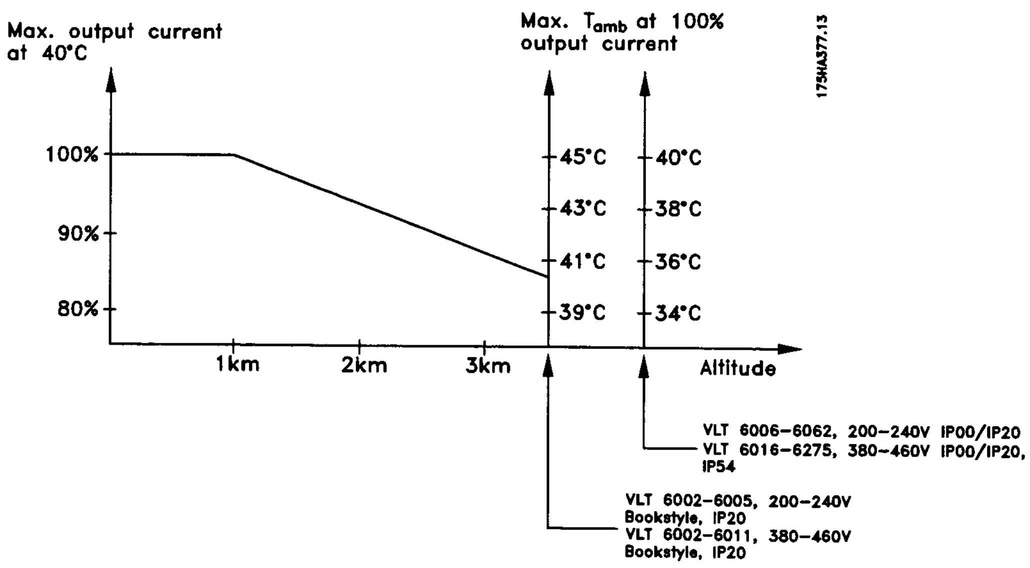


Derating for air pressure

Below 1000 m altitude no derating is necessary.

Above 1000 m the ambient temperature (T_{AMB}) or max. output current ($I_{VLT,MAX}$) must be derated in accordance with the diagram below:

1) Derating of output current versus altitude at T_{AMB} = max. 45°C
2) Derating of max. T_{AMB} versus altitude at 100% output current.



Derating for running at low speed
When a centrifugal pump or a fan is controlled by a VLT 6000 HVAC frequency converter, it is not necessary to reduce the output current at low speed because the load characterstic of the centrifugal pumps/fans, automatically ensures the necessary reduction.

Derating for long motor cables or cables with larger cross-section
VLT 6000 HVAC has been tested using 300 m unscreened/unarmoured cable and 150 m screened/armoured cable.

VLT 6000 HVAC has been designed to work using a motor cable with a rated cross-section. If a cable with a larger cross-section is to be used, it is recommended to reduce the output current by 5% for every step the cross-section is increased. (Increased cable cross-section leads to increased capacity to earth, and thus an increased earth leakage current).

Derating for high switching frequency
A higher switching frequency (to be set in parameter 407, *Switching frequency*) leads to higher losses in the electronics of the VLT frequency converter.

VLT 6000 HVAC has a pulse pattern in which it is possible to set the switching frequency from 3.0-10.0/14.0 kHz.

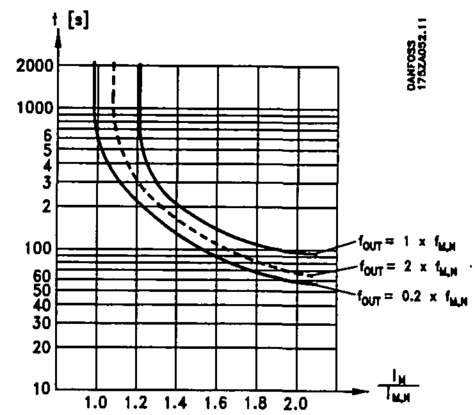
The VLT frequency converter will automatically derate the rated output current $I_{VLT,N}$, when the switching frequency exceeds 4.5 kHz.

In both cases, the reduction is carried out linearly, down to 60% of $I_{VLT,N}$.

The table gives the min., max. and factory-set switching frequencies for VLT 6000 HVAC units.

Switching frequency [kHz]	Min.	Max.	Fact.
VLT 6002-6005, 200 V	3.0	10.0	4.5
VLT 6006-6032, 200 V	3.0	14.0	4.5
VLT 6002-6011, 460 V	3.0	10.0	4.5
VLT 6016-6072, 460 V	3.0	14.0	4.5
VLT 6042-6062, 200 V	3.0	4.5	4.5
VLT 6075-6550, 460 V	3.0	4.5	4.5

Motor thermal protection
The motor temperature is calculated on the basis of motor current, output frequency and time. See parameter 117, *Motor thermal protection*.



Vibration and shock
VLT 6000 HVAC has been tested according to a procedure based on the following standards:

IEC 68-2-6:	Vibration (sinusoidal) - 1970
IEC 68-2-34:	Random vibration broad-band - general requirements
IEC 68-2-35:	Random vibration broad-band - high reproducibility
IEC 68-2-36:	Random vibration broad-band - medium reproducibility

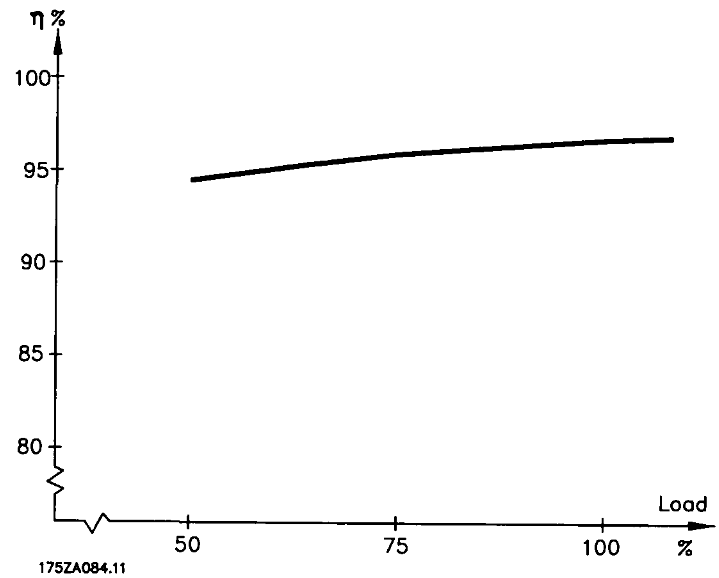
VLT 6000 HVAC complies with requirements that correspond to conditions when the unit is mounted on the walls and floors of production premises, as well as in panels bolted to walls or floors.

Air humidity
VLT 6000 HVAC has been designed to meet the IEC 68-2-3 standard, EN 50178 pkt. 9.4.2.2/DIN 40040, class E, at 40°C.
See specifications under *General technical data*.

All about VLT 6000 HVAC

■ Efficiency

To reduce energy consumption it is very important to optimize the efficiency of a system. The efficiency of each single element in the system should be as high as possible.



Efficiency of VLT 6000 HVAC (η_{VLT})

The load on the frequency converter has little effect on its efficiency. In general, the efficiency is the same at the rated motor frequency $f_{M,N}$, regardless of whether the motor supplies 100% of the rated shaft torque or only 75%, i.e. in case of part loads.

The efficiency declines a little when the switching frequency is set to a value of above 4 kHz (parameter 407 *Switching frequency*). The rate of efficiency will also be slightly reduced if the mains voltage is 460 V, or if the motor cable is longer than 30 m.

Efficiency of the motor (η_{MOTOR})

The efficiency of a motor connected to the frequency converter depends on the sine shape of the current. In general, the efficiency is just as good as with mains operation. The efficiency of the motor depends on the type of motor.

In the range of 75-100% of the rated torque, the efficiency of the motor is practically constant, both when it is controlled by the frequency converter and when it runs directly on mains.

In small motors, the influence from the U/f characteristic on efficiency is marginal; however, in motors from 11 kW and up, the advantages are significant.

In general, the switching frequency does not affect the efficiency of small motors. Motors from 11 kW and up have their efficiency improved (1-2%). This is because the sine shape of the motor current is almost perfect at high switching frequency.

Efficiency of the system (η_{SYSTEM})

To calculate the system efficiency, the efficiency of VLT 6000 HVAC (η_{VLT}) is multiplied by the efficiency of the motor (η_{MOTOR}):

$\eta_{SYSTEM} = \eta_{VLT} \times \eta_{MOTOR}$

Based on the graph outlined above, it is possible to calculate the system efficiency at different speeds.

■ Mains supply interference/harmonics

A frequency converter takes up a non-sinusoidal current from mains, which increases the input current I_{RMS}. A non-sinusoidal current can be transformed by means of a Fourier analysis and split up into sine wave currents with different frequencies, i.e. different harmonic currents I_N with 50 Hz as the basic frequency:

Harmonic currents	I_1	I_5	I_7
Hz	50 Hz	250 Hz	350 Hz

The harmonics do not affect the power consumption directly, but increase the heat losses in the installation (transformer, cables). Consequently, in plants with a rather high percentage of rectifier load, it is important to maintain harmonic currents at a low level to avoid overload of the transformer and high temperature in the cables.

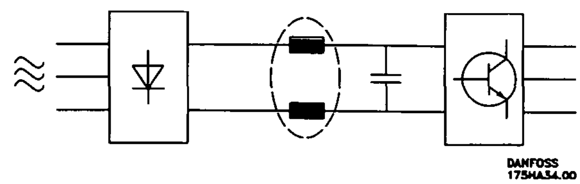
Harmonic currents compared to the RMS input current:

	Input current
I_{RMS}	1.0
I_1	0.9
I_5	0.4
I_7	0.3
I_{11-49}	< 0.1

To ensure low, harmonic currents, VLT 6000 HVAC has intermediate circuit coils as standard. This normally reduces the input current I_{RMS} by 40%.

Some of the harmonic currents might disturb communication equipment connected to the same transformer or cause resonance in connection with power-factor correction batteries. VLT 6000 HVAC has been designed in accordance with the following standards:

- IEC 1000-3-2
- IEEE 519-1992
- IEC 22G/WG4
- EN 50178
- VDE 160, 5.3.1.1.2



The voltage distortion on the mains supply depends on the size of the harmonic currents multiplied by the mains impedance for the frequency in question.
The total voltage distortion THD is calculated on the basis of the individual voltage harmonics using the following formula:

$$THD\% = \sqrt{U_5^2 + U_7^2 + \cdots U_N^2} \qquad (U_N\% \text{ of } U)$$

■ Power factor

The power factor is the relation between I_1 and I_{RMS}.

The power factor for 3-phase control

$$= \frac{\sqrt{3} \times U \times I_1 \times \cos\varphi_1}{\sqrt{3} \times U \times I_{RMS}}$$

$$\text{Power factor} = \frac{I_1 \times \cos\varphi_1}{I_{RMS}} = \frac{I_1}{I_{RMS}} \quad \text{since } \cos\varphi = 1$$

The power factor indicates the extent to which the frequency converter imposes a load on the mains supply.
The lower the power factor, the higher the I_{RMS} for the same kW performance.

In addition, a high power factor indicates that the different harmonic currents are low.

$$I_{RMS} = \sqrt{I_1^2 + I_5^2 + I_7^2 + \ldots + I_n^2}$$

■ EMC test results (Emission, Immunity)

The following test results have been obtained using a system with a VLT frequency converter (with options if relevant), a screened control cable, a control box with potentiometer, as well as a motor and motor cable.

VLT 6002-6011/380-460V VLT 6002-6005/200-240V		Emission				
	Environment	Industrial environment		Housing, trades and light industries		
	Basic standard	EN 55011 Class A1		EN 55011 Class B1		EN 55014
Setup	Motor cable	Conducted 150 kHz-30 MHz	Radiated 30 MHz-1 GHz	Conducted 150 kHz-30 MHz	Radiated 30 MHz-1 GHz	Conducted 150 kHz-230 MHz
VLT 6000 with RFI filter option	300 m unscreened/ unarmoured	Yes 1)	No	No	No	No
	50 m br. screened/ armoured (Bookstyle 20m)	Yes	Yes	Yes	No	No
	150m br. screened/ armoured	Yes	Yes	No	No	No
VLT 6000 with integrated RFI-filter (+ LC-module)	300 m unscreened/ unarmoured	Yes	No	No	No	No
	50 m br. screened/ armoured	Yes	Yes	Yes	No	No
	150m br. screened/ armoured	Yes	Yes	No	No	No

1) Depending on installation conditions

VLT 6016-6550/380-460 V VLT 6006-6062/200-240 V		Emission			
	Environment	Industrial environment		Housing, trades and light industries	
	Basic standard	EN 55011 Class A1		EN 55011 Class B1	
Setup	Motor cable	Conducted 150 kHz-30 MHz	Radiated 30 MHz-1 GHz	Conducted 150 kHz-30 MHz	Radiated 30 MHz-1 GHz
VLT 6000 w/o RFI filter option	300 unscreened/ unarmoured	No	No	No	No
	150 m br. screened/ armoured	No	Yes	No	No
VLT 6000 with RFI-module (integrated)	300 m unscreened/ unarmoured	Yes 1,2)	No	No	No
	50 m br. screened/ armoured	Yes	Yes	Yes	No
	150 m br. screened/ armoured	Yes	Yes	No	No

1) Does not apply to VLT 6350 - 6550.
2) Depending on installation conditions

In order to minimise the conducted noise to the mains supply and the radiated noise from the frequency converter system, the motor cables should be as short as possible and the screen ends should be made in accordance with the section on electrical installation.

■ EMC Immunity

In order to confirm immunity against interference from electrical phenomena, the following immunity test has been made on a system consisting of a VLT frequency converter (with options, if relevant), a screened/armoured control cable and control box with potentiometer, motor cable and motor.

The tests were made in accordance with the following basic standards:

- ***EN 61000-4-2 (IEC 1000-4-2):* Electrostatic discharges (ESD)**
  Simulation of electrostatic discharges from human beings.
- ***EN 61000-4-3 (IEC 1000-4-3):* Incoming electromagnetic field radiation, amplitude modulated**
  Simulation of the effects of radar and radio communication equipment as well as mobile communications equipment.
- ***EN 61000-4-4 (IEC 1000-4-4):* Burst transients**
  Simulation of interference brought about by switching with a contactor, relays or similar devices.
- ***EN 61000-4-5 (IEC 1000-4-5):* Surge transients**
  Simulation of transients brought about e.g. by lightning that strikes near installations.
- ***ENV 50204:* Incoming electromagnetic field, pulse modulated**
  Simulation of the impact from GSM telephones.
- ***ENV 61000-4-6:* Cable-borne HF**
  Simulation of the effect of radio transmission equipment connected to supply cables.
- ***VDE 0160 class W2 test pulse:* Mains transients**
  Simulation of high-energy transients brought about by main fuse breakage, switching of power factor-correction capacitors, etc.

■ Immunity, continued

VLT 6002-6550 380-460 V, VLT 6002-6027 200-240 V

Basic standard	Burst IEC 1000-4-4	Surge IEC 1000-4-5	ESD 1000-4-2	Radiated electro-magnetic field IEC 1000-4-3	Mains distortion VDE 0160	RF common mode voltage ENV 50141	Radiated radio freq.elect.field ENV 50140
Acceptance criterion	B	B	B	A		A	A
Port connection	CM	DM CM		DM	CM	DM	
Line	OK	OK OK	-	-	OK	OK	-
Motor	OK	- -	-	-	-	-	-
Control lines	OK	- OK	-	-	-	OK	-
PROFIBUS option	OK	- OK	-	-	-	-	-
Signal Interface<3 m	OK	- -	-	-	-	-	-
Enclosure	-	- -	OK	OK	-	-	OK
Load sharing	OK	- -	-	-	-	OK	-
Standard bus	OK	- OK	-	-	-	OK	-
Basic specifications							
Line	4 kV/5kHz/DCN	2 kV/2Ω 4 kV/12Ω	-	-	2,3 x U_N 2)	10 V_{RMS}	-
Motor	4 kV/5kHz/CCC	- -	-	-	-	10 V_{RMS}	-
Control lines	2 kV/5kHz/CCC	- 2 kV/2Ω 1)	-	-	-	10 V_{RMS}	-
PROFIBUS option	2 kV/5kHz/CCC	- 2 kV/2Ω 1)	-	-	-	10 V_{RMS}	-
Signal interface<3 m	1 kV/5kHz/CCC	- -	-	-	-	10 V_{RMS}	-
Enclosure	-	- -	8 kV AD 6 kV CD	10 V/m	-	-	-
Load sharing	4 kV/5kHz/CCC	- -	-	-	-	10 V_{RMS}	-
Standard bus	2 kV/5kHz/CCC	- 4 kV/2Ω 1)	-	-	-	10 V_{RMS}	-

DM: Differential mode
CM: Common mode
CCC: Capacitive clamp coupling
DCN: Direct coupling network
1) Injection on cable shield
2) 2.3 x U_N: max. test pulse 380 V_{AC}: Class 2/1250 V_{PEAK}, 415 V_{AC}: Class 1/1350 V_{PEAK}

■ Definitions

Definitions are given in alphabetical order.

Analogue inputs:
The analogue inputs can be used for controlling various functions of the VLT frequency converter.
There are two types of analogue inputs:
Current input, 0-20 mA
Voltage input, 0-10 V DC.

Analogue ref.
A signal transmitted to input 53, 54 or 60. Can be voltage or current.

Analogue outputs:
There are two analogue outputs, which are able to supply a signal of 0-20 mA, 4-20 mA or a digital signal.

Automatic motor adjustment, AMA:
Automatic motor adjustment algorithm, which determines the electrical parameters for the connected motor, at standstill.

AWG:
Means American Wire Gauge, i.e. the American measuring unit for cable cross-section.

Control command:
By means of the control unit and the digital inputs, it is possible to start and stop the connected motor. Functions are divided into two groups, with the following priorities:

Group 1	Reset, Coasting stop, Reset and Coasting stop, DC braking, Stop and the [OFF/STOP] key.
Group 2	Start, Pulse start, Reversing, Start reversing, Jog and Freeze output

Group 1 functions are called Start-disable commands. The difference between group 1 and group 2 is that in group 1 all stop signals must be cancelled for the motor to start. The motor can then be started by means of a single start signal in group 2.
A stop command given as a group 1 command results in the display indication STOP.
A missing stop command given as a group 2 command results in the display indication STAND BY.

Digital inputs:
The digital inputs can be used for controlling various functions of the VLT frequency converter.

Digital outputs:
There are four digital outputs, two of which activate a relay switch. The outputs are able to supply a 24 V DC (max. 40 mA) signal.

f_{JOG}
The output frequency from the VLT frequency converter transmitted to the motor when the jog function is activated (via digital terminals or serial communication).

f_M
The output frequency from the VLT frequency converter transmitted to the motor.

$f_{M,N}$
The rated motor frequency (nameplate data).

f_{MAX}
Maximum output frequency transmitted to the motor.

f_{MIN}
Minimum output frequency transmitted to the motor.

I_M
The current transmitted to the motor.

$I_{M,N}$
The rated motor current (nameplate data).

Initializing:
If initializing is carried out (see parameter 620 *Operating mode*), the VLT frequency converter returns to the factory setting.

$I_{VLT,MAX}$
The maximum output current.

$I_{VLT,N}$
The rated output current supplied by the VLT frequency converter.

LCP:
The control panel, which makes up a complete interface for control and programming of VLT 6000 HVAC. The control panel is detachable and may, as an alternative, be installed up to 3 metres away from the VLT frequency converter, i.e. in a front panel, by means of the installation kit option.

Factory settings

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
001	Language	English		Yes	No	0	5
002	Active Setup	Setup 1		Yes	No	0	5
003	Copying of Setups	No copying		No	No	0	5
004	LCP copy	No copying		No	No	0	5
005	Max value of user-defined readout	100.00	0 - 999.999,99	Yes	Yes	-2	4
006	Unit for user-defined readout	No unit		Yes	Yes	0	5
007	Big display readout	Frequency, Hz		Yes	Yes	0	5
008	Small display readout 1.1	Reference , Unit		Yes	Yes	0	5
009	Small display readout 1.2	Motor current, A		Yes	Yes	0	5
010	Small display readout 1.3	Power, kW		Yes	Yes	0	5
011	Unit of local reference	Hz		Yes	Yes	0	5
012	Hand start on LCP	Enable		Yes	Yes	0	5
013	OFF/STOP on LCP	Enable		Yes	Yes	0	5
014	Auto start on LCP	Enable		Yes	Yes	0	5
015	Reset on LCP	Enable		Yes	Yes	0	5
016	Lock for data change	Not locked		Yes	Yes	0	5
017	Operating state at power-up, local control	Auto restart		Yes	Yes	0	5
100	Configuration	Open loop		No	Yes	0	5
101	Torque characteristics	Automatic Energy Optimisation		No	Yes	0	5
102	Motor power, $P_{M,N}$	Depends on the unit	0.25-500 kW	No	Yes	1	6
103	Motor voltage, $U_{M,N}$	Depends on the unit	200 - 500 V	No	Yes	0	6
104	Motor frequency, $f_{M,N}$	50 Hz	24-1000 Hz	No	Yes	0	6
105	Motor current, $I_{M,N}$	Depends on the unit	0.01 - $I_{VLT,MAX}$	No	Yes	-2	7
106	Rated motor speed, $n_{M,N}$	Depends on par. 102 Motor power	100-60000 rpm	No	Yes	0	6
107	Automatic motor adaptation, AMA	Optimisation disable		No	No	0	5
108	Start voltage of parallel motors	Depends on par. 103	0.0 - par. 103	Yes	Yes	-1	6
109	Resonance dampening	100 %	0 - 500 %	Yes	Yes	0	6
110	High break-away torque	OFF	0.0 - 0.5 sec.	Yes	Yes	-1	5
111	Start delay	0.0 sec.	0.0 - 120.0 sec.	Yes	Yes	-1	6
112	Motor preheater	Disable		Yes	Yes	0	5
113	Motor preheater DC current	50 %	0 - 100 %	Yes	Yes	0	6
114	DC braking current	50 %	0 - 100 %	Yes	Yes	0	6
115	DC braking time	OFF	0.0 - 60.0 sec.	Yes	Yes	-1	6
116	DC brake cut-in frequency	OFF	0.0-par. 202	Yes	Yes	-1	6
117	Motor thermal protection	ETR Trip 1		Yes	Yes	0	5

All about VLT 6000 HVAC

■ Factory settings

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
200	Output frequency range	0 -120 Hz	0 - 1000 Hz	No	Yes	0	5
201	Output frequency low limit, f_{MIN}	0.0 Hz	0.0 - f_{MAX}	Yes	Yes	-1	6
202	Output frequency high limit, f_{MAX}	50 Hz	f_{MIN} - par. 200	Yes	Yes	-1	6
203	Reference site	Hand/Auto linked reference		Yes	Yes	0	5
204	Minimum reference, Ref_{MIN}	0.000	0.000-par. 100	Yes	Yes	-3	4
205	Maximum reference, Ref_{MAX}	50.000	par. 100-999.999,999	Yes	Yes	-3	4
206	Ramp-up time	Depends on the unit	1 - 3600	Yes	Yes	0	7
207	Ramp-down time	Depends on the unit	1 - 3600	Yes	Yes	0	7
208	Automatic ramp-up/down	Enable		Yes	Yes	0	5
209	Jog frequency	10.0 Hz	0.0 - par. 100	Yes	Yes	-1	6
210	Reference type	Sum		Yes	Yes	0	5
211	Preset reference 1	0.00 %	-100.00 - 100.00 %	Yes	Yes	-2	3
212	Preset reference 2	0.00 %	-100.00 - 100.00 %	Yes	Yes	-2	3
213	Preset reference 3	0.00 %	-100.00 - 100.00 %	Yes	Yes	-2	3
214	Preset reference 4	0.00 %	-100,00 - 100,00 %	Yes	Yes	-2	3
215	Current limit, I_{LIM}	1.0 x $I_{VLT,N}$ [A]	0,1-1,1 x $I_{VLT,N}$ [A]	Yes	Yes	-1	6
216	Frequency bypass, bandwidth	0 Hz	0 - 100 Hz	Yes	Yes	0	6
217	Frequency bypass 1	120 Hz	0.0 - par. 200	Yes	Yes	-1	6
218	Frequency bypass 2	120 Hz	0.0 - par. 200	Yes	Yes	-1	6
219	Frequency bypass 3	120 Hz	0.0 - par. 200	Yes	Yes	-1	6
220	Frequency bypass 4	120 Hz	0.0 - par. 200	Yes	Yes	-1	6
221	Warning: Low current, I_{LOW}	0.0 A	0.0 - par. 222	Yes	Yes	-1	6
222	Warning: High current, I_{HIGH}	$I_{VLT,MAX}$	Par. 221 - $I_{VLT,MAX}$	Yes	Yes	-1	6
223	Warning: Low frequency, f_{LOW}	0.0 Hz	0.0 - par. 224	Yes	Yes	-1	6
224	Warning: High frequency, f_{HIGH}	120.0 Hz	Par. 223 - par. 200/202	Yes	Yes	-1	6
225	Warning: Low reference, Ref_{LOW}	-999,999.999	-999,999.999 - par. 226	Yes	Yes	-3	4
226	Warning: High reference, Ref_{HIGH}	999,999.999	Par. 225 - 999,999.999	Yes	Yes	-3	4
227	Warning: Low feedback, FB_{LOW}	-999,999.999	-999,999.999 - par. 228	Yes	Yes	-3	4
228	Warning: High feedback, FB_{HIGH}	999,999.999	Par. 227 - 999,999.999	Yes	Yes	-3	4

Changes during operation:

"Yes" means that the parameter can be changed, while the VLT frequency converter is in operation. "No" means that the VLT frequency converter must be stopped before a change can be made.

4-Setup:

"Yes" means that the parameter can be programmed individually in each of the four setups, i.e. the same parameter can have four different data values. "No" means that the data value will be the same in all four setups.

Conversion index:

This number refers to a conversion figure to be used when writing or reading to or from a VLT frequency converter by means of serial communication.

Conversion index	Conversion factor
74	0.1
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001

Data type:

Data type shows the type and length of the telegram.

Data type	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string

■ Factory settings

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
300	Terminal 16 Digital input	Reset		Yes	Yes	0	5
301	Terminal 17 Digital input	Freeze output		Yes	Yes	0	5
302	Terminal 18 Digital input	Start		Yes	Yes	0	5
303	Terminal 19 Digital input	Reversing		Yes	Yes	0	5
304	Terminal 27 Digital input	Coasting stop, inverse		Yes	Yes	0	5
305	Terminal 29 Digital input	Jog		Yes	Yes	0	5
306	Terminal 32 Digital input	No operation		Yes	Yes	0	5
307	Terminal 33 Digital input	No operation		Yes	Yes	0	5
308	Terminal 53, analogue input voltage	Reference		Yes	Yes	0	5
309	Terminal 53, min. scaling	0.0 V	0.0 - 10.0 V	Yes	Yes	-1	5
310	Terminal 53, max. scaling	10.0 V	0.0 - 10.0 V	Yes	Yes	-1	5
311	Terminal 54, analogue input voltage	No operation		Yes	Yes	0	5
312	Terminal 54, min. scaling	0.0 V	0.0 - 10.0 V	Yes	Yes	-1	5
313	Terminal 54, max. scaling	10.0 V	0.0 - 10.0 V	Yes	Yes	-1	5
314	Terminal 60, analogue input current	Reference		Yes	Yes	0	5
315	Terminal 60, min. scaling	4.0 mA	0.0 - 20.0 mA	Yes	Yes	-4	5
316	Terminal 60, max. scaling	20.0 mA	0.0 - 20.0 mA	Yes	Yes	-4	5
317	Time out	10 sec.	1 - 99 sec.	Yes	Yes	0	5
318	Function after time out	Off		Yes	Yes	0	5
319	Terminal 42, output	0 - $I_{MAX} \Rightarrow$ 0-20 mA		Yes	Yes	0	5
320	Terminal 42, output, pulse scaling	5000 Hz	1 - 32000 Hz	Yes	Yes	0	6
321	Terminal 45, output	0 - $f_{MAX} \Rightarrow$ 0-20 mA		Yes	Yes	0	5
322	Terminal 45, output, pulse scaling	5000 Hz	1 - 32000 Hz	Yes	Yes	0	6
323	Relay 1, output function	Alarm		Yes	Yes	0	5
324	Relay 01, ON delay	0.00 sec.	0 - 600 sec.	Yes	Yes	0	6
325	Relay 01, OFF delay	0.00 sec.	0 - 600 sec.	Yes	Yes	0	6
326	Relay 2, output function	Running		Yes	Yes	0	5
327	Pulse reference, max. frequency	5000 Hz	Depends on input terminal	Yes	Yes	0	6
328	Pulse feedback, max. frequency	25000 Hz	0 - 65000 Hz	Yes	Yes	0	6

Changes during operation:

"Yes" means that the parameter can be changed, while the VLT frequency converter is in operation. "No" means that the VLT frequency converter must be stopped before a change can be made.

4-Setup:

"Yes" means that the parameter can be programmed individually in each of the four setups, i.e. the same parameter can have four different data values. "No" means that the data value will be the same in all four setups.

Conversion index:

This number refers to a conversion figure to be used when writing or reading to or from a VLT frequency converter by means of serial communication.

Conversion index	Conversion factor
74	0.1
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001

Data type:

Data type shows the type and length of the telegram.

Data type	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string

All about VLT 6000 HVAC

■ Factory settings

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
400	Reset function	Manual reset		Yes	Yes	0	5
401	Automatic restart time	10 sec.	0 - 600 sec.	Yes	Yes	0	6
402	Flying start	Disable		Yes	Yes	-1	5
403	Sleep mode timer	Off	0 - 300 sec.	Yes	Yes	0	6
404	Sleep frequency	0 Hz	f_{MIN} - Par. 405	Yes	Yes	-1	6
405	Wake up frequency	50 Hz	Par. 404 - f_{MAX}	Yes	Yes	-1	6
406	Boost setpoint	100%	1 - 200 %	Yes	Yes	0	6
407	Switching frequency	Depends on the unit	3.0 - 14.0 kHz	Yes	Yes	2	5
408	Interference reduction method	ASFM		Yes	Yes	0	5
409	Function in case of no load	Warning		Yes	Yes	0	5
410	Function at mains failure	Trip		Yes	Yes	0	5
411	Function at overtemperature	Trip		Yes	Yes	0	5
412	Trip delay overcurrent, I_{LIM}	60 sec	0 - 60 sec.	Yes	Yes	0	5
413	Minimum feedback, FB_{MIN}	0.000	-999,999.999 - FB_{MIN}	Yes	Yes	-3	4
414	Maximum feedback, FB_{MAX}	100.000	FB_{MIN} - 999,999.999	Yes	Yes	-3	4
415	Units relating to closed loop	%		Yes	Yes	-1	5
416	Feedback conversion	Linear		Yes	Yes	0	5
417	Feedback calculation	Maximum		Yes	Yes	0	5
418	Setpoint 1	0.000	FB_{MIN} - FB_{MAX}	Yes	Yes	-3	4
419	Setpoint 2	0.000	FB_{MIN} - FB_{MAX}	Yes	Yes	-3	4
420	PID normal/inverse control	Normal		Yes	Yes	0	5
421	PID anti windup	On		Yes	Yes	0	5
422	PID start-up frequency	0 Hz	f_{MIN} - f_{MAX}			-1	6
423	PID proportional gain	0.01	0.00 - 10.00	Yes	Yes	-2	6
424	PID integration time	Off	0.01 - 9999.00 s. (Off)	Yes	Yes	-2	7
425	PID differentiation time	Off	0.0 (Off) - 10.00 sec.	Yes	Yes	-2	6
426	PID differentiator gain limit	5.0	5.0 - 50.0	Yes	Yes	-1	6
427	PID lowpass filter time	0.01	0.01 - 10.00	Yes	Yes	-2	6

■ Factory settings

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
500	Protocol	FC protocol		Yes	Yes	0	5
501	Address	1	Depends on par. 500	Yes	No	0	6
502	Baudrate	9600 Baud		Yes	No	0	5
503	Coasting	Logic or		Yes	Yes	0	5
504	DC-brake	Logic or		Yes	Yes	0	5
505	Start	Logic or		Yes	Yes	0	5
506	Direction of rotation	Logic or		Yes	Yes	0	5
507	Selection of Setup	Logic or		Yes	Yes	0	5
508	Selection of preset reference	Logic or		Yes	Yes	0	5
509	Data read-out: Reference %			No	No	-1	3
510	Data read-out: Reference unit			No	No	-3	4
511	Data read-out: Feedback			No	No	-3	4
512	Data read-out: Frequency			No	No	-1	6
513	User defined read-out			No	No	-2	7
514	Data read-out: Current			No	No	-2	7
515	Data read-out: Power, kW			No	No	1	7
516	Data read-out: Power, HP			No	No	-2	7
517	Data read-out: Motor voltage			No	No	-1	6
518	Data read-out: DC link voltage			No	No	0	6
519	Data read-out: Motor temp.			No	No	0	5
520	Data read-out: VLT temp.			No	No	0	5
521	Data read-out: Digital input			No	No	0	5
522	Data read-out: Terminal 53, analogue input			No	No	-1	3
523	Data read-out: Terminal 54, analogue input			No	No	-1	3
524	Data read-out: Terminal 60, analogue input			No	No	4	3
525	Data read-out: Pulse reference			No	No	-1	7
526	Data read-out: External reference %			No	No	-1	3
527	Data read-out: Status word, hex			No	No	0	6
528	Data read-out: Heat sink temperature			No	No	0	5
529	Data read-out: Alarm word, hex			No	No	0	7
530	Data read-out: Control word, hex			No	No	0	6
531	Data read-out: Warning word, hex			No	No	0	7
532	Data read-out: Extended status word, hex			No	No	0	7
533	Display text 1			No	No	0	9
534	Display text 2			No	No	0	9
535	Busfeedback 1			No	No	0	3
536	Busfeedback 2			No	No	0	3
537	Data read-out: Relay status			No	No	0	5
555	Bus time interval	1 sec.	1 - 99 sec.	Yes	Yes	0	5
556	Bus time interval function	OFF		Yes	Yes	0	5
560	N2 Override release time	OFF	1 - 65534 sec.	Yes	No	0	6
565	FLN Bus time interval	60 sec.	1 - 65534 sec.	Yes	Yes	0	6
566	FLN Bus time interval function	OFF		Yes	Yes	0	5

All about VLT 6000 HVAC

■ Factory settings

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
600	Operating data: Operating hours			No	No	74	7
601	Operating data: Hours run			No	No	74	7
602	Operating data: kWh counter			No	No	3	7
603	Operating data: No. of cut-ins			No	No	0	6
604	Operating data: No. of overtemps			No	No	0	6
605	Operating data: No. of overvoltages			No	No	0	6
606	Data log: Digital input			No	No	0	5
607	Data log: Control word			No	No	0	6
608	Data log: Status word			No	No	0	6
609	Data log: Reference			No	No	-1	3
610	Data log: Feedback			No	No	-3	4
611	Data log: Output frequency			No	No	-1	3
612	Data log: Output voltage			No	No	-1	6
613	Data log: Output current			No	No	-2	3
614	Data log: DC link voltage			No	No	0	6
615	Fault log: Error code			No	No	0	5
616	Fault log: Time			No	No	0	7
617	Fault log: Value			No	No	0	3
618	Reset of kWh counter	No reset		Yes	No	0	5
619	Reset of hours-run counter	No reset		Yes	No	0	5
620	Operating mode	Normal function		Yes	No	0	5
621	Nameplate: Unit type			No	No	0	9
622	Nameplate: Power component			No	No	0	9
623	Nameplate: VLT ordering no.			No	No	0	9
624	Nameplate: Software version no.			No	No	0	9
625	Nameplate: LCP identification no.			No	No	0	9
626	Nameplate: Database identification no.			No	No	-2	9
627	Nameplate: Power component identification no.			No	No	0	9
628	Nameplate: Application option type			No	No	0	9
629	Nameplate: Application option ordering no.			No	No	0	9
630	Nameplate: Communication option type			No	No	0	9
631	Nameplate: Communication option ordering no.			No	No	0	9

Changes during operation:

"Yes" means that the parameter can be changed, while the VLT frequency converter is in operation. "No" means that the VLT frequency converter must be stopped before a change can be made.

4-Setup:

"Yes" means that the parameter can be programmed individually in each of the four setups, i.e. the same parameter can have four different data values. "No" means that the data value will be the same in all four setups.

Conversion index:

This number refers to a conversion figure to be used when writing or reading to or from a VLT frequency converter by means of serial communication.

Conversion index	Conversion factor
74	0.1
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001

Data type:

Data type shows the type and length of the telegram.

Data type	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string

A

C

D

E

F

G

H

I

J

L

M

N

O

P

Q

R

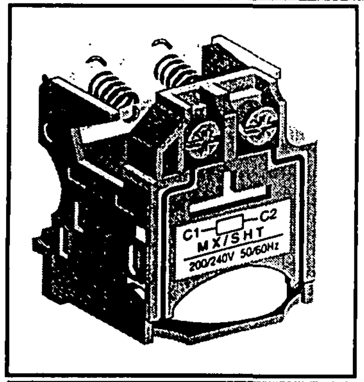
S

T

U

V

1046810000002010



Compact
NS100 → NS250
NSF150-250
NS400-630
NSJ400-600

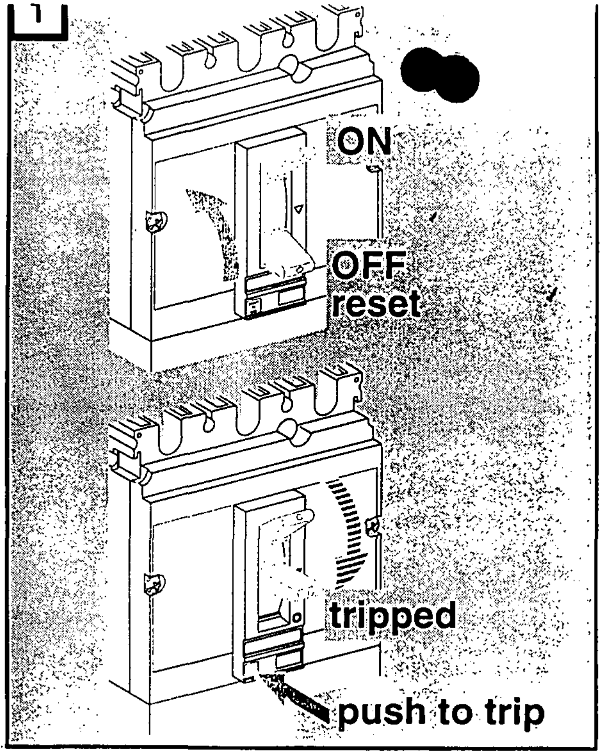
MN/MX
UVR/SHT

MERLIN GERIN
la maîtrise de l'énergie électrique

**Le montage de ces matériels ne peut être effectué que par des professionnels.
Le non respect des indications de la présente notice ne saurait engager la responsabilité du constructeur.**

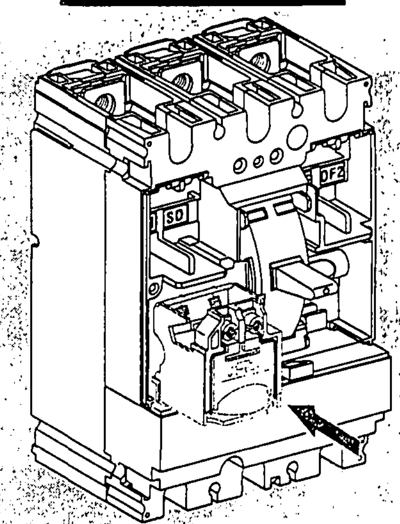
The equipment shall be assembled only by qualified personnel. The manufacturer assumes no responsibility for damages resulting from the non-application or incorrect application of the instructions provided herein.

1

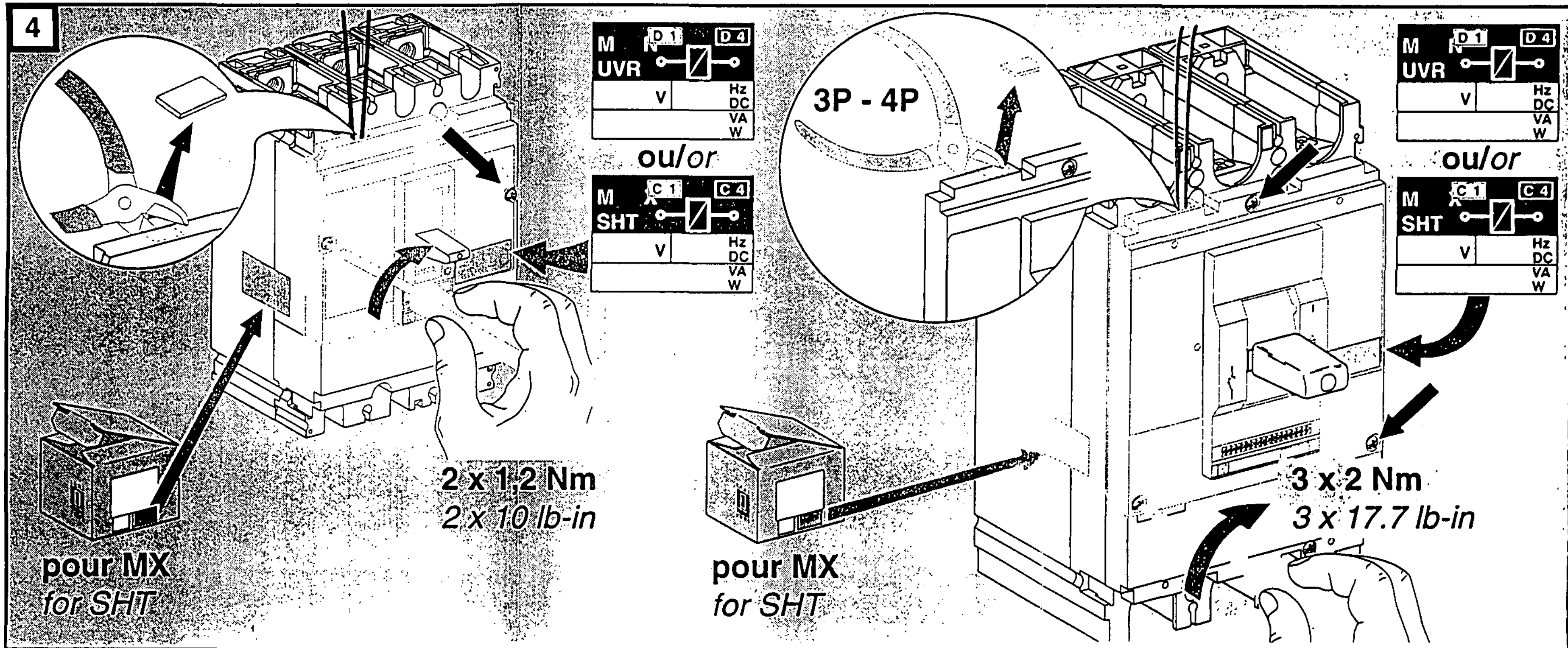


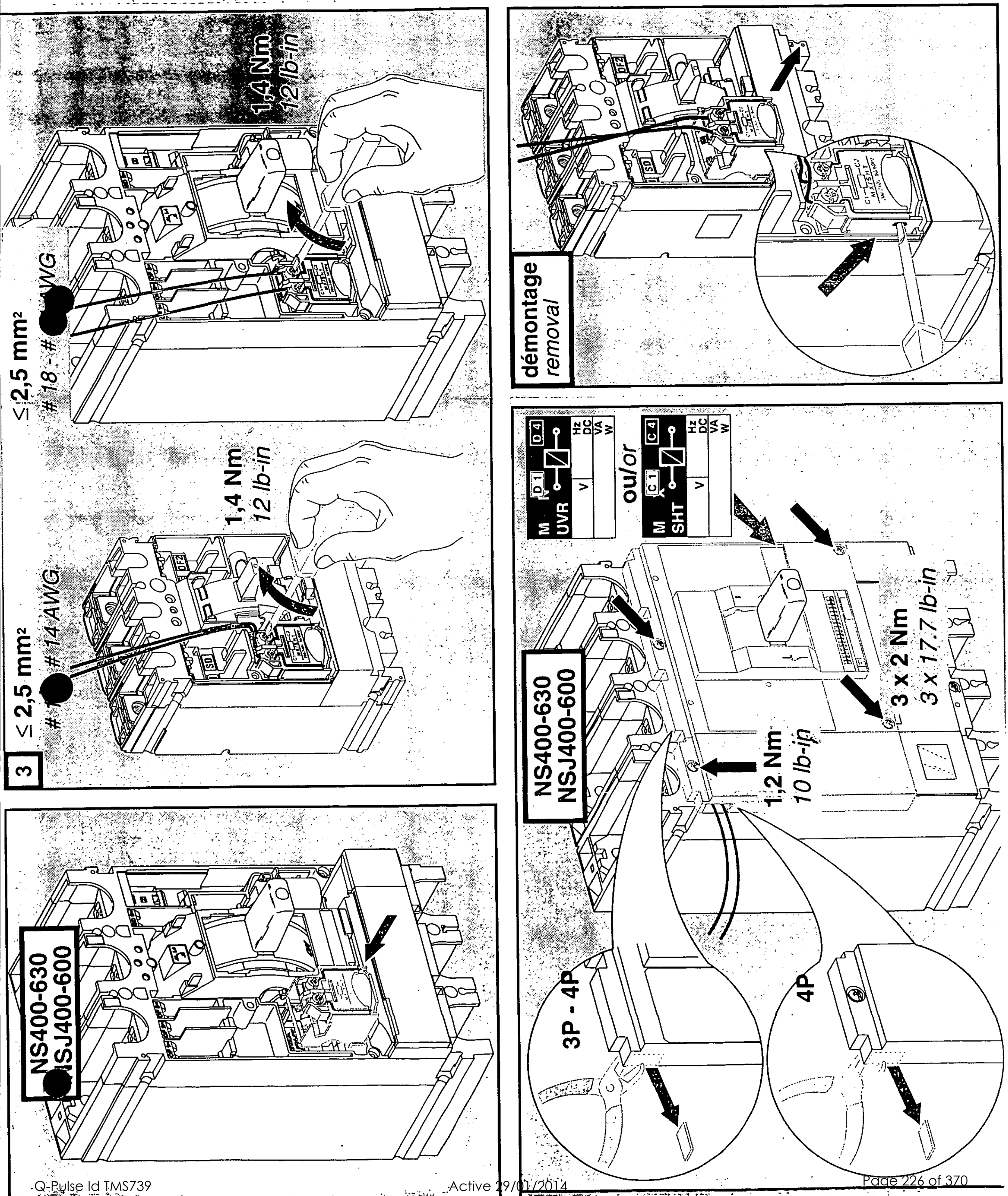
2

NS100 → 250
NSF150-250

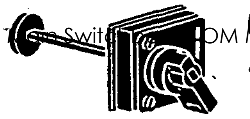


4



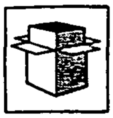


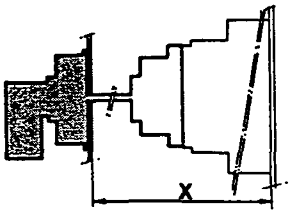
3
≤ 2,5 mm²
14 AWG
1,4 Nm
12 lb-in
≤ 2,5 mm²
18 -
AWG
1,4 Nm
12 lb-in
NS400-630
NSJ400-600
démontage
removal
NS400-630
NSJ400-600
M
UVR
D 1
D 4
V
Hz
DC
VA
W
ou/or
M
SHT
C 1
C 4
V
Hz
DC
VA
W
3 x 2 Nm
3 x 17.7 lb-in
1,2 Nm
10 lb-in
3P - 4P
4P

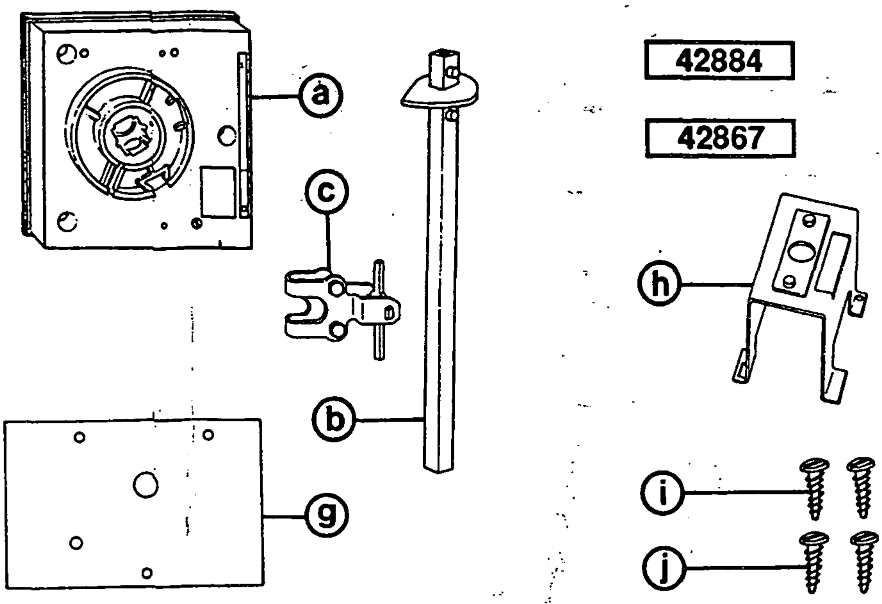


CRP - a - ac
101 → 1251

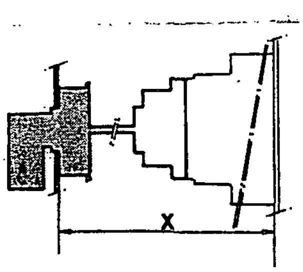
980 753C

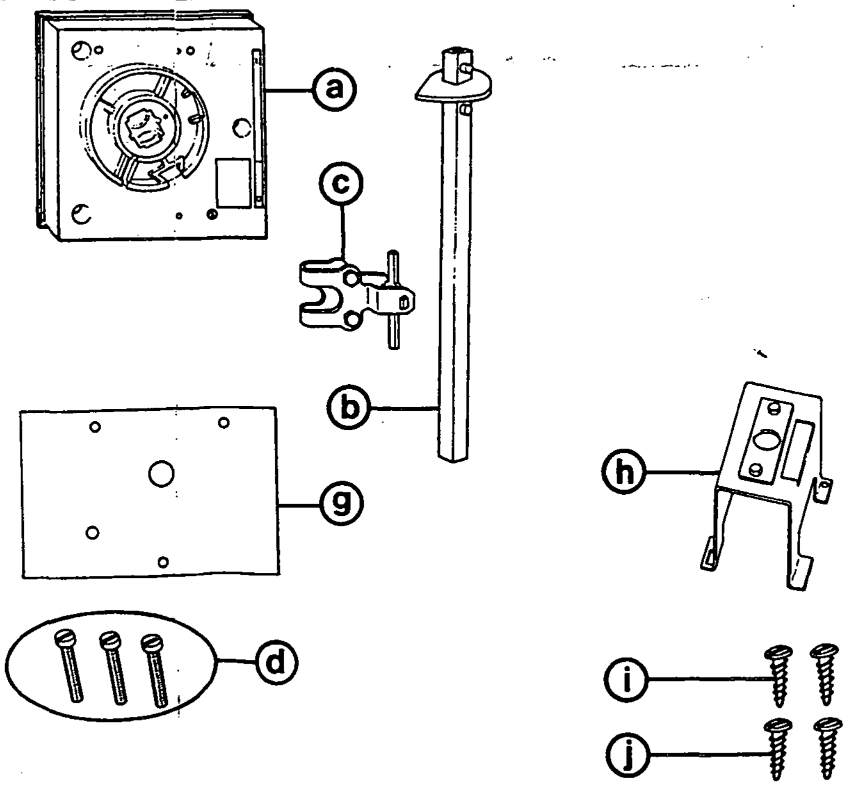


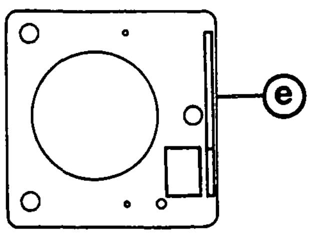




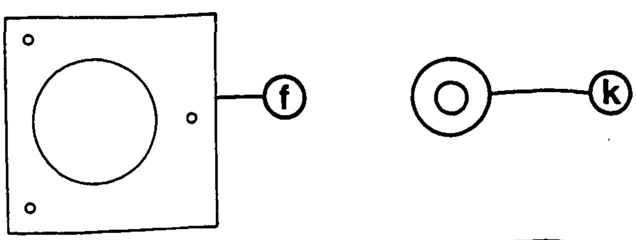
42882	X = ≤ 310/*12.204*
42884	X = ≤ 500/*19.685*
42867	X = ≤ 600/*23.622*

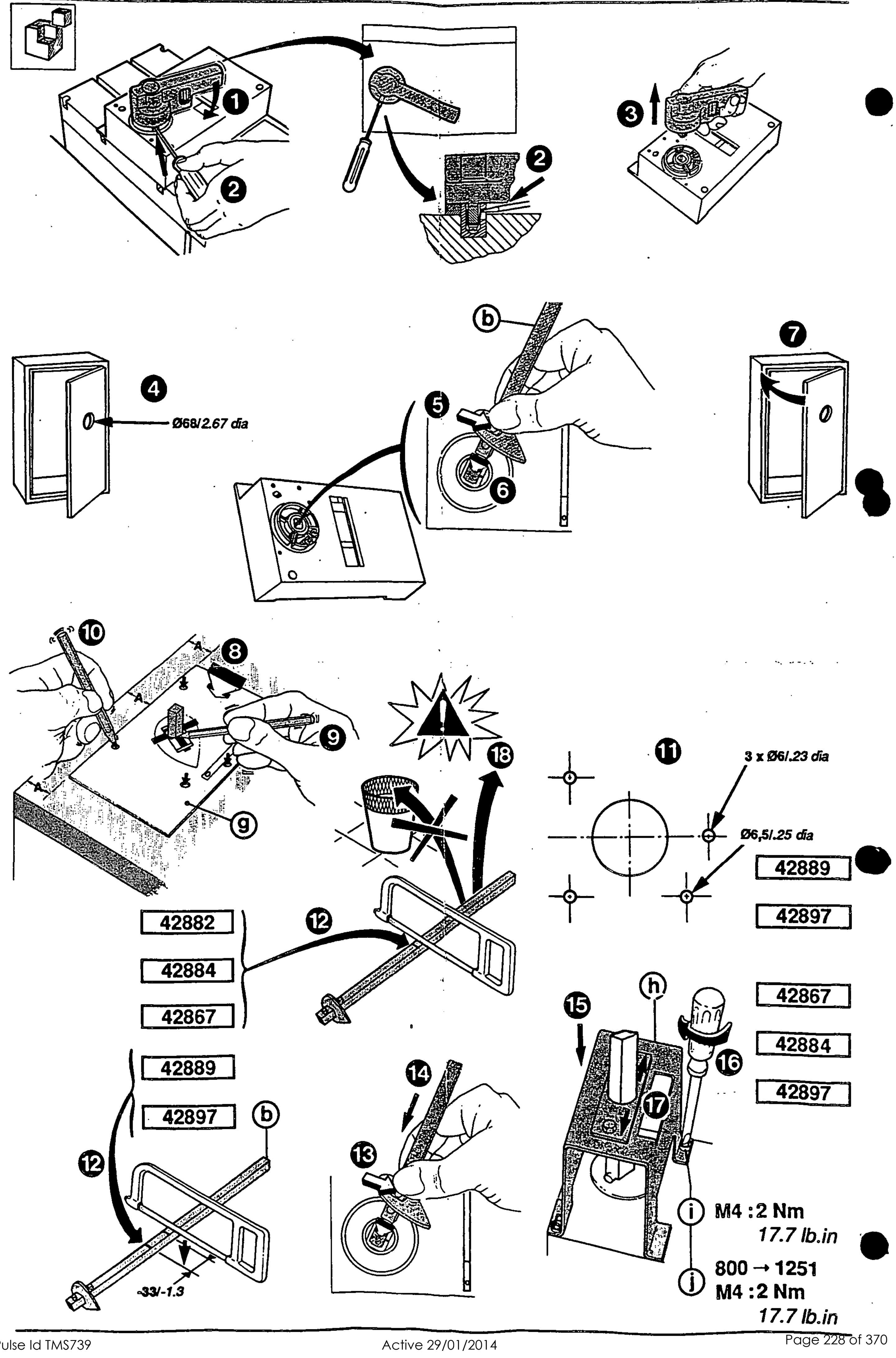






42889	X = ≤ 310/*12.204*
42897	X = ≤ 500/*19.685*



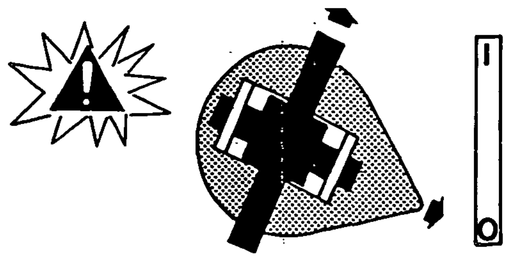


Ø68/2.67 dia
3 x Ø6/.23 dia
Ø6,5/.25 dia
42889
42897
42882
42884
42867
42889
42897
-33/-1.3
42867
42884
42897
M4 :2 Nm
17.7 lb.in
800 → 1251
M4 :2 Nm
17.7 lb.in

42882

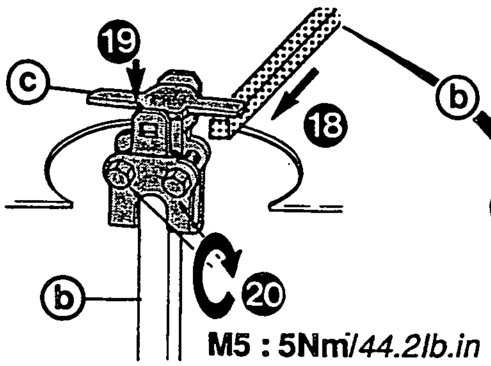
42884

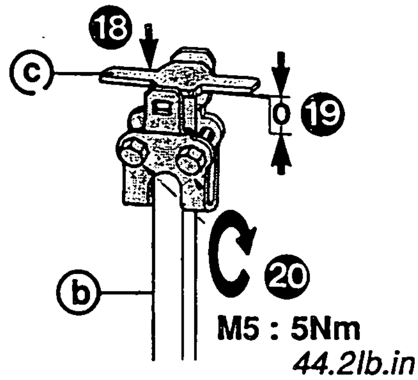
42867



42889

42897

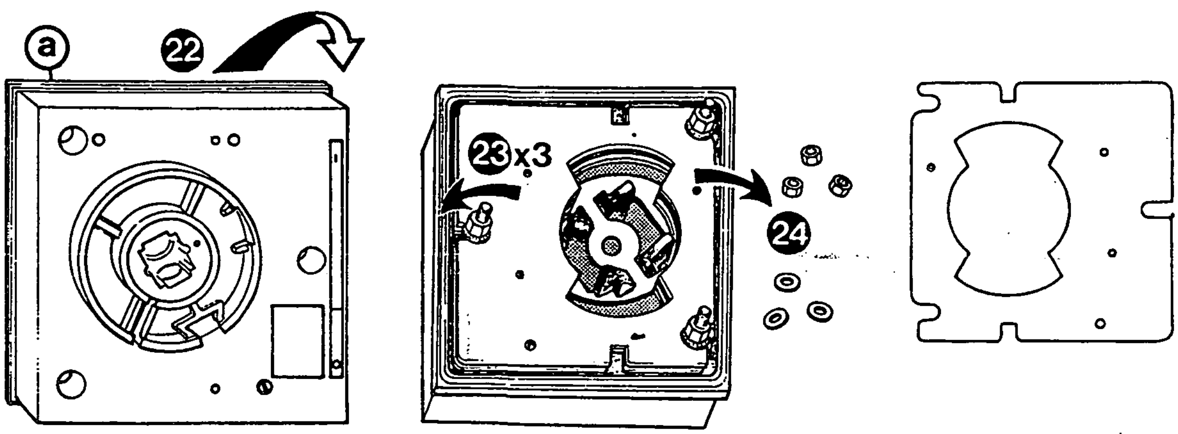


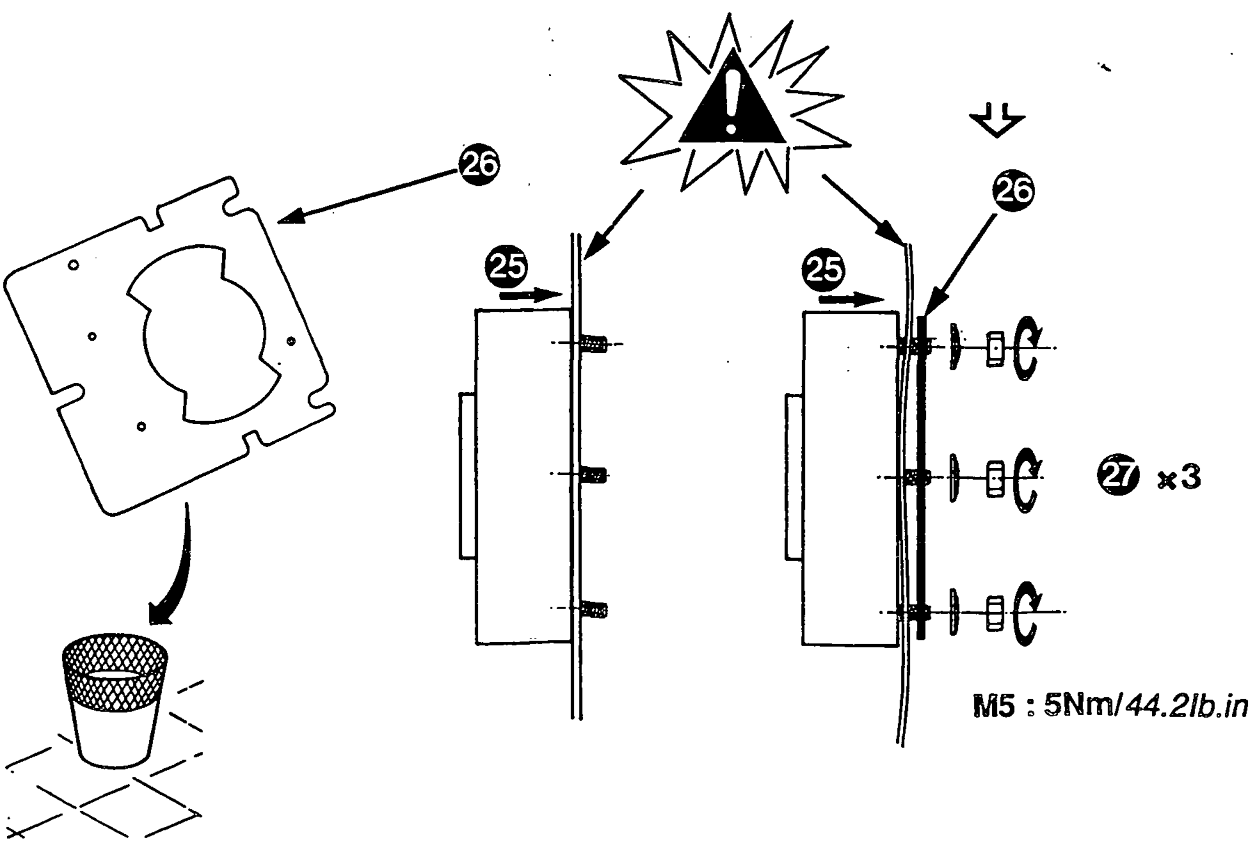


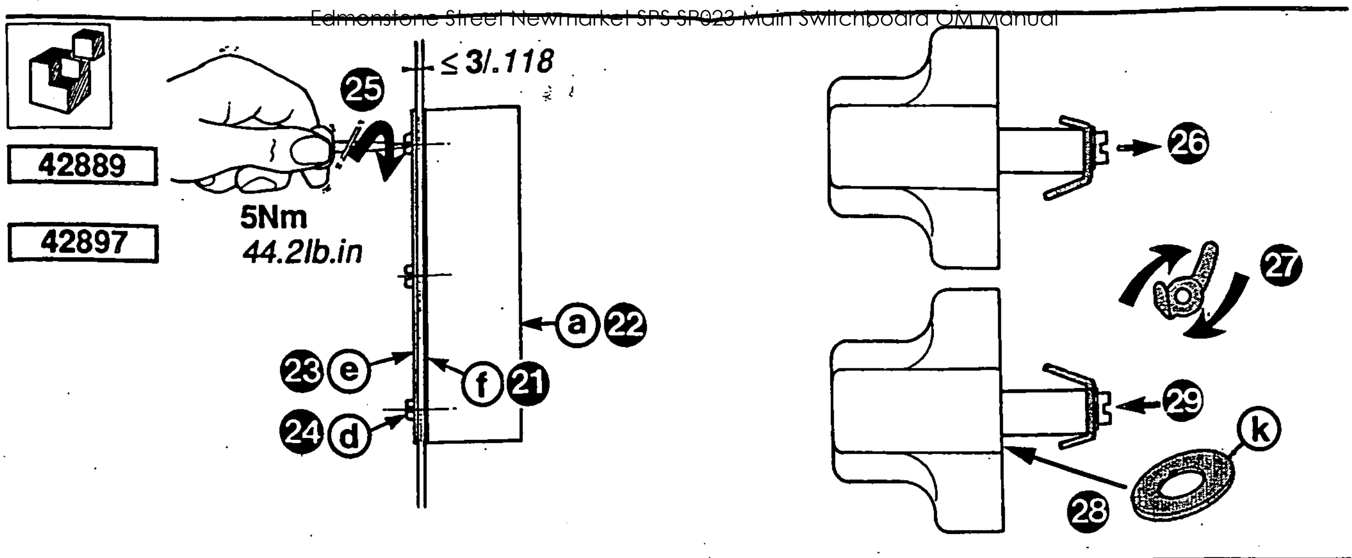
42882

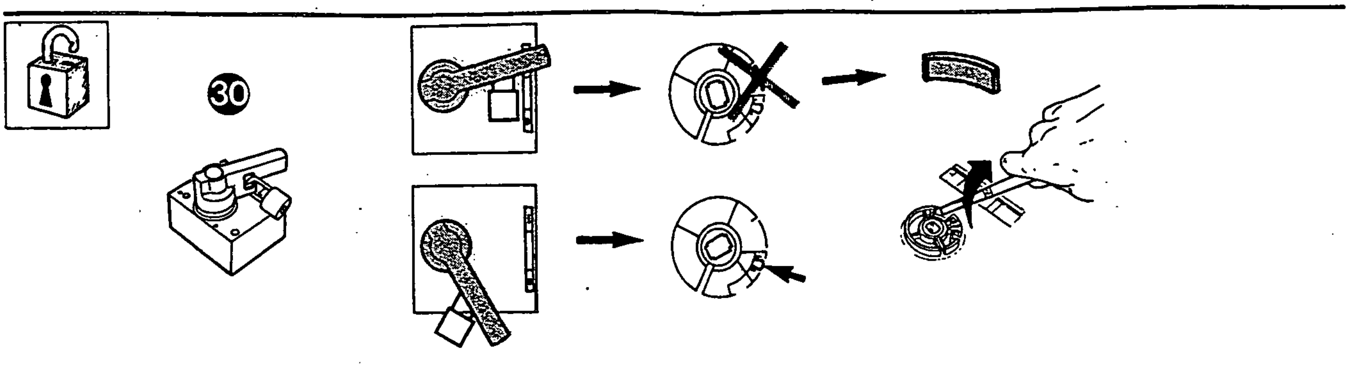
42884

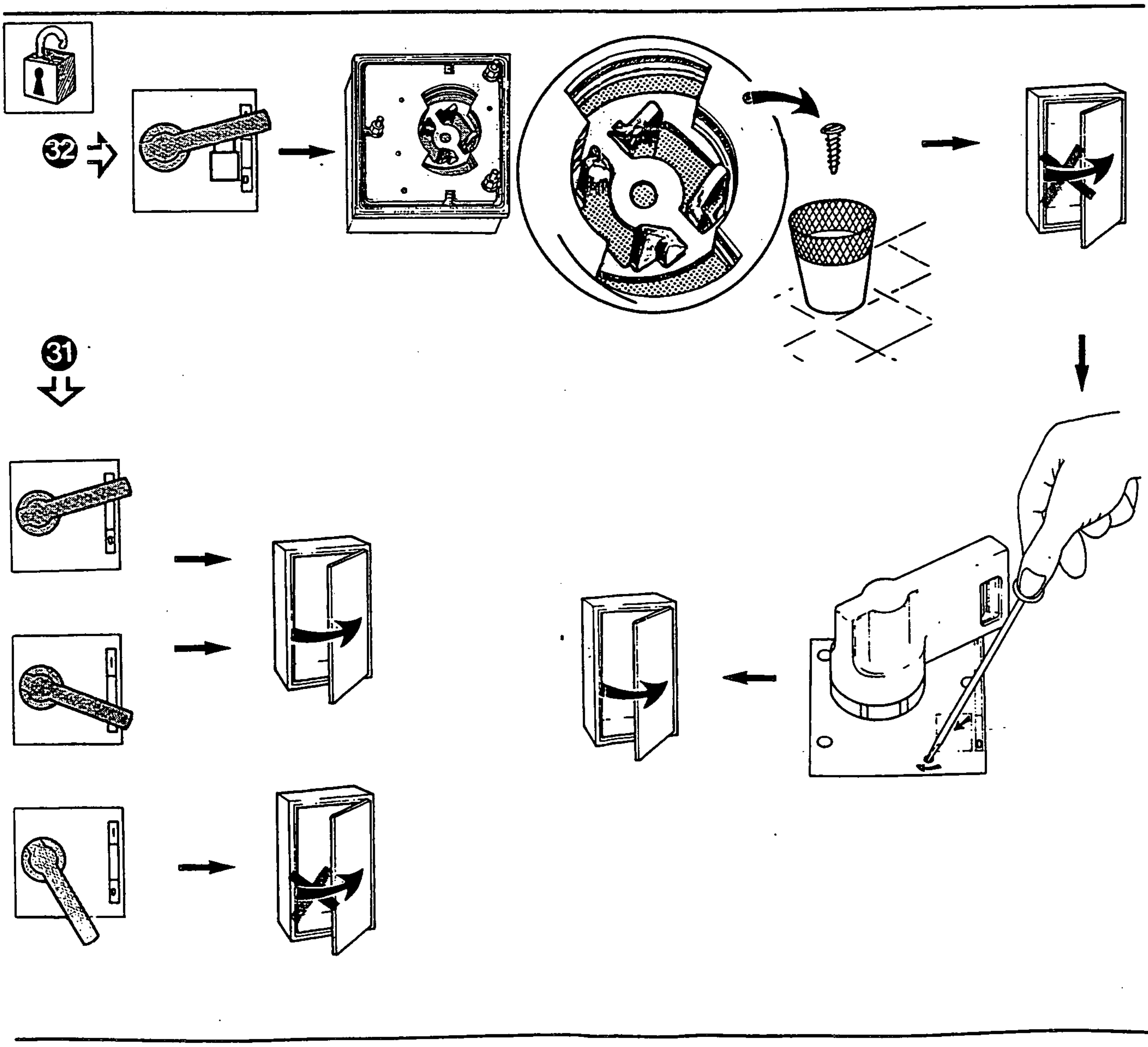
42867






42889
42897
≤ 3/.118
25
5Nm
44.2lb.in
a 22
23 e
f 21
24 d
26
27
29
k
28


30


32
31

10/93

Compact NS400-630

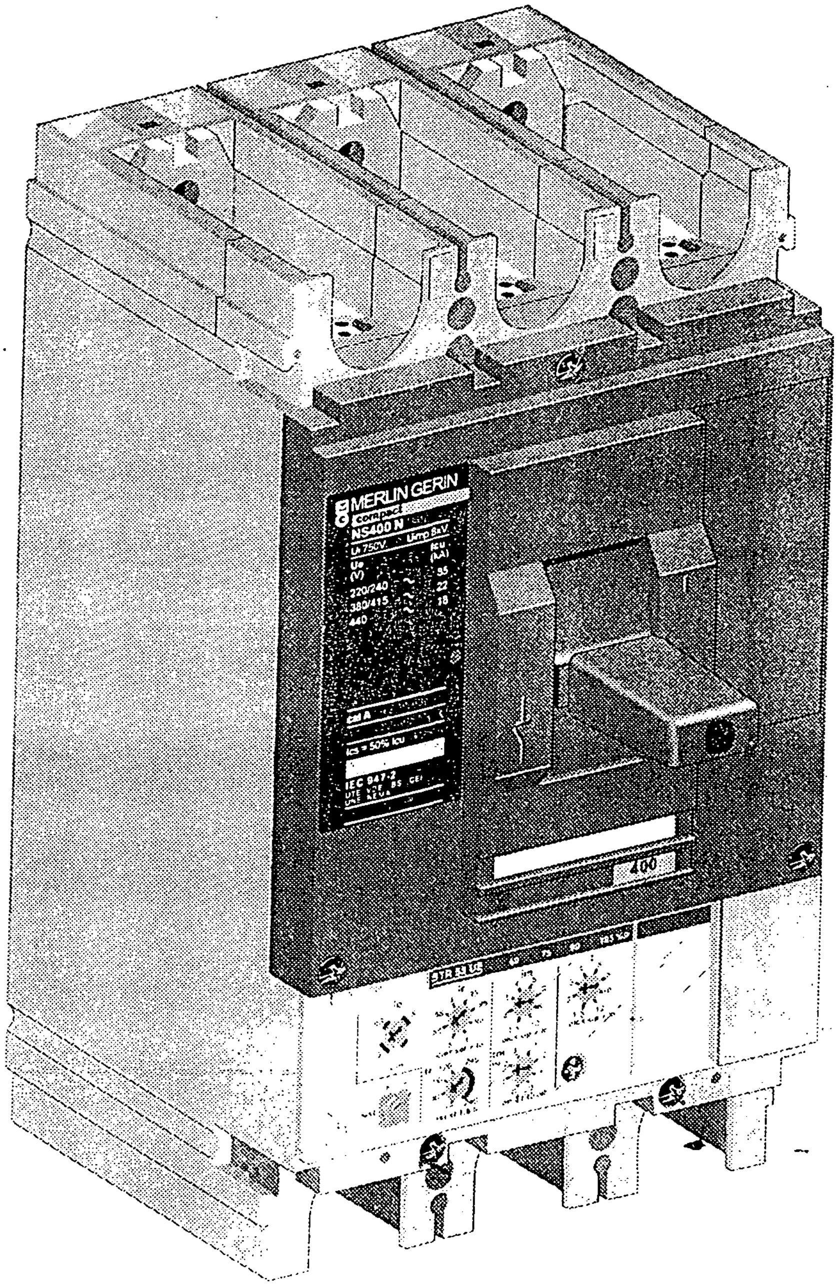
998260AG

circuit breaker
disjoncteur
interruptor automático

The manufacturer assumes no responsibility for damage resulting from the non-application or incorrect application of the instructions provided herein.

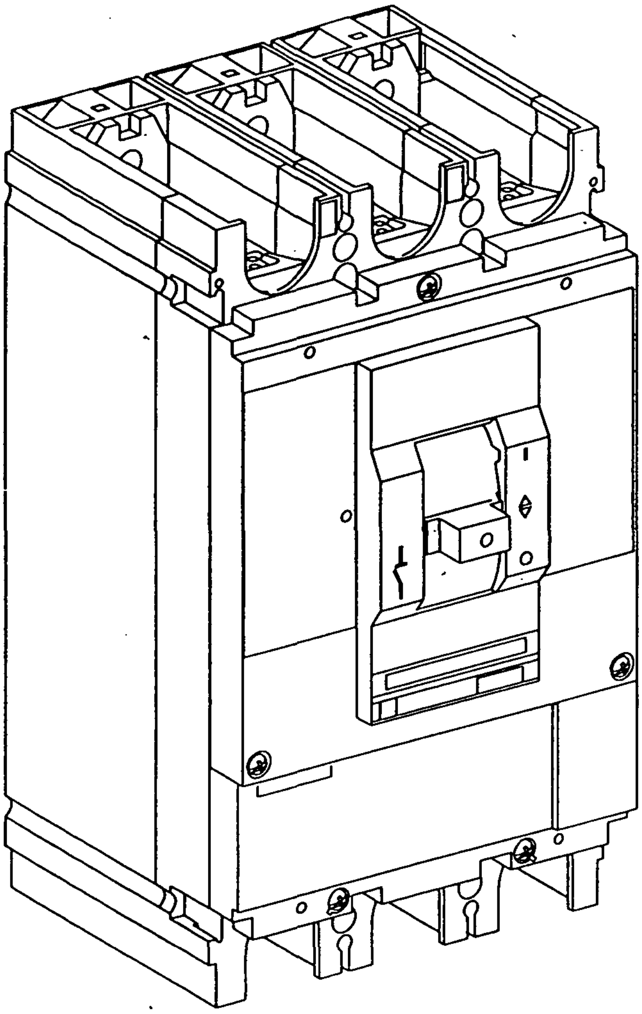
Le non respect des indications de la présente notice ne saurait engager la responsabilité du constructeur.

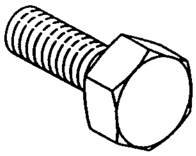
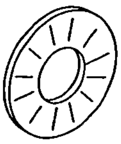
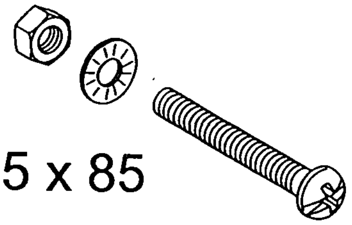
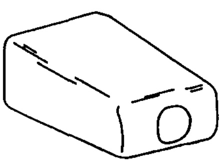
El fabricante no se responsabiliza de los daños originados como resultado de la falta de aplicación o aplicación incorrecta de las presentes instrucciones.

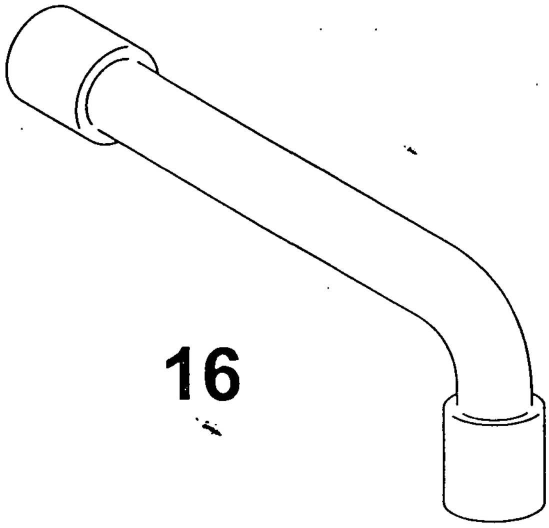


Merlin Gerin
Modicon
Square D
Telemecanique

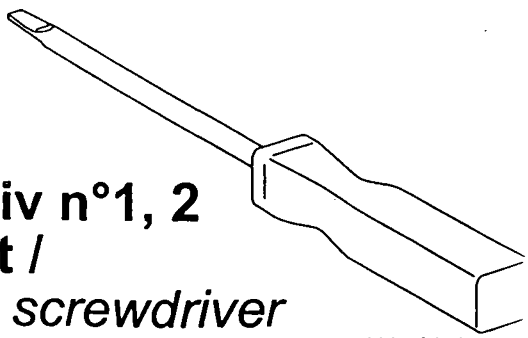
Schneider Electric



3P	4P	
6	8	M10 x 27,5 
6	8	
4		 M5 x 85
1		 +  M4 x 14

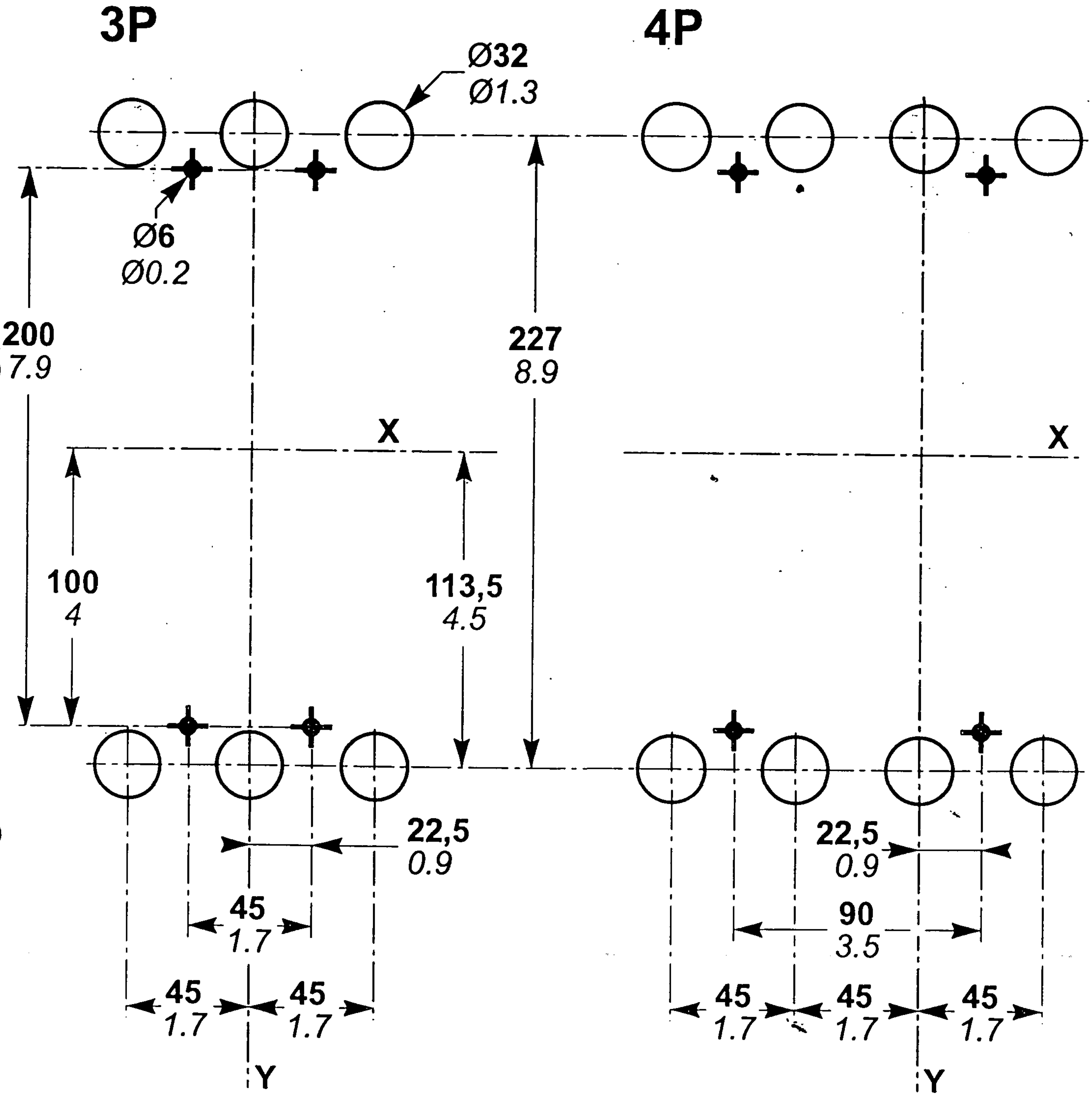


16

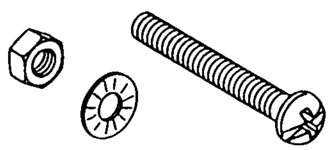


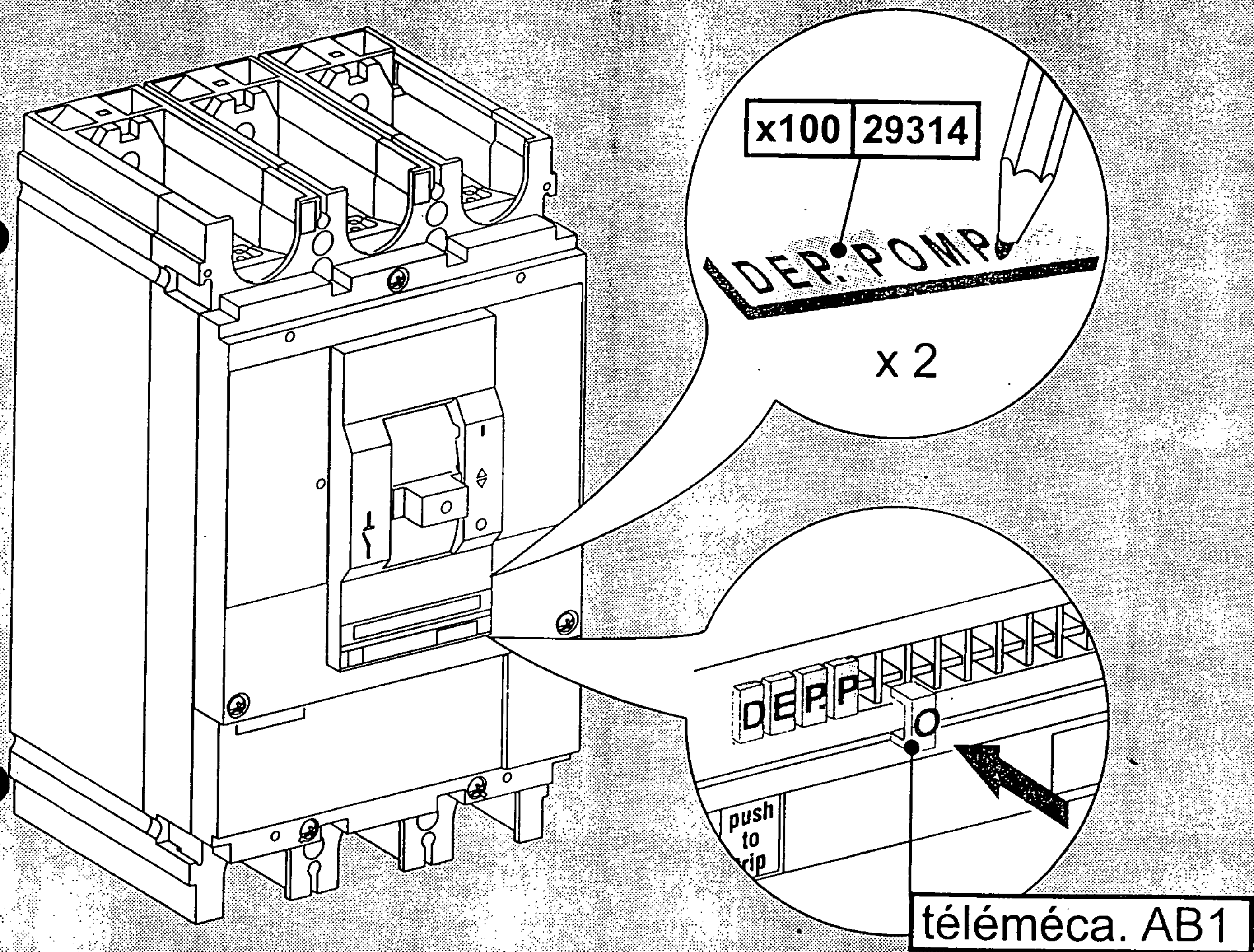
pozidriv n°1, 2
ou plat /
slotted screwdriver

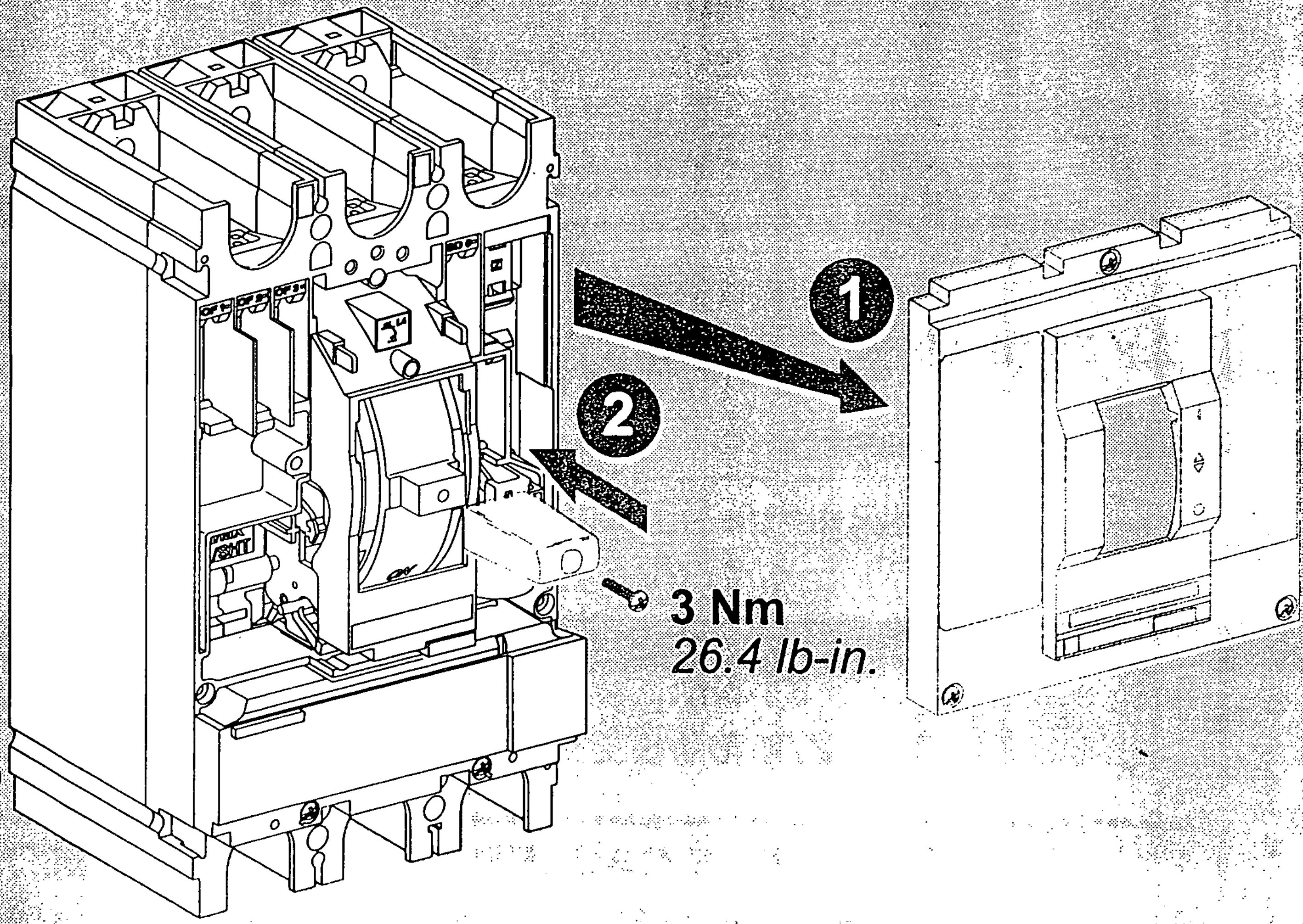
mm
in.

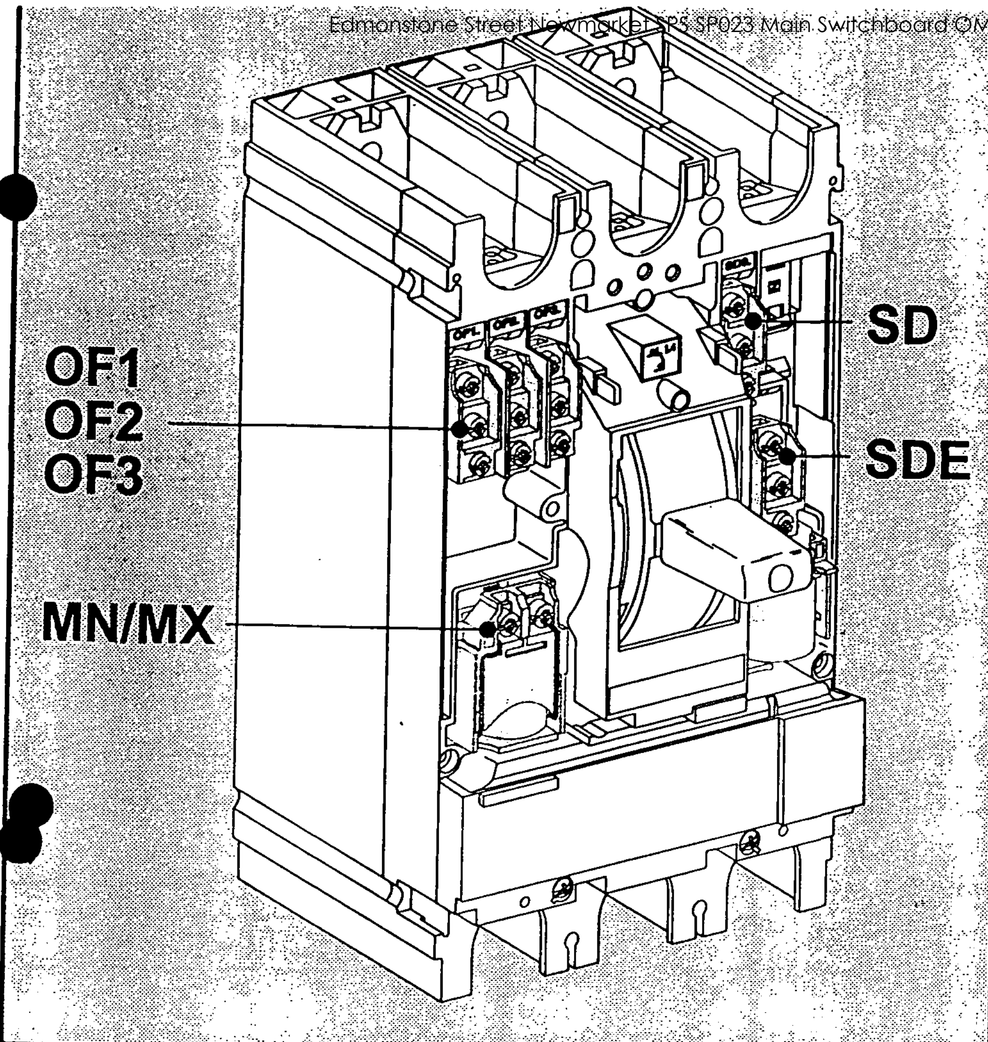

3P
4P
Ø32
Ø1.3
Ø6
Ø0.2
200
7.9
227
8.9
X
X
100
4
113,5
4.5
22,5
0.9
22,5
0.9
45
1.7
90
3.5
45
1.7
45
1.7
45
1.7
45
1.7
45
1.7
Y
Y

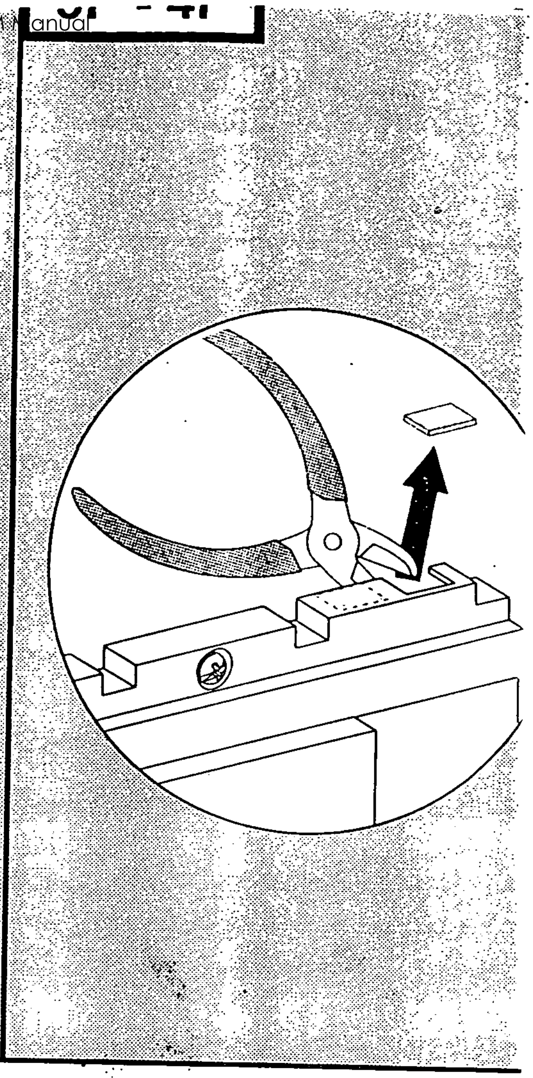
M5 x 85

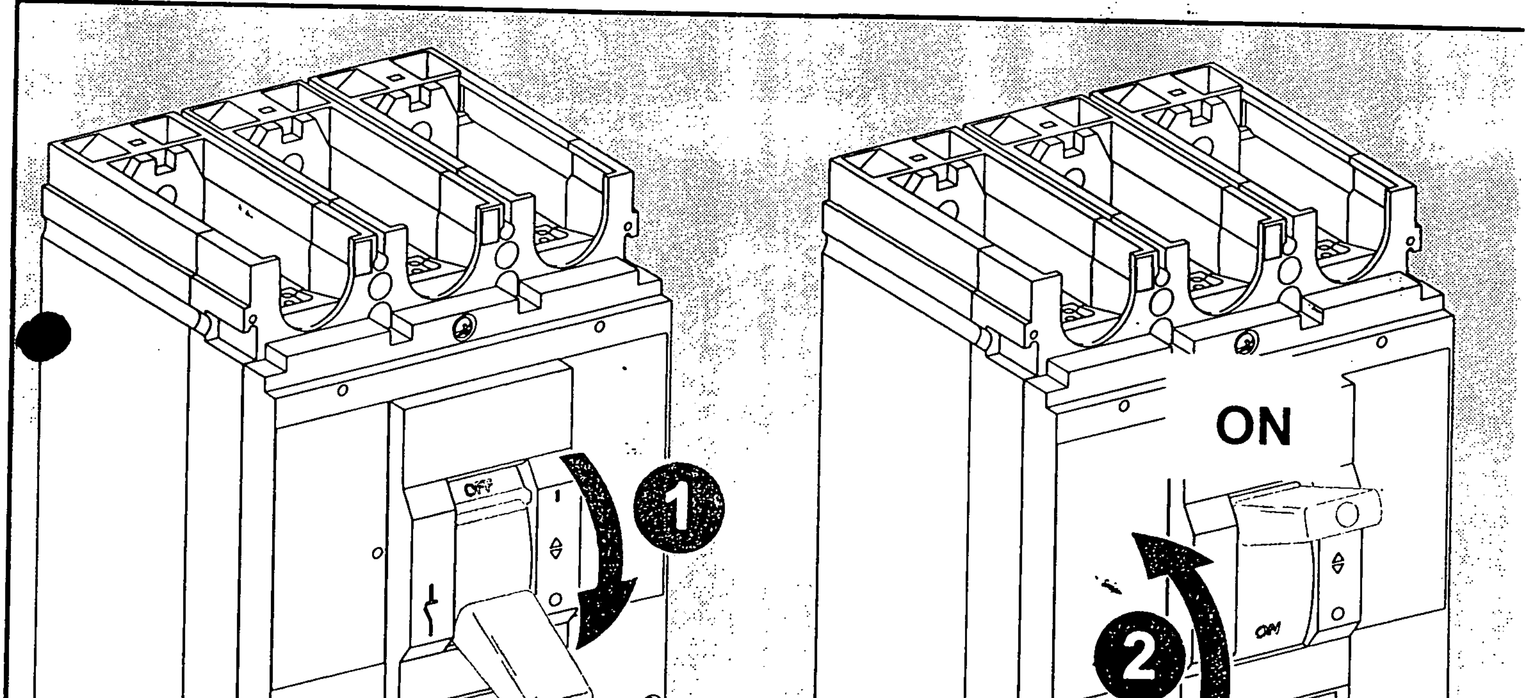


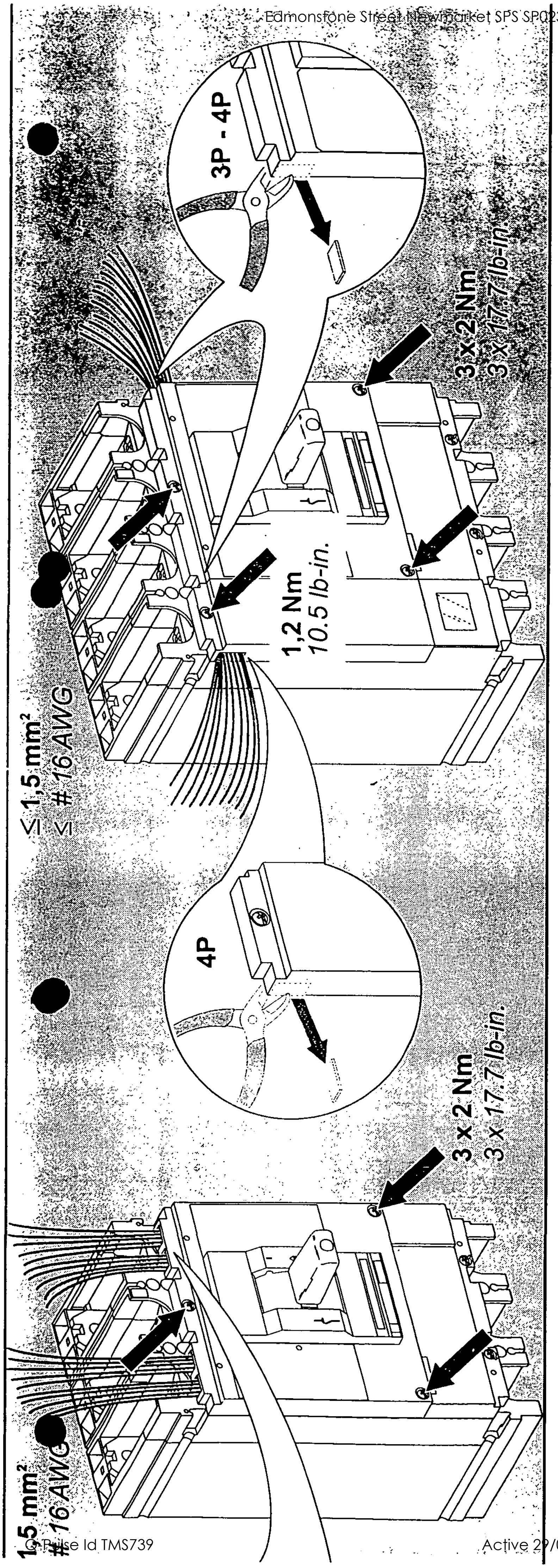

x100
29314
DEP. POMP
x 2
DEPP
O
push
to
trip
téléméca. AB1

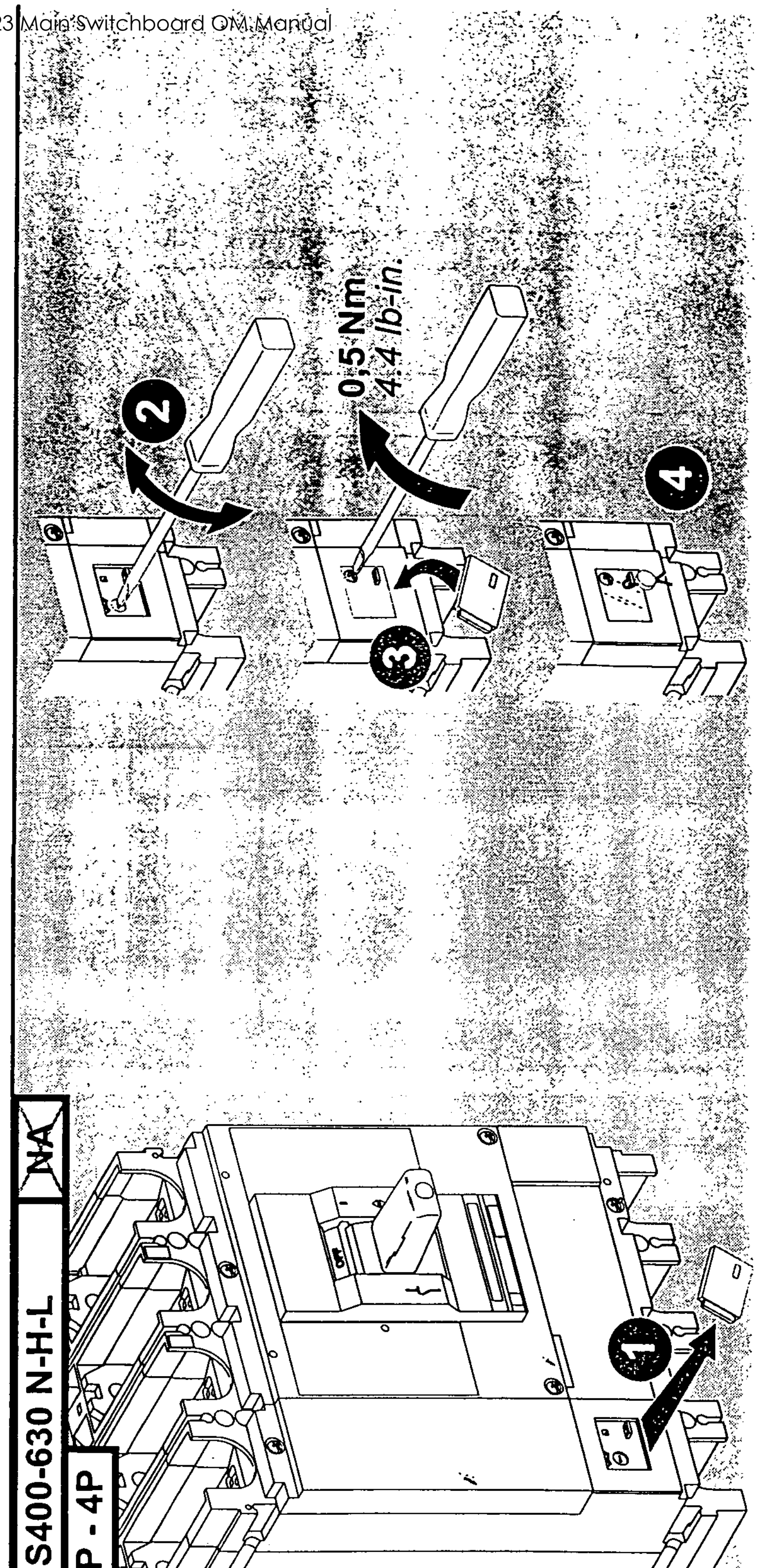

1
2
3 Nm
26.4 lb-in.

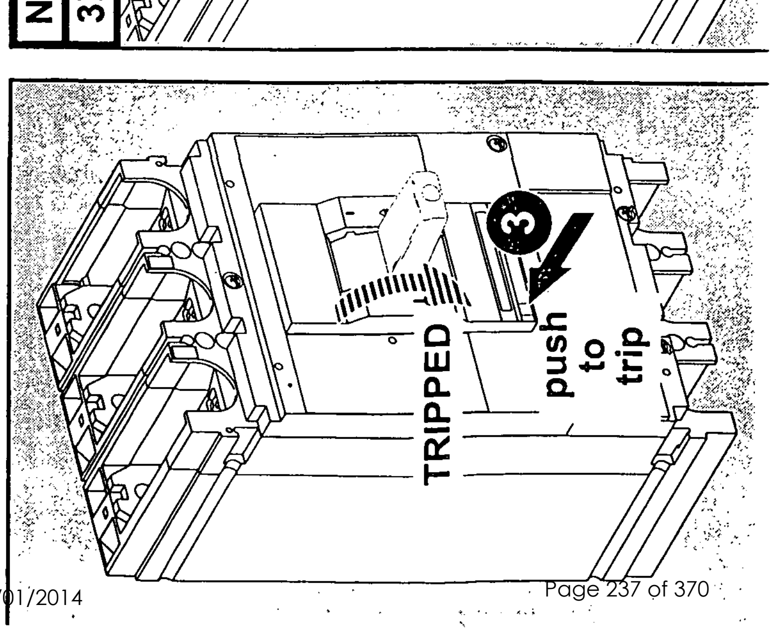

OF1
OF2
OF3
MN/MX
SD
SDE

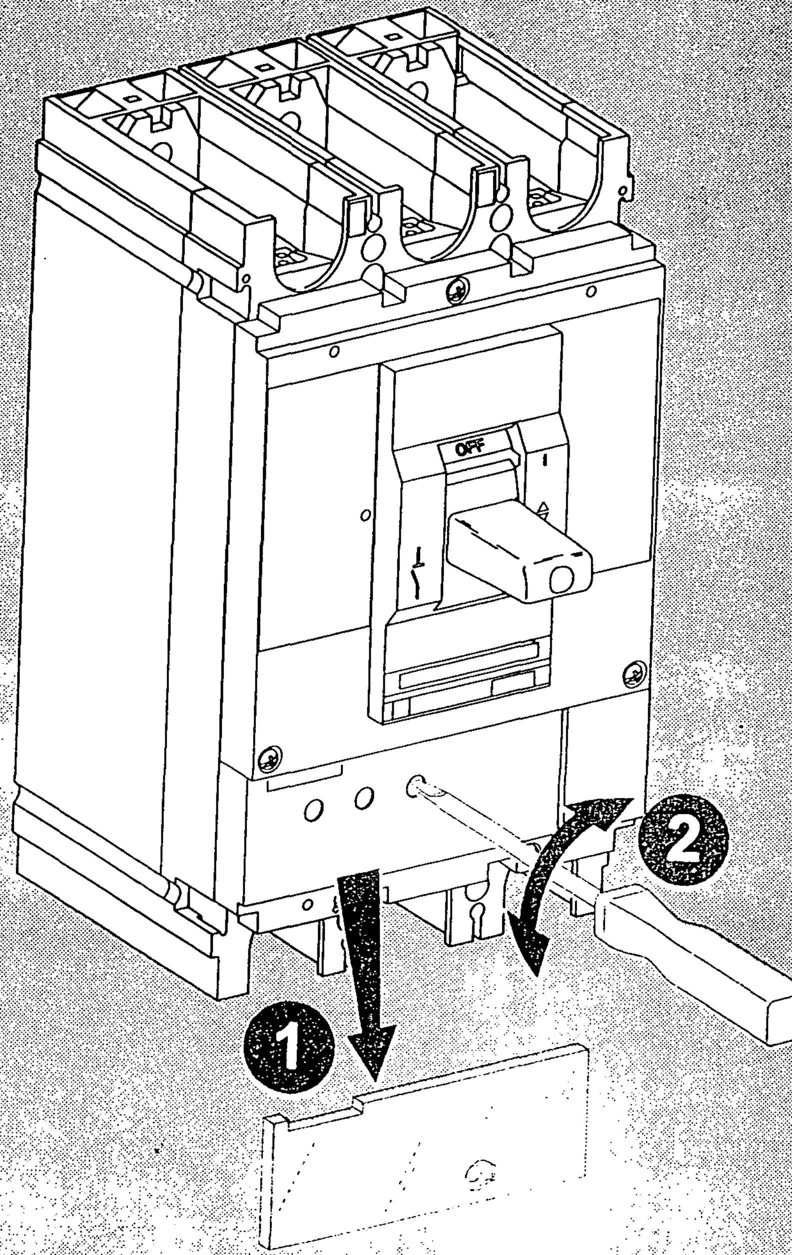



1
OFF
reset
ON
2

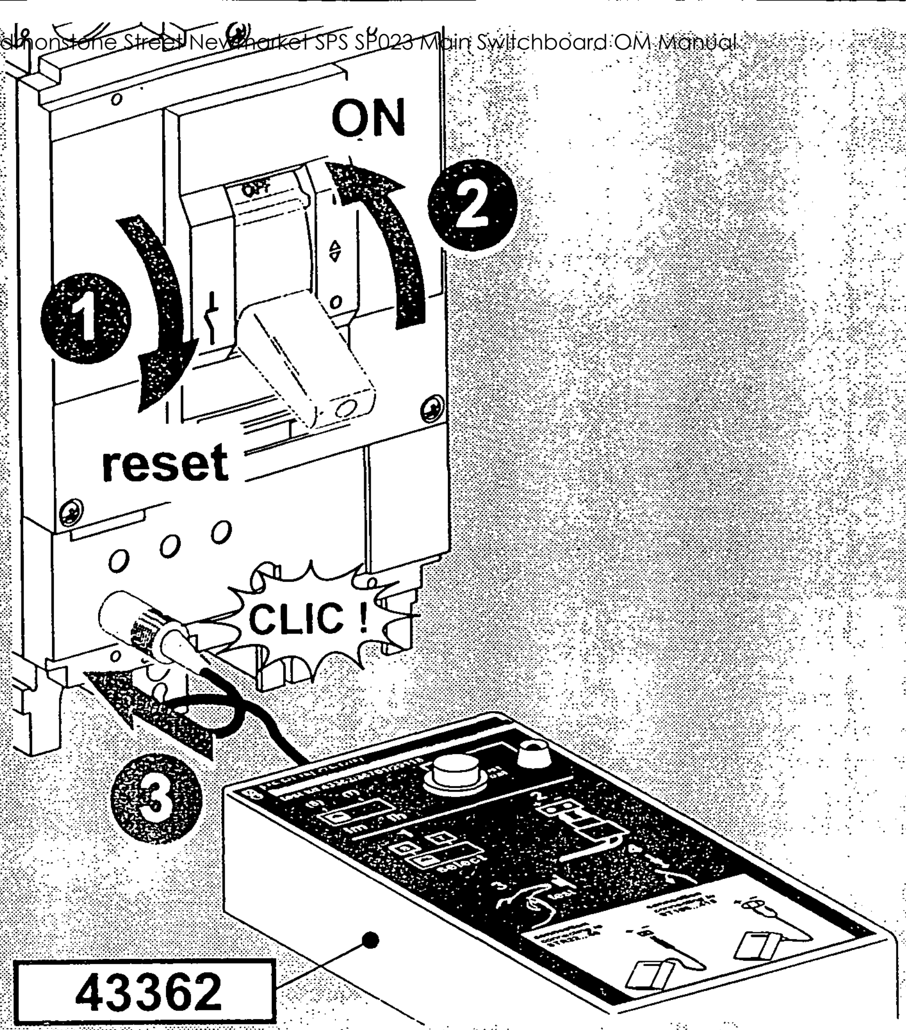

≤ 1,5 mm²
≤ # 16 AWG
3P - 4P
4P
3 x 2 Nm
3 x 17.7 lb-in.
1,2 Nm
10.5 lb-in.
3 x 2 Nm
3 x 17.7 lb-in.
1,5 mm²
16 AWG

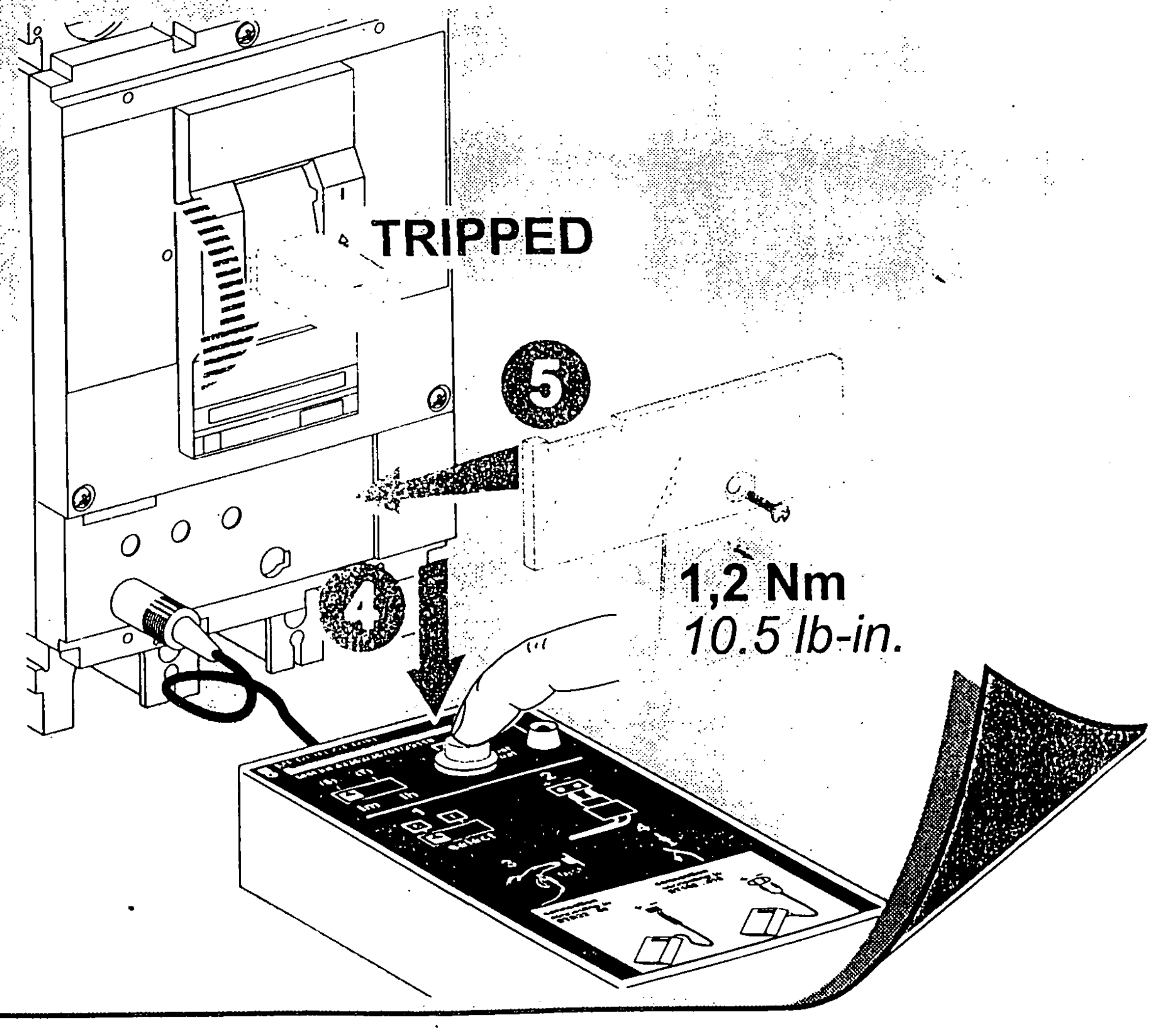

NS400-630 N-H-L
NA
3P - 4P
1
2
0,5 Nm
4.4 lb-in.
3
4


TRIPPED
push
to
trip
3


OFF
1
2

TEST

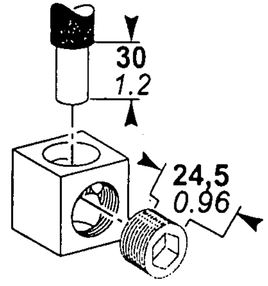




Sélection de la longueur de la vis en fonction de la section du cable
Screw length selection according to the cable cross-section

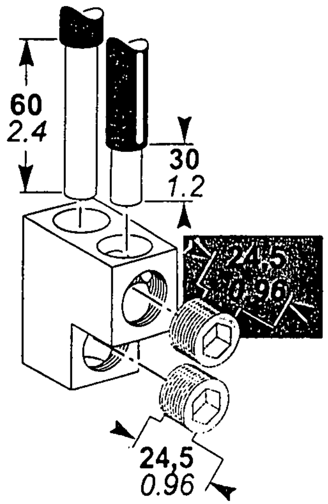
SECTION DES CABLES *CABLES CROSS-SECTION*		
35 mm² ⟶ 300 mm² Cu, Al # 2 AWG ⟶ 600 kcmil Cu/Al9Cu		
Couple de serrage *Tightening torque*		
31 Nm *274 lb-in.*		

mm *In.*



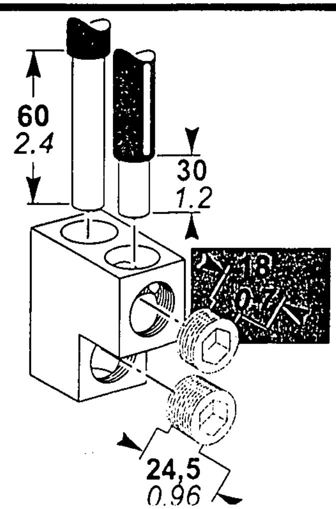
SECTION DES CABLES *CABLES CROSS-SECTION*
2 x 35 mm² ⟶ 2 x 95 mm² Cu, Al 2 x # 2 AWG ⟶ 2 x 4/0 AWG Cu/Al9Cu
Couple de serrage *Tightening torque*
31 Nm *274 lb-in.*

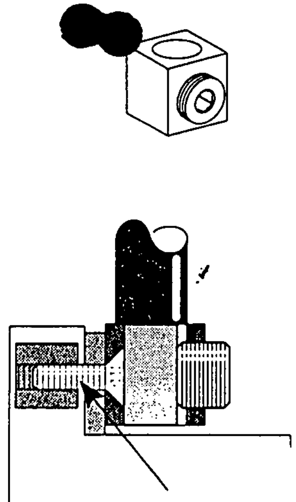
mm *In.*

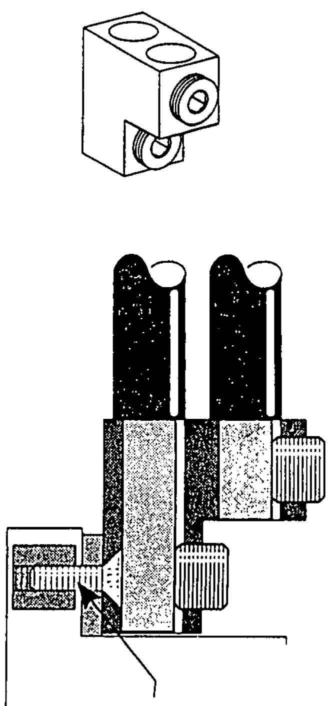


SECTION DES CABLES *CABLES CROSS-SECTION*
2 x 120 mm² ⟶ 2 x 240 mm² Cu, Al 2 x 250 kcmil ⟶ 2 x 500 kcmil Cu/Al9Cu
Couple de serrage *Tightening torque*
31 Nm *274 lb-in.*

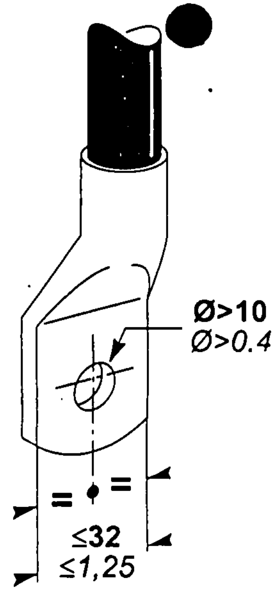
mm *In.*

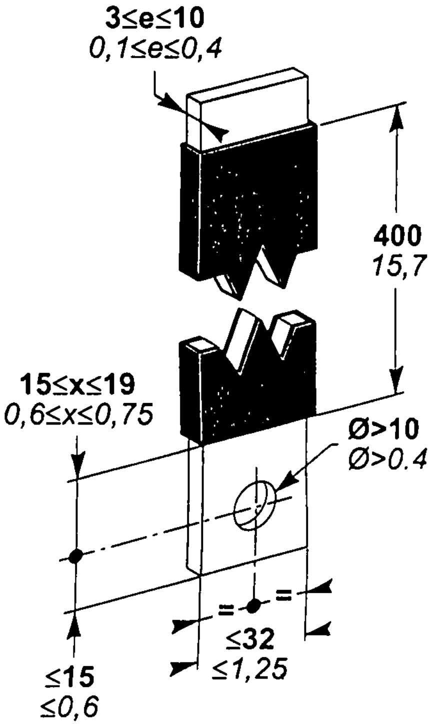


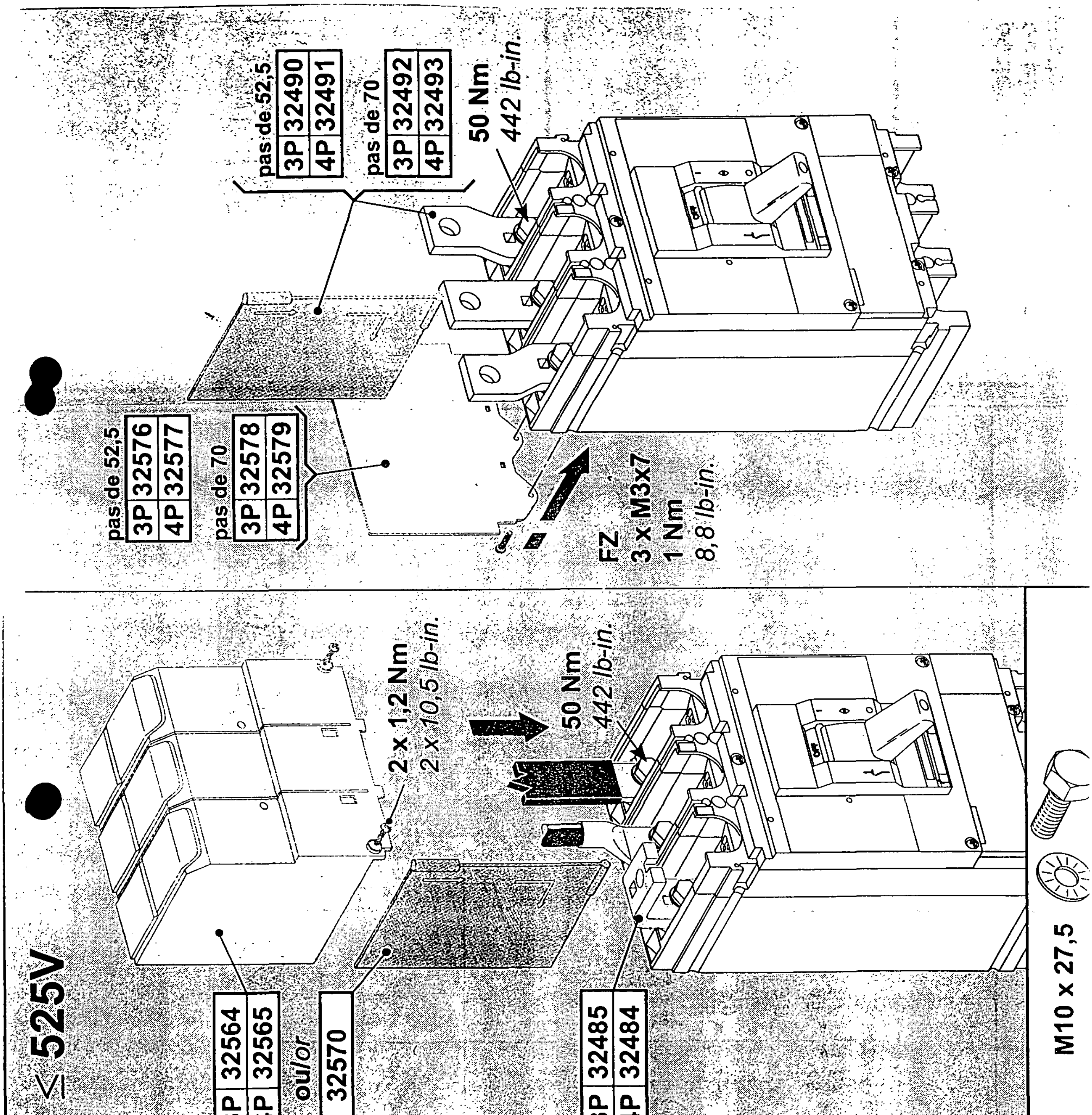


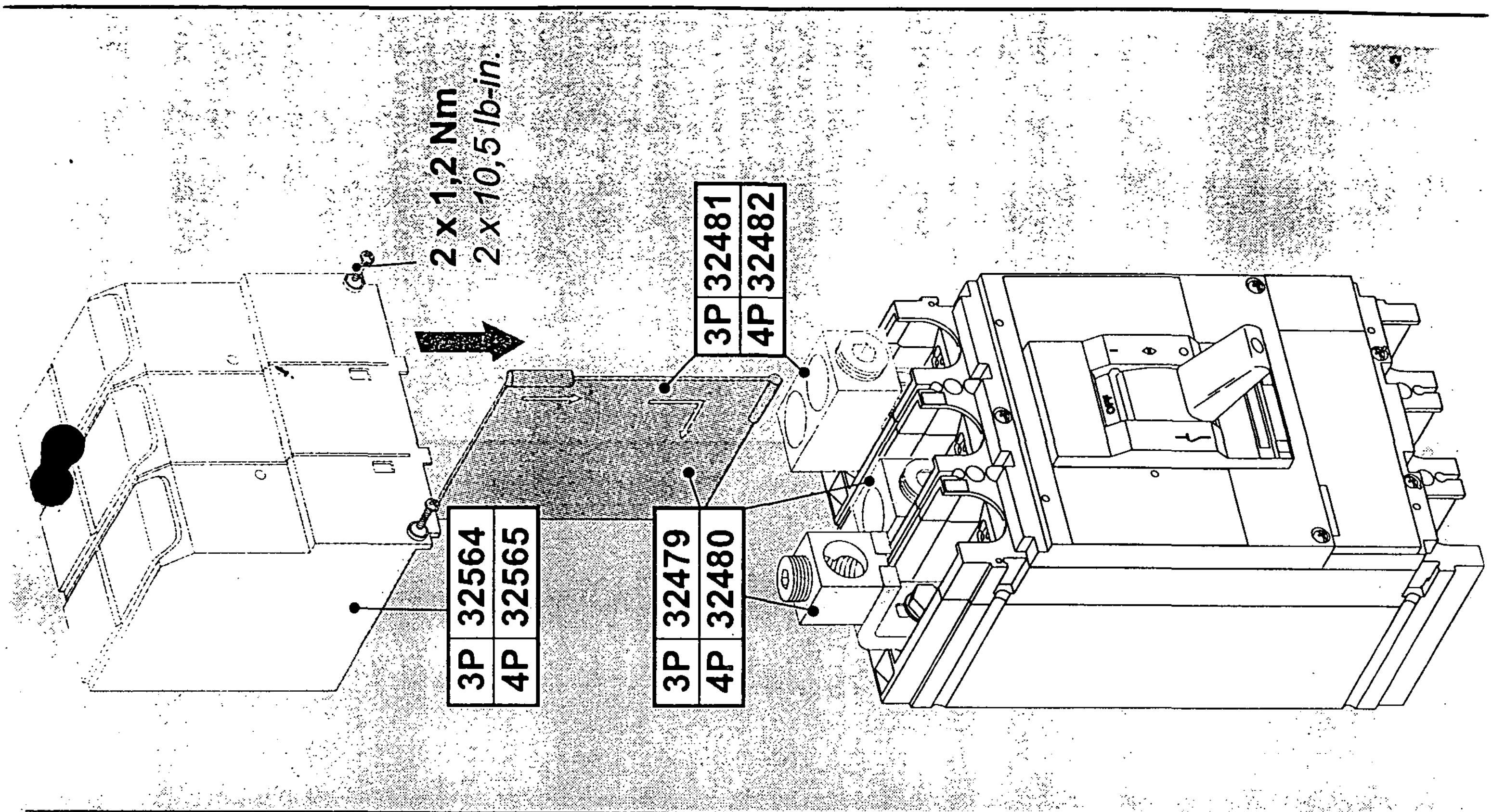


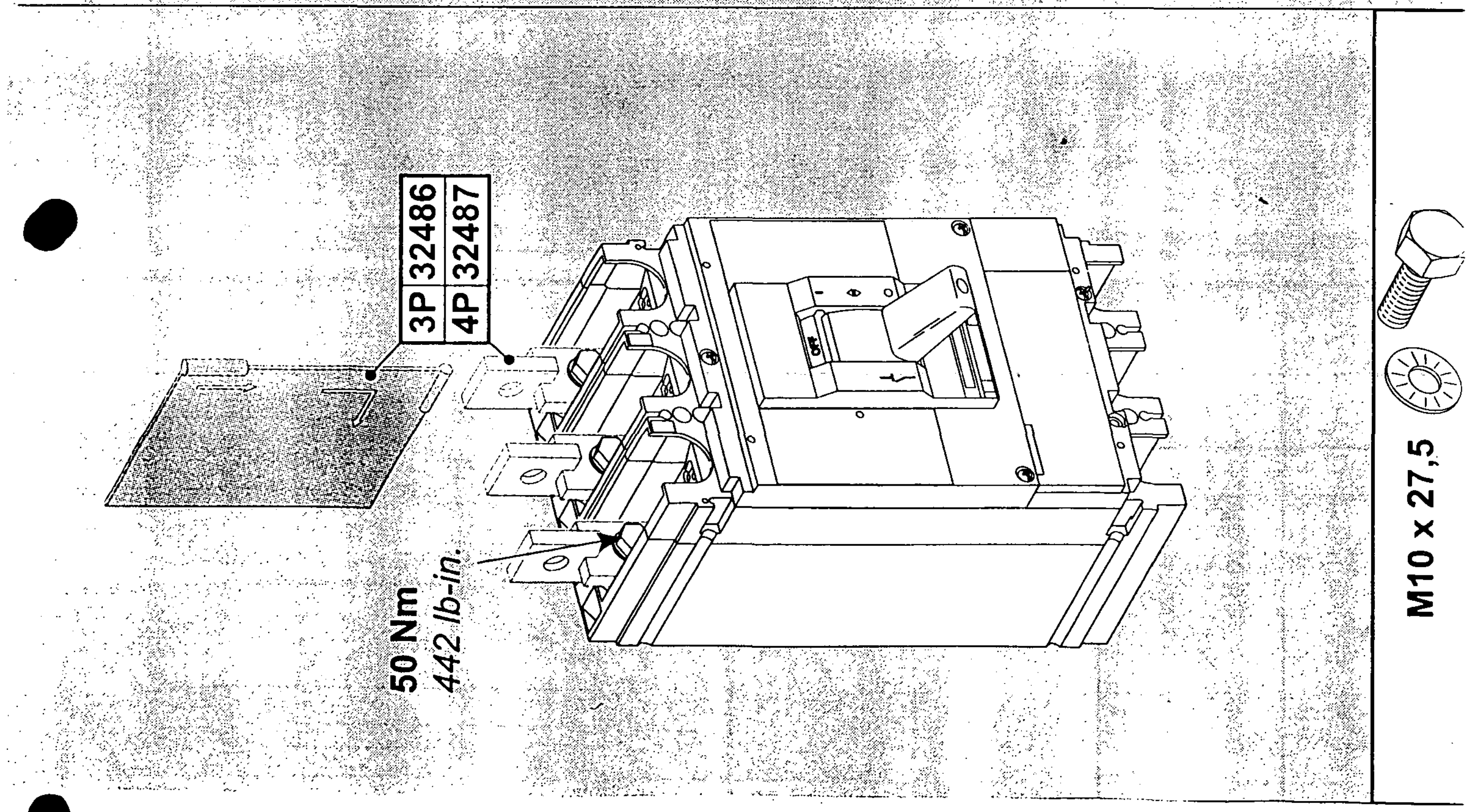
mm *In.*

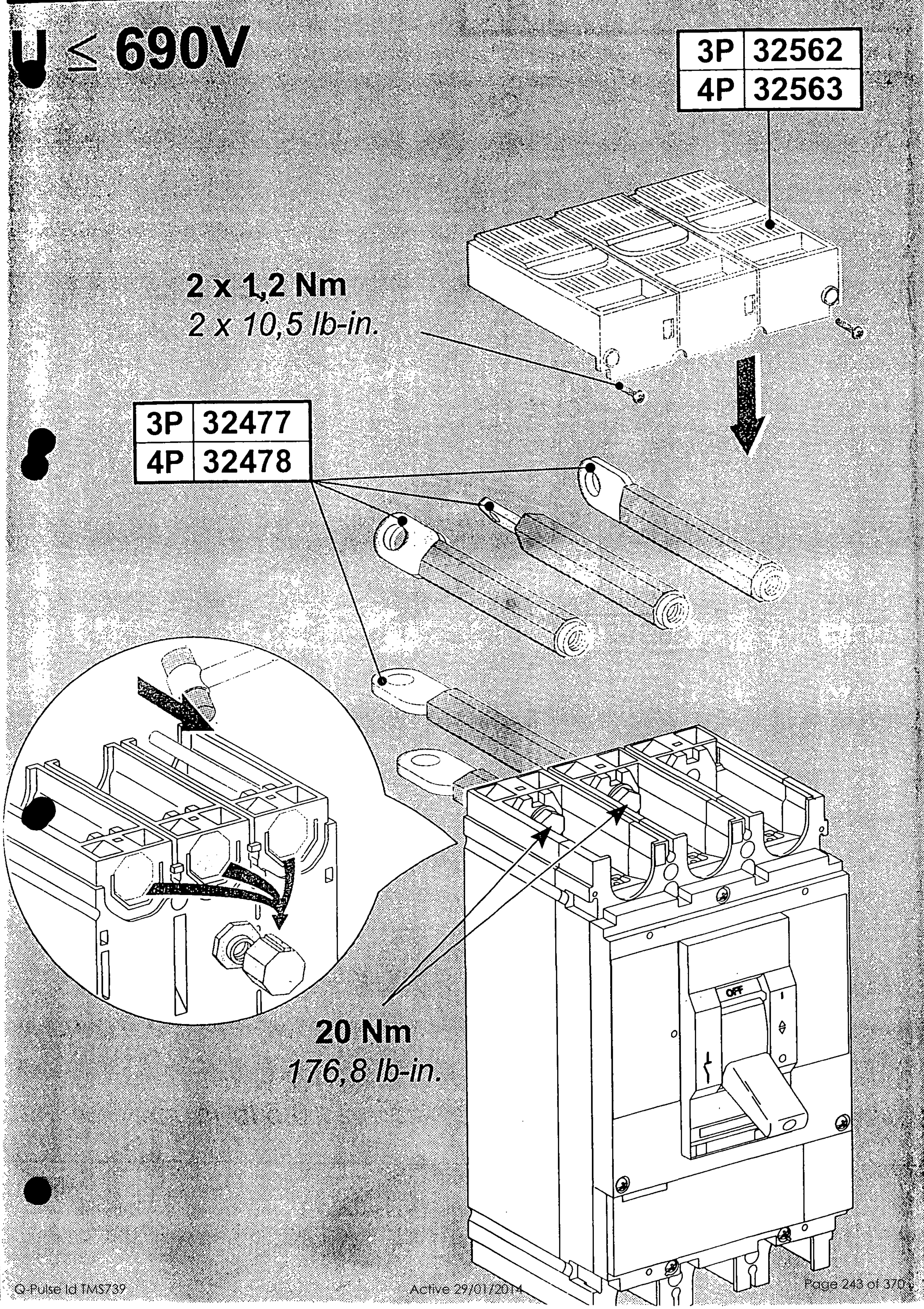


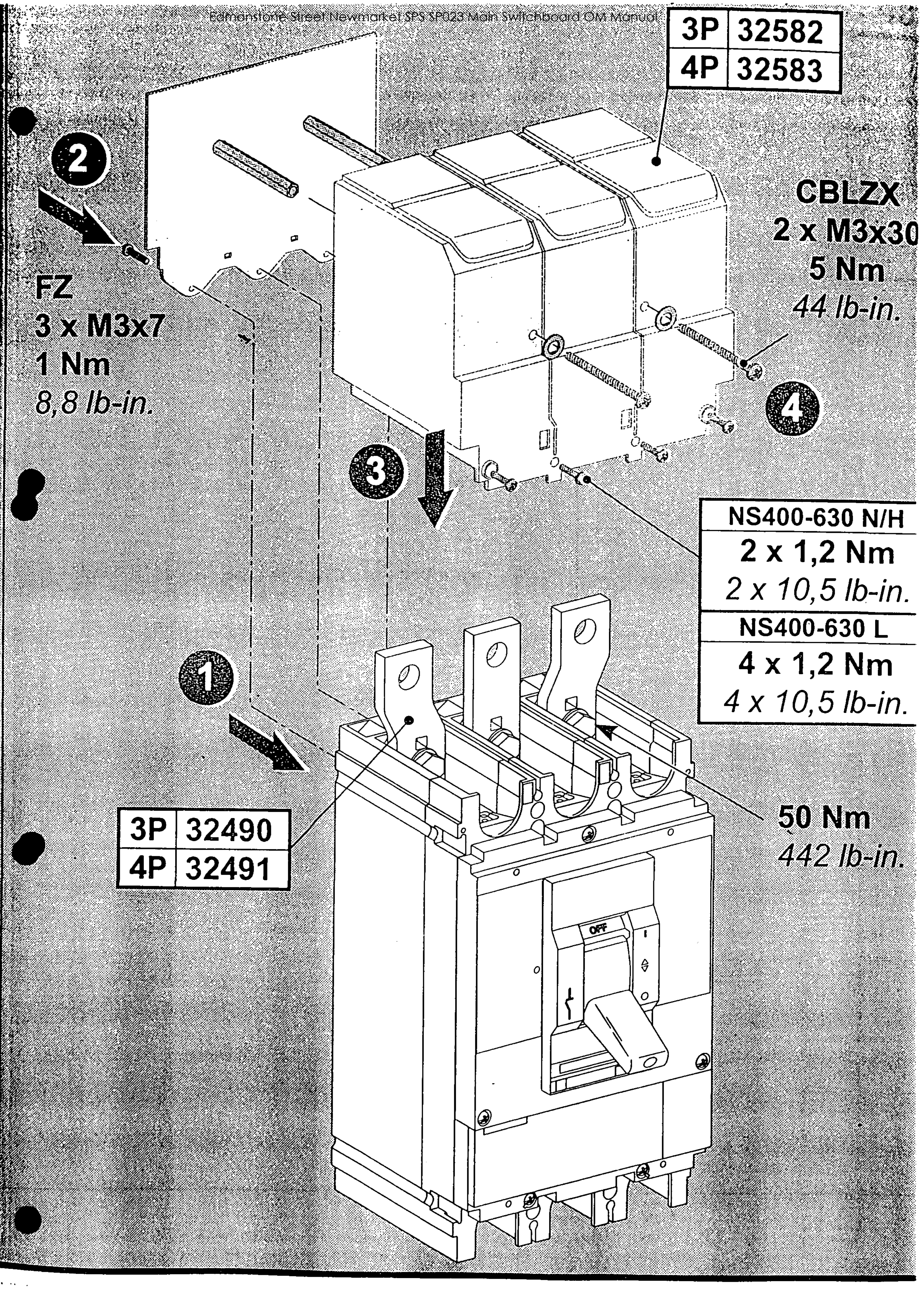


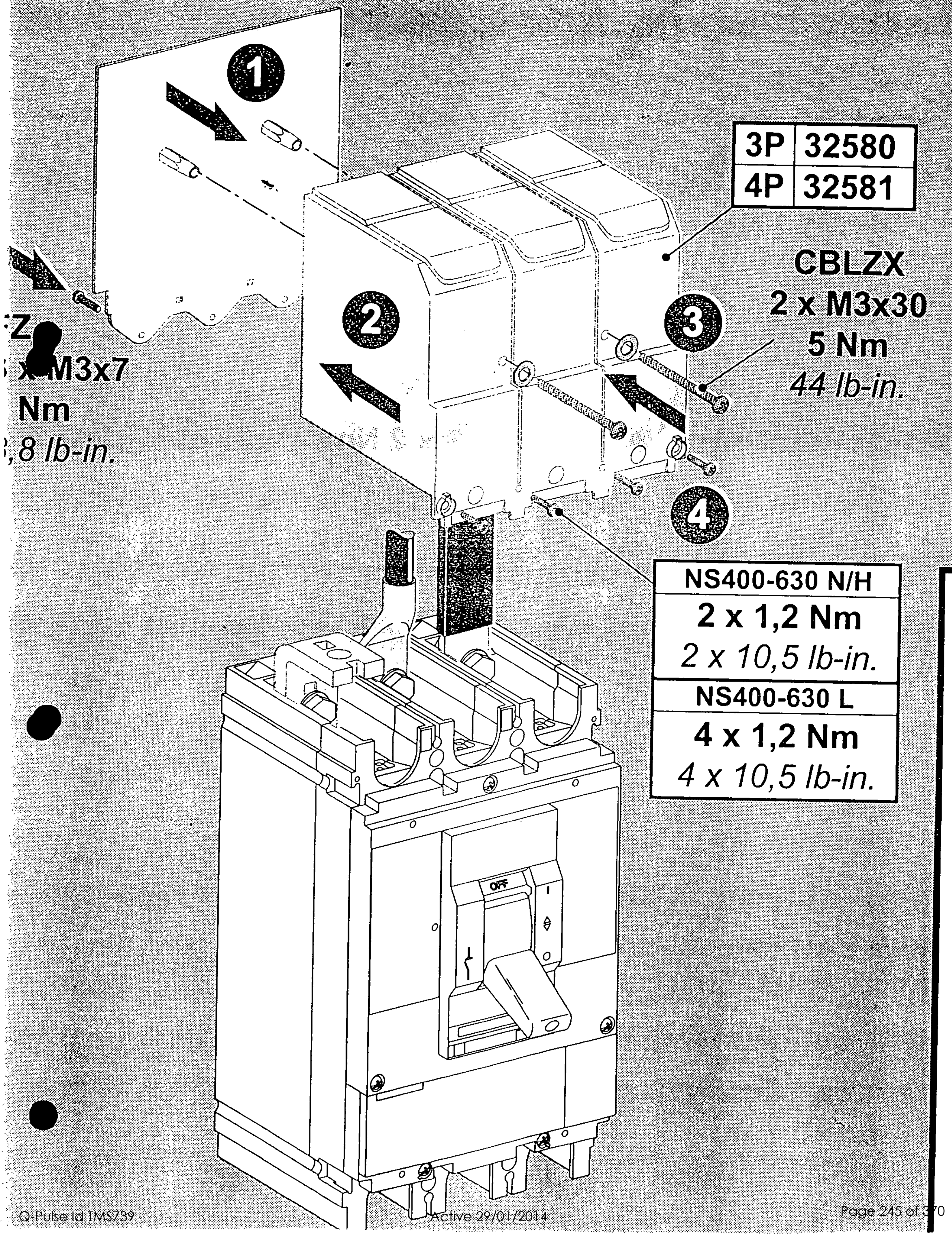

U ≤ 525V
3P 32564
4P 32565
ou/or
32570
2 x 1,2 Nm
2 x 10,5 lb-in.
50 Nm
442 lb-in.
3P 32485
4P 32484
M10 x 27,5
pas de 52,5
3P 32576
4P 32577
pas de 70
3P 32578
4P 32579
FZ
3 x M3x7
1 Nm
8,8 lb-in.
pas de 52,5
3P 32490
4P 32491
pas de 70
3P 32492
4P 32493
50 Nm
442 lb-in.


2 x 1,2 Nm
2 x 10,5 lb-in.
3P 32481
4P 32482
3P 32564
4P 32565
3P 32479
4P 32480

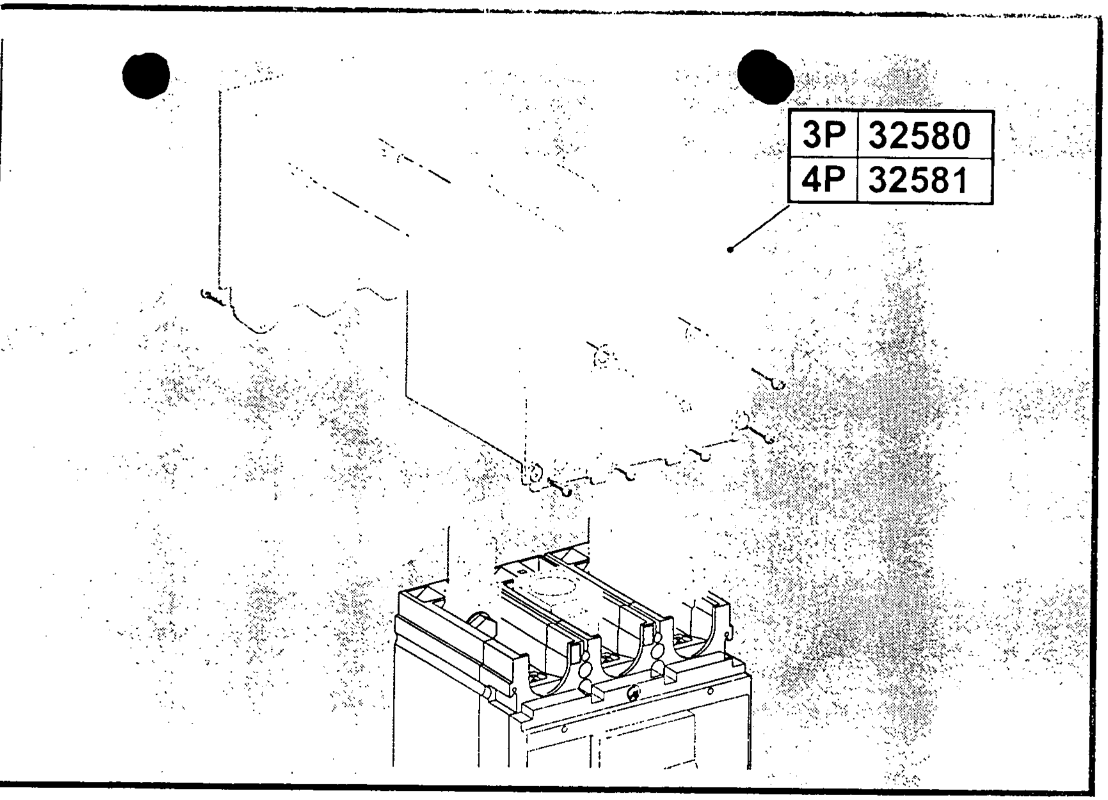

3P 32486
4P 32487
50 Nm
442 lb-in.
M10 x 27,5


U ≤ 690V
3P 32562
4P 32563
2 x 1,2 Nm
2 x 10,5 lb-in.
3P 32477
4P 32478
20 Nm
176,8 lb-in.
OFF

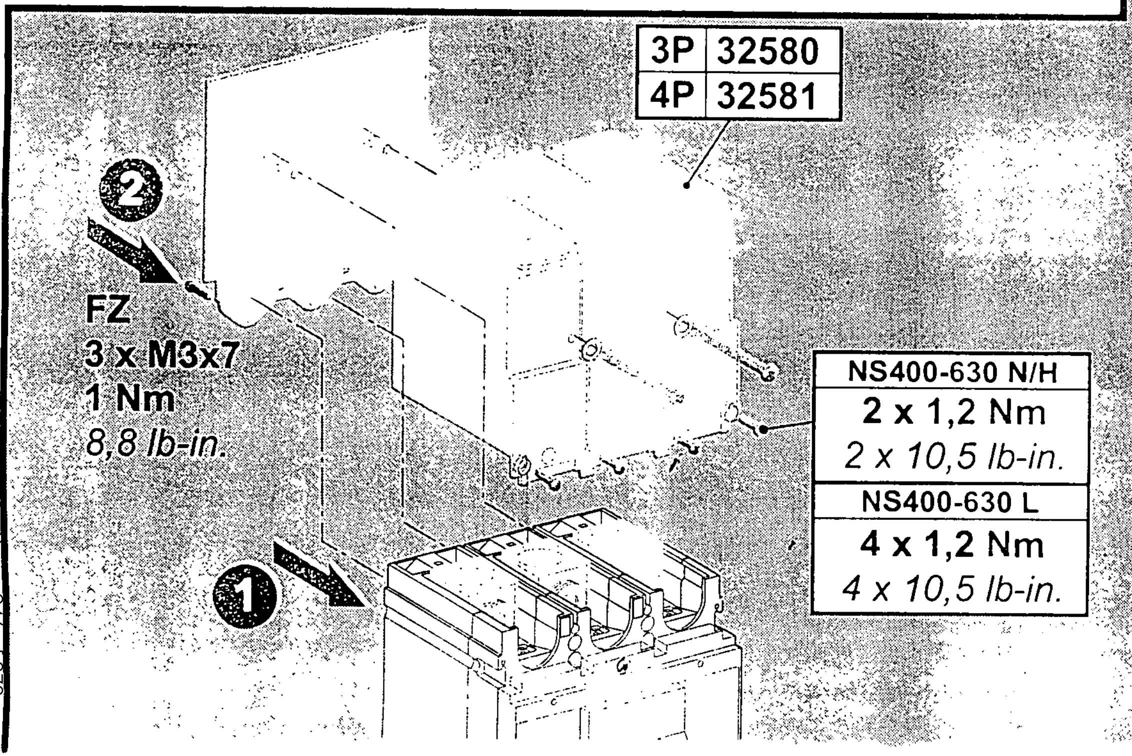

3P 32582
4P 32583
2
CBLZX
2 x M3x30
5 Nm
44 lb-in.
FZ
3 x M3x7
1 Nm
8,8 lb-in.
4
3
NS400-630 N/H
2 x 1,2 Nm
2 x 10,5 lb-in.
NS400-630 L
4 x 1,2 Nm
4 x 10,5 lb-in.
1
50 Nm
442 lb-in.
3P 32490
4P 32491
OFF



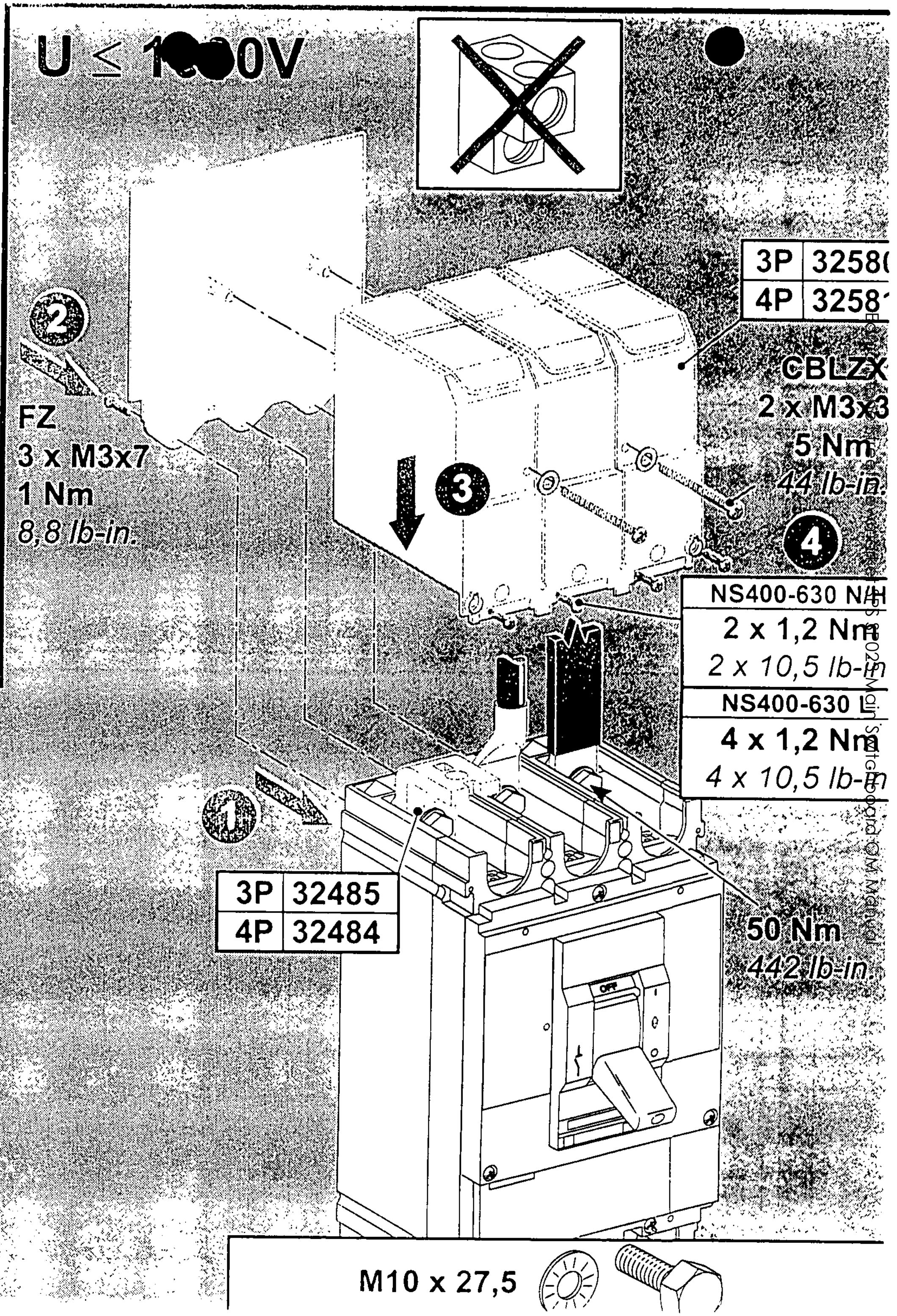
1
2
3
4
3P 32580
4P 32581
CBLZX
2 x M3x30
5 Nm
44 lb-in.
Z
x M3x7
Nm
,8 lb-in.
NS400-630 N/H
2 x 1,2 Nm
2 x 10,5 lb-in.
NS400-630 L
4 x 1,2 Nm
4 x 10,5 lb-in.
OFF



3P 32580
4P 32581



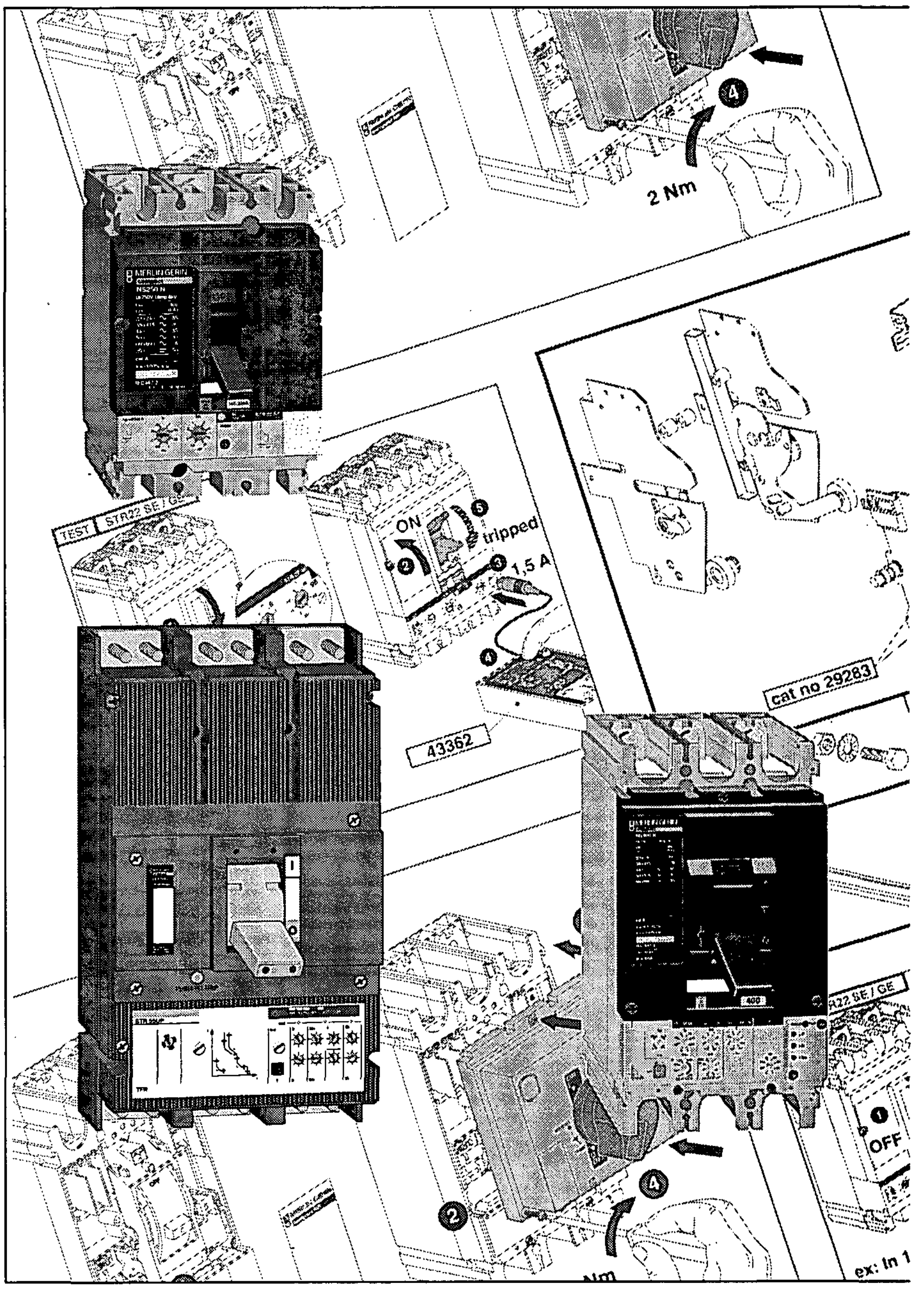
3P 32580
4P 32581
2
FZ
3 x M3x7
1 Nm
8,8 lb-in.
NS400-630 N/H
2 x 1,2 Nm
2 x 10,5 lb-in.
NS400-630 L
4 x 1,2 Nm
4 x 10,5 lb-in.
1



U ≤ 1000V
3P 32580
4P 32581
CBLZX
2 x M3x3
5 Nm
44 lb-in.
2
FZ
3 x M3x7
1 Nm
8,8 lb-in.
3
4
NS400-630 N/H
2 x 1,2 Nm
2 x 10,5 lb-in.
NS400-630 L
4 x 1,2 Nm
4 x 10,5 lb-in.
1
3P 32485
4P 32484
50 Nm
442 lb-in.
M10 x 27,5

Low voltage switchgear Compact Merlin Gerin

Exploitation guide



Merlin Gerin
Modicon
Square D
Telemecanique

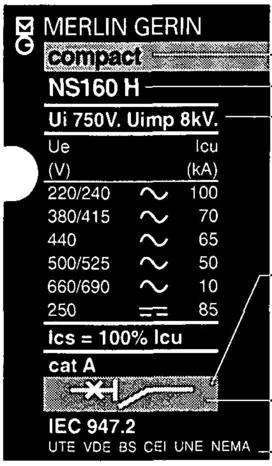
Schneider Electric

summary

discovering your circuit breaker

the toggle operated circuit breaker

rating plate



range

model (rating and breaking capacity)

standardised characteristics:
- Ui = rated insulation voltage
- Uimp = impulse withstand voltage
- Ue = rated operational voltage
- Icu = ultimate breaking capacity
- Ics = service breaking capacity

colour indicating the type of device:
- yellow = E
- silver = N
- pink = H
- blue = L
- green = switch

symbol indicating suitability for isolation as defined by IEC 947.2

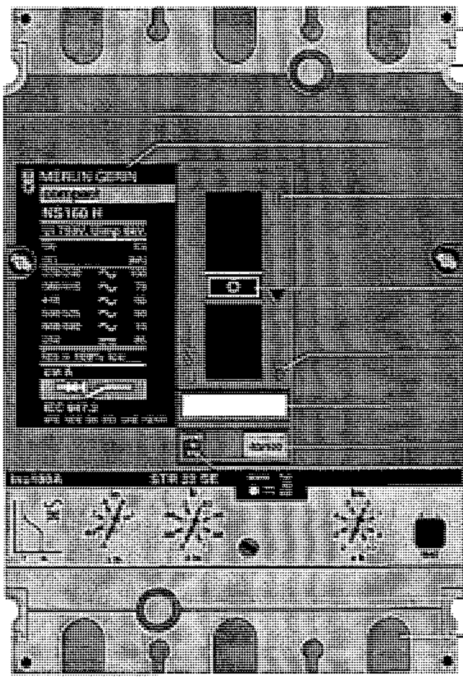
main standards with which device conforms

posative contact indication

Compact NS circuit breakers are suitable for isolation as defined by IEC 947-1 et 947-2.

When the toggle is in the "OFF" position, the main contacts are ALWAYS open.
It is therefore possible to carry out maintenance on the downstream circuits. When doing so, it is advised to lock the circuit breaker in the OFF position and to comply with applicable servicing regulations for low voltage circuits.

circuit breaker with toggle



upstream connections

fixing hole

rating plate **(see above)**

indication of closed **(I/ON)** position

toggle
(shown in tripped position)

indication of open **(O/OFF)** position

circuit identification

trip unit rating

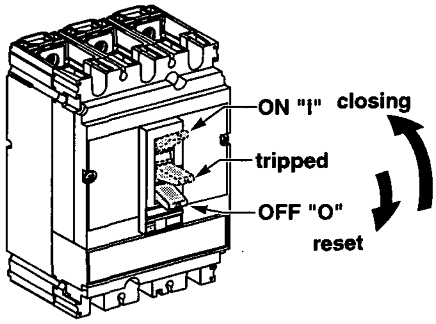
"push to trip" button

trip unit **(see page 11)**

fixing hole

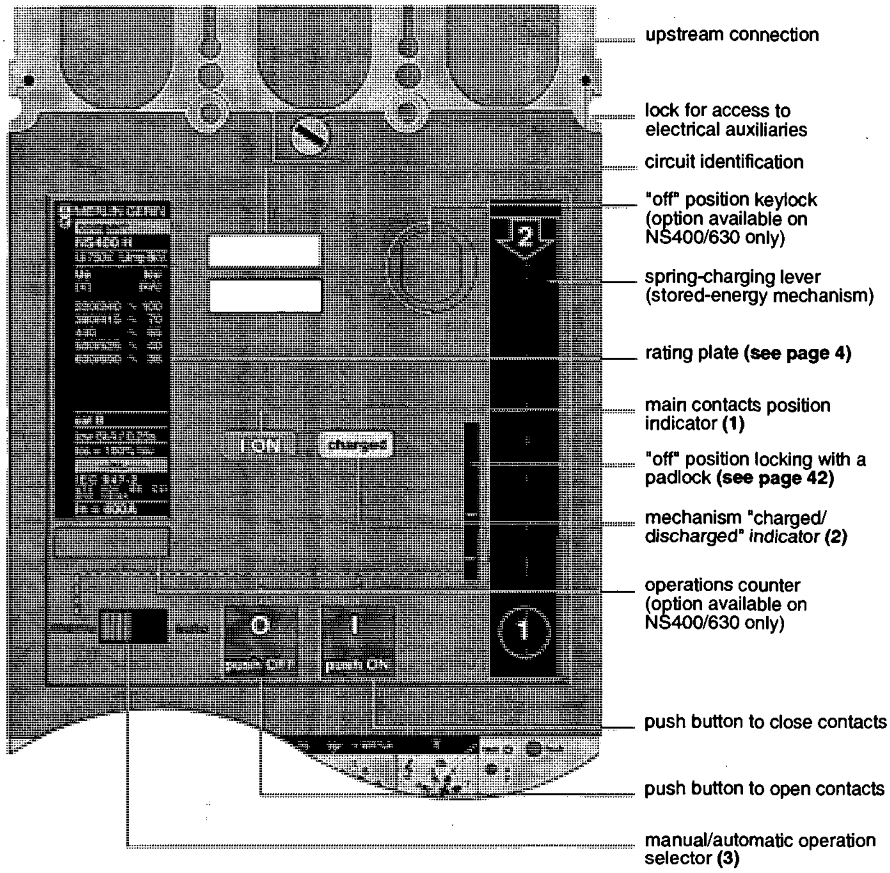
downstream connections

Resetting following a trip
When the circuit breaker is in the "tripped" position it must first be reset by moving the toggle to the OFF position before reclosing is possible.



the motor mechanisms

NS100 to 630 motor mechanisms



The motor mechanism module can be used to open and close the circuit breaker and charge the operating mechanism spring via electrical signals.
Its position and small dimensions leave trip unit settings visible and accessible. It can be tipped forward for access to connections ans auxiliaries (voltage releases, indication switches).

(1) main contacts position indicator

I ON	**closed**
O OFF	**open/isolated**

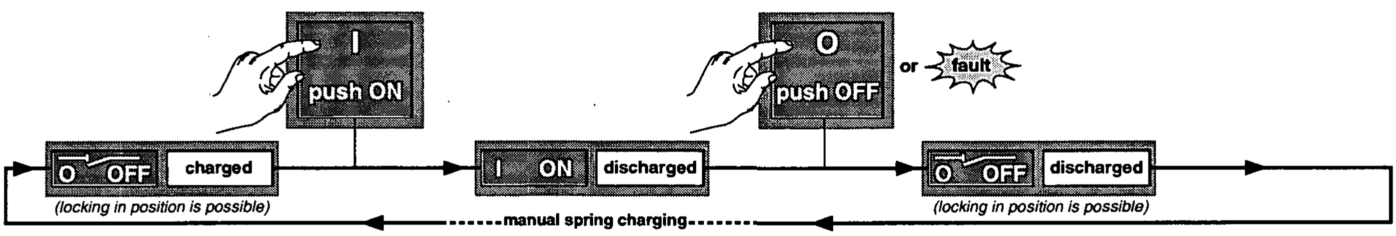
Isolation is guaranteed when the indicator signals OFF.

(2) mechanism status indicator

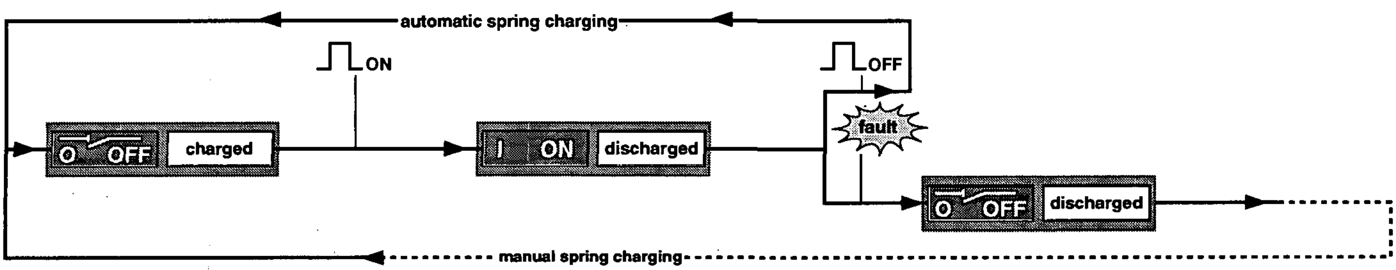
charged	**spring charged**
discharged	**spring discharged**

(3) manual/automatic operation selector :
- in manual mode, electrical control signals are inhibited,
- in automatic mode, only electrical control signals are executed.

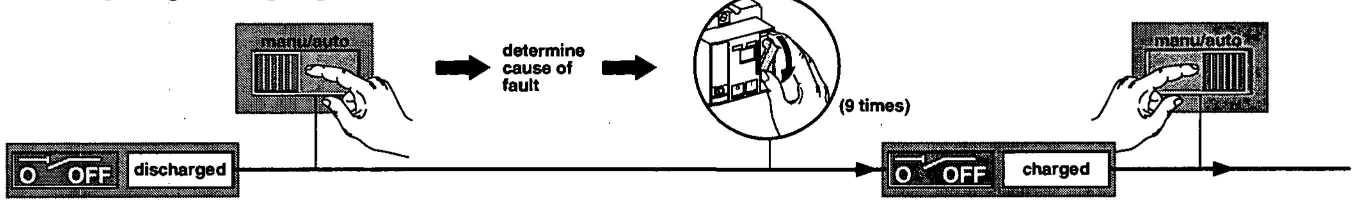
operation cycle in manual mode



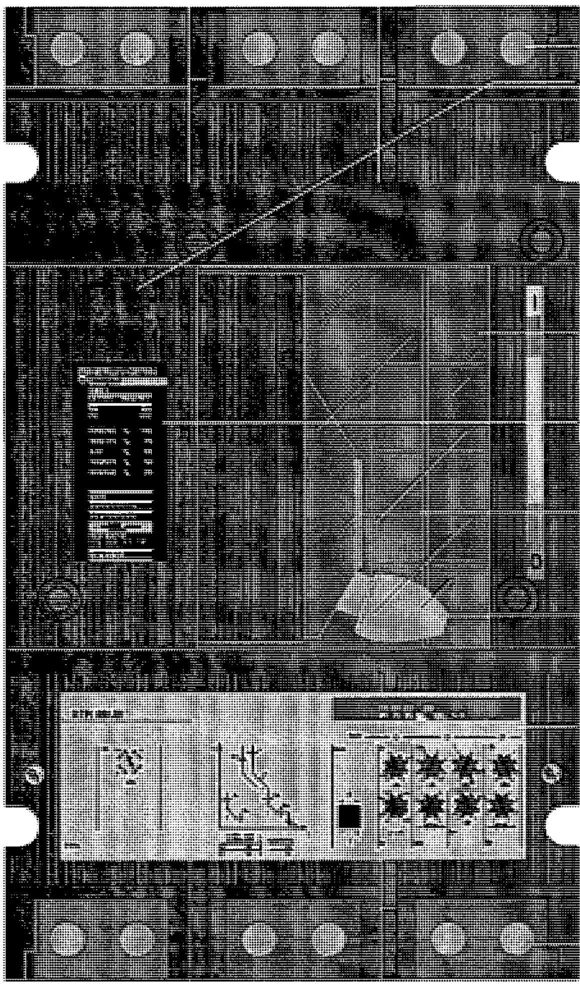
operating cycle in automatic mode



manual spring charging



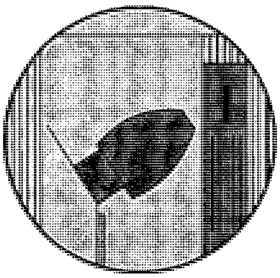
C801 to C1251 type T motor mechanism



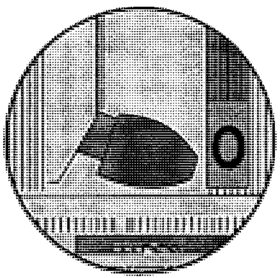
The motor mechanism module can be used to open and close the circuit breaker via electrical signals.
Its position and small dimensions leave trip unit settings visible and accessible.
It can be tipped forward for access to connections ans auxiliaries (voltage releases, indication switches).

Manual operation is possible by opening the transparent front cover :
- breaks the electrical circuit.
- gives access to the operating handle (open - close).
- allows the device to be locked by up to 3 padlocks.

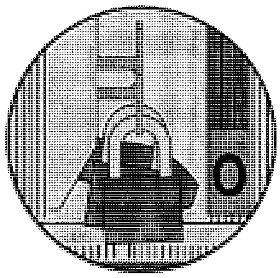
Position "ON" closed



Position "OFF" open

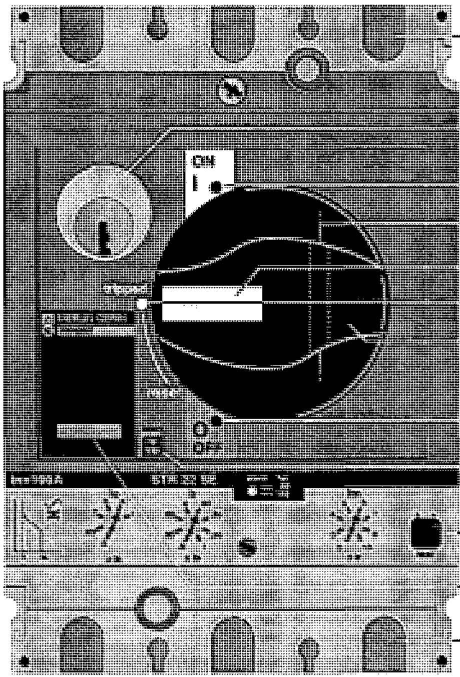


Locking by 3 padlocks



the circuit breaker with rotary handle

circuit breaker with rotary handle

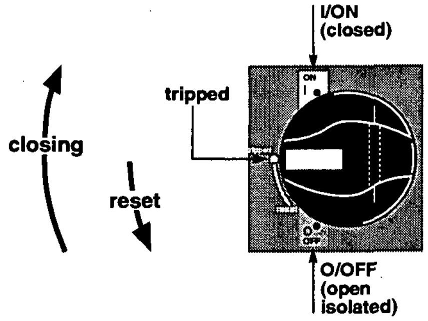


The direct and extended rotary handles do not inhibit:

■ visibility of and access to trip unit settings,
■ positive contact indication (suitability for isolation),
■ indication of the three positions: O, I, "tripped",
■ access to the trip test buttton marked "push to trip".

Compact NS100 to 630 optional handles:

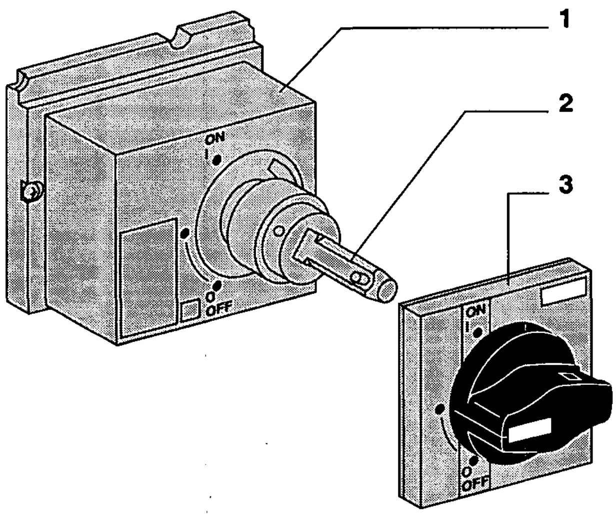
the following accessories are available :
■ MCC version (motor control and command),
■ machine tool version.



circuit breaker equipped with an extended rotary handle

The extended rotary handle comprises :

■ a case mounted on the Compact NS in place of the front cover **(1)**,
■ an extension shaft **(2)**,
■ an assembly fixed to the door (handle and front) **(3)**.



Options :

Telescopic shaft for devices mounted on a withdrawable chassis.
With the exception of the rating plate and the "push to trip" button, the extended rotary handle provides the same information as the direct rotary handle, and is achieved in the same manner.

Access to the trip unit settings and the "push to trip" test button is possible when the door is open.

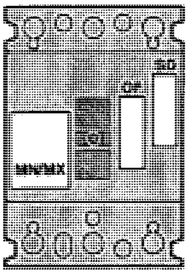
Compact C801 to C1251 option :

includes the same components as the door interlocking version, but is only available with a short extension shaft.

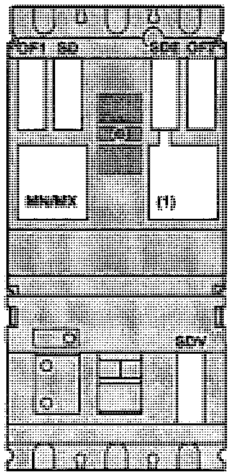
CAM (early make/break contacts)

■ a single early break changeover contact, used to operate pre-tripping mechanisms.
■ a double early make contact.
Both these contacts are mounted in the 'handle front box' for both the direct and extended versions.

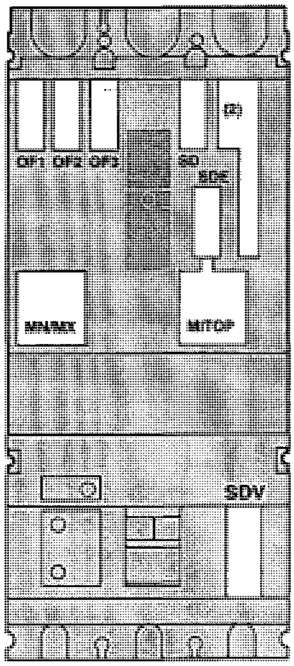
electrical auxiliaries



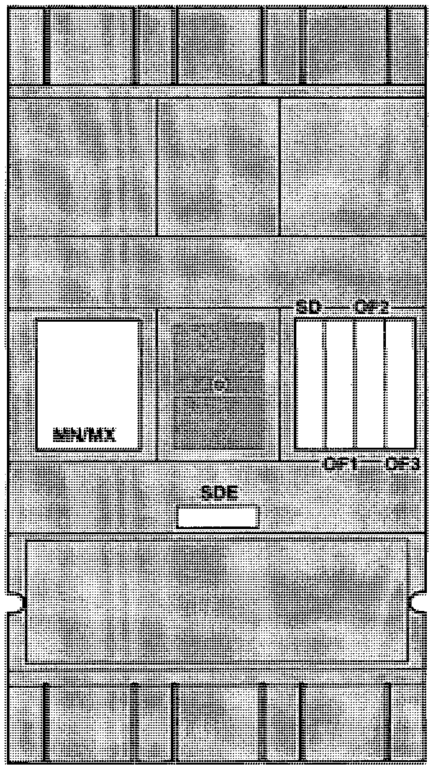
Compact NS80



Compact NS100/160/250
+ Vigi (optional)



Compact NS400/630
+ Vigi (optional)



Compact C801/1001/1251

(1) slot for:
- **a MITOP release** if the circuit breaker is fitted with an electronic trip unit;
- **an adapter** required if the circuit breaker is fitted with a thermal-magnetic trip unit and an SDE contact.

(2) slot for auxiliary connections for STR53UE trip unit options.

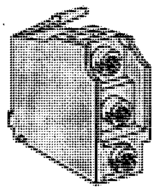
All auxiliaries are located behind the circuit breaker front plate, the motor mechanism module or the rotary handle, in a compartment insulated from the power circuits.
Function and terminal markings are embossed on the circuit breaker frame for each slot.
Auxiliary contacts and releases are physically identical for all ratings.

A single type of auxiliary contact is used for all indication functions (OF, SD, SDE, SDV).
The contact function is determined by the slot it occupies in the circuit breaker.
Auxiliary contacts snap easily into position.

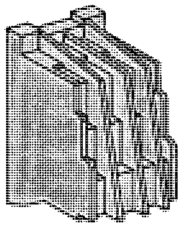
Connections are made via integrated screw terminals.

electrical auxiliaries

auxiliaries switches



For NS100 to NS630



For C801 to C1251

Auxiliary contacts remotely indicate circuit breaker positions.

Contact OF
NC and NO changeover contact.
This auxiliary contact indicates the position of the circuit breaker contacts (open or closed).

Contact SDE
fault trip indication.
This auxiliary contact indicates that the circuit breaker has tripped due to an electrical fault:
- overload,
- short-circuit,
- insulation fault detected by the Vigi module.

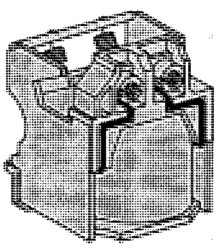
Switch SD
trip indication.
This auxiliary contact indicates that the circuit breaker has tripped due to one of the following:
- overload,
- short-circuit,
- earth fault,
- an MX or MN release,
- pressing of the "Push to trip" button,
- racking in or out,
- manual opening on the front of the motor mechanism module.

Contact SDV
insulation fault indication.
This auxiliary contact indicates that the circuit breaker has tripped due to an earth fault.

Contact CAM
early make/break contact which mounts in the rotary handle.

Option COM (communication).
For transmission of data using the Dialpact protocol.

voltage releases



Voltage releases are used to trip the circuit breaker voluntarily by means of an electric signal (e.g. emergency off button).

Release MN
This undervoltage release trips the Compact NS when the voltage in its control circuit drops below 70% of the rated voltage.
The circuit breaker can be reclosed as soon as the voltage has reached 85% of the rated value.

Release MX
This shunt release trips the Compact NS as soon as the voltage across its terminals reaches 70% of the rated voltage.

how to set up your trip unit

trip unit settings - general comments

trip unit settings - details

remote indication and electronic trip unit options

testing of electronic trip units

electronic trip unit settings for motor protection

trip unit settings - general comments

The trip unit is the component that monitors the electrical current flowing through the circuit breaker and opens the circuit breaker in the event of a fault.

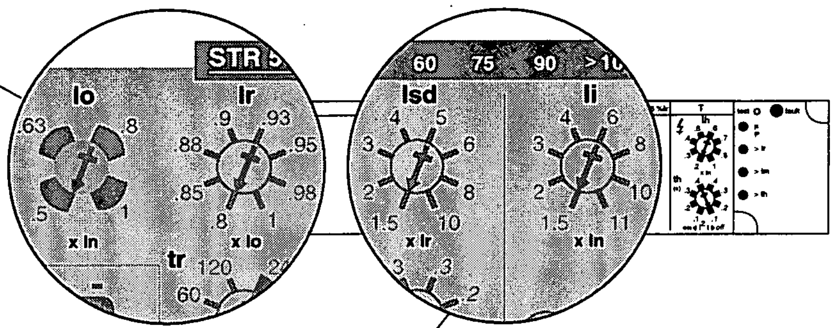
- thermal-magnetic and electronic trip units detect overloads and short-circuits;
- Compact circuit breakers can also be fitted with a Vigi earth-fault protection module that trips the circuit breaker in the event of an insulation fault (risk of electrocution or fire due to earth leakage current).

All Compact trip units (NS100 to NS630) incorporate the reflex-tripping system, an exclusive Merlin Gerin feature that ensures discrimination, even for very high short-circuit currents.

overload protection

Tripping time depends on the level of the fault:

- the circuit breaker will trip within 2 hours for a current equal to :
  - 120% of Ir for electronic trip units,
  - 130% of Ir for thermal-magnetic trip units.
- the circuit breaker must not trip for a load under 105% of Ir.



short circuit protection

The tripping is :

- time delayed as soon as the current exceeds the Isd threshold.
- instantaneous as soon as the current exceeds the Ii threshold.

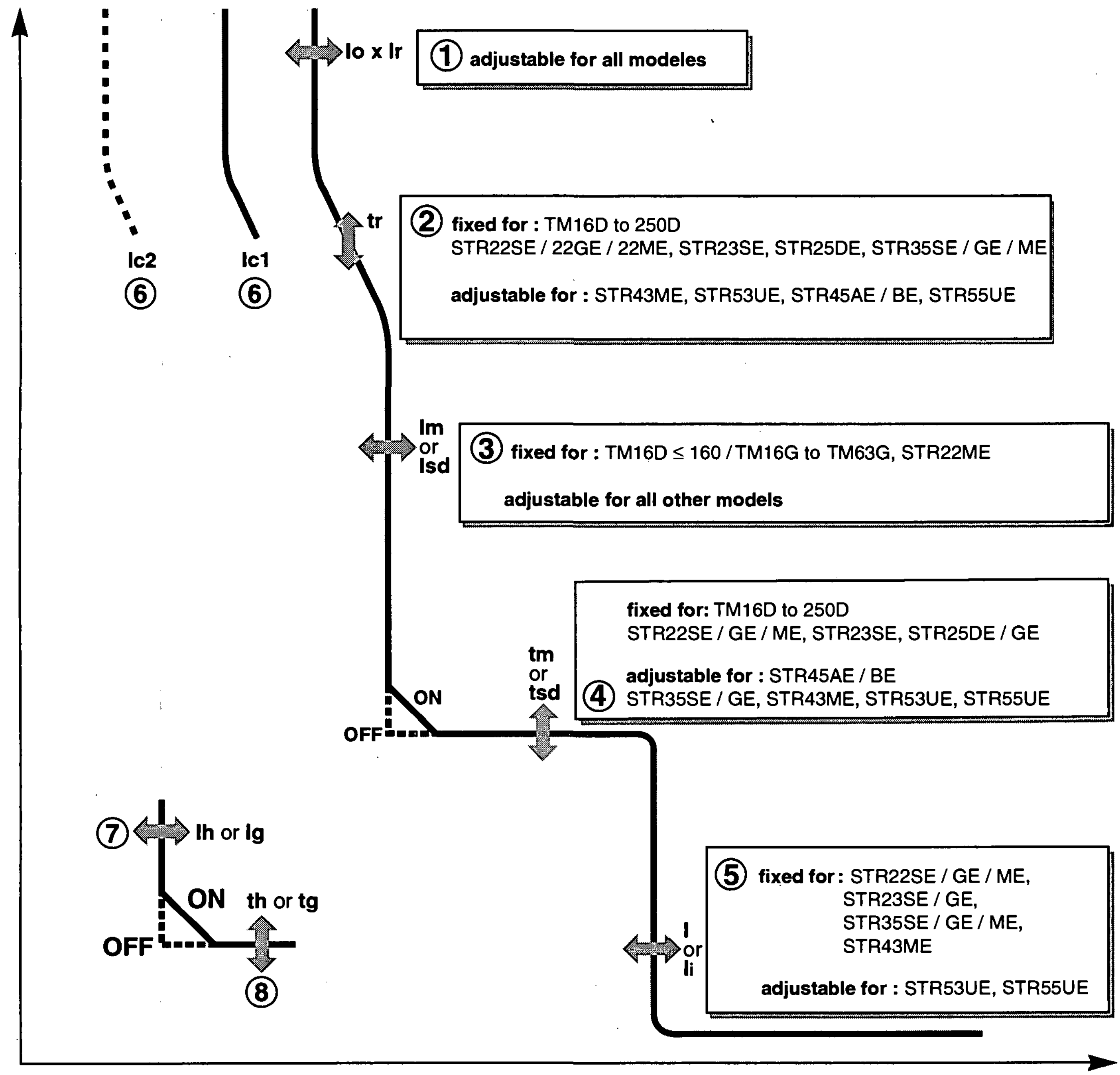
The ME trip units conform to IEC 947-4.1 (motor protection).

In 1997, IEC 947-4.2 brought modification to the symbols related to the settings of the trip units. These modifications are :

- the short circuit threshold is **Isd** (instead of Im)
- the short circuit time delay is **tsd** (instead of tm)
- the instantaneous threshold is **Ii** (instead of I)
- the earth fault protection threshold is **Ig** (instead of In)
- the earth fault protection time delay is **tg** (instead of **tn**)

These new symbols have been applied to NS400/630 trip units STR53UE and STR43ME (issued after the modification)

terminology of the overload and short-circuit protection settings



Long time protection against overloads

① **Io** = coarse adjustment (function of In)
Ir = fine adjustment

② **tr** = long time delay fixed or adjustable depending on the trip unit

Short circuit protection

③ **Im** = short circuit threshold,
or
Isd I^2t curve in position ON or OFF (depending on the trip unit)

④ **tm** = short circuit time delay
or
tsd fixed or adjustable,

Instantaneous protection

⑤ **I** = instantaneous threshold,
or
Ii fixed or adjustable depending on the trip unit

⑥ **Ic1** = adjustable load shedding threshold for STR45 and STR55
Ic2 = adjustable load shedding threshold for STR45 and STR55

Earth fault protection

⑦ **Ih** = insulation fault threshold,
or
Ig I^2t curve in position ON or OFF

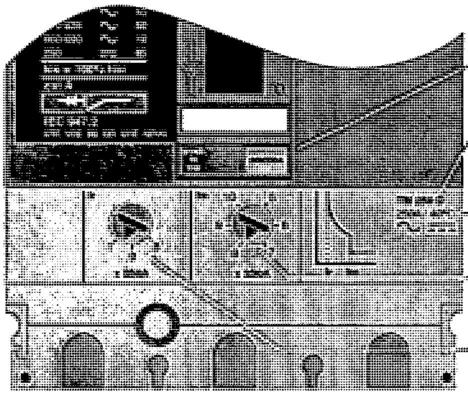
⑧ **th** = earth fault time delay
or
tg

trip unit settings - general comments

Compact NS100-160-250A

2 interchangeable families

thermal-magnetic trip unit



- mini/maxi value of thermal protection
- trip unit identification
- trip unit rating and reference temperature
- magnetic setting (or value if fixed) for short-circuit protection
- thermal setting for overload protection

Trip unit identification

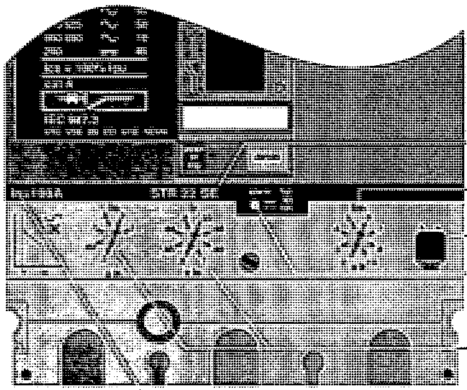
TM 250 D

type
D : standard trip unit
G : low magnetic-threshold trip unit

rating

family
TM = thermal-magnetic
MA = magnetic

electronic trip unit



- trip unit identification
- short time setting **(Im)** for short circuit protection
- test connector **(see page 32)**
- alarm **(see page 23)**
- long time setting Io x Ir **(LR)** for overload protection
  Io : base setting
  Ir : fine adjustment
- trip unit rating (calculation basis for settings)

Trip unit identification

STR 22 SE

E : IEC
P : UL

type
S : selective trip unit
G : generator protection trip unit
M : motor protection trip unit

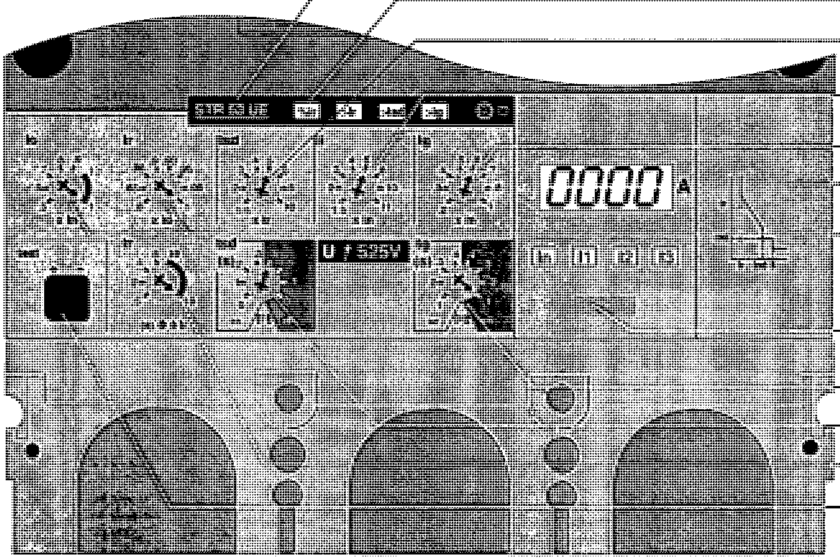
rating group
2 : NS100/160/250

number of settings

family
STR = electronic

Compact NS400-630 A

electronic trip unit STR53UE and STR53SV



trip unit identification

indication/alarm **(see page 23)**

short time setting for
short circuit protection **(Isd)**

instantaneous setting for
short circuit protection **(Ii)**

earth fault protection **(Ig) (*)**

slot for the SD option
"fault indication"

long time setting **(LR)**
for overload protection
Io : base setting
Ir : fine adjustment

slot for options
"earth-fault" or **"load monitoring"**

earth fault time delay **(tg) (*)**

short time time-delay setting **(tsd)**

long time time-delay setting **(tr)**

test connector **(see page 32)**

(*) options only for STR53UE

Trip unit identification

STR 53 UE

E : IEC
P : UL

type
S : selective trip unit
U : universal trip unit
M : motor protection trip unit

rating group
3 : NS400/630

number of settings

family
STR = electronic

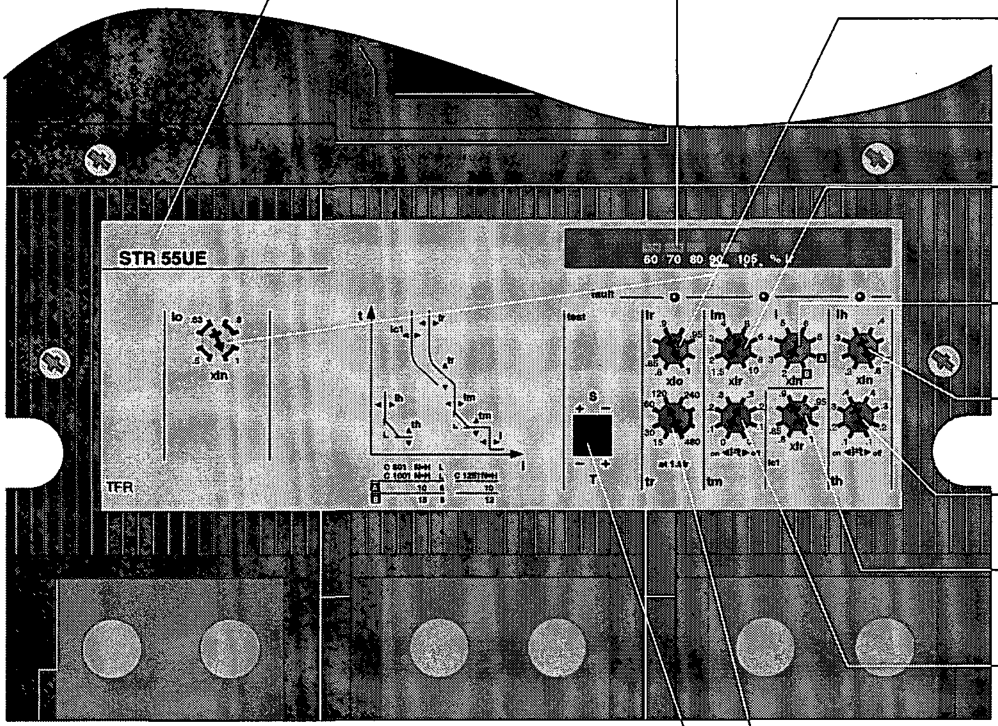
STR 53 SV

U > 525V applications

■ STR23SE and STR53UE are dedicated for use on networks up to 525 Volts (Ue ⩽ 525 V). STR23SV and STR53SV are dedicated for use on ligher operational voltage networks (Ue > 525 V).

trip unit settings - general comments

C801-1001-1251 A
exclusively electronic



Trip unit identification

STR 5 5 U E

standard
E : IEC
P : UL

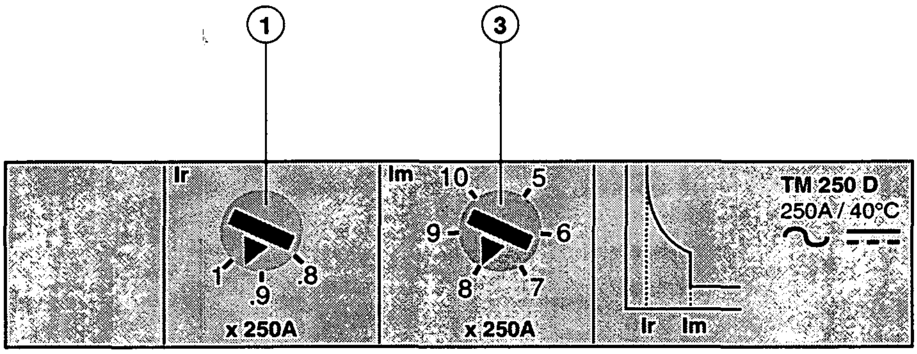
application
I : isolator
D : distribution
S : selective
G : generator protection
M : motor protection
U : universal
B : selim

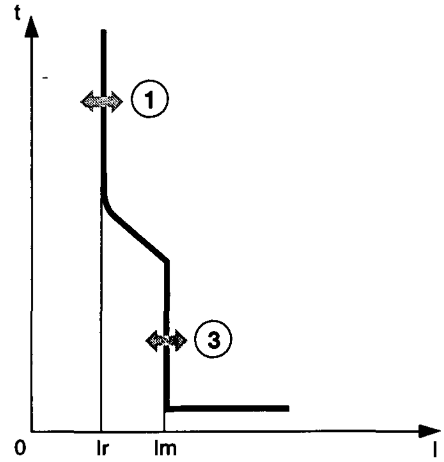
circuit breaker
5 : C801/1001/1251

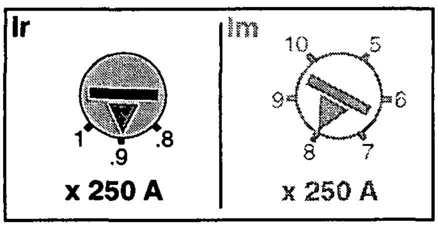
number of settings

family
STR = electronic

trip unit settings - details
thermal-magnetic TM16D to TM250D



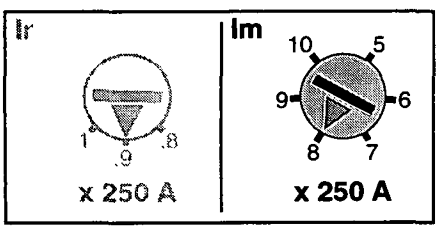




Thermal overload protection

setting	trip unit rating (A)									
	16	25	40	63	80	100	125	160	200	250
0.8	12.8	20	32	50.4	64	80	100	128	160	200
0.9	14.4	22.5	36	56.7	72	90	112.5	144	180	225
1	16	25	40	63	80	100	125	160	200	250

Ir = 250 A x 0.9 = **225 A**

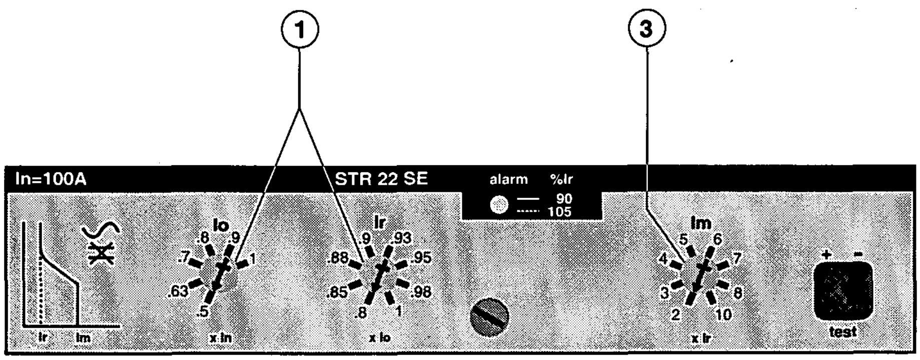


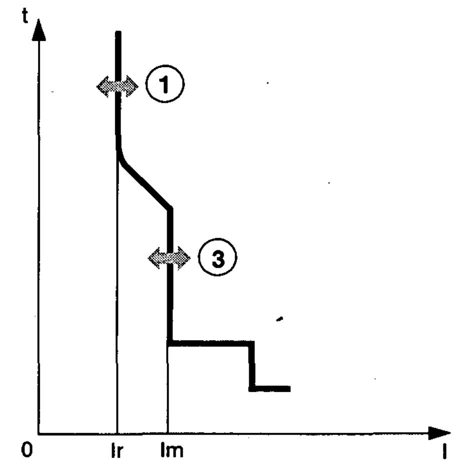
Magnetic short-circuit protection

setting	trip unit rating (A)									
	16	25	40	63	80	100	125	160	200	250
5									1000	1250
6									1200	1500
7				fixed					1400	1750
8									1600	2000
9									1800	2250
10									2000	2500

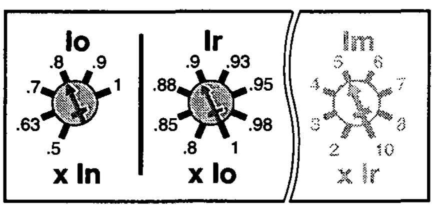
Im = 250 A x 8 = **2000 A** ⟷ The circuit breaker trips instantaneously when the current exceeds 2000 A.

trip unit settings - details electronic STR22SE and STR22GE





electronic trip unit STR22SE and GE rating 40, 100, 160, 250 A



Long time overload protection

STR22SE 40 A	Ir (fine adjustment)							
Io (coarse setting)	0.8	0.85	0.88	0.9	0.93	0.95	0.98	1
0.5	16	17	17,5	18	185	19	19,5	20
0.63	20	21	22	22,5	23	23,5	24,5	25
0.7	22,5	24	24,5	25	26	25,5	27,5	28
0.8	25,5	27	28	29	29,5	30	31	32
0.9	29	30,5	31,5	32	33,5	34	35	36
1	32	34	35	36	37	38	39	40

STR22SE 100 A	Ir (fine adjustment)							
Io (coarse setting)	0.8	0.85	0.88	0.9	0.93	0.95	0.98	1
0.5	40	42,5	44	45	46,5	47,5	49	50
0.63	50,5	53,5	55,5	57	59	60	62	63
0.7	56	59,5	61,5	63	65	66,5	68,5	70
0.8	64	68	70,5	72	74,5	76	78,5	80
0.9	72	76,5	79	81	83,5	85,5	88	90
1	80	85	88	90	93	95	98	100

STR22SE 160 A	Ir (fine adjustment)							
Io (coarse setting)	0.8	0.85	0.88	0.9	0.93	0.95	0.98	1
0.5	64	68	70,5	72	74,5	76	78,5	80
0.63	81	86	89	91	94	96	99	101
0.7	89,5	95	98,5	101	104	106,5	110	112
0.8	102,5	109	112,2	115	119	121,5	125,5	128
0.9	115	122,5	127	129,5	134	137	141	144
1	128	136	141	144	149	152	157	160

STR22SE 250 A	Ir (fine adjustment)							
Io (coarse setting)	0.8	0.85	0.88	0.9	0.93	0.95	0.98	1
0.5	100	106	110	112,5	116	119	122,5	125
0.63	126	134	138,5	142	146,5	150	154	157,5
0.7	140	149	154	157,5	163	166	171,5	175
0.8	160	170	176	180	186	190	196	200
0.9	180	191	198	202,5	209	214	220,5	225
1	200	212,5	220	225	232,5	237,5	245	250

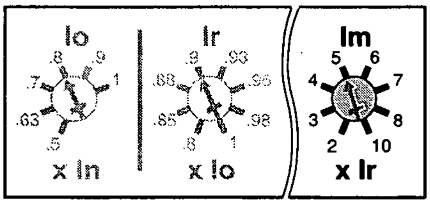
Eg. **In** **160 A**

Io: 0.5 | 0.63 | 0.7 | **0.8** | 0.9 | 1

coarse setting 128 A

Ir: 0.8 | 0.85 | 0.88 | **0.9** | 0.93 | 0.95 | 0.98 | 1

Ir = 128 A x 0.9 = 115 A



Short-circuit protection

Eg. **In** **160 A**

Io: 0.5 | 0.63 | 0.7 | **0.8** | 0.9 | 1

Ir: 0.8 | 0.85 | 0.88 | **0.9** | 0.93 | 0.95 | 0.98 | 1

Ir = 128 A x 0.9 = 115 A

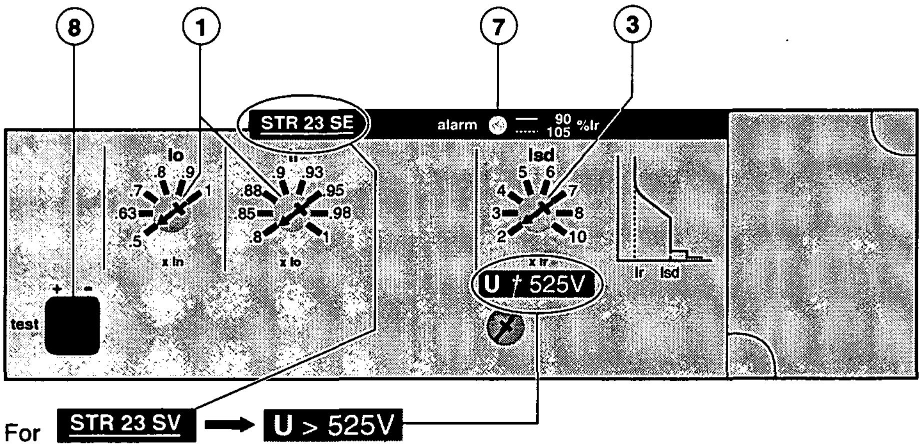
Im: 2 | 3 | 4 | **5** | 6 | 7 | 8 | 10

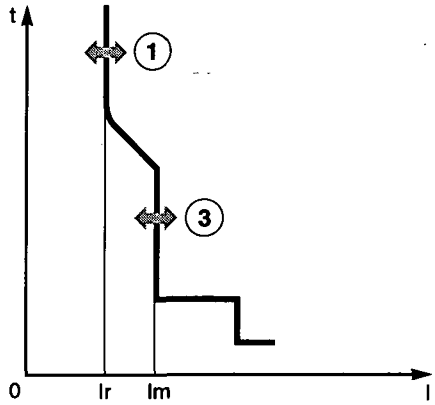
Im = 115 A x 5 = 575 A

With an electronic trip unit, the short circuit threshold is a multiple of the overload setting.

The device trips instantaneously when the current exceeds 575 A.

trip unit settings - details electronic STR23SE, STR23SV



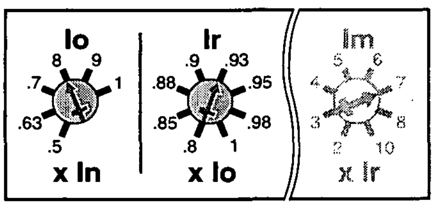


The trip unit rating for STR23SE, STR23SV, STR53SV and STR53UE is fixed by the current transformer within the circuit breaker.

Overload protection

Compact NS400	Ir (fine adjustment)							
Io (coarse setting)	0.8	0.85	0.88	0.9	0.93	0.95	0.98	1
0.5	160	170	176	180	186	190	196	200
0.63	202	214	222	227	234	239	247	252
0.7	224	238	246	252	260	256	274	280
0.8	256	272	282	300	298	304	314	320
0.9	288	306	316	324	334	342	352	360
1	320	340	352	360	372	380	392	400

Compact NS630	Ir (fine adjustment)							
Io (coarse setting)	0.8	0.85	0.88	0.9	0.93	0.95	0.98	1
0.5	252	268	277	284	293	299	309	315
0.63	318	337	349	357	369	377	389	397
0.7	352	374	388	396	410	418	432	441
0.8	403	428	443	472	469	479	494	504
0.9	453	481	498	510	527	538	555	567
1	504	535	554	567	586	598	617	630



Example of protection settings

Eg.

In 400 A

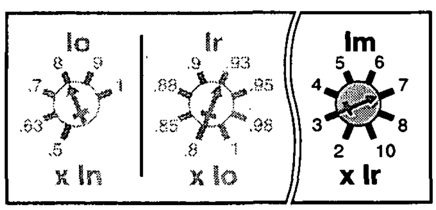
Io: 0.5 | 0.63 | 0.7 | 0.8 | 0.9 | 1

coarse setting 320 A

Ir: 0.8 | 0.85 | 0.88 | 0.9 | 0.93 | 0.95 | 0.98 | 1

Ir = 320 A x 0.93 = 298 A

Short circuit protection



The short circuit threshold is a multiple of the overload setting.

Eg.

In 400 A

Io: 0.5 | 0.63 | 0.7 | 0.8 | 0.9 | 1

Ir: 0.8 | 0.85 | 0.88 | 0.9 | 0.93 | 0.95 | 0.98 | 1

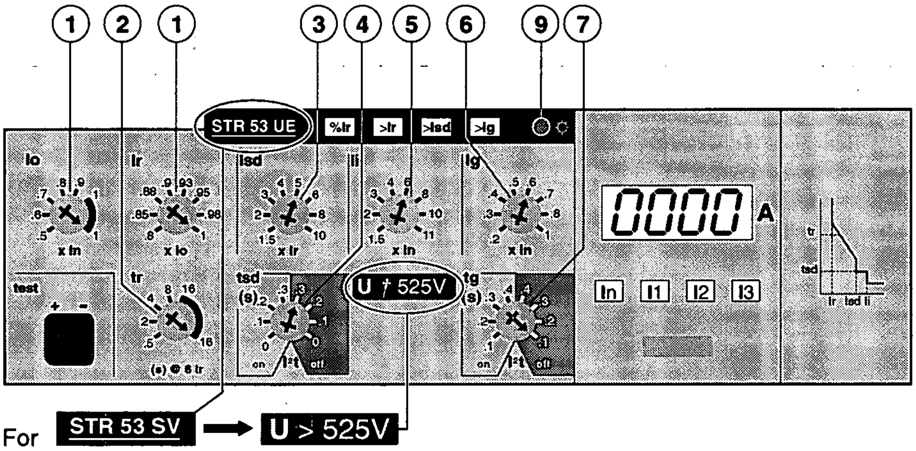
Ir = 320 A x 0.93 = 298 A

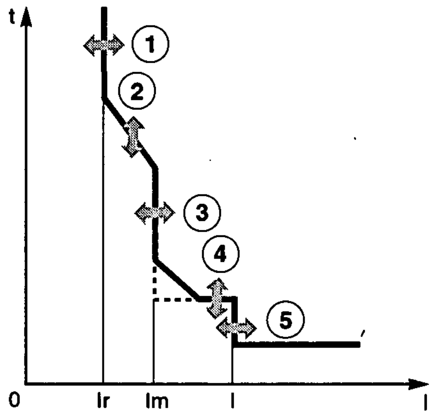
Im: 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10

Im = 298 A x 7 = 2086 A

For a NS400 circuit breaker with 400 A CTs, the STR23SE trip unit is calibrated at 400 A

trip unit settings - details electronic STR53UE and STR53SV





trip unit adjustment STR53UE

Overload protection

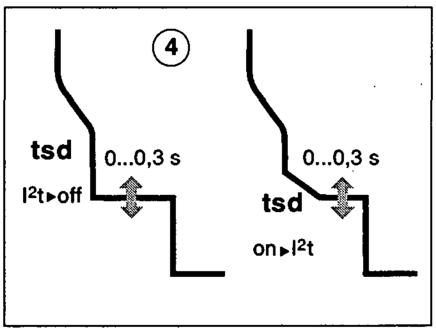
Compact NS400	Ir (fine adjustment)							
Io (coarse setting)	**0.8**	**0.85**	**0.88**	**0.9**	**0.93**	**0.95**	**0.98**	**1**
0.5	160	170	176	180	186	190	196	200
0.6	192	204	211	216	223	228	235	240
0.7	224	238	246	252	260	266	274	280
0.8	256	272	281	288	297	304	313	320
0.9	288	306	316	324	334	342	352	360
1	320	340	352	360	372	380	392	400

Compact NS630	Ir (fine adjustment)							
Io (coarse setting)	**0.8**	**0.85**	**0.88**	**0.9**	**0.93**	**0.95**	**0.98**	**1**
0.5	252	267	277	283	292	299	308	315
0.6	302	321	332	340	351	359	370	378
0.7	352	374	388	396	410	418	332	441
0.8	403	428	443	453	468	478	493	504
0.9	453	481	498	510	527	538	555	567
1	504	535	554	567	585	598	617	630

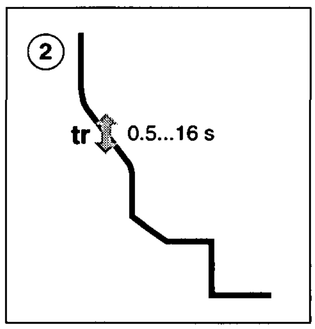
Trip unit STR53UE provides an even finer balance between safety and service continuity for installations with special characteristics (for example induction furnaces, fluorescent lighting, arc-welding systems, SCR-based regulation systems, etc.), by the use of three additional settings:

- instantaneous tripping threshold (I);
- overload protection delay (tr);
- short circuit protection delay (tm).

Short circuit time delay

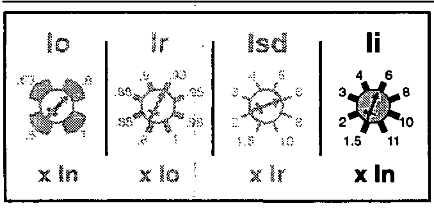


Overload time delay



tr is given at 6 Ir

Options : see page 23.



Increased short circuit protection with the adjustable instantaneous threshold, I

Eg. **In** **400 A**

I	1.5	2	3	4	6	8	10	11

Ii = 400 A x 6 = 2400A

The tripping time is faster than that of the short circuit time delay. The threshold is a function of the **circuit breaker rating.**

increased setting range with 150 and 250 A CTs

trip unit adjustment STR23SE / STR23SV

Overload protection

NS400 (150 A)	Ir (fine adjustment)							
Io (coarse setting)	**0.8**	**0.85**	**0.88**	**0.9**	**0.93**	**0.95**	**0.98**	**1**
0.5	60	63,76	66	67,5	69,75	71,25	73,5	75
0.63	75,6	80,32	83,16	85,05	87,88	89,77	92,61	94,5
0.7	84	89,25	92,4	94,5	97,65	99,75	102,9	105
0.8	96	102	105,6	138	111,5	114	117,6	120
0.9	108	114,75	118,8	121,5	125,55	128,55	132,5	135
1	120	127,5	132	135	139,5	142,5	147	150

NS400 (250 A)	Ir (fine adjustment)							
Io (coarse setting)	**0.8**	**0.85**	**0.88**	**0.9**	**0.93**	**0.95**	**0.98**	**1**
0.5	100	106,25	110	112,5	116,25	118,75	122,5	125
0.63	126	133,87	138,6	141,75	146,57	149,62	154,35	157,6
0.7	140	148,75	154	157,5	162,75	166,25	171,5	175
0.8	160	170	176	180	185	190	196	200
0.9	180	191,25	198	202,5	209,25	213,75	220,5	225
1	200	212,2	220	225	232,5	237,5	245	250

trip unit adjustment STR53UE / STR53SV

Overload protection

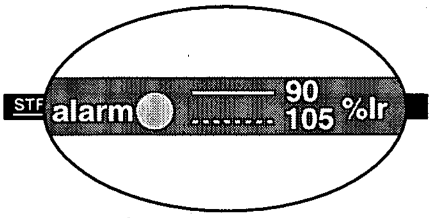
NS400 (150 A)	Ir (fine adjustment)							
Io (coarse setting)	**0.8**	**0.85**	**0.88**	**0.9**	**0.93**	**0.95**	**0.98**	**1**
0.5	100	106	110	112	116	118	122	125
0.6	120	127	132	135	139	142	147	150
0.7	140	148	154	157	162	166	171	175
0.8	160	170	176	180	186	190	196	200
0.9	180	191	198	202	209	213	220	225
1	200	212	220	225	232	237	245	250

NS400 (250 A)	Ir (fine adjustment)							
Io (coarse setting)	**0.8**	**0.85**	**0.88**	**0.9**	**0.93**	**0.95**	**0.98**	**1**
0.5	60	63	66	67	69	71	73	75
0.6	72	76	79	81	83	85	88	90
0.7	84	89	92	94	97	99	102	105
0.8	96	102	105	108	111	114	117	120
0.9	108	114	118	121	125	128	132	135
1	120	127.5	132	135	139	142	147	150

remote indication and electronic trip unit options STR22SE, STR23SE, STR23SV, STR53UE, STR53SV

indication

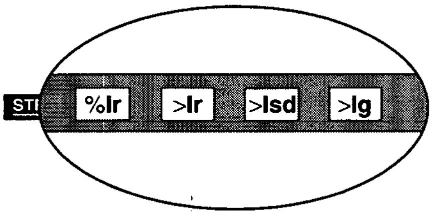
alarm LED STR22SE and STR23SE



For Compact NS100/160/250: STR22SE or STR23SE
The LED lights and remains lit when the load exceeds 90 % of Ir.

The LED blinks for an overload (≥ 105% Ir), warning that the circuit breaker may trip.

STR53UE/SV



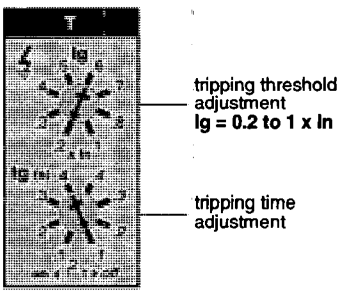
For Compact NS400/630: STR53UE or STR53SV
Overload indications (%Ir)
■ LED goes on when the current exceeds 0.9Ir;
■ LED flashes when the current exceeds the long-time thresholds Ir.

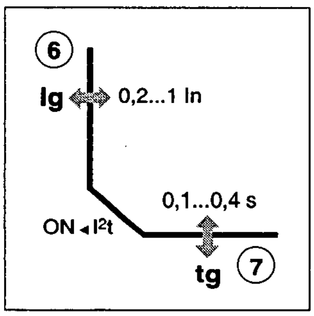
Fault indications

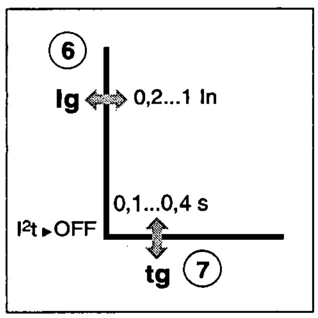
LEDs indicate the type of fault that caused tripping:
■ overload (LT protection) ot abnormal component temperature **(>Ir);**
■ short-circuit (ST or instantaneous protection) **(>Isd);**
■ microprocessor malfunction (both **(>Ir)** and **(>Isd)** LEDs go on, plus the **(>Ig)** LED if the earth fault protection option is present).

When a fault occurs, the LED indicating the type of fault goes of after about 10 minutes to preserve battery power. The information is however stored in memory and the LED can be re-illuminated by pressing the battery/LED test pushbutton. The LED automatically goes off and the memory is cleared when the circuit breaker is reset

options for STR53UE



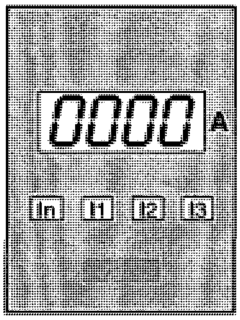




Earth fault protection - option T
This function will trip the circuit breaker in the event of a fault to earth on a TNS system.

remote indication and electronic trip unit options STR22SE, STR23SE, STR53UE

ammeter (I)



A digital display continuously indicates the current of the phase with the greatest load. By pressing a scroll button, it is also possible to display successively the readings of I1, I2, I3 and I neutral.
LEDs indicate the phase for which the current is displayed.

Ammeter display limits:

■ minimum current ⩾ 0,2 x In (lower currents are not displayed) ;

■ maximum current ⩽ 10 x In.

zone selective interlocking (ZSI)

A number of circuit breakers are interconnected one after another by a pilot-wire.
In the event of a short-time or earth fault:

■ if a given trip unit STR53UE detects the fault, it informs the upstream circuit breaker which applies the set time delay;

■ if the trip unit STR53UE does not detect the fault, the upstream circuit breaker trips after its shortest time delay.

In this way, the fault is cleared rapidly by the nearest circuit breaker. In addition, the thermal stresses on the circuits are minimised and time discrimination is maintained throughout the installation.

The trip unit STR53UE can only handle the downstream end of a zone selective interlocking function. Consequently, the zone selective interlocking option cannot be implemented between two Compact NS circuit breakers.

Opto-electronic outputs

The use of opto-transistors ensures total isolation between the internal circuits of the trip unit and the circuits wired by the user.

communication (COM)

Transmission of data to Digipact distribution monitoring and control modules.
Transmitted data:

■ settings;

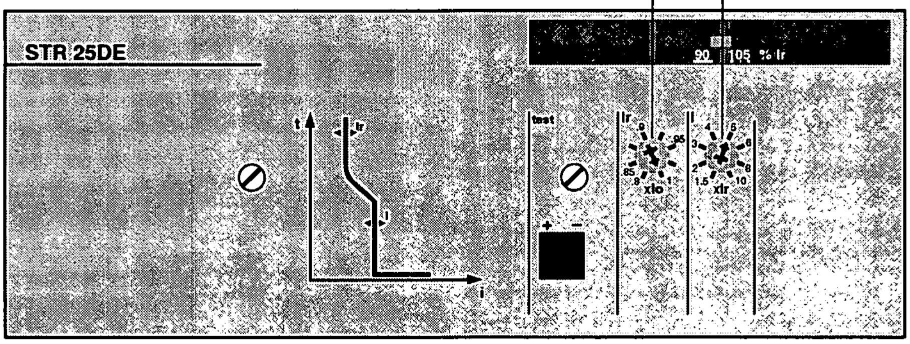
■ phase and neutral currents (rms values);

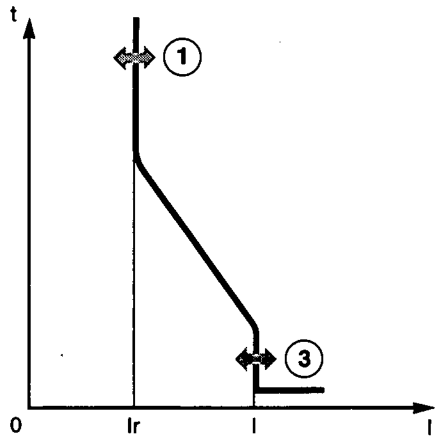
■ highest current of the three phases;

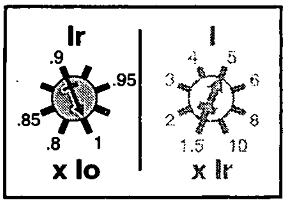
■ overload condition alarm;

■ cause of tripping (overload, short-circuit, etc.).

trip unit settings - details electronic STR25DE

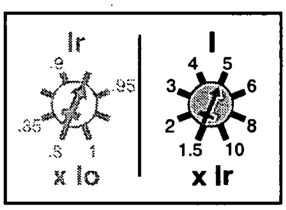




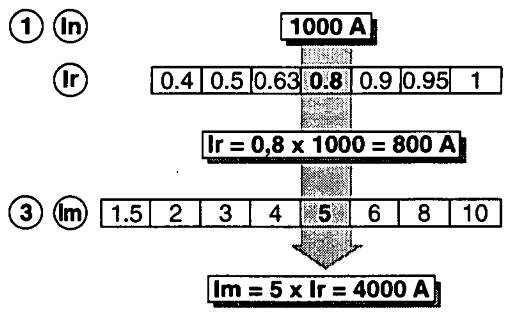


Setting STR25DE

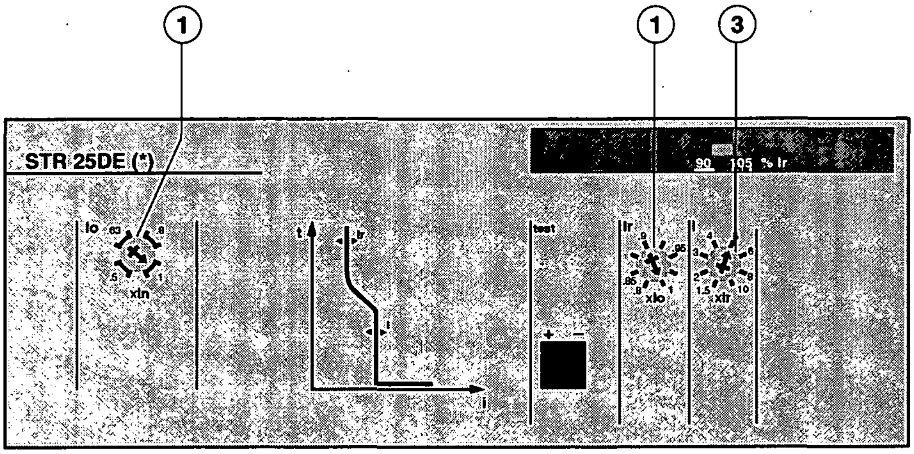
Compact C801N/H/L	**In = 800 A**							
setting 1	**1**	**0.95**	**0.9**	**0.8**	**0.7**	**0.63**	**0.5**	**0,4**
Ir (A)	800	760	720	640	560	504	400	320
Compact C1001N/H/L	**In = 1000 A**							
setting 1	**1**	**0.95**	**0.9**	**0.8**	**0.7**	**0.63**	**0.5**	**0,4**
Ir (A)	1000	950	900	800	700	630	500	400
Compact C1251N/H/L	**In = 1250 A**							
setting 1	**1**	**0.95**	**0.9**	**0.8**	**0.7**	**0.63**	**0.5**	**0,4**
Ir (A)	1250	1187	1125	1000	875	787	625	500



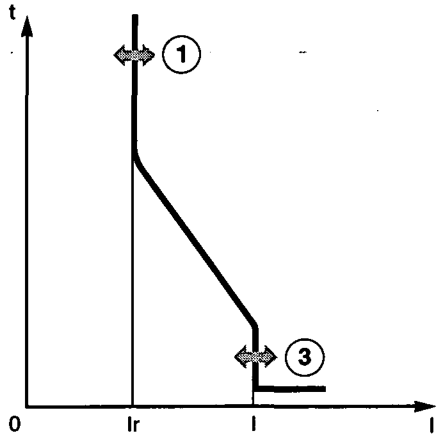
Example :
In = 1000 A,
Ir = 800 A
Im = 4000 A

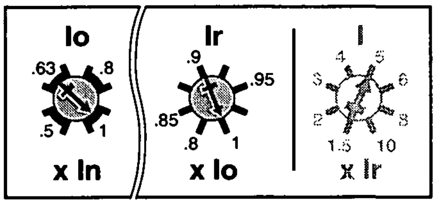


trip unit settings - details
electronic STR25DE (*) (fine adjustment)



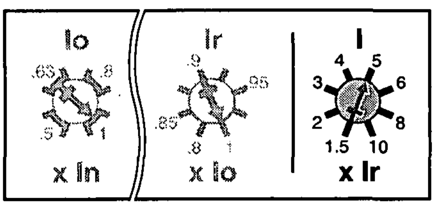
(*) fine adjustment



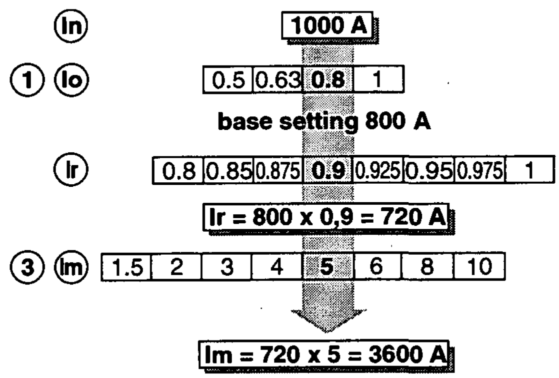


Setting STR25DE (*)

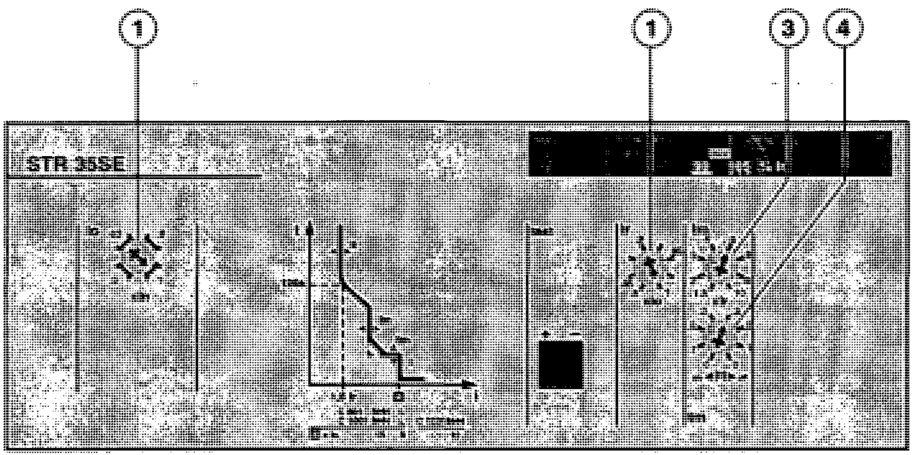
Io \ Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
Compact C801N/H/L (1)	**In = 800 A**							
0,5	400	390	380	370	360	350	340	320
0,63	504	491	479	466	454	441	428	403
0,8	640	624	608	592	576	560	544	512
1	800	780	760	740	720	700	680	640
Compact C1001N/H/L (1)	**In = 1000 A**							
0,5	500	488	475	463	450	438	425	400
0,63	630	614	599	583	567	551	536	504
0,8	800	780	760	740	720	700	680	640
1	1000	975	950	925	900	875	850	800
Compact C1251N/H/L (1)	**In = 1250 A**							
0,5	625	609	594	578	563	547	531	500
0,63	788	768	748	728	709	689	669	630
0,8	1000	975	950	925	900	875	850	800
1	1250	1219	1188	1156	1125	1094	1063	1000

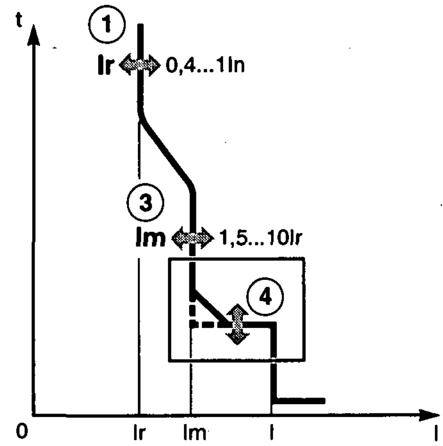


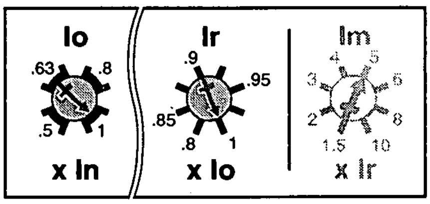
Example :
C1001N : In = 1000 A,
Ir = 720 A,
Im = 3600 A,



trip unit settings - details
electronic STR35SE/GE

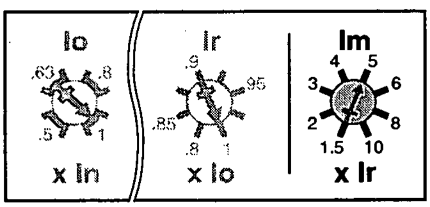




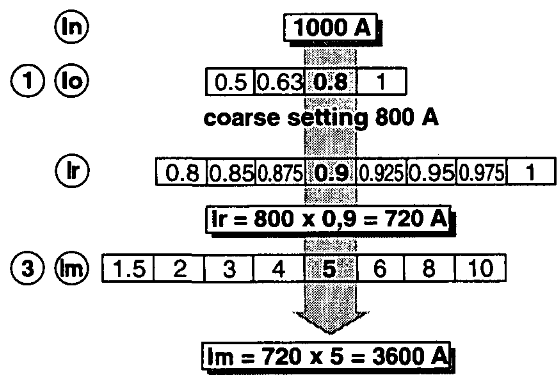


Setting STR35SE/GE

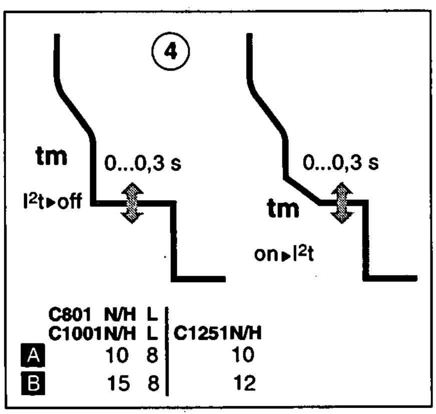
Compact C801N/H/L (1)	In = 800 A						
Io \ Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
0,5	400	390	380	370	360	350	340	320
0,63	504	491	479	466	454	441	428	403
0,8	640	624	608	592	576	560	544	512
1	800	780	760	740	720	700	680	640
Compact C1001N/H/L (1)	**In = 1000 A**							
Io \ Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
0,5	500	488	475	463	450	438	425	400
0,63	630	614	599	583	567	551	536	504
0,8	800	780	760	740	720	700	680	640
1	1000	975	950	925	900	875	850	800
Compact C1251N/H/L (1)	**In = 1250 A**							
Io \ Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
0,5	625	609	594	578	563	547	531	500
0,63	788	768	748	728	709	689	669	630
0,8	1000	975	950	925	900	875	850	800
1	1250	1219	1188	1156	1125	1094	1063	1000



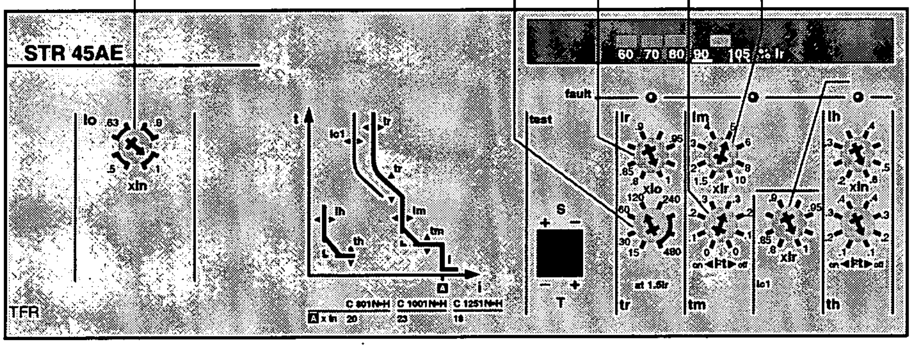
Example :
C1001N : In = 1000 A,
Ir = 720 A,
Im = 3600 A,

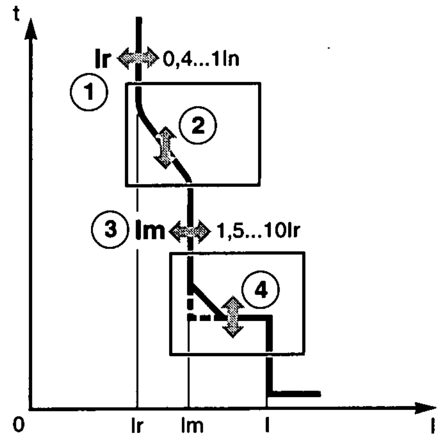


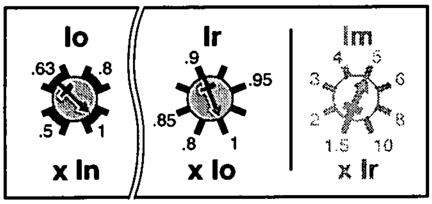
Short circuit time delay



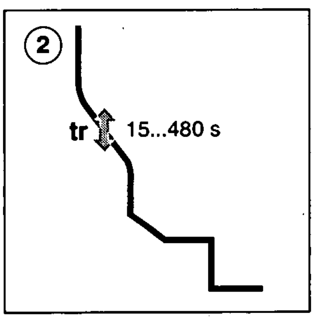
trip unit settings - details
electronic STR45AE





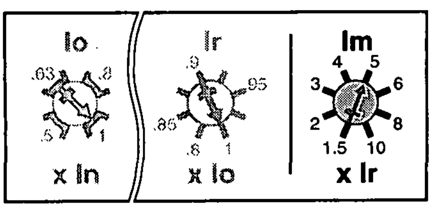


Overload time delay



SettingSTR45AE

Compact C801N/H/L (1)	In = 800 A							
Io \ Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
0,5	400	390	380	370	360	350	340	320
0,63	504	491	479	466	454	441	428	403
0,8	640	624	608	592	576	560	544	512
1	800	780	760	740	720	700	680	640
Compact C1001N/H/L (1)	**In = 1000 A**							
Io \ Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
0,5	500	488	475	463	450	438	425	400
0,63	630	614	599	583	567	551	536	504
0,8	800	780	760	740	720	700	680	640
1	1000	975	950	925	900	875	850	800
Compact C1251N/H/L (1)	**In = 1250 A**							
Io \ Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
0,5	625	609	594	578	563	547	531	500
0,63	788	768	748	728	709	689	669	630
0,8	1000	975	950	925	900	875	850	800
1	1250	1219	1188	1156	1125	1094	1063	1000



Example :
C1001N : In = 1000 A,
Ir = 720 A,
Im = 3600 A,

(In) **1000 A**

(1) (Io) 0.5 | 0.63 | **0.8** | 1

coarse setting 800 A

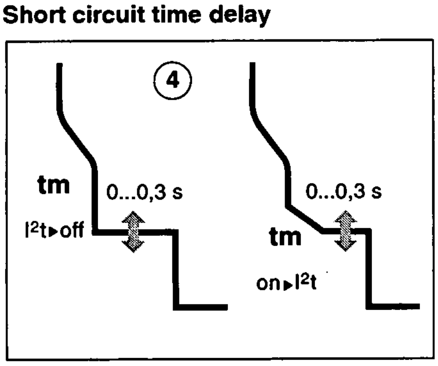
(Ir) 0.8 | 0.85 | 0.875 | **0.9** | 0.925 | 0.95 | 0.975 | 1

Ir = 800 x 0,9 = 720 A

(3) (Im) 1.5 | 2 | 3 | 4 | **5** | 6 | 8 | 10

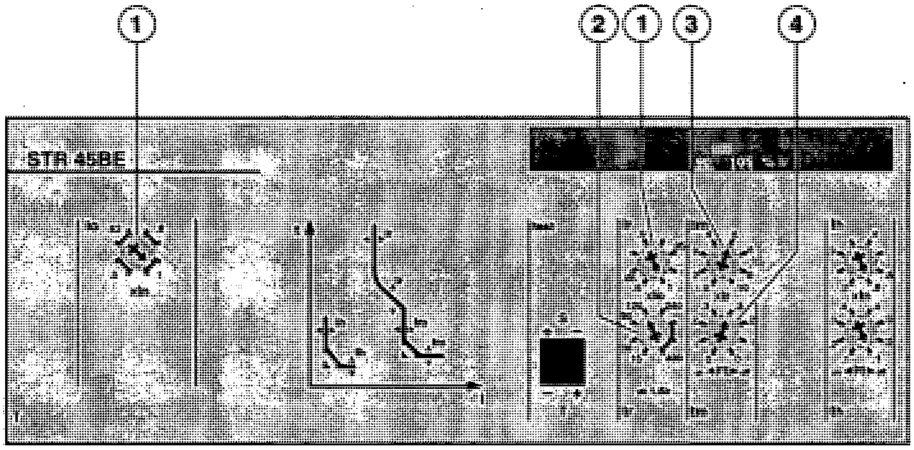
Im = 720 x 5 = 3600 A

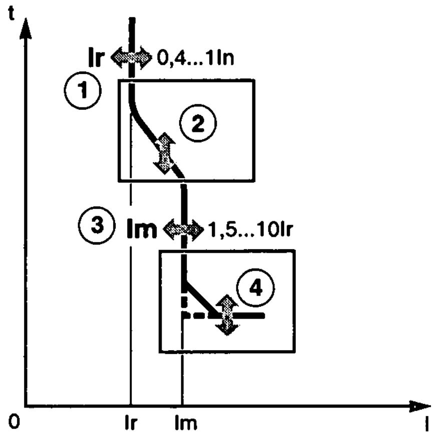
Short circuit time delay

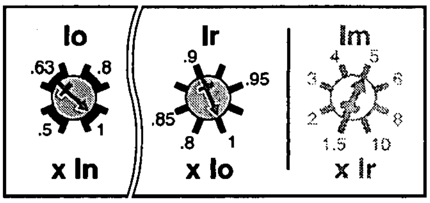


Options : see page 31

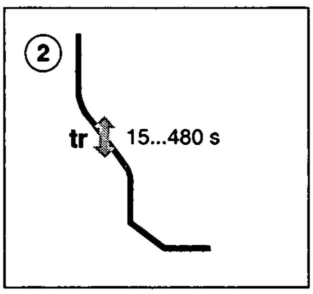
trip unit settings - details electronic STR45BE





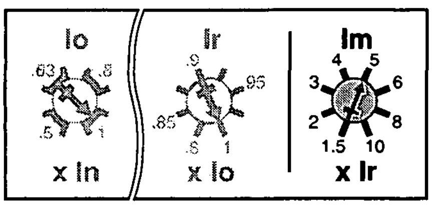


Overload time delay

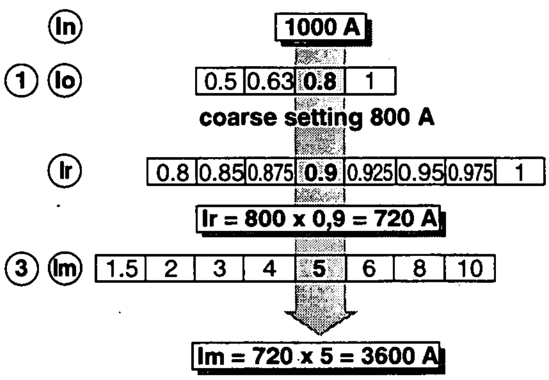


Setting STR45BE

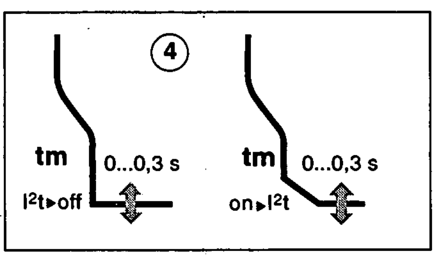
Io \ Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
Compact C801N/H/L (1) In = 800 A								
0,5	400	390	380	370	360	350	340	320
0,63	504	491	479	466	454	441	428	403
0,8	640	624	608	592	576	560	544	512
1	800	780	760	740	720	700	680	640
Compact C1001N/H/L (1) In = 1000 A								
Io \ Ir	**1**	**0.975**	**0.95**	**0.925**	**0.9**	**0.875**	**0.85**	**0,8**
0,5	500	488	475	463	450	438	425	400
0,63	630	614	599	583	567	551	536	504
0,8	800	780	760	740	720	700	680	640
1	1000	975	950	925	900	875	850	800
Compact C1251N/H/L (1) In = 1250 A								
Io \ Ir	**1**	**0.975**	**0.95**	**0.925**	**0.9**	**0.875**	**0.85**	**0,8**
0,5	625	609	594	578	563	547	531	500
0,63	788	768	748	728	709	689	669	630
0,8	1000	975	950	925	900	875	850	800
1	1250	1219	1188	1156	1125	1094	1063	1000



Example :
C1001N : In = 1000 A,
Ir = 720 A,
Im = 3600 A,

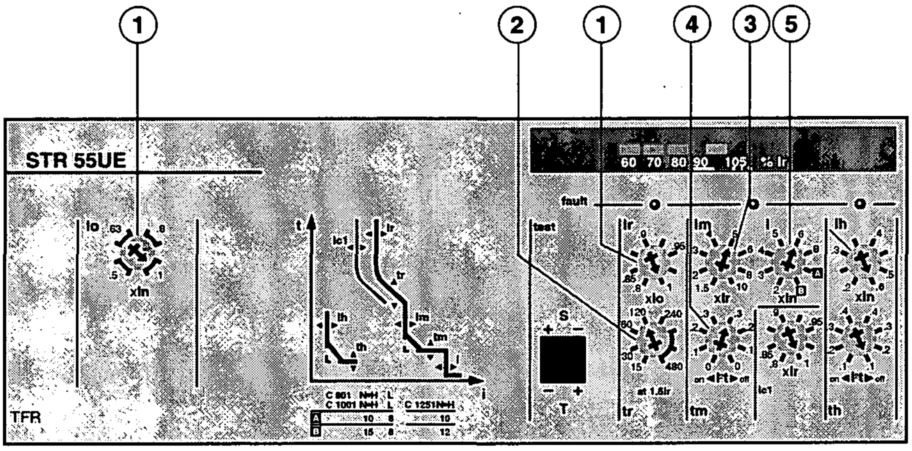


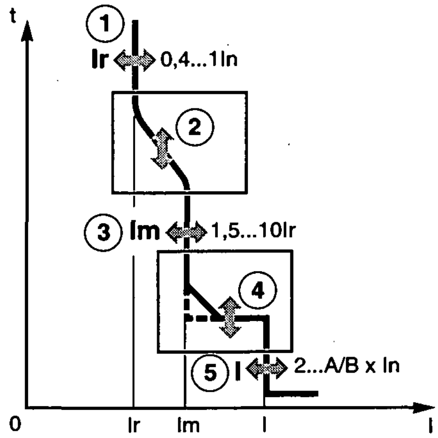
Short circuit time delay

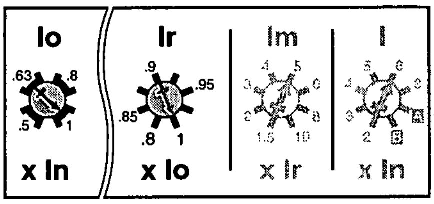


Options : see page 31

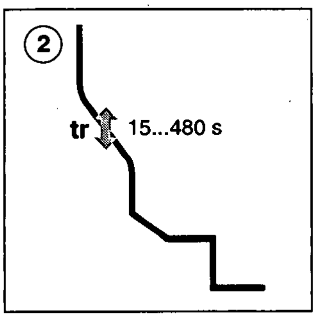
trip unit settings - details electronic STR55UE





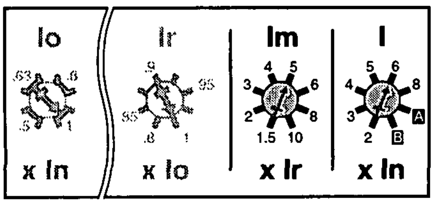


Overload time delay

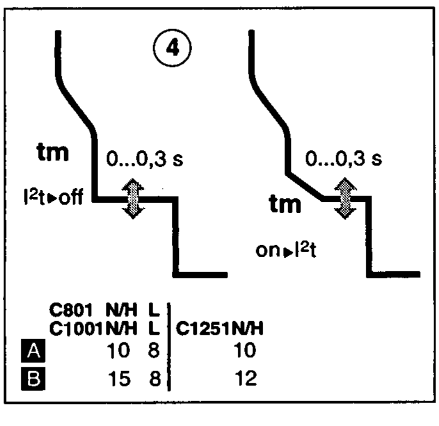


Setting STR55UE

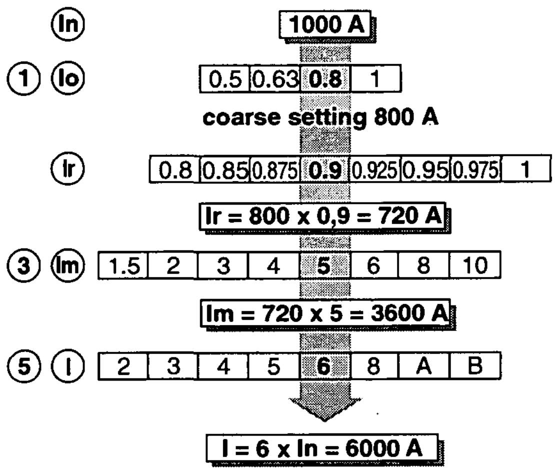
Compact C801N/H/L (1)	In = 800 A							
Io \ Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
0,5	400	390	380	370	360	350	340	320
0,63	504	491	479	466	454	441	428	403
0,8	640	624	608	592	576	560	544	512
1	800	780	760	740	720	700	680	640
Compact C1001N/H/L (1)	**In = 1000 A**							
Io \ Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
0,5	500	488	475	463	450	438	425	400
0,63	630	614	599	583	567	551	536	504
0,8	800	780	760	740	720	700	680	640
1	1000	975	950	925	900	875	850	800
Compact C1251N/H/L (1)	**In = 1250 A**							
Io \ Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
0,5	625	609	594	578	563	547	531	500
0,63	788	768	748	728	709	689	669	630
0,8	1000	975	950	925	900	875	850	800
1	1250	1219	1188	1156	1125	1094	1063	1000



Short circuit time delay



Example :
C1001N : **In** = 1000 A,
Ir = 720 A,
Im = 3600 A,
I = 6000 A

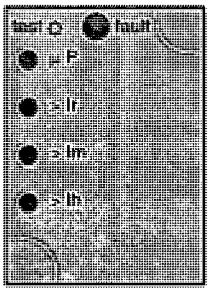


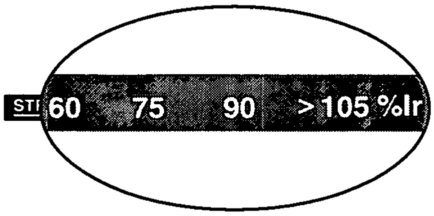
Options : see page 31

remote indication and electronic trip unit options STR45AE/BE, STR55UE

indication

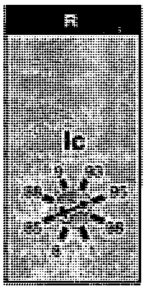
LED alarme

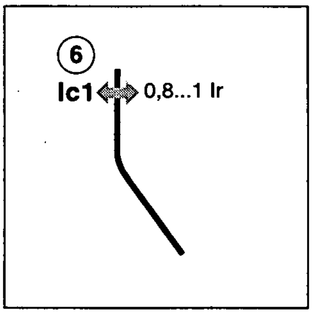


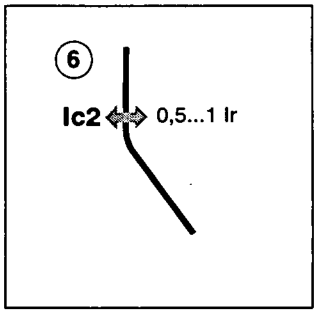


Fault indication - option F
this option is not available on the STR45BE.

STR45AE/BE STR55UE options

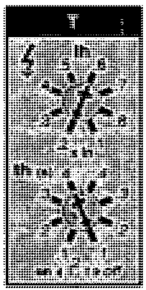


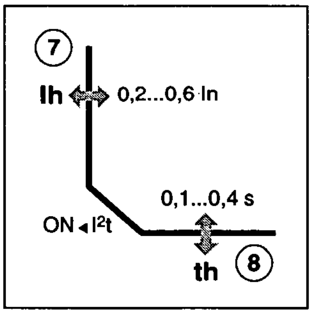


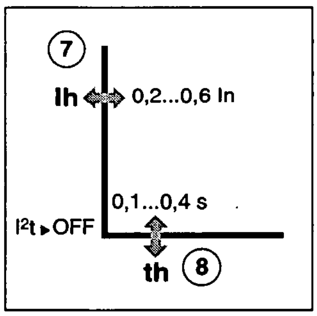


Load shedding control - option R

6 Ic1 = 0,8 to 1
Ic2 = 0,5 to 1







Earth fault protection - option T
earth fault protecyion setting for your network

7 Ih = 0,2 to 0,6 In
I^2t = constant : ON or OFF

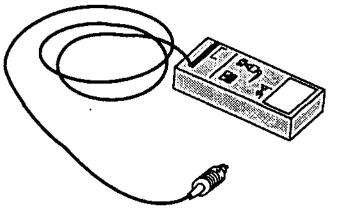
8 th = 0,1 to 0,4 s

testing of electronic trip units STR22SE, STR23SE, STR53UE, STR25DE, STR35SE/GE STR45AE/BE, STR55UE

testing of electronic trip units

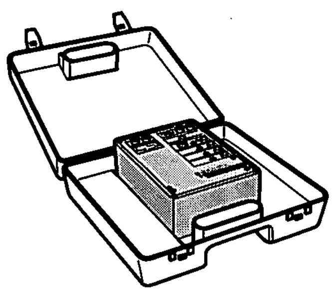
mini test kit

A test socket on the front of the electronic trip units enables connection to a mini test kit or calibration test kit. These kits tests trip unit operation and circuit breaking tripping.

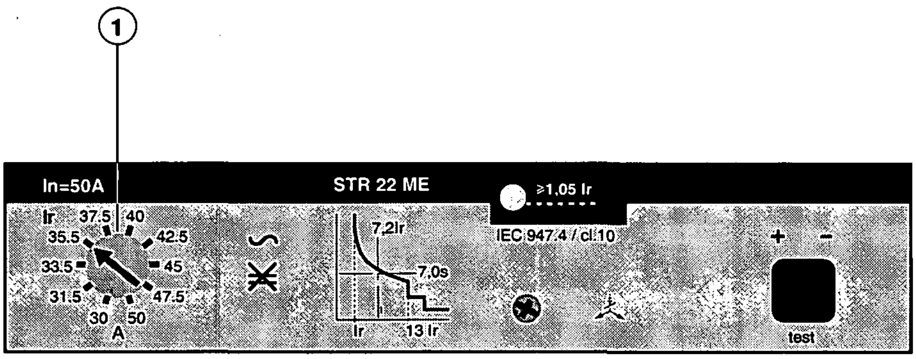


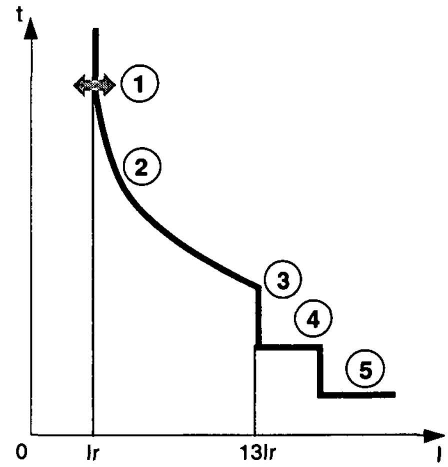
calibration test kit

The calibration test kit checks the protection systems by measuring the real tripping times at any point of the tripping curve.
This device checks that the trip unit is operational and that the breaker will trip according to the tripping curve.



trip unit settings - details electronic STR22ME, STR35ME for motor protection





Protection settings (STR22ME)

■ overload protection, adjustable threshold Ir (1), conformes to tripping class 10 according to IEC 947-4-1 (2);

■ protection against single phase operation : initiates circuit breaker opening in 3.5 to 6 s ;

■ short circuit protection :

□ fixed threshold, Im (13 x Ir) (3),

□ fixed time delay (4).

■ instantaneous protection against high short circuits, fixed threshold (13 x In) (5).

Indication as standard

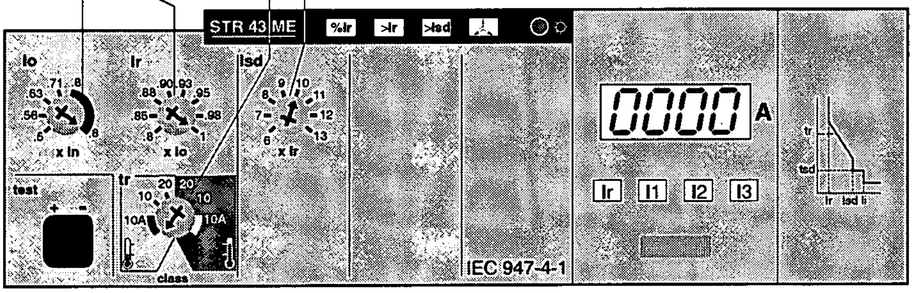
Indication of load by diode on front face :

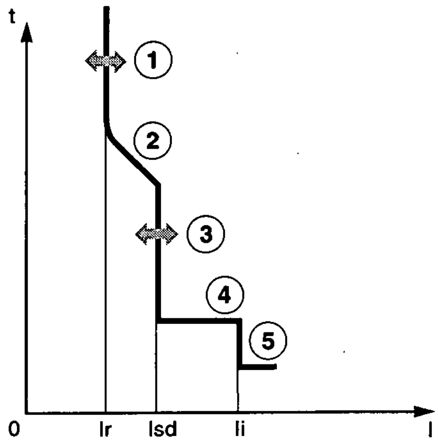
■ non operational for I < 1.05 x In ;

■ flashes for I ⩾ 1.05 x In.

trip unit STR22ME										
rating(A)	adjustment thresholds (A)									
20	12	12.6	13.4	14.2	15	16	17	18	19	20
25	15	15.7	16.7	17.7	18.7	20	21.2	22.5	23.5	25
40	24	25.5	27	28.5	30	32	34	36	38	40
50	30	31.5	33.5	35.5	37.5	40	42.5	45	47.5	50
80	48	51	54	57	60	64	68	72	76	80
100	60	63	67	71	75	80	85	90	95	100
150	90	95	101	107	113	120	127	135	142	150
220	132	140	148	157	166	177	187	198	209	220

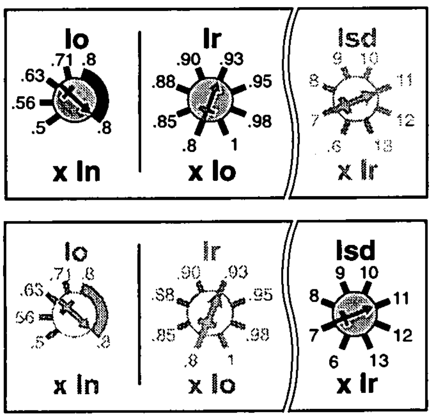
trip unit settings - details electronic STR43ME for motor protection





Protection settings (STR43ME)

- overload protection :
  - adjustable threshold, Ir (1),
  - adjustable long time delay (2), conformes to trip unit classes types 5, 10 and 20 according to IEC 947-4.1 ;
- protection against single phase operation : initiates circuit breaker opening in 4 s ± 10% ;
- short circuit protection :
  - adjustable threshold, Im (6 to 13 x Ir) (3),
  - fixed time delay (4) ;
- instantaneous protection against high short circuits, fixed threshold (13 x In) (5).



Overload protection settings

Compact NS400	Ir (fine adjustment)							
Io (coarse setting)	0.8	0.85	0.88	0.9	0.93	0.95	0.98	1
0.5	160	170	176	180	186	190	196	200
0.56	180	190	197	202	208	215	220	224
0.63	202	214	222	227	234	239	247	252
0.7	224	238	246	252	260	256	274	280
0.8	256	272	282	300	298	304	314	320

Compact NS630	Ir (fine adjustment)							
Io (coarse setting)	0.8	0.85	0.88	0.9	0.93	0.95	0.98	1
0.5	252	268	277	284	293	299	309	315
0.56	282	300	310	318	328	335	346	353
0.63	318	337	349	357	369	377	389	397
0.7	352	374	388	396	410	418	432	441
0.8	403	428	443	472	469	479	494	504

Example ofprotection settings

Eg. In **400 A**

Io: | 0.5 | 0.63 | 0.7 | **0.8** | 0.9 | 1 |

coarse setting 320 A

Ir: | 0.8 | 0.85 | 0.88 | 0.9 | **0.93** | 0.95 | 0.98 | 1 |

Ir = 320 A x 0.93 = 298 A

Im: | 6 | 7 | 8 | 9 | **10** | 11 | 12 | 13 |

Im = 298 A x10 = 2980 A

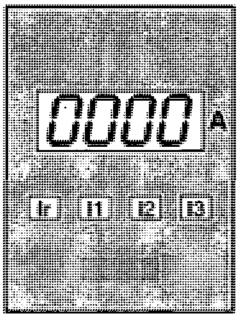
Increased setting range with 150-250 A CTs

NS400 (150 A)	Ir (fine adjustment)							
Io (coarse setting)	0.8	0.85	0.88	0.9	0.93	0.95	0.98	1
0.5	60	63.76	66	67.5	69.75	71.25	73.5	75
0.56	67.2	71.4	73.92	75.6	78.12	79.8	82.32	84
0.63	75.6	80.32	83.16	85.05	87.88	89.77	92.61	94.5
0.7	84	89.25	92.4	94.5	97.65	99.75	102.9	105
0.8	96	102	105.6	138	111.5	114	117.6	120
NS400 (250 A)	**Ir (fine adjustment)**							
Io (coarse setting)	**0.8**	**0.85**	**0.88**	**0.9**	**0.93**	**0.95**	**0.98**	**1**
0.5	100	106.25	110	112.5	116.25	118.75	122.5	125
0.56	112	119	123.2	126	130.2	133	137.2	140
0.63	126	133.87	138.6	141.75	146.57	149.62	154.35	157.6
0.7	140	148.75	154	157.5	162.75	166.25	171.5	175
0.8	160	170	176	180	185	190	196	200

options for trip unit STR43ME

ammeter (I)

E33990



A digital display continuously indicates the current of the phase with the greatest load. By pressing a scroll button, it is also possible to display successively the readings of I1, I2, I3 an the long time threshold setting Ir.
LEDs indicate the phase or setting for which the current is displayed.

Ammeter display limits:

- minimum current ⩾ 0,2 x In (lower currents are not displayed) ;
- maximum current ⩽ 10 x In.

contactor tripping module (SDTAM)

- opens the contactor in the event of an overload. It is thus possible to differentiate between tripping due to overloads and short-circuits;
- may also be used to signal a thermal fault;
- must be reset manually (locally or remotely;
- compatible with the following control voltages:
  - 24 to 72 V DC and 24 to 48 V AC,
  - 110 to 240 V AC / DC;
- fits in place of the MN and MX auxiliary voltage releases.

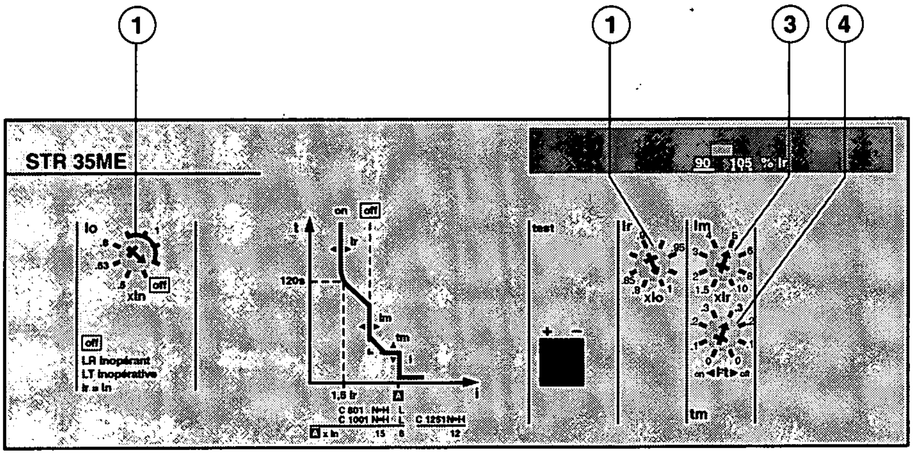
communication (COM)

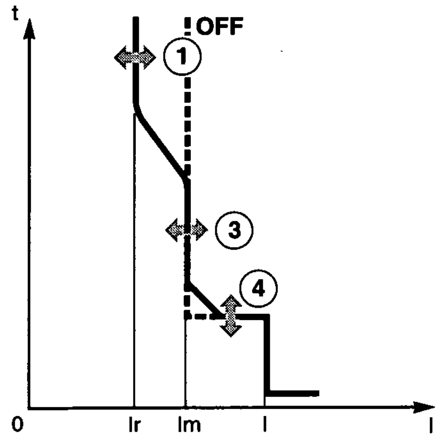
Transmission of data to Digipact distribution monitoring and control modules.
Transmitted data:

- settings;
- phase currents (rms values);
- highest current of the three phases;
- overload condition alarm;
- cause of tripping (overload, short-circuit, etc.).

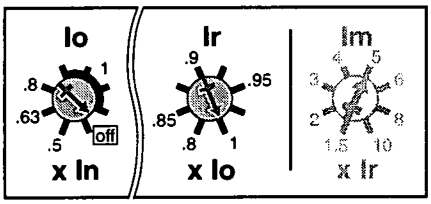
trip unit settings - details electronic STR35ME for motor protection

E32685





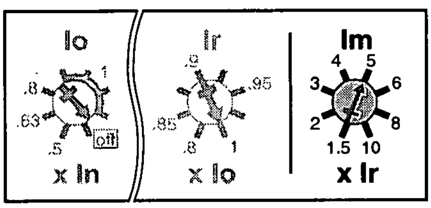
E33467



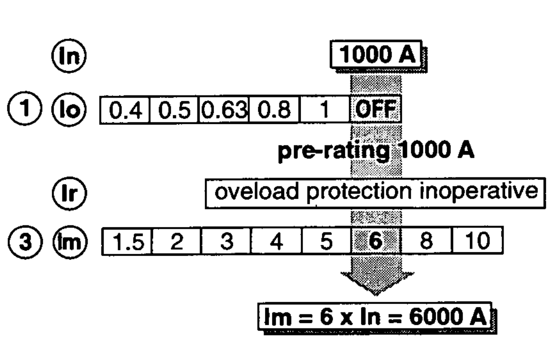
Settings STR35ME

Compact C801N/H/L (1)		In = 800 A						
Io / Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
0,5	400	390	380	370	360	350	340	320
0,63	504	491	479	466	454	441	428	403
0,8	640	624	608	592	576	560	544	512
1	800	780	760	740	720	700	680	640
Compact C1001N/H/L (1)		**In = 1000 A**						
Io / Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
0,5	500	488	475	463	450	438	425	400
0,63	630	614	599	583	567	551	536	504
0,8	800	780	760	740	720	700	680	640
1	1000	975	950	925	900	875	850	800
Compact C1251N/H/L (1)		**In = 1250 A**						
Io / Ir	1	0.975	0.95	0.925	0.9	0.875	0.85	0,8
0,5	625	609	594	578	563	547	531	500
0,63	788	768	748	728	709	689	669	630
0,8	1000	975	950	925	900	875	850	800
1	1250	1219	1188	1156	1125	1094	1063	1000

E33468

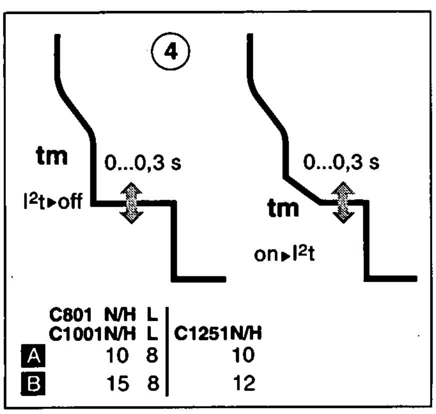


Example :
C1001N : In = 1000 A,
Im = 6000 A,



Short circuit time delay

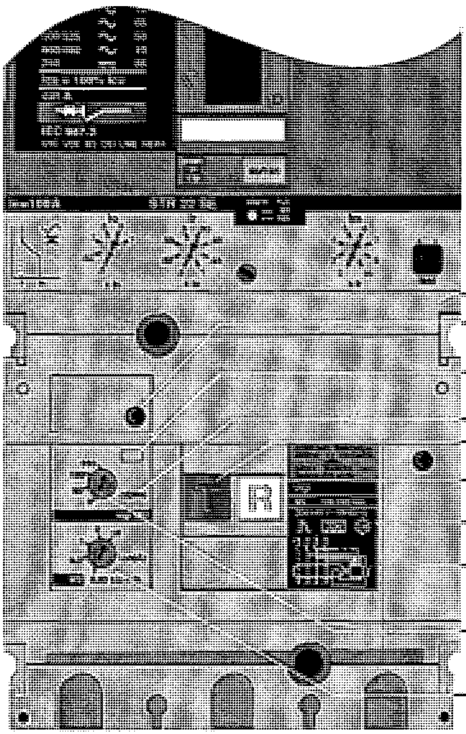
E32690



supplementary functions

Vigi bloc and Visu bloc

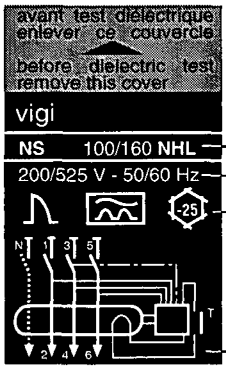
Vigi bloc



The Vigi bloc provides residual current protection against indirect contact and the risk of fire and destruction due to faults to earth. It actuates the trip unit by means of a direct mechanical action.
The Vigi bloc can be fitted with an alarm contact (SDV) which can be used to remotely indicate that the device has tripped due to an earth fault .
The "**Test**" push button allows regular verification that the Vigi bloc is operational by simulating an earth fault.
The test cannot be carried out with the circuit braker in the open position.
The "**Reset**" push button. After all trips initiated by the Vigi, this button must be pressed in order to reset the Vigi.

(1) The intermediate terminal shield is necessary in order for the Vigi to function.
(2) When the device is set to 30mA, any time delay selected is nullified i.e. instantaneous operation.

rating plate



the Visu bloc

The standard fixed versions of the Compact circuit breakers exist in ratings 100 A to 1250 A. A Visu bloc can be directly connected, which provides visible break isolation according to French standard NF C 13.100 : the contacts are visibles through a transparent cover, and are operated by means of a handle.
The Visu bloc is padlockable as standard with barrel locking optional.
Specific auxiliaries are available for the Visu bloc : auxiliary contacts, terminal shields, etc.
The Compact NS100/630 and C801/1251 can be equiped, as an option, with a pre-tripping mechanism preventing the "on-load" opening of the Visu bloc.

The Visu bloc must be fitted with a CAM contact and the circuit breaker with a voltage release.

Connection

- fixed front connected. The Compact circuit breakers with Visu bloc are delivered ready for connection by bars or cables fitted with lugs;
- connection of bare cables : upstream by a set of terminals for the Visu bloc and downstream a set of teminals for the Compact;

□ accessories : the Visu bloc can be fitted with terminal spreaders, right angle terminals, terminal extensions and lugs.

- fixed rear connected : by adaptation of the Compact's specific rear connectors with the Visu bloc, delivered per pole.

The Compact circuit breakers with Visu bloc can be fitted with specific short terminal shields (rear connection) or standard long terminal shields (front connection), both of which are lead sealable.

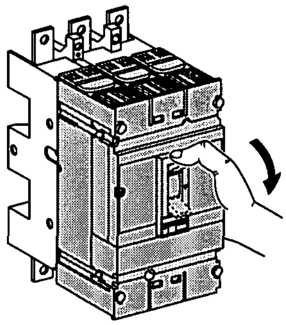
Accessories

Compact NS100/630 with Visu bloc can be fitted with :

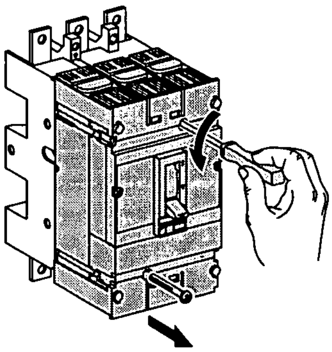
- in the Visu bloc : auxiliary contacts (OF, CAM), Ronis or Profalux barrel locks, a contact to earth the neutral (obligatory if the tansformer neutral is earthed downstream of the Compact with Visu bloc), etc.
- in the Compact NS frame : all the Compact NS auxiliaries.

plug-in version

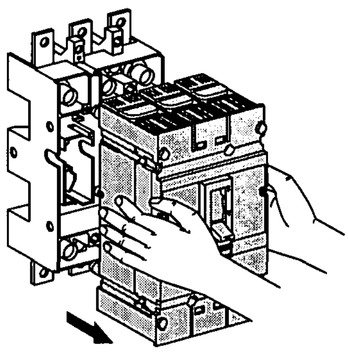
the plug-in circuit breaker
unplugging



1 - open the circuit breaker.



2 - remove the two fixing screws.



3 - pull the circuit breaker out horizontally.

The auxiliary circuits are disconnected by the automatic auxiliary connector block located at the back of the device.

Safety mechanism
If the circuit breaker is closed (I/ON position) when pulled out, advanced opening ensures operator safety, i.e. the poles automatically open before the power connections are withdrawn.

plugging in

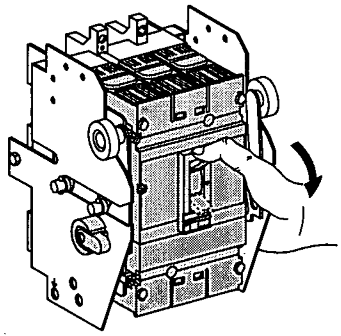
1 - open the circuit breaker.
2 - plug the circuit breaker in.
3 - refit the fixing screws.
4 - the circuit breaker is ready for operation.

degree of protection against direct contact with the power circuits

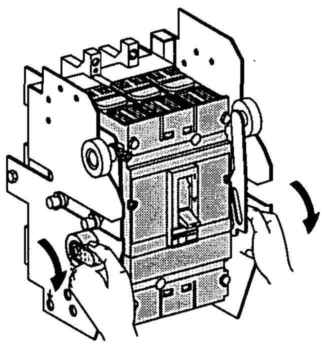
- device plugged in: IP40 (with terminal shields),
- device unplugged: IP20,
- device unplugged and base fitted with safety shutters: IP40.

withdrawable chassis for Compact NS100 to 630

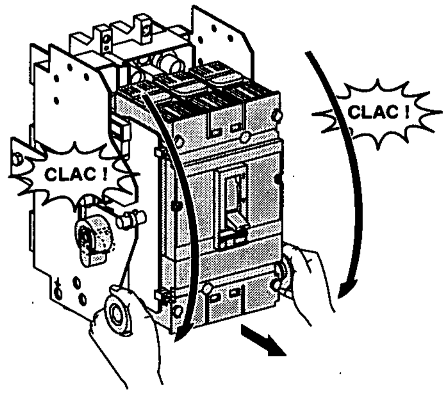
chassis mounted plug-in circuit breaker
disconnection



1 - open the circuit breaker.



2 - turn the two locking levers.



3 - simultaneously pull down on the two handles until the two locking levers "clack".

the auxiliary circuits are disconnected at the same time as the power circuits, unless the device is equipped with a manual auxiliary connector (see below). Advanced opening ensures operator safety, as with the plug-in version.

removal

1 - disconnect the circuit breaker (as above).
2 - unplug the manual auxiliary connector (if installed).
3 - turn the two locking levers, as for disconnection.
4 - push the two handles down.
5 - pull the circuit breaker out forwards.

connection

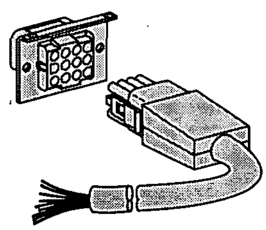
1 - turn the two locking levers.
2 - simultaneouly push up the two handles.

Connection of the auxiliary circuits and circuit breaker advanced opening occur as for disconnection.

degree of protection with circuit breaker disconnected or removed

- no special equipment: IP20,
- base fitted with safety shutters: IP40.

auxiliary circuit test



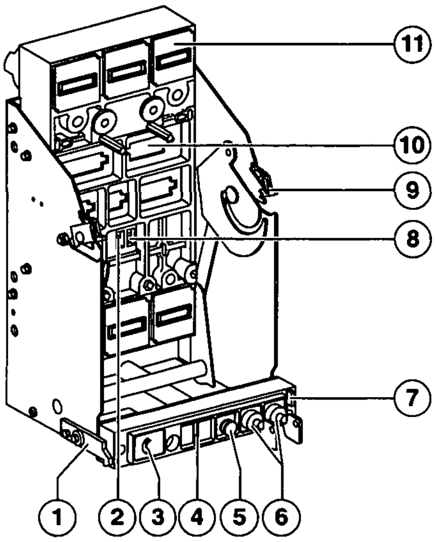
This function is available when the circuit breaker is equipped with the manual auxiliary connector. Following disconnection, the circuit breaker can be operated (toggle, "push to trip" button) to check the auxiliary circuits are still connected.

indication contacts (optional)

Changeover contacts:
- "end-of-connection (fully connected)" contact,
- "end-of-disconnection (fully withdrawn)" contact.

universal chassis for Compact C801 to 1251

the withdrawable circuit breaker and universal chassis



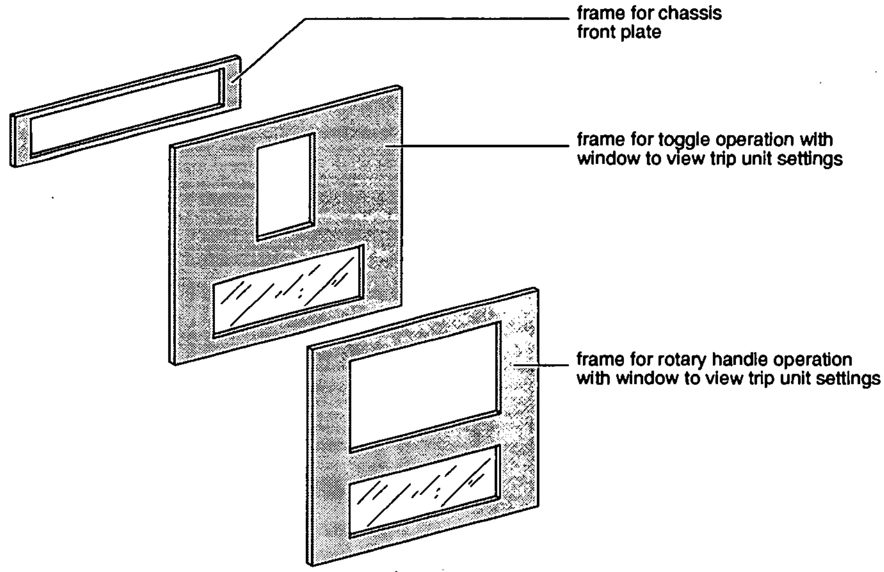
1 door interlocking (optional)
2 2 'racked-out' auxiliary contacts (optional)
3 position indicator
4 locking by 3 padlocks in the 'racked-in' (or 'racked-out') position
5 racking handle storage
6 locking in the withdrawn (or 'racked-out') position (optional)
7 racking interlock (optional)
8 2 'racked-in' auxiliary contacts (optional)
9 extraction operators (1)
10 connector for withdrawable terminal block (optional)
11 safety shutters IP 40 (optional)

The universal chassis for Compact C801 to C1251 is particularly well suited to main incoming circuit breakers :
■ racking in and out is possible with the door closed by means of a racking handle which is normally stored in the base of the chassis ;
■ 2 positions (racked-in and racked-out) are indicated :
□ locally by a position indicator,
□ remotely by auxiliary contacts (2 racked-in contacts and 2 racked-out contacts) ;
■ the circuit breaker can be operated from the exterior of the panel.

Locking
A wide range of locking options :
■ chassis locking in both the racked-in and racked-out positions by 3padlocks and 2 barrel locks, accessable from the panel exterior ;
■ door interlocking, with the breaker racked-in ;
■ can be locked in the racked-in position with the panel door open.

Door cut-out
A set of 'surrounds' allow :
■ optimises the number of cut-outs : only 1 cut-out per circuit breaker :
□ 3 and 4 poles,
□ toggle or direct rotary handle operated ;
■ guarantees a degree of protection to IP 40.
This set comprises :
■ a frame for the chassis front plate, which gives access to the locking facilities and racking mechanism (see below) ;
■ a frame for the circuit breaker handle with window to view trip unit settings.

Fixation
■ rear : panel or rail mounted ;
■ on a shelf : solid or rails.
Power connections
■ by cables with crimped lugs ;
■ by flat or edgewise bars.
Auxiliary connections
The standard Compact C withdrawable terminal block.



Door front covers and surrounds

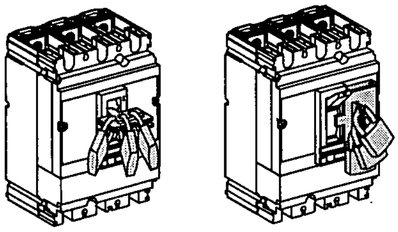
locking options

Whatever locking method is chosen, the circuit breaker will always **trip** in the event of a fault.

■ each device is able to accept between 1 and 3 padlocks of diameter 5 to 8 mm.

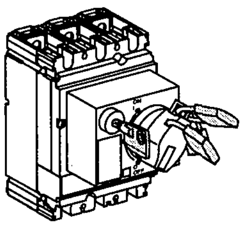
■ locking in the OFF/O position guarantees **isolation** according to IEC 947-2.

toggle



function	means	accessories required	for circuit breaker	
			NS100...630	C801...C1251
locking device in position O	padlock	removable lock. device	■	■
locking device in position O or I	padlock	fixed locking device	■	

standard direct rotary handle



function	means	accessories required	for circuit breaker	
			NS100...630	C801...C1251
locking device position O	padlock	–	■	■
	keylock	locking device and keylock	■	■

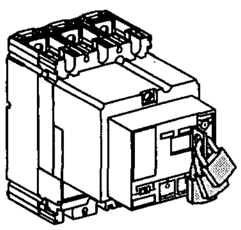
MMC type direct rotary handle

function	means	accessories required	for circuit breaker	
			NS100...630	C801...C1251
locking device position O	padlock	–	■	
device in position I : door opening prevented door open: device closing prevented	rotary handle (integral)	–	■	

extended rotary handle

function	means	accessories required	for circuit breaker	
			NS100...630	C801...C1251
locking in OFF position O	padlock	–	■	■
door opening prevented	keylock			■
device in I position: door opening prevented door open: device closing prevented	rotary handle (integral)	–		

motor mechanism



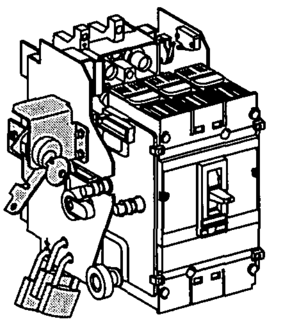
function	means	accessories required	for circuit breaker	
			NS100...630	C801...C1251
locking in OFF position O	padlock	–	■	■
motor mechanism locked out	keylock	1 locking device	■	■

1 - set the selector on the front to the manual position.
2 - pull the locking lever.
3 - fit the padlock(s).

It is then impossible to actuate the spring charging lever, the closing push-button and the manual/automatic operation selector.

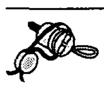
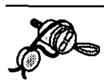
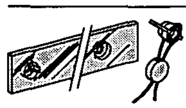
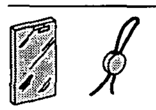
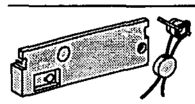
locking and lead sealing

withdrawable chassis



function	means	accessories required
connection prevented	padlock	–
lock in connected or disconnected position	keylock	locking device and keylock

different lead sealing systems

seal		inhibited operations
	front cover fixing screw	■ removal of front cover ■ access to auxiliaries ■ removal of trip unit
	rotary handle fixing screw	■ removal of the rotary handle ■ access to auxiliaries ■ removal of trip unit
	motor mechanism cover locking screw	■ removal of the motor mechanism ■ access to auxiliaries ■ removal of trip unit
	transparent protection plate for trip unit settings	changes in settings: ■ for overload protection ■ for short-circuit protection
	transparent protection plate for Vigi module settings	changes in settings for earth fault protection
	intermediate terminal shield on Vigi module	■ disabling of earth fault protection function ■ access to power connection (protection against direct contact)
	terminal shield fixing screw	access to power connections (protection against direct contact)

interlocking

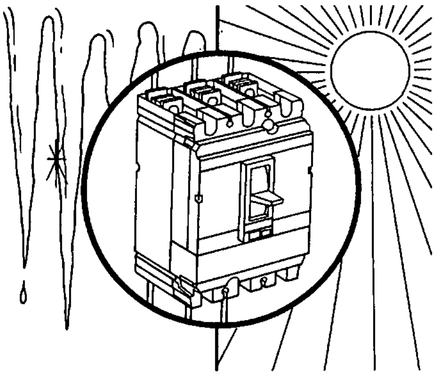
Prevents closing of a circuit breaker when another is already closed.

function	means
interlocking of 2 circuit breakers fitted with **toggle**	double-bolt mechanical device
interlocking of 2 circuit breakers fitted with **rotary handle**	mechanical device 2 keylocks (1 key)

operational conditions

environmental conditions

ambient temperature



operation

Ambient temperature between –25°C and +40 °C:
The rated characteristics for Compact NS circuit breakers are guaranteed if the temperature of the air immediately surrounding the device is within the above range.

Ambient temperature between +40°C and +70°C :
Take into account the derating coefficients presented in the technical documents:
- for circuit breakers with a thermal-magnetic trip unit, there is a natural drop in the thermal tripping threshold (overload protection),
- for circuit breakers with an electronic trip unit, there is a drop in the maximum setting authorised for overload protection.

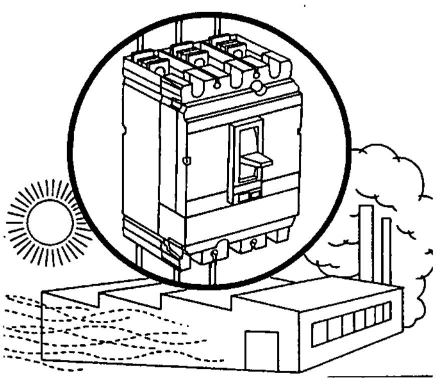
Ambient temperature above +70°C:
Various systems trip the circuit breaker to protect components from the effects of excessive temperature. It follows that continuity of service for the electrical installation is not guaranteed if the circuit breakers operate at temperatures greater than 70°C. Ventilation (natural or forced-air) should be provided for switchboards to avoid temperatures greater than 70°C.

storage and commissioning

In their original packing, Compact NS circuit breakers may be stored at temperatures ranging from **-55°C to +95°C**.

Commissioning should be carried out at normal ambient temperatures (see above). However, commissioning may exceptionally be carried out at an ambient temperature ranging from -35°C to -25°C.

special atmospheric conditions

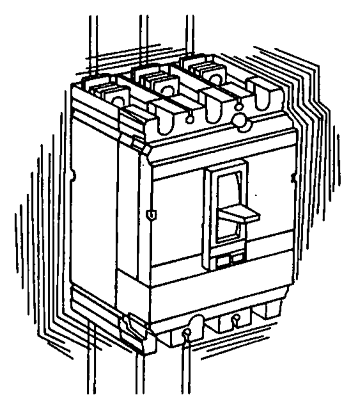


Compact NS circuit breakers operate within their rated characteristics in all normal climatic conditions. They have successfully passed (no drop in rated characteristics) the tests defined by the following standards:
- IEC 68-2-2 : dry heat at +85°C,
- IEC 68-2-1 : dry cold at –55°C,
- IEC 68-2-30 : damp heat (temperature + 55°C, relative humidity 95 %),
- IEC 68-2-11 : salt spray.

Compact NS circuit breakers are designed to operate in industrial atmospheres as defined in IEC standard 947 (pollution degree ⩽ 3).

It is however advised to ensure that the circuit breakers are installed in correctly cooled switchboards without excessive dust.

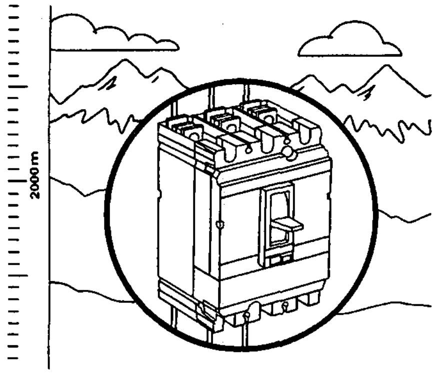
vibrations



Compact NS circuit breakers are guaranteed against mechanical or electromagnetic vibration levels as specified in the following standards:
- IEC68-2-6,
- Veritas NI122E,
- Lloyd's Register of Shipping,
- JIS 8370.

Excessive vibration may however provoke untimely tripping, loosening of connections or even rupture of parts.

altitude

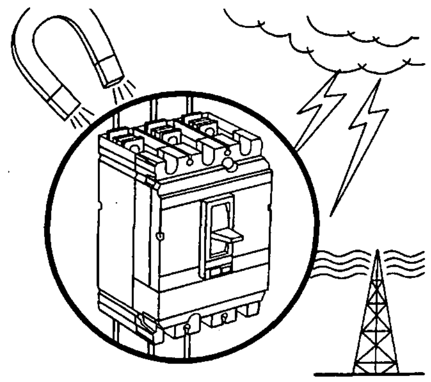


Compact NS circuit breakers are designed to operate within their rated characteristics at altitudes up to 2 000 metres.

Above 2 000 m, modifications in the ambient air characteristics (dielectric withstand capacity, cooling capacity) result in the following derating:

altitude (m)	≤ 2000	3000	4000
maximum operating voltage(V)	690	600	480
rated thermal current (A) at 40°C	In	0,96 x In	0,93 x In

electromagnetic disturbances



Compact NS circuit breakers equipped with an electronic trip unit and a Vigi module are protected against:
- overvoltages produced by electromagnetic switchgear,
- overvoltages produced by atmospheric disturbances and conducted by electrical networks (eg. lightning strikes),
- devices emitting radio waves (radio transmitters, walkie-talkies, radar, etc.),
- electrostatic discharges produced directly by operators.

They pass EMC (electromagnetic compatibility) tests in compliance with the following international standards:
- IEC 255-22-1 class 3:
  - □ 10 kV 1.2 / 50 µs overvoltage wave,
  - □ 2.5 kV1 MHz damped oscillatory wave,
- IEC 1000-4-2 class 4:
electrostatic discharges 15 kV,
- IEC 1000-4-3 class 3:
10 V/m radiated electromagnetec fields,
- IEC 1000-4-4 class 4:
4 kV fast transient waves,
- IEC 1000-4-5 class 4:
  - □ 4 kV 1.2 / 50 µs voltage waves,
  - □ 2 kA 8 / 20 µs current waves,
- EN 50081-1 class B:
conducted and radiated emissions in switchboards,
- IEC 947-2 annex F.

The above tests ensure:
- absence of nuisance tripping,
- overload tripping times.

commissioning and exploitation

prior to commissioning new circuit breakers or following an extended shutdown

A general check requires only a few minutes and eliminates any risks of incorrect operation due to error or neglect.

All checks must be carried out with the switchboard de-energised. For compartmented switchboards, it is sufficient that all accessible sections be de-energised.

	A	B	C	D	E	F	G
prior to commissioning	■	■	■	■	■	■	■
periodically during service life				■	■		■
following servicing on the switchboard		■	■	■	■		■
periodically during an extended shutdown		■		■		■	
following an extended shutdown	(1)	■	(2)	■	■	■	■

A electrical tests
B switchboard inspection
C conformity with diagram
D device mounting, connections-
E auxiliaries
F mechanical operation
G operation of the electronic trip units and the Vigi modules.

(1) extended shutdown or modifications in the switchboard
(2) modification in the switchboard

electrical tests

Insulation and dielectric withstand capacity tests are carried out prior to delivery of the switchboard. These tests are governed by applicable standards and must always be carried out by an authorised specialist.

switchboard inspection

Check that the circuit breakers are installed in a clean environment, free of dust and all installation debris (tools, wiring, chips, metal particles, etc.).

compliance with diagram

Check the conformity of devices with the installation diagram:
□ ratings and breaking capacities indicated on the rating plates,
□ trip unit identification (type, rating),
□ presence of additional functions (Vigi earth fault protection, motor mechanism, rotary handle, auxiliaries, indication and measurement modules),
□ protection settings (overload, short-circuit, earth fault),
□ outgoing circuit identification on the front of devices,
□ for Vigicompact earth fault protection circuit breakers, check that the intermediate terminal shield is installed, otherwise the earth fault protection function is inoperative.

device mounting-status of connections and auxiliaries

Check **device mounting** in the switchboard and the tightness of power connection.

Check that **auxiliaries and accessories are correctly installed**:
□ motor mechanism modules or rotary handles,
□ accessories (terminal shields, door escutcheons, etc.),
□ connection of auxiliary circuits.

mechanical operation

Check the **mechanical operation** of devices:
□ contact opening,
□ contact closing,
□ tripping using the "push to trip".

operation of the electronic trip units and the Vigi modules

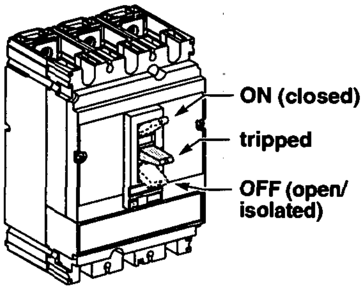
Check the **electronic trip units** using the mini test kit or calibration test kit (see page 13).

Check the **Vigi modules** using the test button on the front plate. This test guarantees tripping in the event of an earth fault.

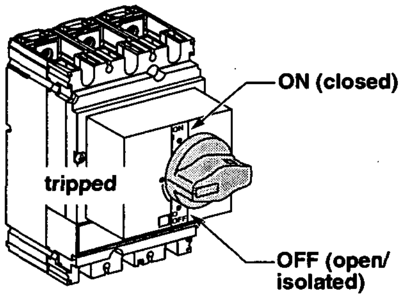
following tripping

trip indication
Tripping is indicated on the front:

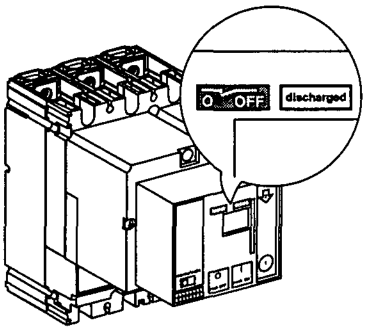
by the toggle



by the rotary handle



by the motor mechanism



identifying causes

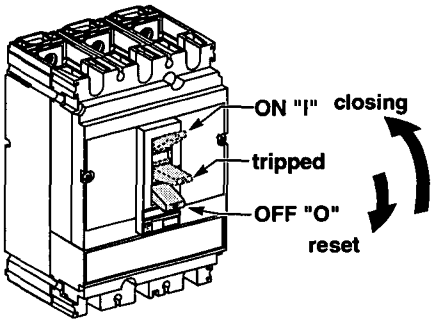
A circuit breaker must NEVER be reset before identifying and eliminating the cause of the trip.

Causes may be multiple:
- depending on how the circuit breaker is fitted out, certain auxiliaries (SD, SDE, SDV, etc.) or LED indications on the trip unit are important means in identifying the cause of the trip (see table page 48),
- depending on the cause of the trip and prior to restarting the installation, certain precautions must be taken, namely insulation and dielectric tests on the installation, in part or in whole. These checks and tests must be carried out by qualified personnel.

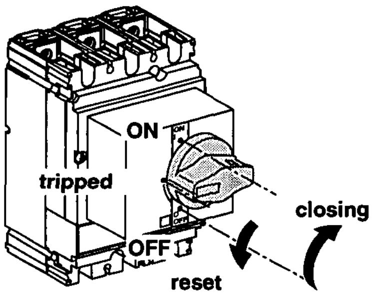
circuit breaker reset

When the lever is in the "tripped" position, the device must first be reset by setting the lever to the O/OFF position before reclosing (ON position).

toggle



rotary handle



motor mechanism
See page 5 for the applicable procedure.

operational anomalies

The table below does not list all possibilities, but can nonetheless assist in troubleshooting and providing corrective action.

If however, the problem persists, consult the Schneider Electric after-sales support department.

problems	indication	probable cause	corrective action
repeated tripping			
	SD SDE "alarm" on electronic trip units	■ protection settings are incorrect.	check the rated current of the supply network and set the proper value. check the setting for overload protection.
	SD	■ supply voltage for the undervoltage release (MN) is too low or subject to major fluctuations.	check the value of the power supply voltage and correct it. (DC networks are subject to major voltage fluctuations when loads are turned on. Voltage drops may provoke tripping on the circuit breaker by the MN release.
	SD	■ inadvertent powering of MX shunt release.	determine the causes of the powering.
	SD SDE	■ ambient temperature too high.	ventilate the room or the device.
	SD SDE SDV	■ Vigi module settings are incorrect.	
		■ insulation fault.	check the insulation of the protected circuit.
circuit breaker does not close			
manual operation	SD SDE	■ supply network is faulty.	identify and eliminate the fault.
	SD	■ MX shunt release is supplied with power.	determne the causes of the supply of power.
		■ MN undervoltage relese is not supplied with power.	check for power across the terminals and that connections are correct.
	OF	■ circuit breaker is interlocked.	check the installation diagram and the interlocking system (electrical or mechanical) of the two circuit breakers.
motor mechanism	OF	■ closing order inoperative.	■ check that the selector on the front is in the automatic position. ■ check the power supply for the motor mechanism module, the motor and the closing signals.
	SDE SD	■ the device tripped due on an electrical fault.	■ identify and eliminate the fault. ■ manually charge the motor mechanism module spring.

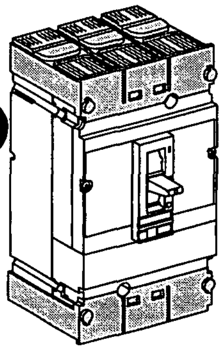
practical advice

maintaining performance levels of circuit breakers

Due to their design and characteristics, **Compact NS circuit breakers require no maintenance.**
It is nonetheless recommended to ensure that devices operate in the conditions specified in the catalogue, namely:

- electrical and mechanical conditions,
- environmental conditions (see pages 46 and 47).

improved safety



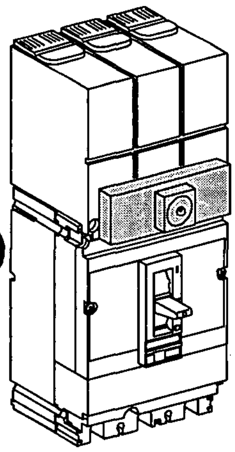
The following options are available:

- **long or short terminal shields** providing IP 40 protection,
- a sealable **plate to block access to settings** (thermal-magnetic trip units),
- **flexible phase barriers** to improve insulation between power connections,
- toggle cover to ensure IP 43 protection.

The base (plug-in configuration) can be fitted with:

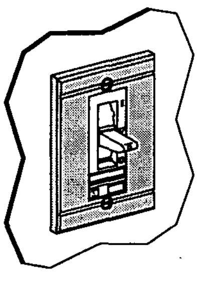
- **shutters** to block access to power parts (IP 4x protection).

improved comfort



- a full range of **electrical indication auxiliaries** (OF, SD, SDE, SDV),
- **indication of voltage presence** across device terminals,
- **current measurement** module with an incorporated ammeter or remote indication of the measured value,
- **load-circuit identification means** (see Telemecanique catalogue, catalogue number AB1),
- **alarm indications** (standard on devices equipped with electronic trip units).
- **indication options** on trip unit STR53UE (see page 23),
- **Digipact** indication, measurement and control modules.

improved aesthetics



- a range of **escutcheons** providing different protection (IP) levels for fixed devices, plug-in and withdrawable configutations, motor mechanism modules and rotary handles.

notes

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As standards, specifications and designs change from time to time, please ask for confirmation of the information given in this publication.

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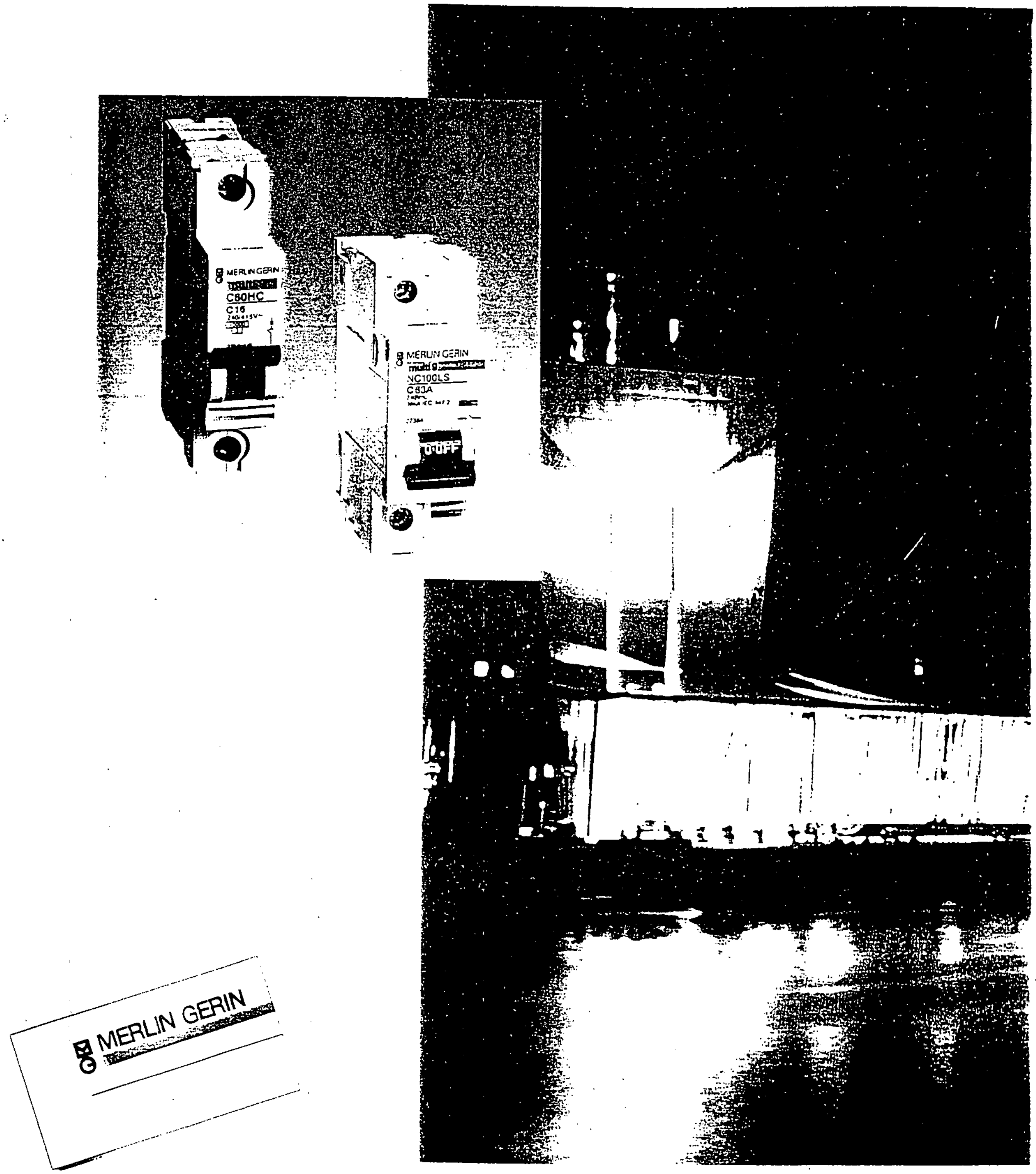
07-99

Multi 9
Miniature Circuit Breakers

Selection Guide



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Merlin Gerin   Modicon   Square D   Telemecanique

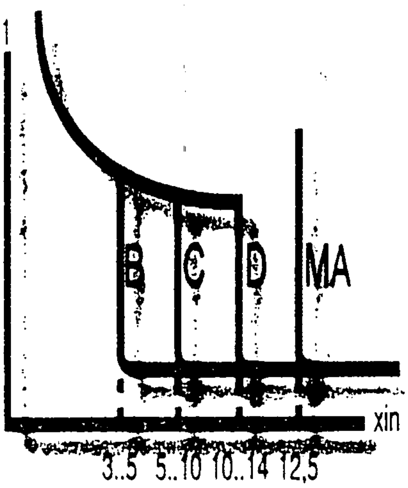
Multi 9

Miniature Circuit Breakers

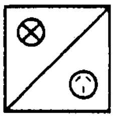
Trip Unit Variations

Circuit Protection

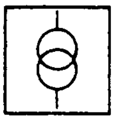
A choice of several curves
Whatever circuit has to be protected, a C60 or NC100 circuit breaker provides the perfect solution with a suitable curve.



Curve B
tripping:
3 to 5 times the rated current (In);
protection of generators, persons, very long cables.



Curve C
tripping:
5 to 10 In;
protection of circuits, general applications.

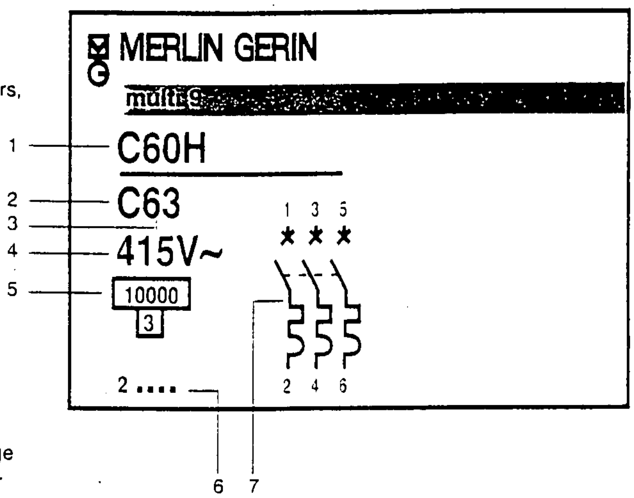


Curve D
tripping;
10 to 14 In;
protection of high surge circuits, welders transformers, motors.

Curve MA
(magnetic only)
tripping: 12 In;
protection of motor starters (+ thermal protection when combined with contactor).

Circuit Breaker Marking

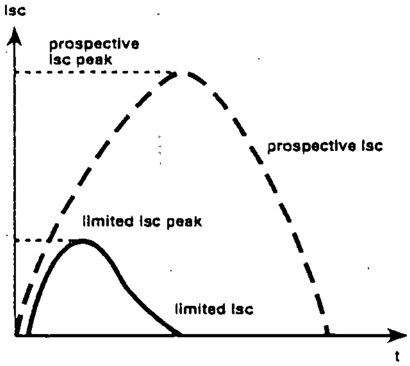
3P



1. Circuit Breaker Model Number
2. Tripping Curve
3. Circuit Breaker Current Rating
4. Operating Voltage
5. Rated Breaking Capacity
6. Circuit Breaker Part Number
7. Electrical Diagram - No. of Poles

Circuit Breaker Limitation Capability

The limitation capability of a circuit breaker is that characteristic whereby only a current less than the prospective fault current is allowed to flow under short-circuit conditions.



Prospective current and actual limited current

This is illustrated by limitation curves which give:

- The limited peak current in relation to the RMS value of the prospective short-circuit current (the short-circuit current being that current which would flow continuously in the absence of protection equipment.
- The limited current stress in relation to the RMS value of the prospective short-circuit current.
- Current limiting capability. The advanced design of the Multi 9 range provides current limitation with far better protection than conventional circuit breakers. For example, on a 6A rating with a prospective short circuit of 5000A, the current will be limited at 350A or 7%.

Installation of current limiting circuit breakers offers several advantages:

- **Better network protection**
  Current limiting circuit breakers considerably reduce the undesirable effects of short-circuit currents in an installation.
- **Reduced thermal effects**
  Cable heating is reduced hence longer cable life.
- **Reduced mechanical effects**
  Electrodynamic forces reduced, thus electrical contacts are less likely to be deformed or broken.
- **Reduced electromagnetic effects**
  Measuring equipment situated near an electrical circuit less affected.

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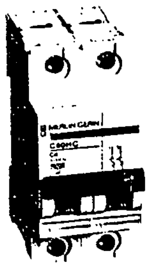
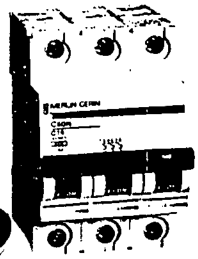
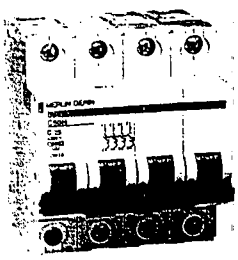
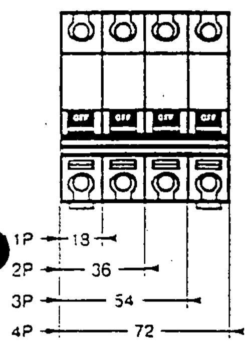
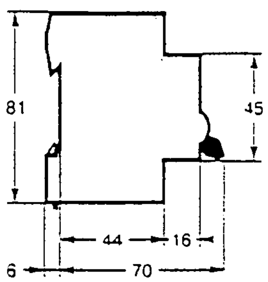
Multi 9 - C60 Series

Miniature Circuit Breakers

AS3111 / AS3858 / AS3947-2

	type	width in mod. of 9mm	In (A)	D60 4.5kA cat no C curve	C60N 6kA cat no C curve	C60H 10kA cat no B curve	C60H 10kA cat no C curve	C60H 10kA cat no D curve
	1P	2	1		25797	25839	25639	25696
			2		25798	25840	25640	25698
			4		25800	25841	25642	25699
			6	11354	25801	25842	25643	25700
			10	11355	25802	25843	25644	25701
			16	11356	25803	25844	25646	25702
			20	11357	25804	25845	25646	25703
			25	11339	25805	25846	25647	25704
			32	11358	25806	25847	25648	25705
			40	11359	25807	25848	25649	25707
			50	11360	25808	25849	25651	25708
			63	11361	25809	25850	25652	25709
	2P	4	1		25811	25852	25653	25710
			2		25812	25853	25654	25712
			4		25814	25854	25656	25713
			6		25815	25855	25657	25714
			10		25816	25856	25658	25715
			16		25817	25857	25659	25716
			20		25818	25858	25660	25717
			25		25819	25859	25661	25718
			32		25820	25860	25662	25719
			40		25821	25861	25663	25721
			50		25822	25862	25665	25722
	2 protected poles		63		25823	25863	25666	25723
	3P	6	1		25825	25865	25667	25724
			2		25826	25866	25668	25726
			4		25828	25867	25670	25727
			6		25829	25868	25671	25728
			10		25830	25869	25672	25729
			16		25831	25870	25673	25730
			20		25832	25871	25674	25731
			25		25833	25872	25675	25732
			32		25834	25873	25676	25733
			40		25835	25874	25677	25735
			50		25836	25875	25679	25736
	3 protected poles		63		25837	25876	25680	25737
	4P	8	1			25878	25007	25211
			2			25879	25008	25212
			4			25880	25010	25214
			6			25881	25011	25215
			10			25882	25012	25216
			16			25883	25013	25217
			20			25884	25014	25218
			25			25885	25015	25219
			32			25886	25016	25220
			40			25887	25017	25221
			50			25888	25018	25222
	4 protected poles		63			25889	25019	25223





- Connection: tunnel terminals for rigid cables – 25mm² up to 25A rating – 35mm² above 25A rating.
- Suitable for Busscomb, MSC18, MSC18/27 Chassis Mounting.

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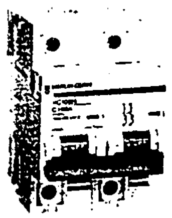
Multi 9 - NC100 Series Miniature Circuit Breakers

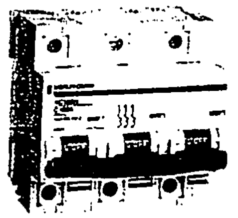
AS3111 / AS3858 / AS3947-2

Model No.	NC100H	NC100LS	NC100LMA
Breaking Capacity	10kA	36kA	50kA

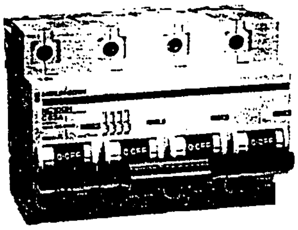
type	width in mod. of 9mm	In (A)	cat no C curve	cat no D curve	cat no C curve	In (A)	AC3 kW	cat no
1P	3	10	27245	27289	27377			
		16	27246	27290	27378			
		20	27247	27291	27379			
		25	27248	27292	27380			
		32	27249	27293	27381			
		40	27250	27294	27382			
		50	27251	27295	27383			
		63	27252	27296	27384			
		80	27253	27297				
		100	27254	27298				
		125	27255					



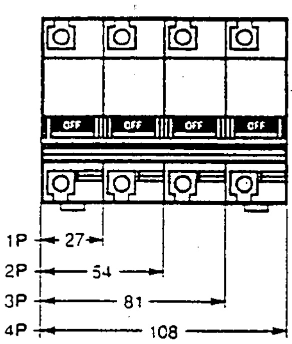
type	width in mod. of 9mm	In (A)	cat no C curve	cat no D curve	cat no C curve	In (A)	AC3 kW	cat no
2P	6	10	27256	27300	27388			
		16	27257	27301	27389			
		20	27258	27302	27390			
		25	27259	27303	27391			
		32	27260	27304	27392			
		40	27261	27305	27393			
		50	27262	27306	27394			
		63	27263	27307	27395			
		80	27264	27308				
		100	27265	27309				
2 protected poles		125	27266					

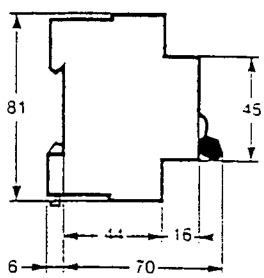


type	width in mod. of 9mm	In (A)	cat no C curve	cat no D curve	cat no C curve	In (A)	AC3 kW	cat no
3P	9	10	27267	27311	27399	1.6	0.37	27564
		16	27268	27312	27400	2.5		
		20	27269	27313	27401	4.0	1.5	27566
		25	27270	27314	27402	6.3	2.2	27567
		32	27271	27315	27403	10	4	27568
		40	27272	27316	27404	12	5.5	27569
		50	27273	27317	27405	16	7.5	27570
		63	27274	27318	27406	25	10	27571
		80	27275	27319		40	18.5	27572
		100	27276	27320				
3 protected poles		125	27277					



type	width in mod. of 9mm	In (A)	cat no C curve	cat no D curve	cat no C curve	In (A)	AC3 kW	cat no
4P	12	10	27278	27322	27399			
		16	27279	27323	27400			
		20	27280	27324	27401			
		25	27281	27325	27402			
		32	27282	27326	27403			
		40	27283	27327	27404			
		50	27284	27328	27405			
		63	27285	27329	27406			
		80	27286	27330				
		100	27287	27331				
4 protected poles		125	27288					





- Connection: tunnel terminals for rigid cables – 35mm^2 up to 63A rating – 50mm^2 above 63A rating.
- Suitable for MSC27. MSC18/27 Chassis Mounting.

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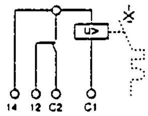
Multi 9 Miniature Circuit Breakers

Auxiliaries

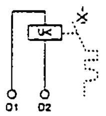
MX + OF shunt trip release

C60 width in mod. of 9mm	C60 voltage	C60 cat. No.	NC100 voltage	NC100 cat. No.
2	220-415V AC 110-130V AC	26946	220-380V AC 240-415V AC	27136
	48-130V AC 48V DC	26947	110-220V AC 110-125V DC	27137
	24V AC and DC	26948	24-48V AC and DC	27138



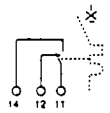
MN undervoltage release

C60 width in mod. of 9mm	C60 voltage	C60 cat. No.	NC100 voltage	NC100 cat. No.
instantaneous				
2	220-240V AC	26960	220-240V AC-DC	27140
	48V AC	26961		
	48V DC	26962		
time delayed	0.5s			
4	220-240V AC	26963	220-240V AC/DC	27143



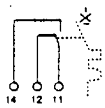
SD alarm switch

C60 width in mod. of 9mm	C60 cat. No.	NC100 cat. No.
1	26927	27135



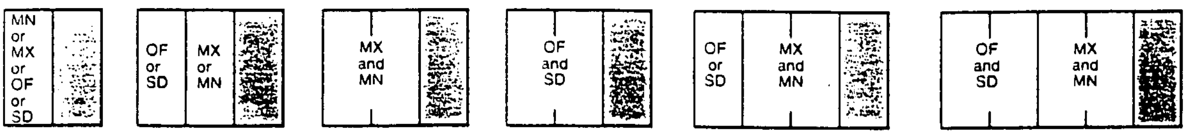
OF auxiliary switch

C60 width in mod. of 9mm	C60 cat. No.	NC100 cat. No.
1	26924	27132

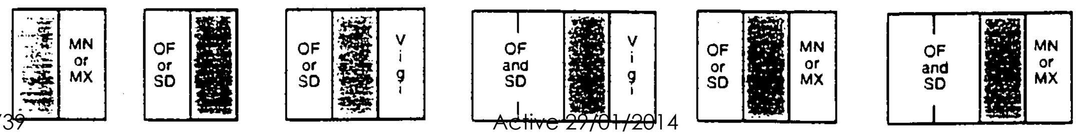


Auxiliaries combinations

C60



NC100



Multi 9 Compact 'NS' Enhanced Discrimination Table

For each combination of two circuit breakers, the tables indicate the:

15/25

- downstream device breaking capacity enhanced by cascading
- selectivity limit enhanced by cascading

The shaded background indicates that the two values are equal, i.e. for all faults likely to occur downstream, only the downstream device trips (total discrimination).

Upstream circuit breaker: Compact NS160 to NS250. Downstream circuit breaker: Multi 9

Upstream		NS160N				NS250N			NS160H/L				NS250H/L		
		36 kA				36 kA			70/150 kA				70/150 kA		
	trip unit	TM-D													
Downstream	rating	80	100	125	160	160	200	250	80	100	125	160	160	200	250
C60N 6 kA	≤16	25 / 25	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 / 30
	20 - 25	25 / 25	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 / 30
	32 - 40	15 / 25	25 / 25	25 / 25	25 / 25	25 / 25	25 / 25	25 / 25	15 / 30	30 / 30	30 / 30	30 / 30	30 / 30	30 / 30	30 / 30
	50	10 / 25	15 / 25	25 / 25	25 / 25	25 / 25	25 / 25	25 / 25	15 / 30	30/ 30	30/ 30	30/ 30	30/ 30	30/ 30	30/ 30
	63		15 / 25	25 / 25	25 / 25	25 / 25	25 / 25	25 / 25		30 / 30	30 / 30	30 / 30	30 / 30	30 / 30	30 / 30
C60H 10 kA	≤16	30 / 30	30 / 30	30 / 30	30 / 30	30 / 30	30 / 30	30 / 30	50 / 50	50 / 50	50 / 50	50 / 50	40 / 40	40 / 40	40 / 40
or	20 - 25	30 / 30	30 / 30	30 / 30	30 / 30	30 / 30	30 / 30	30 / 30	50 / 50	50 / 50	50 / 50	50 / 50	40 / 40	40 / 40	40 / 40
V40H	32 - 40	15 / 30	30 / 30	30 / 30	30 / 30	30 / 30	30 / 30	30 / 30	15 / 50	50 / 50	50 / 50	50 / 50	40 / 40	40 / 40	40 / 40
	50	15/ 30	30/ 30	30/ 30	30/ 30	30/ 30	30/ 30	30/ 30	15/ 40	40/ 40	40/ 40	40/ 40	30/ 30	30/ 30	30/ 30
	63		30 / 30	30 / 30	30 / 30	30 / 30	30 / 30	30 / 30		40 / 40	40 / 40	40 / 40	30 / 30	30 / 30	30 / 30
NC100H 10 kA	50	2.5 / 25	2.5 / 25	2.5 / 25	2.5 / 25	25 / 25	25 / 25	25 / 25	2.5 / 30	2.5 / 30	2.5 / 30	2.5 / 30	30 / 30	30 / 30	30 / 30
	63		2.5 / 25	2.5 / 25	2.5 / 25	25 / 25	25 / 25	25 / 25		2.5 / 30	2.5 / 30	2.5 / 30	30 / 30	30 / 30	30 / 30
	80			2.5 / 25	2.5 / 25	25 / 25	25 / 25	25 / 25			2.5 / 30	2.5 / 30	30 / 30	30 / 30	30 / 30
	100				2.5 / 25	25 / 25	25 / 25	25 / 25				2.5 / 30	30 / 30	30 / 30	30 / 30

	trip unit	STR22SE					
Downstream	rating	100	160	250	100	160	250
C60N 6 kA	≤63	1.2 / 25	25 / 25	25 / 25	1.2 / 30	30 / 30	30 / 30
C60H 10 kA	≤40	1.2 / 25	30 / 30	30 / 30	1.2 / 40	50 / 50	40 / 40
C60H 10 kA	50-63	1.2/ 25	30 / 30	30 / 30	1.2 / 40	40 / 40	40 / 40
V40H 10kA	≤40A	1.2 / 25	30 / 30	30 / 30	1.2 / 40	50 / 50	40 / 40
NC100H 10 kA	≤100	1.2 / 25	2/ 25	25/ 25	1.2 / 30	2 / 30	30 / 30

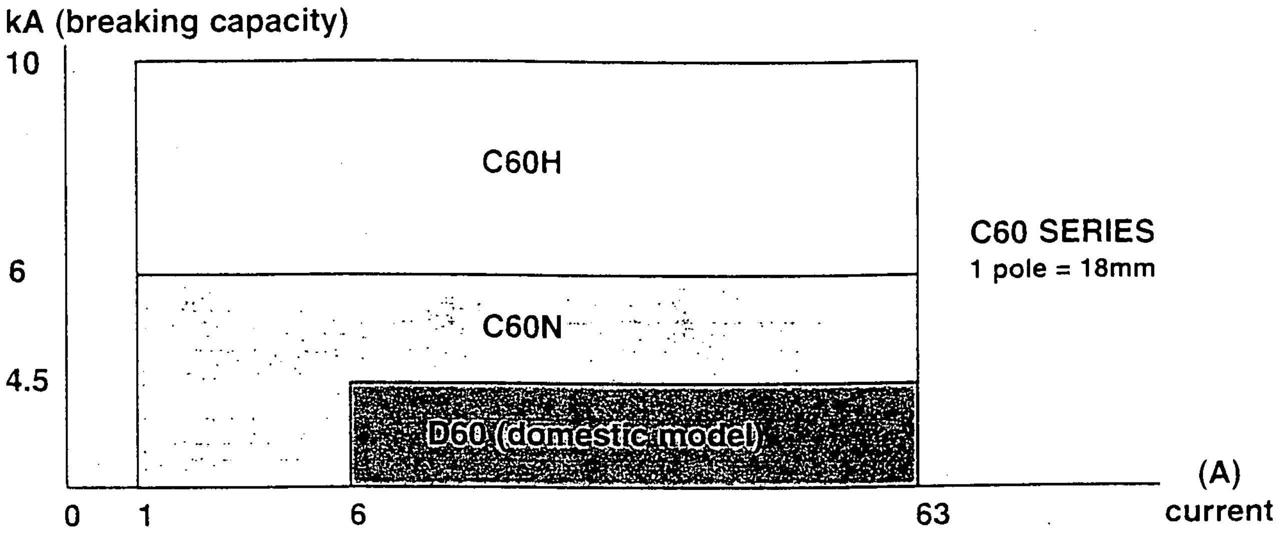
Upstream		NS160H				NS250H			NS160L				NS250L		
		70 kA				70 kA			150 kA				150 kA		
	trip unit	TM-D or STR22SE													
Downstream	rating	80	100	125	160	160	200	250	80	100	125	160	160	200	250
NC100LS	10	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	100/100	100/100	100/100	100/100	100/100	100/100	100/100
36 kA	16	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	100/100	100/100	100/100	100/100	100/100	100/100	100/100
	20	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	100/100	100/100	100/100	100/100	100/100	100/100	100/100
	25	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	100/100	100/100	100/100	100/100	100/100	100/100	100/100
	32	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	100/100	100/100	100/100	100/100	100/100	100/100	100/100
	40	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	100/100	100/100	100/100	100/100	100/100	100/100	100/100
	50	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	100/100	100/100	100/100	100/100	100/100	100/100	100/100
	63		70 / 70	70 / 70	70 / 70	70 / 70	70 / 70	70 / 70		100/100	100/100	100/100	100/100	100/100	100/100

Cascading (back up) at 415V

Upstream		Compact	NS100N	NS100H	NS100L	NS160N	NS160H	NS160L	NS250N	NS250H	NS250L
Rated breaking capacity			25	70	150	36	70	150	36	70	150
Downstream		rated brk.cap.	enhanced breaking capacity								
Multi 9	C60N	6	25	30	30	25	30	30	25	30	30
	V40H	10	25	50	50	30	50	50	30	40	40
	C60H (≤40A)	10	25	50	50	30	50	50	30	40	40
	C60H (50-63A)	10	25	40	40	30	40	40	30	40	40
	NC100H	10	25	30	30	25	30	30	25	30	30
	NC100LS	36		70	100		70	100		70	100
	NC100LMA	50		70	150		70	150		70	150
Compact	NS100N	25		70	150	36	70	150			
	NS100H	70			150			150			
	NS160N	36					70	150			
	NS160H	70						150			

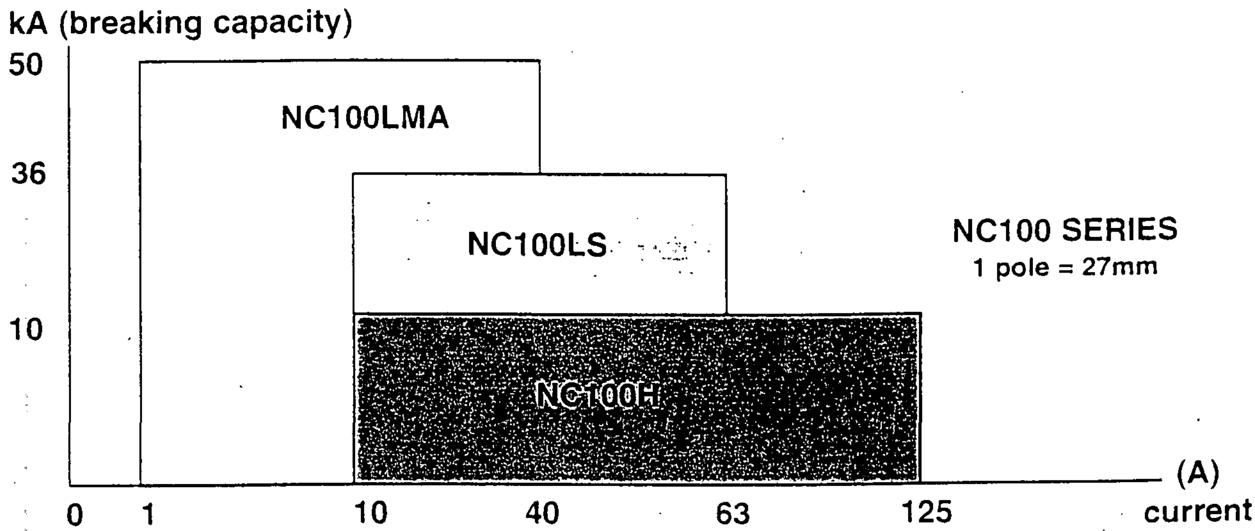
SCHNEIDER

Multi 9 Selection Tables



C60 Circuit Breakers

Standard	(A) Rating	(V) Voltage	Model No.	Curve	Breaking Capacity	Poles
AS3111	6 - 63	240V	D60	C	4.5kA	1 (Domestic Model)
AS3858	1 - 63	440V	C60N	C	6kA	1, 2 & 3
AS3858	1 - 63	440V	C60H	B,C,D	10kA	1, 2, 3 & 4

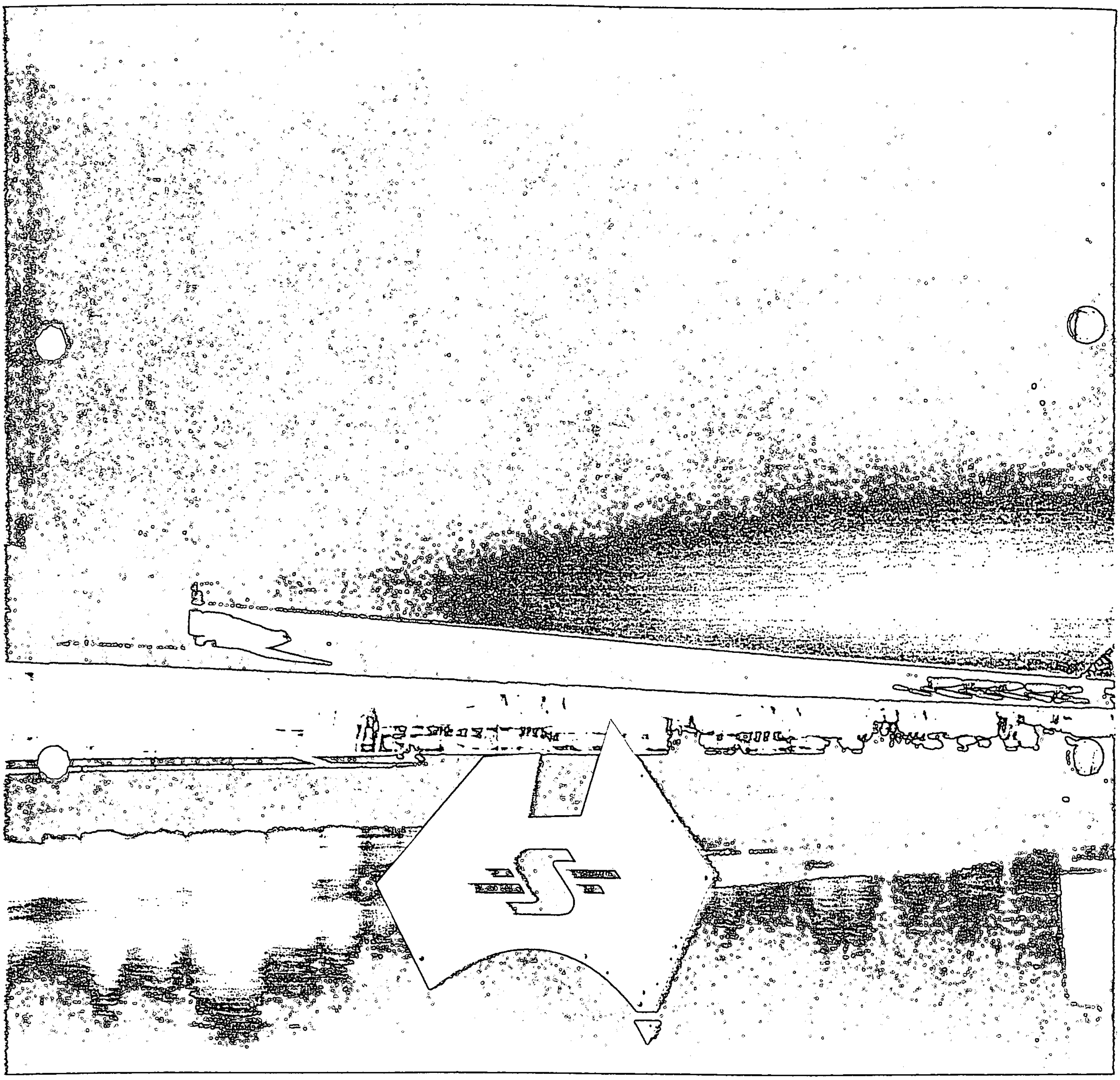


NC100 Circuit Breakers

Standard	(A) Rating	(V) Voltage	Model No.	Curve	Breaking Capacity	Poles
AS3858	10 - 125	440V	NC100H	C	10kA	1, 2, 3 & 4
IEC947-2	10 - 60	440V	NC100LS	C	36kA	1, 2, 3 & 4
	1.6 - 40	440V	NC100LMA	MA	50kA	3

* The above information represents the current Australian offer. Other breaking capacities and curve types are available on an indent basis. Please contact Schneider for more details.

SCHNEIDER



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Victoria
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Mt. Waverley 3149
Tel: (03) 9558 9876
Fax: (03) 9558 9701

Manufacturing
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Fax: (03) 9558 9700

Transformer Manufacturing
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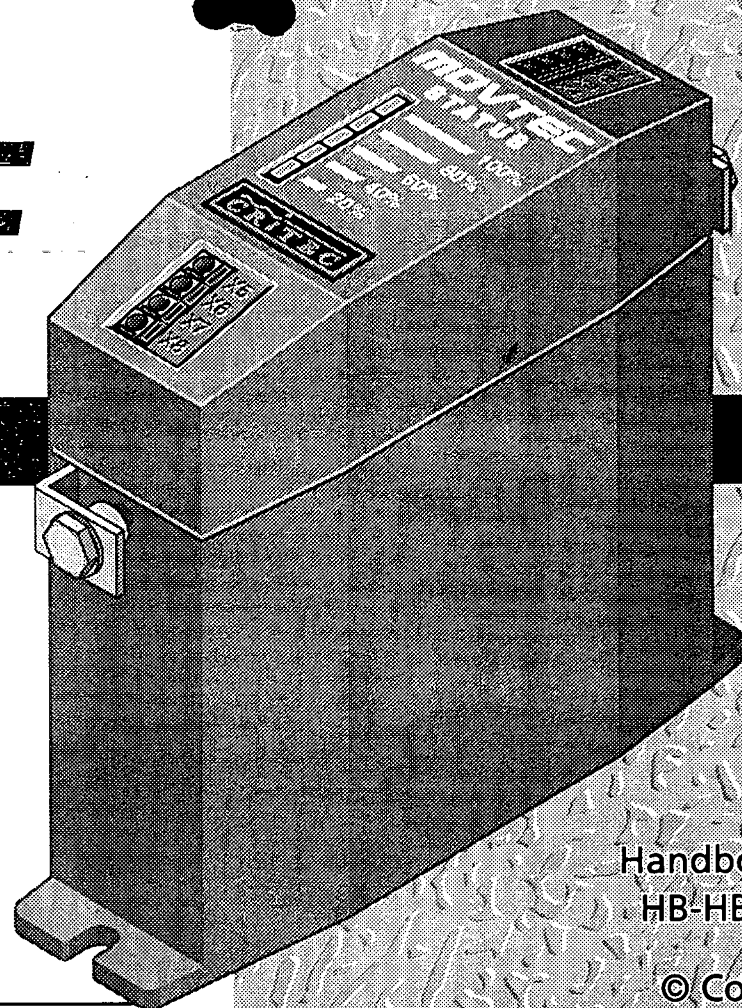
MOVTEC AND TDS-MOVTEC

SURGE DIVERTERS

INSTALLATION INSTRUCTIONS

Includes MPM Movtec Protection Module Instructions



Handbook No:
HB-HBCR-111

ISSUE: 2 April 1999

ERICO®

ERICO Lightning Technologies Pty. Ltd. design and manufacture the Critec range of products. CRITEC

CONTENTS

1. WARNINGS

- Prior to installation ensure that the Movtec is of the correct voltage and frequency, and is the type recommended for the local power distribution, and for the equipment being protected.
- Hazardous voltages may exist internally to the units. The units should be installed (and replaced) only by qualified personnel in accordance with all relevant Electricity Safety Standards.
- Do not power MPMs and three phase connected Movtecs (Ph-N) without the upstream neutral connected. Failure to do so may damage the Movtecs and/or the load.
- Where the MPMs/Movtecs are connected to an earth, this must be a low impedance earth ($<10\ \Omega$) for correct operation.
- X1-X4 connections may be at phase voltages dependant upon connection method.
- If connecting to the Movtec alarm outputs do not exceed the maximum permissible ratings as damage may occur.
- Movtecs must be installed in an enclosure or panel, ensure this does not cause their environmental ratings to be exceeded.
- Do not "Megger" or "Flash Test" circuits with Movtecs installed.
- The DINLINE Surge Counter (DSC) should not be used in voltage sensing mode with TDS-Movtecs. Voltage sensing mode is not compatible with TDS-Movtecs.
- All instructions must be followed to ensure correct and safe operation.
- Diagrams are illustrative only, and should not be relied on in isolation.

2. INTRODUCTION

Movtecs are designed to protect mains powered equipment from the damaging effects of lightning and transients. They are ideal for point-of-entry shunt protection applications where robustness and high surge ratings are required.

The Movtec family is designed to suit many distribution systems including TN-C, TN-S, TN-C-S and TT. They can be selected for use with distribution systems with nominal voltages of 110/120V, 220/240V and 277Vrms at frequencies of 50/60 Hz.

The TDS Technology (Transient Discriminating Suppressor) units are specifically designed for distribution systems that may feature poor voltage regulation where the actual supply voltage may exceed the nominal ratings for extended periods.

This Installation Manual details the preferred procedure for the installation of the family of Critec Movtec™ Surge Diverters.

The Critec Movtec family includes:

- Critec Movtec, Single Mode, enhanced MOV technology units eg. (MT275V-135K-A)
- Critec TDS-Movtec, Single Mode, TDS technology unit featuring high over-voltage withstand for added robustness (TDS-MT-277)
- Critec TDS-Movtec, Three Mode, TDS technology unit featuring high over-voltage withstand for added robustness (TDS-MTU)

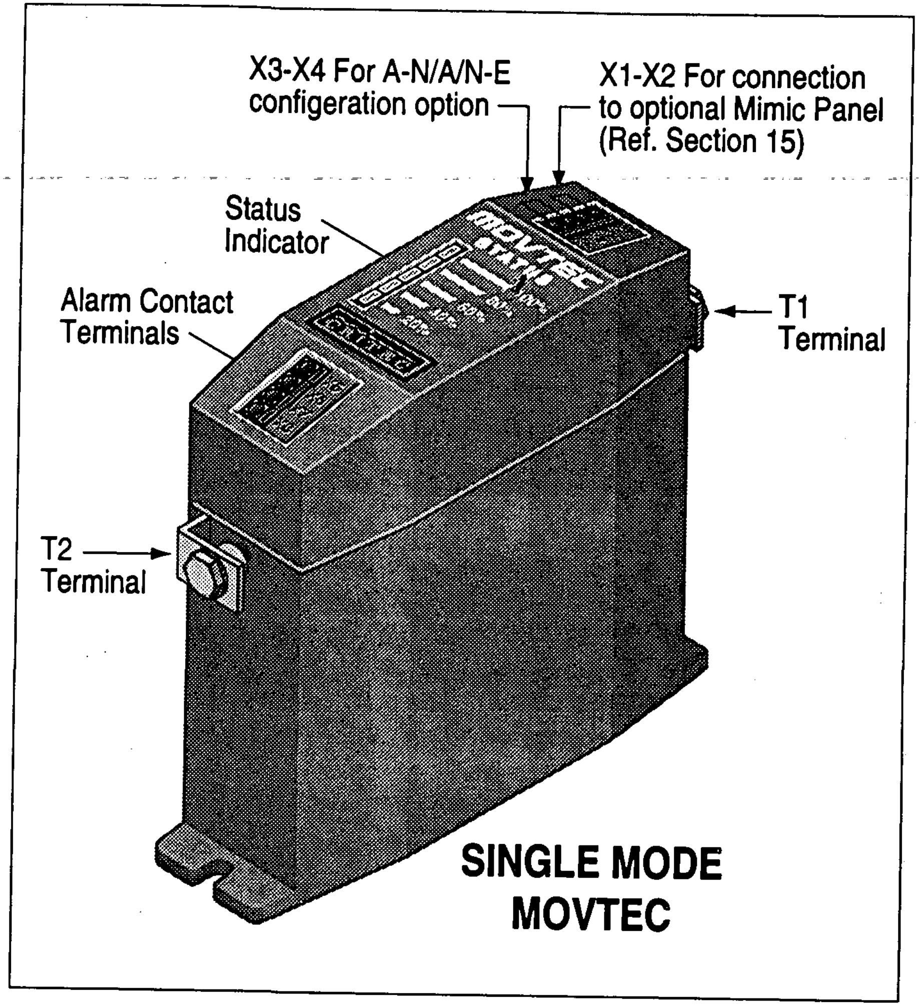
TDS-Movtec units are coloured blue for easy identification, while enhanced MOV technology units are coloured red.

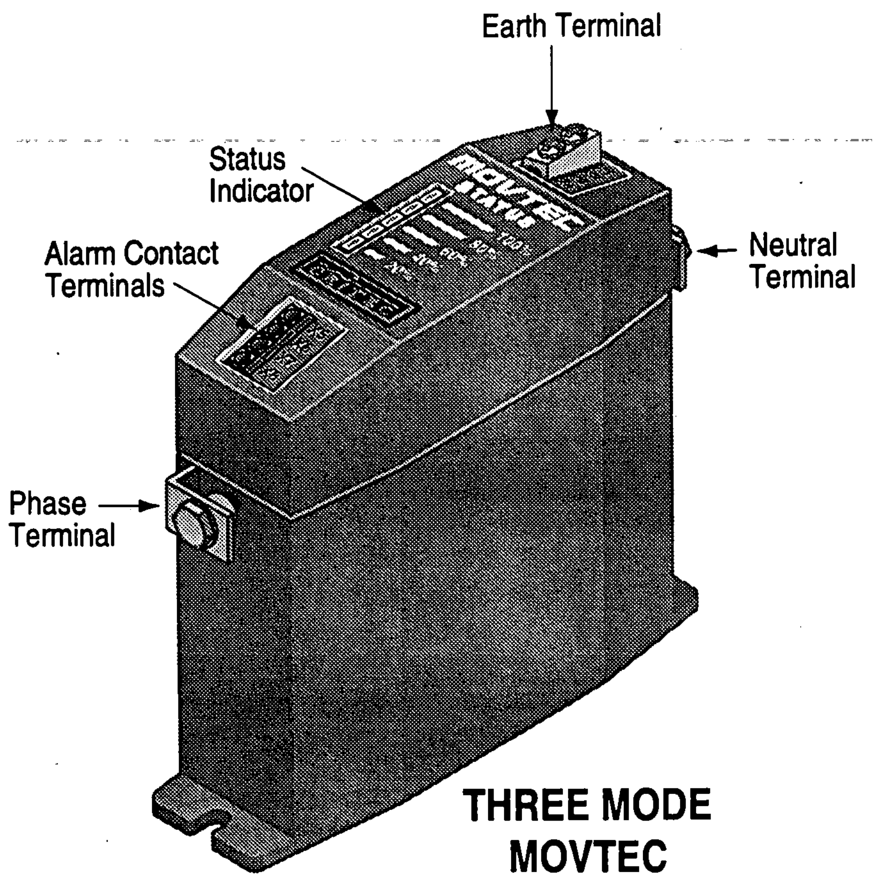
In this manual, reference to " Movtec" also includes "TDS-Movtec".

This manual also details the installation of the MPM (Movtec Protection Module). The MPM is a supplied enclosure with three Movtecs and a high energy neutral to earth protection device for three phase protection. The MPM is often used where Movtecs can not be fitted in an existing switchboard and must be mounted externally. Therefore the Movtec installation instructions are also applicable to the MPM. Section 11 gives details which are specific to the MPM.

Two standard MPMs are available:

- Critec TDS-MPM, Single Mode, TDS Technology unit (uses 3 x TDS-MT-277)
- Critec MPM-275V, Single Mode, Enhanced MOV Technology unit (uses 3 x MT275V-135K-A)





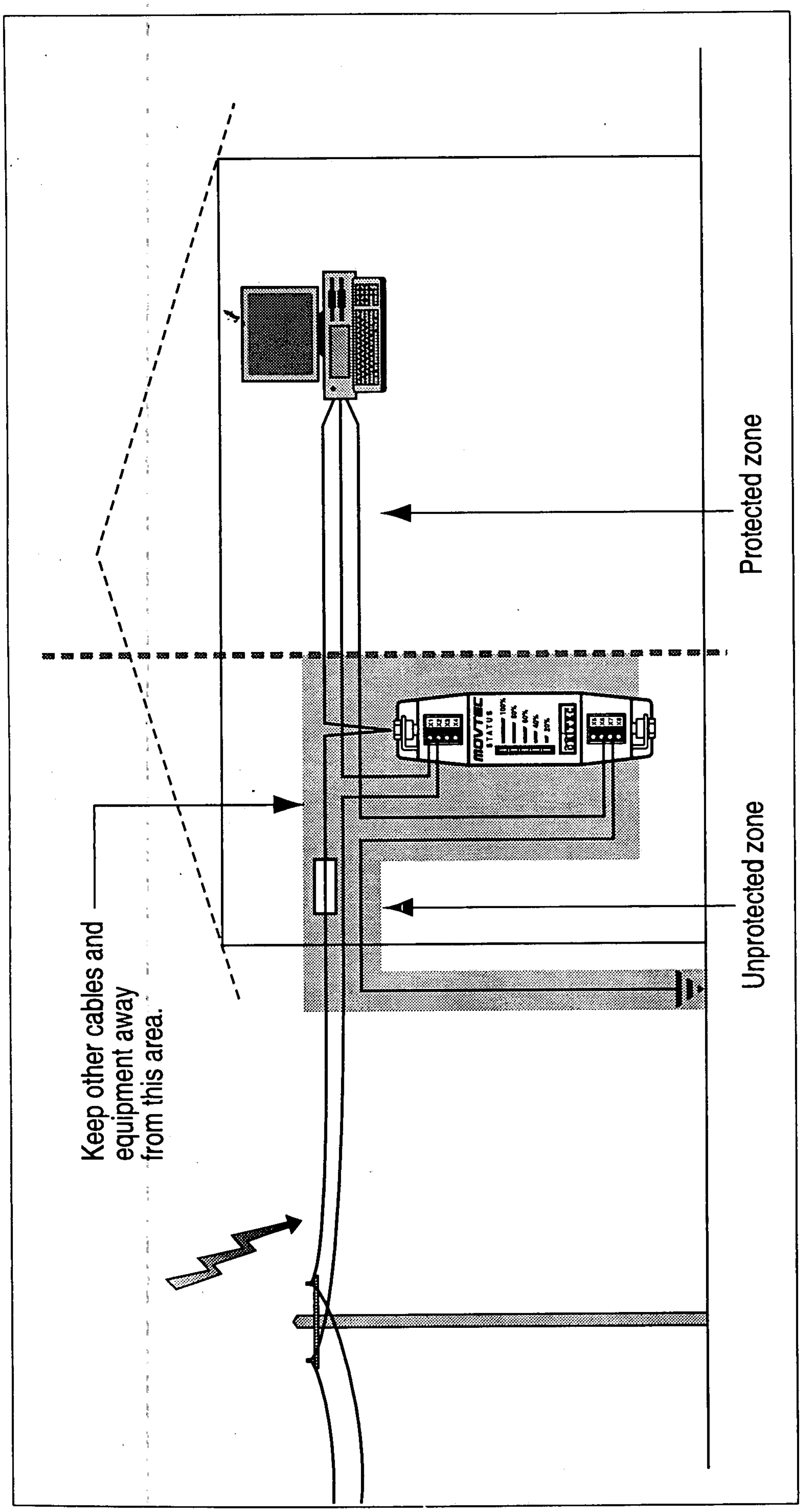
THREE MODE MOVTEC

3. PROTECTION CONCEPTS

To optimise effectiveness of installed protection a concept of "Unprotected" and "Protected" wiring should be followed. Wiring from the transient source to the Movtec should be considered "Unprotected" and kept remote from all other wiring (approximately 300mm) where possible. Wiring on the equipment side of the Movtec should be considered "Protected".

The separation of "Protected" from "Unprotected" wiring is recommended in order to minimise the risk of transients conducted on "Unprotected" wiring cross coupling on to "Protected" circuits, thus compromising the level of protection available from the Movtec.

ERICO INSTALLATION INSTRUCTIONS



4. MOUNTING & CAUTIONS

The performance of surge diverters can be dramatically affected by the method of connection (refer section 7). Where possible select a mounting method that allows the Movtec to be connected in the "Preferred Connection Method".

Failure of a Movtec under severe AC over-voltage, such as 11kV on 240V mains, can result in the generation of significant heat. Consideration should be given to ensure that Movtecs are not installed in close proximity to combustible materials.

Units must be installed in an enclosure or panel to provide the appropriate degree of electrical and environmental protection.

Only use enclosures that:

- Do not cause the Movtec temperature to exceed 60 deg C
- Provide adequate electrical and safety protection
- Prevent the ingress of moisture and water
- Allow Movtec Status Indication to be inspected

5 VOLTAGE RATINGS

The TDS (Transient Discriminating Suppressor) technology has been specifically developed to cater for abnormal over-voltage conditions that may occur on sites with poor voltage regulation, or due to wiring or distribution faults. The TDS units feature an extremely high over-voltage withstand to eliminate heat build up that can occur with standard technologies when the protection devices start to clamp on the peak of each abnormal mains cycle.

Traditional MOV technology (eg MT-275V/135K/A) is not suitable in applications where sustained over-voltage conditions can be experienced.

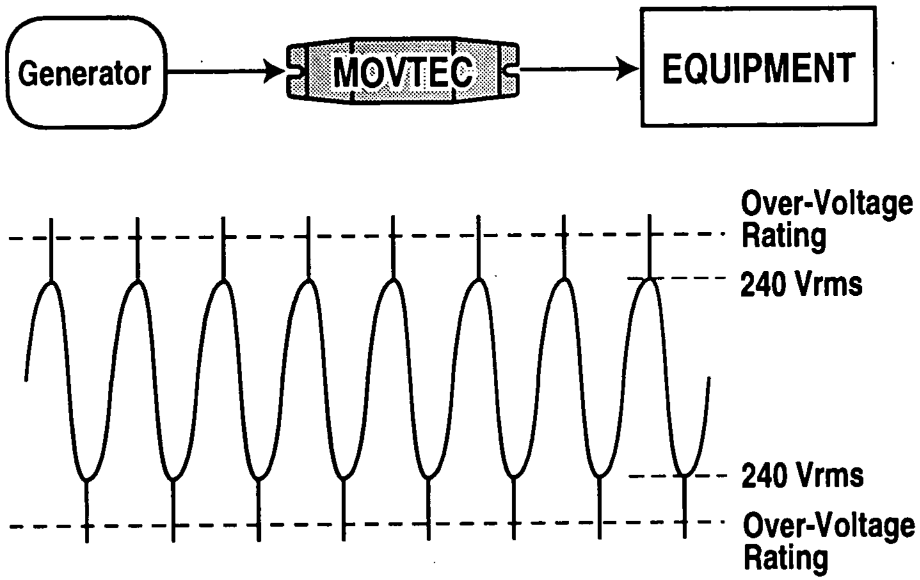
Examples of poorly regulated voltage environments include:

- Smaller power generation supplies
- Sites with large earth currents
- Variable motor speed control circuits
- High harmonic voltage environments (non-linear loads)

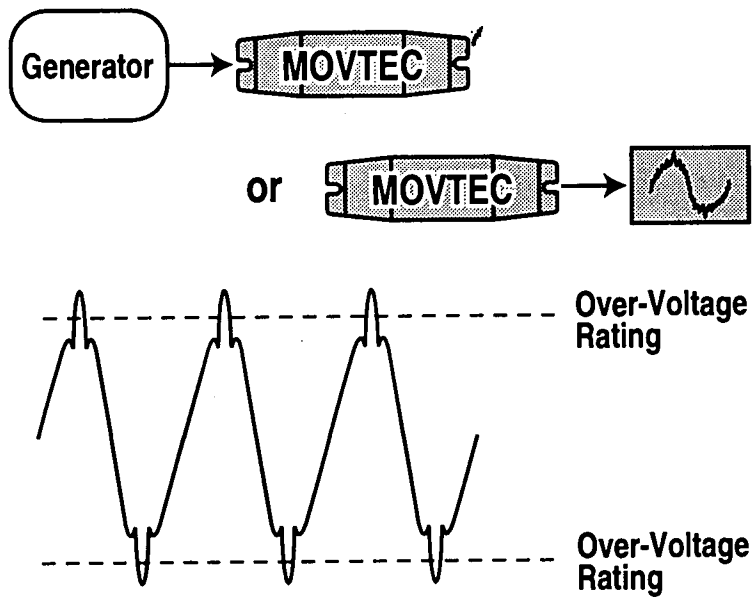
The TDS range of Movtecs with a higher over-voltage withstand may be able to be used in these environments following advice.

Transient protection devices are usually rated to protect against non-repetitive pulses from such sources as direct or induced lightning strikes. They are not designed to provide protection against repeated cyclic anomalies. Nor are they designed to provide protection

INSTALLATION INSTRUCTIONS MOVTEC



Avoid repetitive voltages in excess of rating



Avoid high harmonic voltages

against *sustained over-voltage conditions where the supply voltage exceeds the protection equipment's nominal rating for an extended period of time*, ie continuous over-voltages from poorly regulated generators or distribution systems.

Smaller power generation equipment (particularly capacitive excitation induction generators) does not generally conform to the same standards of voltage regulation that are in place for mains power reticulation. A large number of smaller and/or cheaper generators have a voltage waveform that is "loosely" 240Vrms (often poorly regulated), but more importantly, often contains significant higher order harmonics. These generators may exhibit a peak voltage on each half cycle far in excess of the normal 340V. The problem is usually worse when the generator is lightly loaded.

Whilst electrical equipment may tolerate this over-voltage for a period of time, the clamping elements in the power protection devices will begin to conduct on the peak of each 50Hz cycle, as their voltage threshold is reached (typically 400V peak for a traditional 275V diverter). This will cause slow degradation and ultimate failure of the clamping device (time dependent upon how poor the waveform is).

Harmonic voltages may also be present in distribution systems that do not feature generators. This is normally where non-linear loads are used, such as UPSs, rectifiers, switch mode power supplies and motor speed controls. The high harmonic voltages in certain applications may have peak voltages in excess of the protective clamping voltage causing problems as described above. Seek the manufacturer's advice before installing any product into a circuit which features a total harmonic voltage ratio above 5%.

Model	Nominal Voltage	†Maximum Permissible Abnormal Over-Voltage
TDS-MT-277	220-277V	480V
TDS-MTU	220-277V	480V
MT275V-135K-A	220-240V	275V

Ensure that the correct voltage rating unit is installed. Exceeding the nominal rating while transient events occur may affect product life.

† *Note: Other voltage rating Movtecs are available. Refer to Movtec table for actual ratings.*

6. PROTECTION MODES

Movtecs are available in Three Mode and Single Mode configurations. This refers to how the internal protection is arranged and applied to the circuit to be protected.

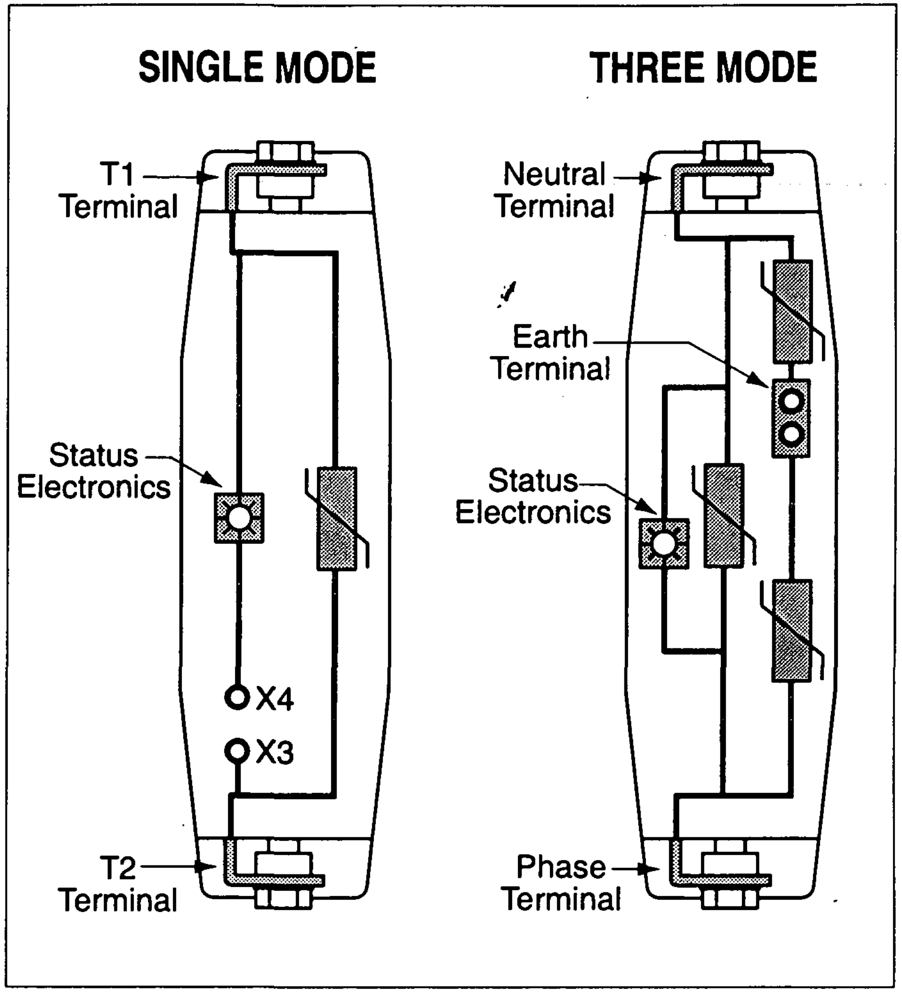
Three Mode units provide protection between the Phase-Neutral*, Phase-Earth* and Neutral-Earth circuit within one Movtec.

Single Mode units provide protection between two conductors connected to the terminals marked T1 and T2. These units can be connected to provide protection from Phase-Neutral* or Phase-Earth* or Neutral-Earth. To allow the status indication and alarm circuitry to operate, a neutral connection is required for Phase-Earth* configured units, and a Phase* connection is required for

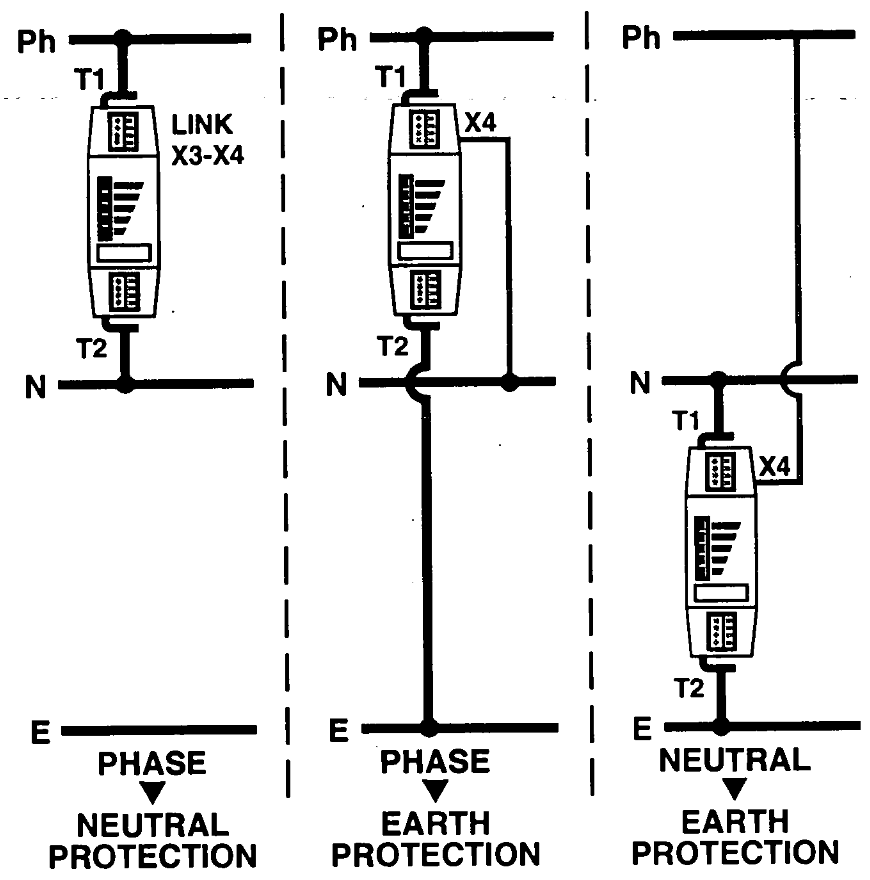
Neutral-Earth configured units. Connection details for single mode units are detailed on page 15. Warning - this connection link can be at mains potential.

* Note. Some users may be used to the terminology “Active” or “Line”, in place of “Phase”. For consistency “Phase” is used throughout this documentation.

Model	Modes
TDS-MTU	Three Mode
TDS-MT-277	Single Mode
MT275V-135K-A	Single Mode



SINGLE MODE CONNECTIONS OPTIONS



7. CONNECTION METHOD

To optimise transient performance, attempt to connect the Movtecs in the "Preferred" fashion as depicted on pages 16 and 17. This is recommended for cable sizes between 6mm^2 and 16mm^2. Take care not to run the protected and unprotected wire parallel or in close proximity.

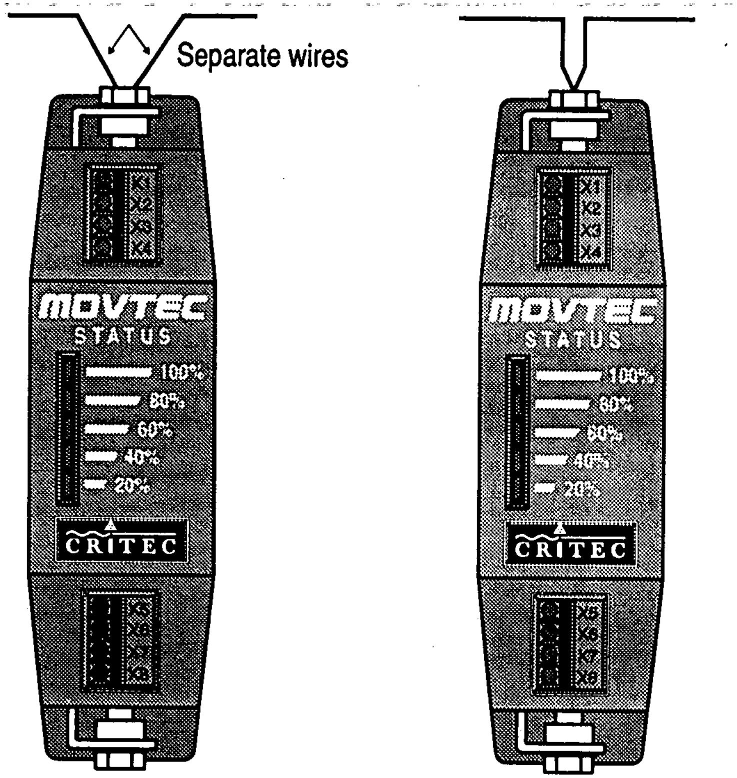
Where this is not possible due to layout or conductor size, use the "Non-preferred" "T" connection method as depicted on pages 16 to 18. With this connection method, the "T" lead should be between 6mm^2 and 16mm^2. The connection should be as short as practicable (less than 100mm).

Cable sizes less than 6mm^2 should not be used without specialist advice.

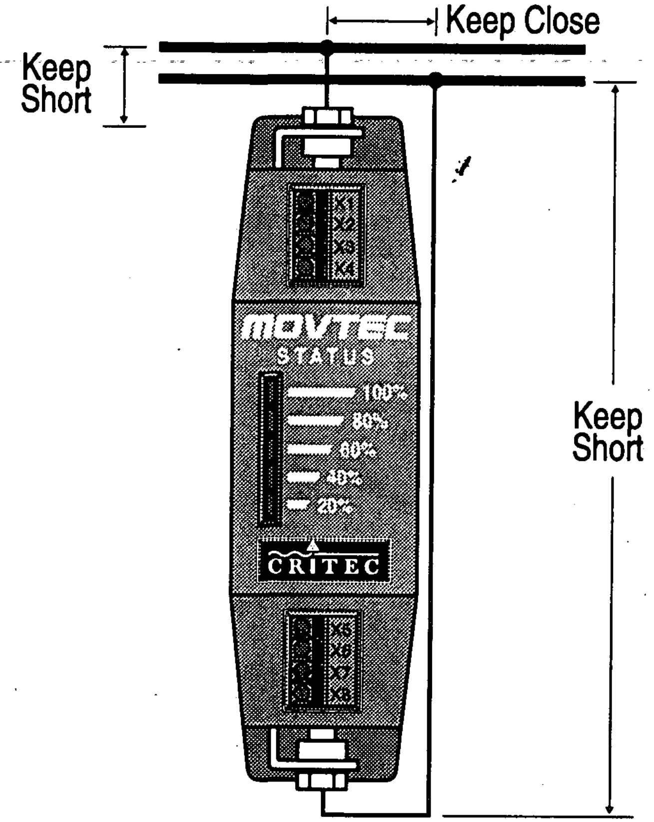
PREFERRED CONNECTION METHOD

✓ CORRECT

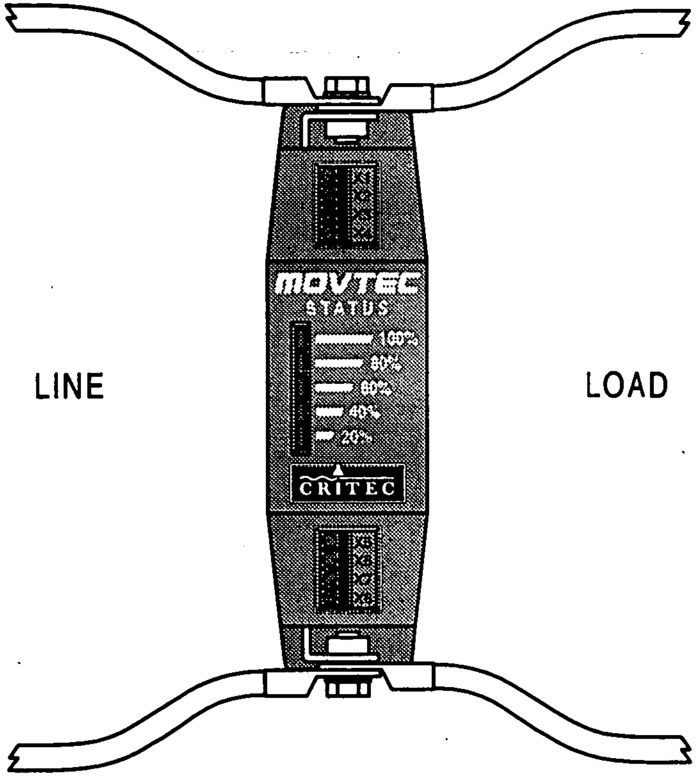
✗ INCORRECT



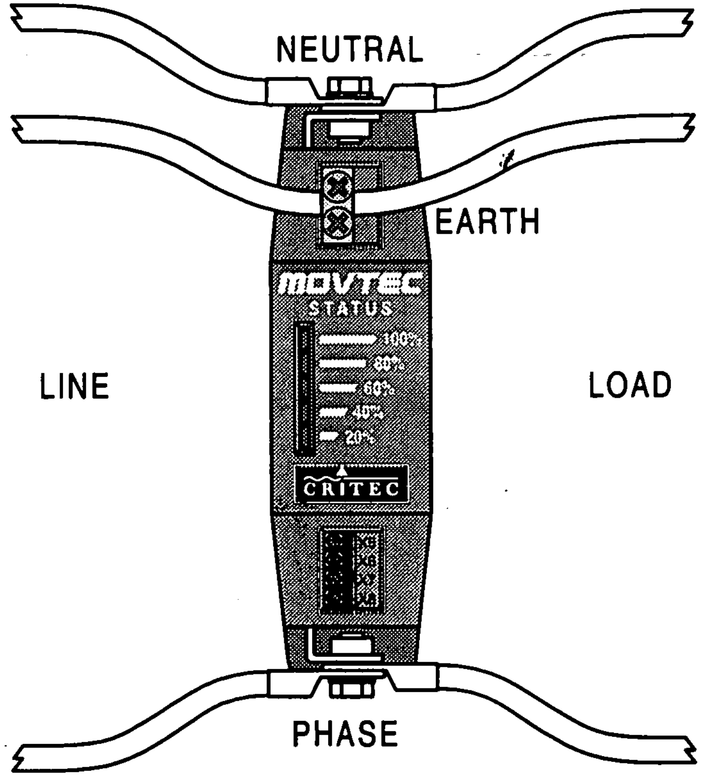
NON-PREFERRED "T" CONNECTION METHOD



PREFERRED CONNECTION METHOD EXAMPLES

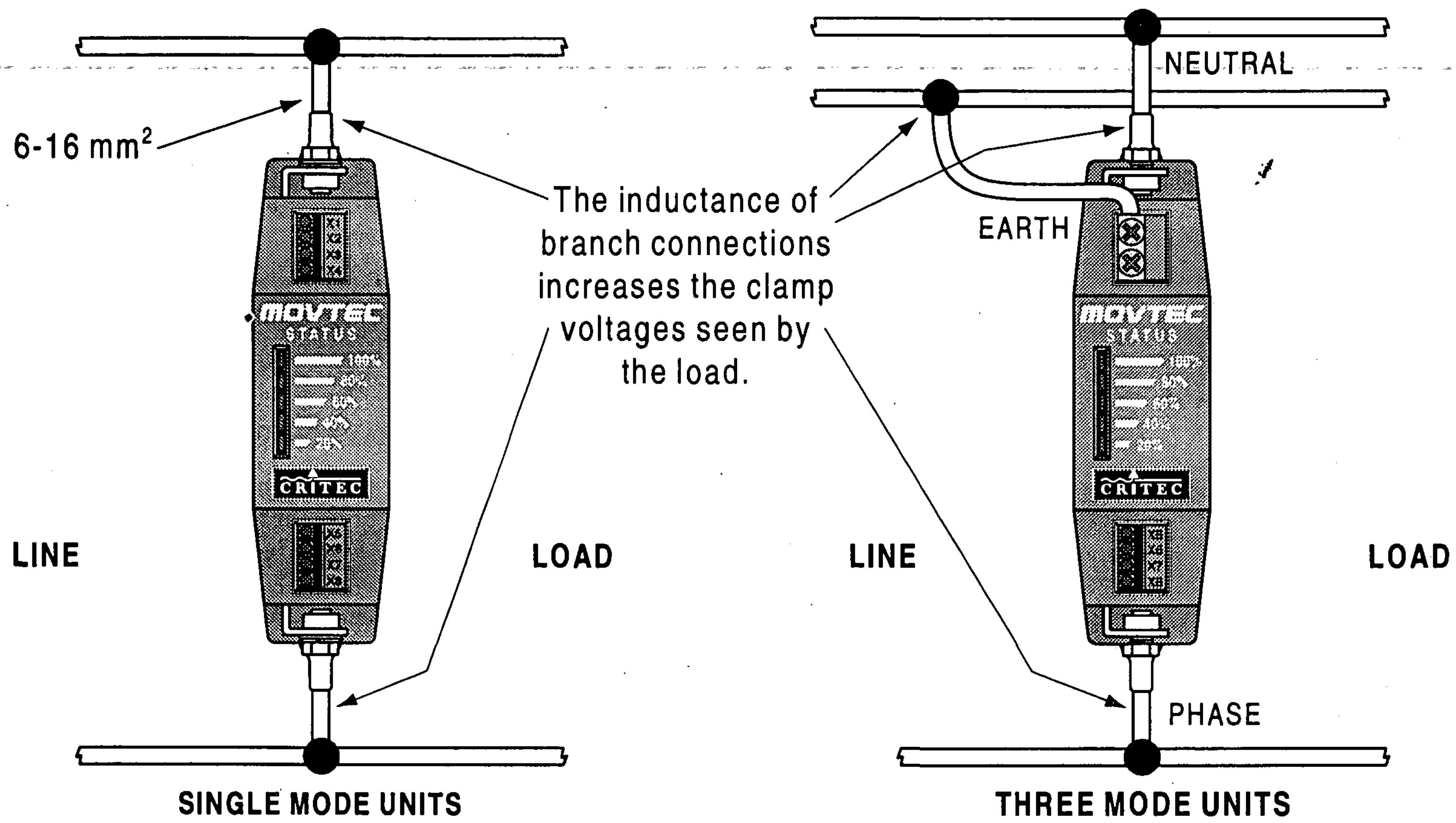


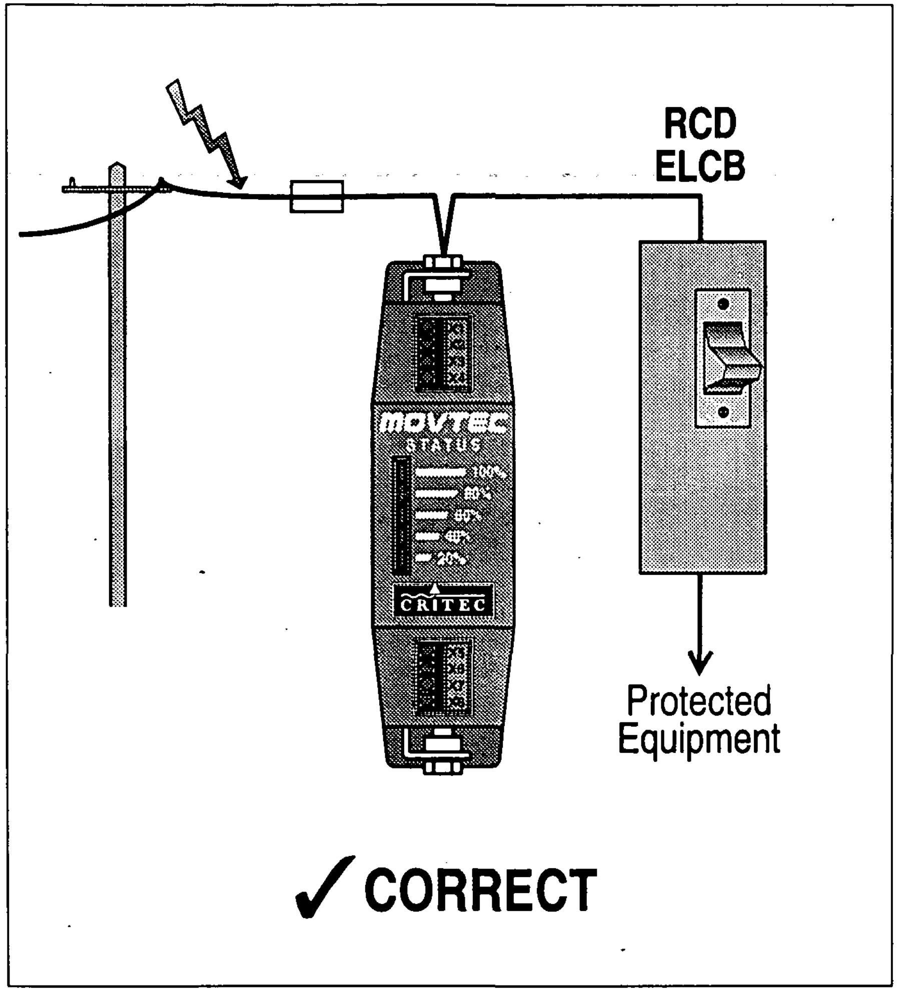
SINGLE MODE UNITS

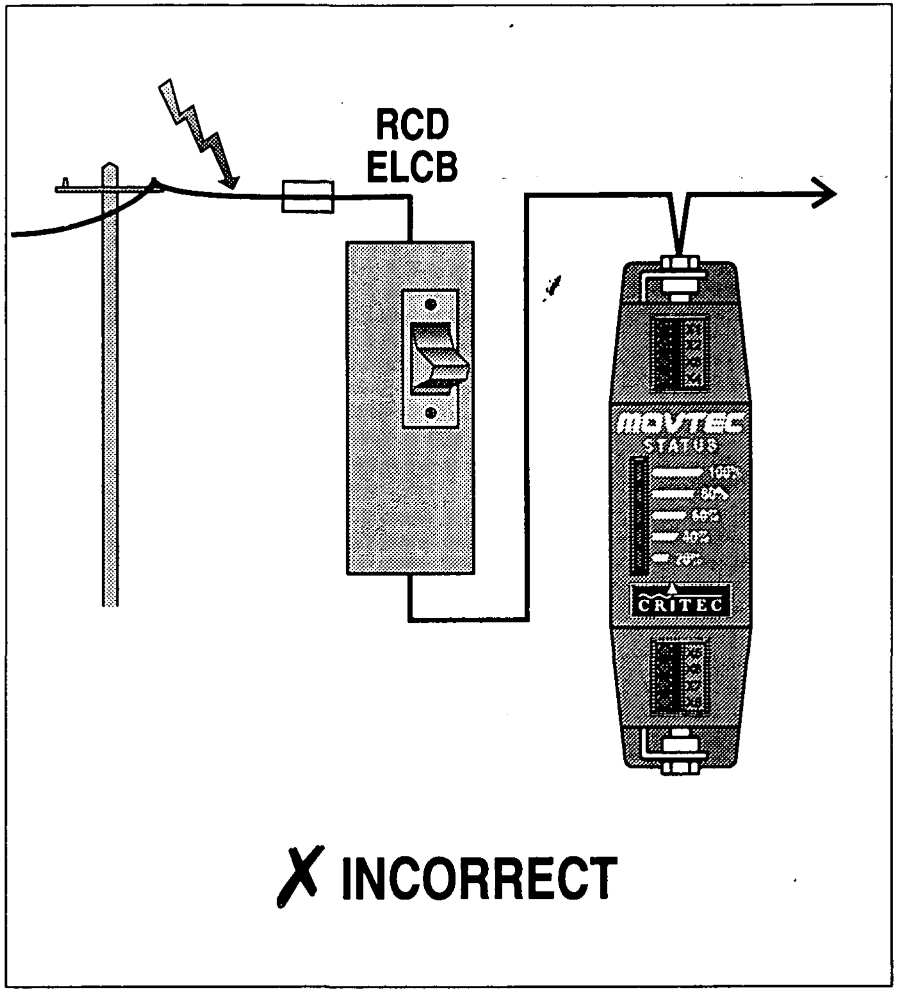


THREE MODE UNITS

NON-PREFERRED "T" CONNECTION METHOD EXAMPLES




RCD
ELCB
MOVTEC
STATUS
100%
80%
60%
40%
20%
CRITEC
Protected Equipment
✓ CORRECT


RCD
ELCB
MOVTEC
STATUS
CRITEC
✗ INCORRECT

8. RCD, ELCB

Where RCDs/ELCBs (Residual Current Devices / Earth Leakage Circuit Breakers) are fitted the Movtecs should be installed in the circuit prior to these devices (ie upstream). Where this can not be avoided and RCDs/ELCBs are installed upstream, nuisance tripping of the RCD/ELCB may occur during transient activity.

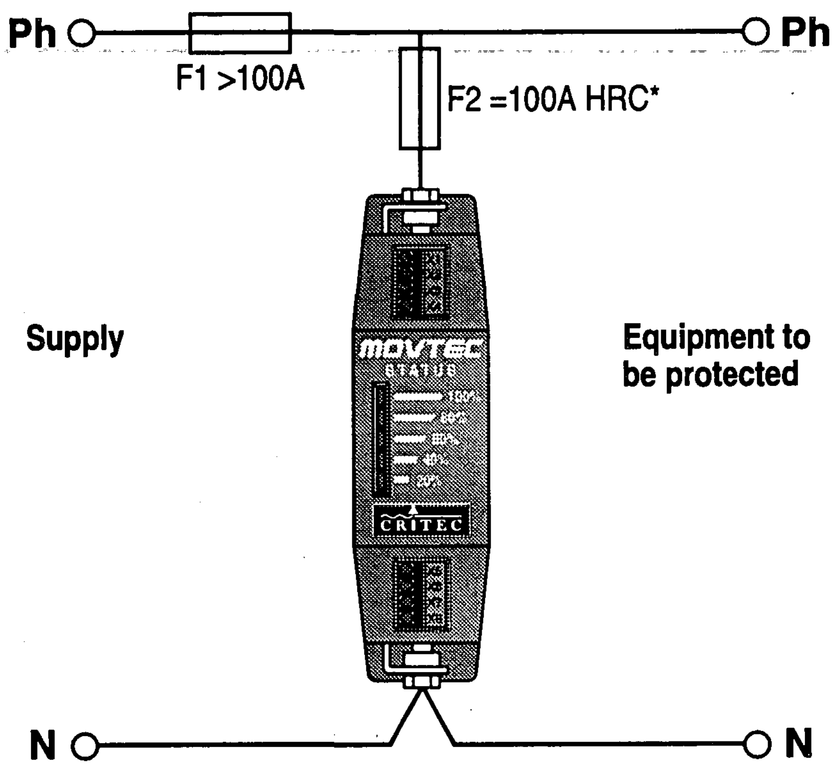
Contact your local ERICO agent for advice if upstream RCDs/ELCBs can not be avoided.

9. ISOLATION AND FUSING

Overcurrent and short circuit protection must be provided to protect the Movtec and associated wiring if a fault develops. The overcurrent protection should be installed in such a manner to also provide a means of isolating the Movtec module from the mains supply. This is an important safety consideration and is required in the event that any future maintenance or testing is needed.

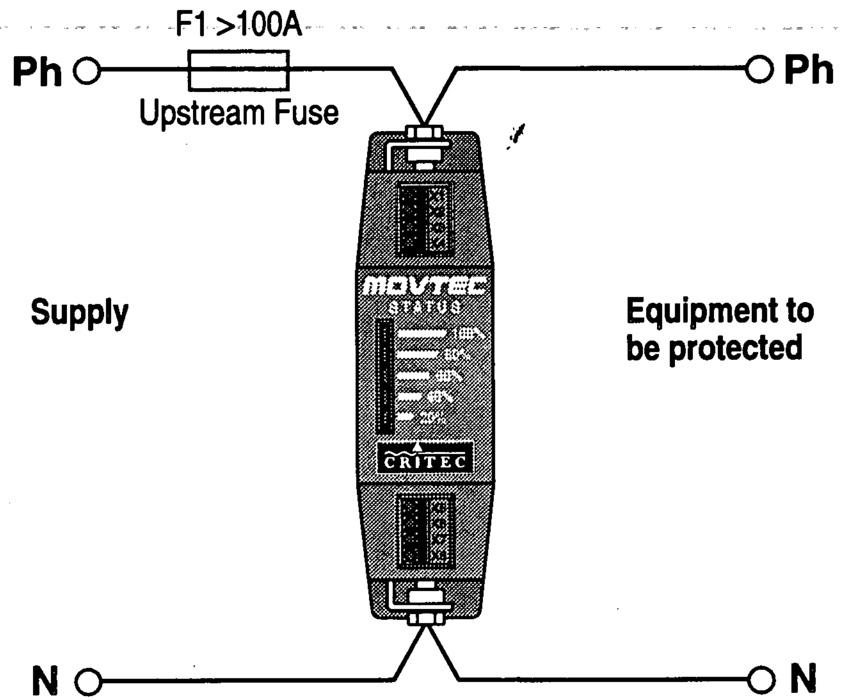
The Movtec uses disconnection devices to isolate internal segments that have reached the end of their service life. In order for this disconnection to occur correctly, Movtecs should be only used on circuits with fuse or circuit breaker ratings of 32A or greater. (Nuisance operation of the overcurrent protection may occur during transient activity on smaller capacity circuits.)

OVERCURRENT PROTECTION



Install F2 when F1 exceeds 100A
*HRC - High Rupture Capacity

OVERCURRENT PROTECTION



Suitable connection method when upstream Fuse/Supply capacity does not exceed 100A

On circuits with a capacity of greater than 100A, the Movtecs should be installed in series with a 100A HRC fuse being placed prior to the Movtec, as detailed in the diagram on page 21. This will require the Movtec to be installed in a similar manner to the non-preferred "T" connection method. Care must be taken to keep "T" connections as short and straight as possible. Note that this fuse may rupture under surge events exceeding 60kA, thereby disconnecting the protection circuit. Under such conditions it is important that suitable monitoring of the alarm contact should be carried out to detect this possible occurrence.

10. STATUS INDICATION AND ALARMS

A characteristic of **all** transient and surge protection devices is that they degrade in proportion to the magnitude and number of incident surges to which they have been subjected. Status indication should be periodically monitored to determine if replacement is required.

Each Movtec features 5 protection segments. The status for each of these sectors is provided by way of a 5 segment LED bar graph. If any sector is damaged due to excess surge activity, a LED will extinguish. The LEDs extinguish in a sequential order (100% LED out first, 80% LED out next etc.) irrespective of which sector has sustained damage.

When mains voltage is applied to the fully functional Movtec, the alarm contacts will be **closed**. Should the surge handling capacity fall to below the alarm threshold, these contacts will **open**. The contacts are “fail-safe” in that, if power to the unit fails, the contacts will also revert to the open condition.

For Single Mode units (TDS-MT-277 and MT275V-135K-A)

- The voltage free alarm contacts are activated (opened) as soon as the primary protection status displays 60% or less and indicates that the Movtec unit should be replaced.

For Three Mode units (TDS-MTU)

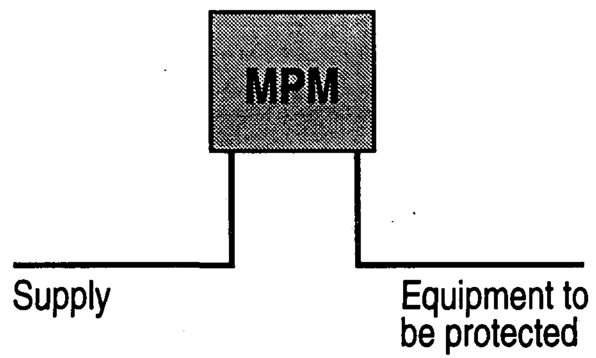
- The voltage-free alarm contacts are activated (opened) as soon as the protection status displays 80% or less. This indicates that damage has been sustained to the protection of one of the three modes and that the TDS-Movtec unit should be replaced.

MOVTEC MODEL	TERMINALS	ALARM OPERATES WHEN
TDS-MT-277	X5 & X7	MOVTEC displayed capacity =< 60%
MT275V-135K-A	X5 & X7	MOVTEC displayed capacity = <60%
TDS-MTU	X5 & X7	MOVTEC displayed capacity = <80%
Contact Rating	250Vac, 10A resistive, 1A inductive	
Contact connection	Multi-stranded wire with CSA not greater than $1.5mm^2$	

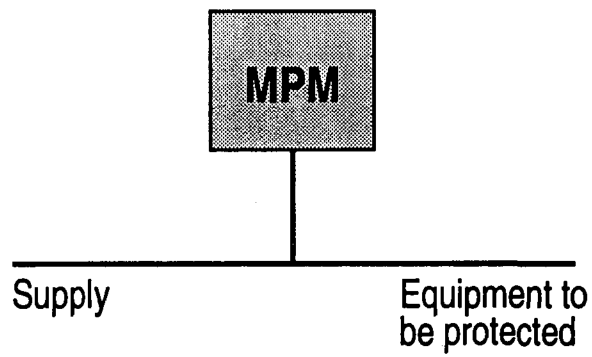
Where multiple Movtecs are used, such as in three phase distribution systems the alarm contacts may simply be connected in series to provide a common alarm output connection.

11. MPM, MOVTEC PROTECTION MODULE

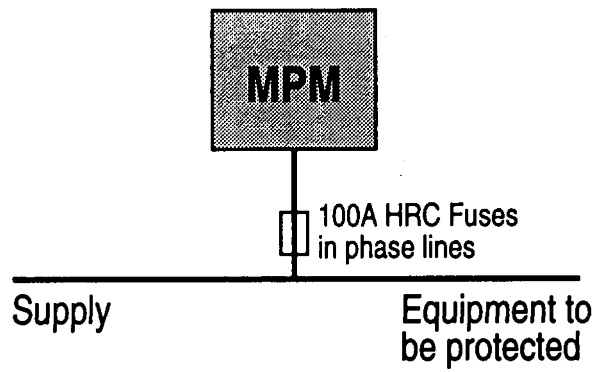
The MPM utilises a high energy Neutral to Earth spark gap to provide robust protection against earth potential rise problems. Care is required to ensure co-ordination of this device if any other voltage limiting device is connected either upstream or downstream in the Neutral to Earth circuit. **Contact your local agent for further information if other N-E protection devices are installed and co-ordination may be affected.**



PREFERRED CONNECTION METHOD



NON PREFERRED "T" CONNECTION METHOD
(Refer section 7)



CONNECTION METHOD ON CIRCUITS GREATER THAN 100A

INSTALLATION PROCEDURE FOR MPM

1 Remove the cover from the MPM

2 Select the MPM mounting position to ensure optimum electrical connection method (refer section 7) and in accordance with all given instructions

3 Position and mark the mounting position of the MPM on the wall

4 Prepare suitable anchoring holes for the marked positions

5 Mount the unit to the wall, preserving IP rating (if required)

6 Prepare the appropriate cable glands, preserving IP rating (if required) using suitable sealants

7 Install wiring, taking care to support cabling directly connecting to the MPM unit, and tighten all terminals

8 Check that the MPM is installed in accordance with all instructions, and relevant electrical and safety codes

9 Replace MPM cover, then apply power

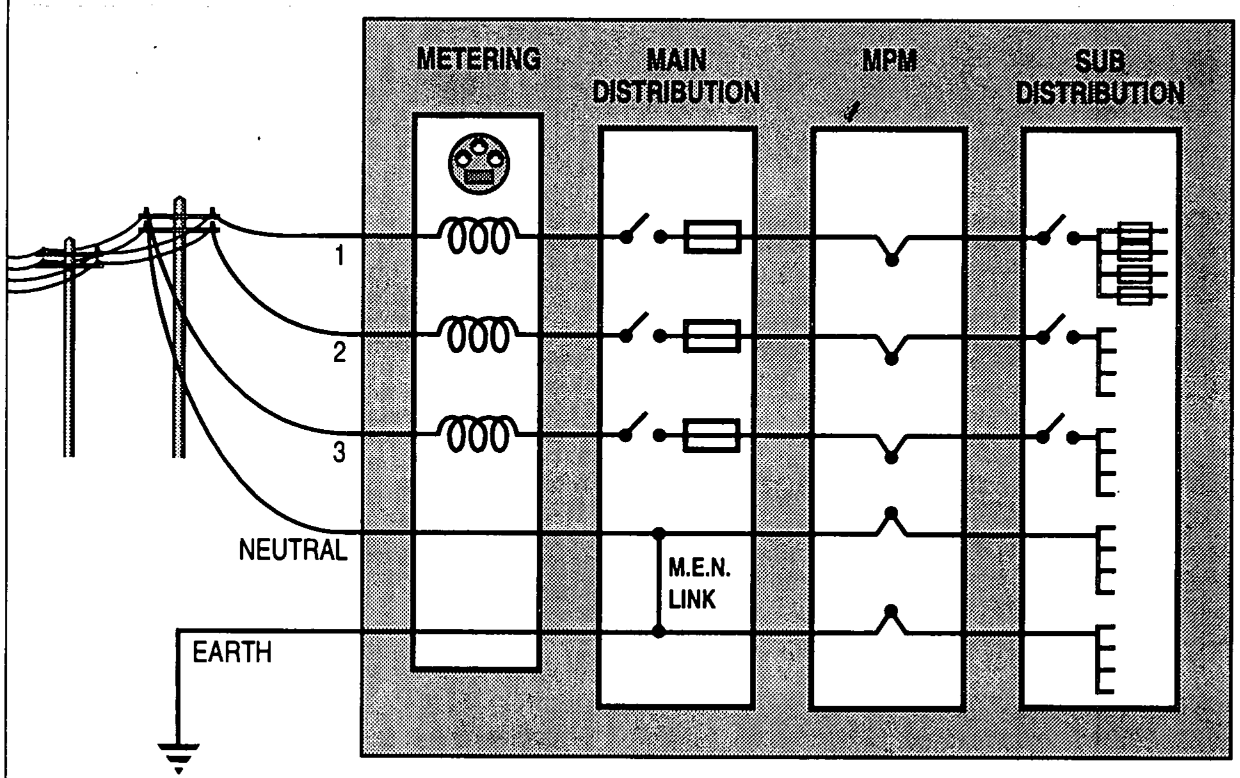
10 Correct operation of the MPM unit is established by checking that all 5 LED's on each Movtec bar graph are lit, and that power is correctly being supplied to the load(s)

INSTALLATION ARRANGEMENT FOR AUSTRALIAN MEN SYSTEMS

Under Australian Standards classification, MPMs are considered a piece of equipment to be connected to the mains supply. The MPMs are not intended for use as, nor are they, a 'switch board', 'distribution board' or other equipment. As MPMs are classified as 'electrical equipment' (ie: a product), AS 3000 Wiring Regulations apply to the installation and operation of the units.

In the multiple earth neutral (MEN) distribution system, the MPM equipment should be installed as close as possible after the MEN point and after both the main disconnect switch/ overcurrent protector and any metering equipment.

TYPICAL CONNECTION DETAIL FOR MPM POINT-OF-ENTRY INSTALLATION IN MEN DISTRIBUTION SYSTEM



12. MAINTENANCE & TESTING

Before removing any unit from service ensure that power to the device is isolated. Replacement of any Movtec units should only be undertaken in accordance with all relevant Electricity and Safety Standards by suitably qualified personnel.

Movtecs should be inspected periodically, and also following any periods of lightning or transient activity. Check the status indicators and replace if in the “Alarm” condition as detailed in Section 10 -STATUS INDICATION.

For high transient exposure sites or those of a critical operational nature, it is recommended that the alarm outputs be monitored to provide an additional warning of reduced capacity (refer Section 10).

Movtecs are designed for optimum performance under severe transient activity. To provide this performance, electronic components in the Movtec are encased in a patented proprietary, shock and thermal absorbant compound. **Units cannot be serviced, they must be replaced.**

Do not attempt to open or tamper with the units in any way as this may compromise performance and will void warranty.

Do not “Megger” or perform other types of electrical tests that apply voltages greater than the nominal operating voltage of the Movtec. The Movtec will attempt to limit these voltages thereby affecting the test result. Where these tests must be performed, remove the Movtec from circuit first.

13. EXTENDED WARRANTY

This product has a limited warranty to be free from defects in materials and workmanship for a period of five (5) years from the date of dispatch from the Manufacturer. The Purchaser acknowledges that lightning is a natural event with statistical variation in behaviour and energy levels which may exceed product ratings, and 100 % protection is not offered and cannot be provided for. Therefore the Manufacturer's liability is limited to the repair or replacement of the product (at the Manufacturer's sole option) which in its judgement has not been abused, misused, interfered with by any person not authorised by the Manufacturer, or exposed to energy or transient levels exceeding the Manufacturer's specifications for the product. The product must be installed and earthed (where applicable) in strict accordance with the Manufacturer's specifications and all relevant national Electricity and Safety Standards. The Manufacturer and the Purchaser mutually acknowledge that the product, by its nature, may be subject to degradation as a consequence of the number and severity of surges and transients that it experiences in normal use, and that this warranty excludes such gradual or sudden degradation. This warranty does not indemnify the Purchaser of the product for any consequential claim for damages or loss of operations or service or profits. Customers should contact their nearest manufacturer's agent to obtain a Product Repair Authorisation Number prior to making any claim under this warranty. This is only a summary of the warranty given by the Manufacturer. The full text of the warranty is set out in the Manufacturer's Conditions of Quotation and Sale. The above limited warranty is additional to rights which arise in respect of the sale of industrial and technical products and services to knowledgable buyers under the Australian Trade Practices Act 1974 as amended.

14. SIX POINT PLAN

Critec Movtec surge diverters form an important part of the much larger ERICO lightning, surge and transient protection philosophy (ERICO Lightning Technologies "Six Point Plan"). The level of protection and the degree of attention dedicated to each of the six points will require careful consideration for each site. The degree of protection required is determined by the individual site location/exposure with the aid of risk management principals.

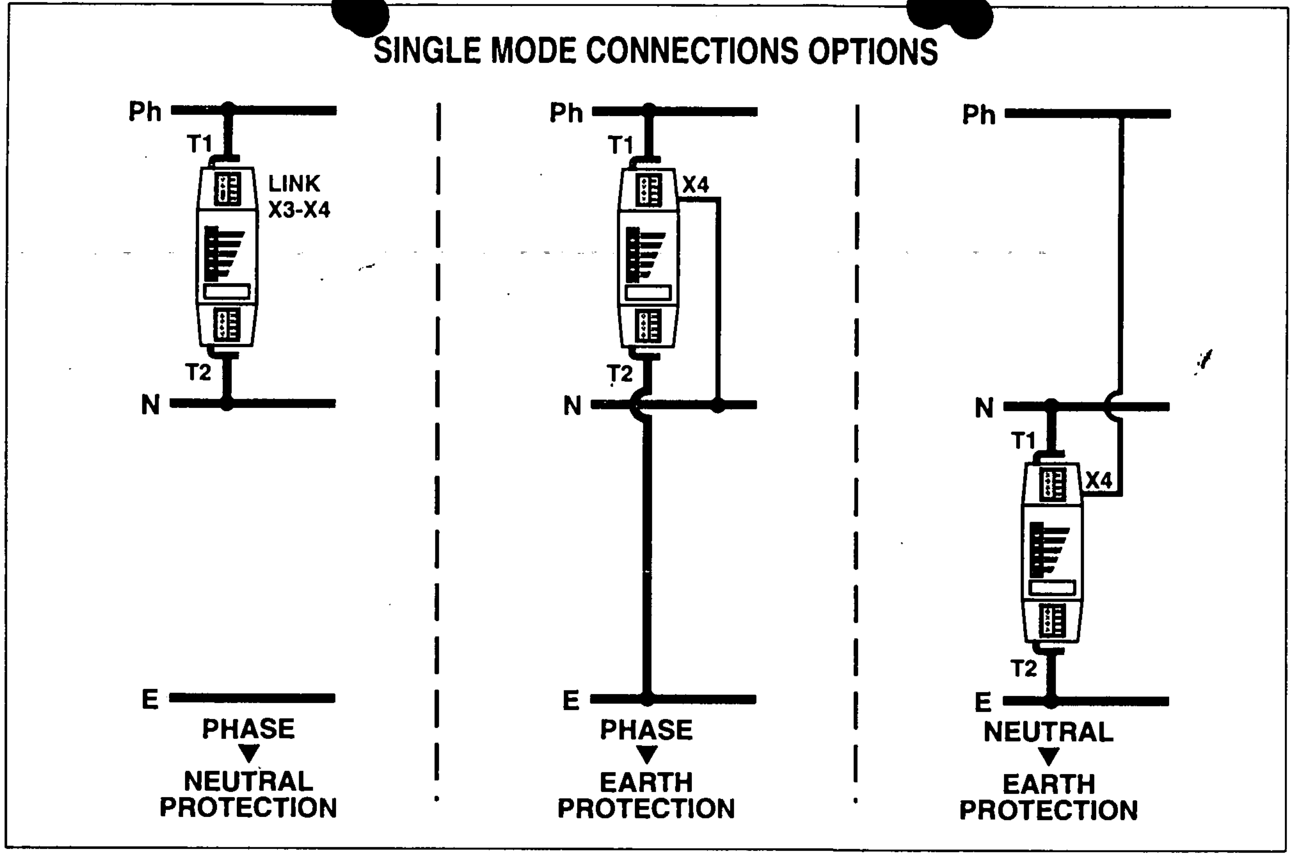
For further advice on your protection needs please contact your local representative.

15. USE OF MIMIC PANELS

Movtecs are used in the Proline range of Surge Reduction Filters where superior protection is required for critical or sensitive electronic equipment. Some models of SRF use an electronic mimic panel to display in the front door the status of the internal Movtecs. The X1-X4 terminals on the Movtec are used for this purpose. If this Movtec is to be used with a mimic panel (possibly as a replacement for an existing Movtec in a SRF) please ensure compatibility as below.

MOVTEC & MIMIC COMPATIBILITY

Movtec Version	Mimic Version		
	TDS-Mimic #300732 EA-SRFP-117 EA-117	Hybrid Mimic #300731 EA-SRFP-115 EA-115	Discrete Mimic #300730 EA-SRFP-104 EA-104
TDS-MT-277	Yes	Note 1	No
MT-275V/135K/A #300867	Yes	Yes	Note 2
MT-275V/135K/A #300865/300866	Yes	Yes	Yes
Note 1	Mimic will operate for supply voltages up to 275Vrms		
Note 2	Request Product Update 44 for further details		



ERICO® Technopark, Dowsings Point, Tasmania, Australia.
GPO Box 536 Hobart, Tasmania, Australia 7001
Telephone: 61 (0) 3 6237 3200 Facsimile: 61 (0) 3 6273 0399

Accessories (also to suit ZB5A double insulated pushbuttons & XAL control stations)

Standard (30 x 40mm) legend plates

Description	Legend Colour			Reference
With blank legend (for engraving)	Black or red background			**ZBY2101**
	White or yellow background			**ZBY4101**
Already engraved	O (black background)	**ZBY2146**	HAND	**ZBY2316**
	O (red background)	**ZBY2931**	HAND-OFF-AUTO	**ZBY2387**
	I	**ZBY2147**	INCH	**ZBY2321**
	II	**ZBY2148**	LEFT	**ZBY2310**
	O-1	**ZBY2178**	OFF	**ZBY2312**
	I-II	**ZBY2179**	OFF-ON	**ZBY2367**
	I-O-II	**ZBY2186**	OPEN	**ZBY2313**
	AUTO	**ZBY2115**	POWER ON	**ZBY2326**
	STOP (red background)	**ZBY2304**	RESET (red background)	**ZBY2323**
	AUTO-HAND	**ZBY2364**	RESET (black background)	**ZBY2322**
	AUTO-O-HAND	**ZBY2385**	REVERSE	**ZBY2306**
	CLOSE	**ZBY2314**	RIGHT	**ZBY2309**
	DOWN	**ZBY2308**	RUN	**ZBY2334**
	EMERGENCY STOP	**ZBY2330**	SLOW	**ZBY2327**
	FAST	**ZBY2328**	START (black background)	**ZBY2303**
	FORWARD	**ZBY2305**	STOP-START	**ZBY2366**
			UP	**ZBY2307**

Circular legends for emergency stop mushroom heads

Diameter mm	Marking on yellow background	Reference
60	EMERGENCY STOP	**ZBY9330**
90	EMERGENCY STOP	**ZBY8330**

Metal guards Padlocking possible	Ø40 emergency stop and mushroom head pushbuttons	Blue	**ZBZ1601**
		Black	**ZBZ1602**
		Red	**ZBZ1604**
		Yellow	**ZBZ1605**
Metal blanking plug, round, chromium plated (1)	For Ø22 control and signalling units		**ZB4SZ3**
Plastic blanking plug, round, black (2)	For Ø22 control and signalling units		**ZB5SZ3**

(1) Requires a ZB4BZ009 body/fixing collar for mounting.
(2) Fixing nut included with blanking plug.

Selection guide to the new double insulated pushbutton range from Telemecanique

Harmony
Style 5
ZB5
Double insulated

XAL
Control stations

Ø22

IP65 and NEMA 4X

Merlin Gerin
Modicon
Square D
Telemecanique

Schneider Electric

XAL Double Insulated Control Stations

- Same mounting points as the old products
- Stainless steel screws as standard
- Compact overall dimensions
- Up to 3 electrical blocks per head

Protected® LED

Empty Enclosures

+ Heads + Bodies

Complete Stop/Start Function

(light grey base/dark grey lid)

					Old	New
"Start"	Marking on pushbutton	1 N/O	Flush	Green	XALB103	**XALD103**
"Stop"	Marking on pushbutton	1 N/C	Flush	Red	-	**XALD114**
"Start"	Marking on pushbutton	1 N/O	Flush	Green	XALB215	**XALD215**
"Stop"		1 N/C	Flush	Red		
"O-I"	Marking on legend plate	1 N/O			XALB134	**XALD134**
1 selector switch, 2 position stay put						
"O-I"	Marking on legend plate				XALB144	**XALD144**
1 key selector switch, 2 position stay put						
"I"	Marking on pushbutton	1 N/O	24VAC/DC		-	**XALD363B**
"O"		1 N/C	110...120VAC		-	**XALD363G**
1pilot light with red "Protected LED"			230...240VAC		XALB376	**XALD363M**

Complete Emergency Stop Function

(light grey base/yellow lid)

1 mushroom head pushbutton, red Ø40mm, latching "turn to release"	XALJ174	**XALK174**
1 mushroom head pushbutton, red Ø40mm, latching "key release"	XALJ184	**XALK184**

Components for Customer Assembly

• light grey base	1 hole	XALB01	**XALD01**
• dark grey lid	2 holes	XALB02	**XALD02**
	3 holes	XALB03	**XALD03**
	4 holes	XALB04	**XALD04**
	5 holes	XALB05	**XALD05**

(see XB5A heads on left pages)

Electrical Contact Blocks (for base mounting with metal clip)

Contact blocks			
	N/O	XENL1111	**ZENL1111**
	N/C	XENL1121	**ZENL1121**

"Protected LED" modules	White	24VAC/DC	XALV6+bulb	**ZALVB1**
	Green		XALW6+bulb	**ZALVB3**
	Red			**ZALVB4**
	Yellow			**ZALVB5**
	Blue			**ZALVB6**
	White	48...120VAC	XALV6+bulb	**ZALVG1**
	Green		XALW6+bulb	**ZALVG3**
	Red			**ZALVG4**
	Yellow			**ZALVG5**
	Blue			**ZALVG6**
	White	230...240VAC	XALV7+bulb	**ZALVM1**
	Green		XALW7+bulb	**ZALVM3**
	Red			**ZALVM4**
	Yellow			**ZALVM5**
	Blue			**ZALVM6**

Protected® LED

(1) You can also mount XB5A contact blocks directly beneath the heads.

Volt-free terminal for XAL stations (common/earth)	**XALZ09**

Selection guide to the new metal pushbutton range from Telemecanique

Harmony
Style 4
ZB4
Metal

Ø22

IP65 and NEMA 4X

Merlin Gerin
Modicon
Square D
Telemecanique

Schneider Electric

Illuminated Pushbuttons and Selector Switches
Unique, patented "Protected LED" technology
2 references ZB5AW• = 1 complete product

Head

+

Body

Illuminated Pushbuttons

			Old	New
	Flush	White	ZA2BW37	**ZB5AW313**
	Flush	Green	ZA2BW33	**ZB5AW333**
	Flush	Red	ZA2BW34	**ZB5AW343**
	Flush	Yellow	ZA2BW35	**ZB5AW353**
	Flush	Blue	ZA2BW36	**ZB5AW363**
	Booted	White	ZA2BW57	**ZB5AW513**
	Booted	Green	ZA2BW53	**ZB5AW533**
	Booted	Red	ZA2BW54	**ZB5AW543**
	Booted	Yellow	ZA2BW55	**ZB5AW553**
	Booted	Blue	ZA2BW56	**ZB5AW563**

Illuminated Selector Switches (2 position stay put (*))

		White	ZA2BK127	**ZB5AK1213**
		Green	ZA2BK123	**ZB5AK1233**
		Red	ZA2BK124	**ZB5AK1243**
		Yellow	ZA2BK125	**ZB5AK1253**
		Blue	ZA2BK126	**ZB5AK1263**

(*) other configurations are available.

Collar + LED module + Contact Block (1)

24VAC/DC	1 N/O	White	ZA2BW061+bulb	**ZB5AW0B11**
	1 N/O	Green	ZA2BW061+bulb	**ZB5AW0B31**
	1 N/C	Red	ZA2BW062+bulb	**ZB5AW0B42**
	1 N/O	Yellow	ZA2BW061+bulb	**ZB5AW0B51**
	1 N/O	Blue	ZA2BW061+bulb	**ZB5AW0B61**
48...120VAC	1 N/O	White	ZA2BW061+bulb	**ZB5AW0G11**
	1 N/O	Green	ZA2BW061+bulb	**ZB5AW0G31**
	1 N/C	Red	ZA2BW062+bulb	**ZB5AW0G42**
	1 N/O	Yellow	ZA2BW061+bulb	**ZB5AW0G51**
	1 N/O	Blue	ZA2BW061+bulb	**ZB5AW0G61**
230...240VAC	1 N/O	White	ZA2BW071	**ZB5AW0M11**
	1 N/O	Green	ZA2BW071	**ZB5AW0M31**
	1 N/C	Red	ZA2BW072	**ZB5AW0M42**
	1 N/O	Yellow	ZA2BW071	**ZB5AW0M51**
	1 N/O	Blue	ZA2BW071	**ZB5AW0M61**

(1) for 1 N/O + 1 N/C contacts, replace in ZB5AW01, the last digit "1" by "5"**

Accessories

Description	For use with	
Plastic blanking plug, round, black (1)	For Ø22 control and signalling units with circular head	**ZB5SZ3**
Add-on square trim	Gives square appearance to circular heads ZB5-A	**ZB5AZ31**
Lock nut	Fixing head	**ZB5AZ901**
Tightening tool		**ZB5AZ905**
Anti-rotation plate	For selection switches	**ZB5AZ902**
Single boot	Booted pushbuttons with circular head	**ZBP0**
Double boot	Double headed pushbuttons with or without pilot light	**ZBW008**

(1) Fixing nut included with blanking plug.

Schneider Electric

Pushbuttons and Selector Switches
2 references ZB4B• = 1 complete product

Head

+

Body

Pushbuttons

			Old	New
Flush	Black		ZB2BA2	**ZB4BA2**
Flush	Green		ZB2BA3	**ZB4BA3**
Flush	Red		ZB2BA4	**ZB4BA4**
Flush	Yellow		ZB2BA5	**ZB4BA5**
Flush	Blue		ZB2BA6	**ZB4BA6**
Booted	Black		ZB2BP2	**ZB4BP2**
Booted	Green		ZB2BP3	**ZB4BP3**
Booted	Red		ZB2BP4	**ZB4BP4**
Booted	Yellow		ZB2BP5	**ZB4BP5**
Booted	Blue		ZB2BP6	**ZB4BP6**

Selector Switches (1)

2 position stay put		ZB2BD2	**ZB4BD2**
2 position spring return		ZB2BD4	**ZB4BD4**
3 position stay put		ZB2BD3	**ZB4BD3**
3 position spring return		ZB2BD5	**ZB4BD5**
3 position spring return		ZB2BD8	**ZB4BD8**

Key Selector Switches (1)

2 position stay put		ZB2BG2	**ZB4BG2**
2 position stay put		ZB2BG4	**ZB4BG4**
2 position spring return		ZB2BG6	**ZB4BG6**
3 position stay put		ZB2BG0	**ZB4BG0**
3 position stay put		ZB2BG3	**ZB4BG3**
2 position spring return		ZB2BG7	**ZB4BG7**

The symbol indicates key removal position(s)

(1) For activation of lateral contacts only.

Mushroom Head Pushbuttons (Spring Return)

Ø40mm	Green	ZB2BC3	**ZB4BC3**
Ø40mm	Red	ZB2BC4	**ZB4BC4**

Emergency Stop Pushbuttons (Latching)

Ø40mm	Red	turn to release	ZB2BS54	**ZB4BS54**
Ø40mm	Red	push/pull	ZB2BT4	**ZB4BT4**
Ø40mm	Red	key release	ZB2BS14	**ZB4BS14**

Collar + Contact Block(s)

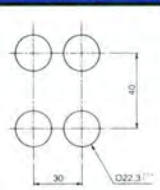
1 N/O	ZB2BZ101	**ZB4BZ1[illegible]**
1 N/C	ZB2BZ102	**ZB4BZ102**
2 N/O	ZB2BZ103	**ZB4BZ103**
2 N/C	ZB2BZ104	**ZB4BZ104**
1 N/O + 1 N/C	ZB2BZ105	**ZB4BZ105**

Additional Contact Block

1 N/O	ZB2BE101	**ZBE101**
1 N/C	ZB2BE102	**ZBE102**
2 N/O	-	**ZBE203**
2 N/C	-	**ZBE204**
1 N/O + IN/C	-	**ZBE205**

XB4B Mounting

Support Panel Cut-Out
(suitable for mounting all types of pushbuttons and pilot lights)



Panel thickness: 1 to 6mm

Assembly – 3 simple steps

Schneider Electric

Pilot Lights
Unique, patented "Protected LED" technology
1 reference XB5AV• • = 1 complete product

Protected® LED

Pilot lights with integral LED		Old	New
24VAC/DC	White	ZA2BV6+ZA2BV07+bulb	**XB5AVB1**
	Green	ZA2BV6+ZA2BV03+bulb	**XB5AVB3**
	Red	ZA2BV6+ZA2BV04+bulb	**XB5AVB4**
	Yellow	ZA2BV6+ZA2BV05+bulb	**XB5AVB5**
	Blue	ZA2BV6+ZA2BV06+bulb	**XB5AVB6**
48...120VAC	White	ZA2BV6+ZA2BV07+bulb	**XB5AVG1**
	Green	ZA2BV6+ZA2BV03+bulb	**XB5AVG3**
	Red	ZA2BV6+ZA2BV04+bulb	**XB5AVG4**
	Yellow	ZA2BV6+ZA2BV05+bulb	**XB5AVG5**
	Blue	ZA2BV6+ZA2BV06+bulb	**XB5AVG6**
230...240VAC	White	ZA2BV7+ZA2BV07	**XB5AVM1**
	Green	ZA2BV7+ZA2BV03	**XB5AVM3**
	Red	ZA2BV7+ZA2BV04	**XB5AVM4**
	Yellow	ZA2BV7+ZA2BV05	**XB5AVM5**
	Blue	ZA2BV7+ZA2BV06	**XB5AVM[illegible]**

"Protected LED" technology

- High resistance to vibrations
- In-built patented electronic protection against voltage transients and electromagnetic interference (IEC 100-4)

hence a **100,000 hour service life**

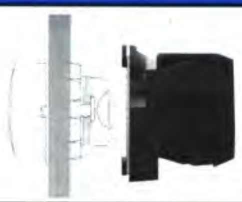
Efficient signalling

- Low current consumption
- Reduced heat dissipation
- No access to live connection from the front

A new aesthetics

- Enhanced brightness
- Purity of colours (white, green, red, yellow, blue)
- Available in three voltages (24VACDC, 48-120VAC, 230VAC)

Contact blocks



Schneider Electric

Pilot Lights
Unique, patented "Protected LED" technology
1 reference XB4BV• • = 1 complete product

Protected® LED

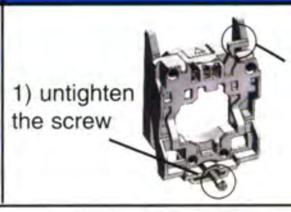
Pilot lights with integral LED		Old	New
24VAC/DC	White	ZB2BV6+ZB2BV07+bulb	**XB4BVB1**
	Green	ZB2BV6+ZB2BV03+bulb	**XB4BVB3**
	Red	ZB2BV6+ZB2BV04+bulb	**XB4BVB4**
	Yellow	ZB2BV6+ZB2BV05+bulb	**XB4BVB5**
	Blue	ZB2BV6+ZB2BV06+bulb	**XB4BVB6**
48...120VAC	White	ZB2BV6+ZB2BV07+bulb	**XB4BVG1**
	Green	ZB2BV6+ZB2BV03+bulb	**XB4BVG3**
	Red	ZB2BV6+ZB2BV04+bulb	**XB4BVG4**
	Yellow	ZB2BV6+ZB2BV05+bulb	**XB4BVG5**
	Blue	ZB2BV6+ZB2BV06+bulb	**XB4BVG6**
230...240VAC	White	ZB2BV7+ZB2BV07	**XB4BVM1**
	Green	ZB2BV7+ZB2BV03	**XB4BVM3**
	Red	ZB2BV7+ZB2BV04	**XB4BVM4**
	Yellow	ZB2BV7+ZB2BV05	**XB4BVM5**
	Blue	ZB2BV7+ZB2BV06	**XB4BVM6**

"Protected LED" technology
- High resistance to vibrations
- In-built patented electronic protection against voltage transients and electromagnetic interference (IEC 100-4)

hence a **100,000 hour service life**

Efficient signalling
- Low current consumption
- Reduced heat dissipation
- No access to live connection from the front

A new aesthetics
- Enhanced brightness
- Purity of colours (white, green, red, yellow, blue)
- Available in three voltages (24VACDC, 48-120VAC, 230VAC)

	Contact blocks	Dismounting
		

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Pushbuttons and Selector Switches
2 references ZB5A• = 1 complete product

Head

Pushbuttons (1)			Old	New
	Flush	Black	ZA2BA2	**ZB5AA2**
	Flush	Green	ZA2BA3	**ZB5AA3**
	Flush	Red	ZA2BA4	**ZB5AA4**
	Flush	Yellow	ZA2BA5	**ZB5AA5**
	Flush	Blue	ZA2BA6	**ZB5AA6**
	Booted	Black	ZA2BP2	**ZB5AP2**
	Booted	Green	ZA2BP3	**ZB5AP3**
	Booted	Red	ZA2BP4	**ZB5AP4**
	Booted	Yellow	ZA2BP5	**ZB5AP5**
	Booted	Blue	ZA2BP6	**ZB5AP6**

(1) Square heads are also available

Selector Switches (1)		Old	New
	2 position stay put	ZA2BD2	**ZB5AD2**
	2 position spring return	ZA2BD4	**ZB5AD4**
	3 position stay put	ZA2BD3	**ZB5AD3**
	3 position spring return	ZA2BD5	**ZB5AD5**
	3 position spring return	ZA2BD8	**ZB5AD8**

Key Selector Switches (1)		Old	New
	2 position stay put	ZA2BG2	**ZB5AG2**
	2 position stay put	ZA2BG4	**ZB5AG4**
	2 position spring return	ZA2BG6	**ZB5AG6**
	3 position stay put	ZA2BG0	**ZB5AG0**
	3 position stay put	ZA2BG3	**ZB5AG3**
	3 position spring return	ZA2BG7	**ZB5AG7**

The symbol indicates key removal position(s)

(1) For activation of lateral contacts only.

Mushroom Head Pushbuttons (Spring Return)			Old	New
	Ø40mm	Green	ZA2BC3	**ZB5AC3**
	Ø40mm	Red	ZA2BC4	**ZB5AC4**

Emergency Stop Pushbuttons (Latching)				Old	New
	Ø40mm	Red	turn to release	ZA2BS54	**ZB5AS54**
	Ø40mm	Red	push/pull	ZA2BT4	**ZB5AT4**
	Ø40mm	Red	key release	ZA2BS14	**ZB5AS14**

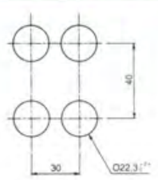
Body

Collar + Contact Block(s)		Old	New
	1 N/O	ZA2BZ101	**ZB5AZ101**
	1 N/C	ZA2BZ102	**ZB5AZ102**
	2 N/O	ZA2BZ103	**ZB5AZ103**
	2 N/C	ZA2BZ104	**ZB5AZ104**
	1 N/O + 1 N/C	ZA2BZ105	**ZB5AZ105**

Additional Contact Block		Old	New
	1 N/O	ZB2BE101	**ZBE101**
	1 N/C	ZB2BE102	**ZBE102**
	2 N/O	-	**ZBE203**
	2 N/C	-	**ZBE204**
	1 N/O + 1 N/C	-	**ZBE205**

XB5A Mounting

Support Panel Cut-Out
(suitable for mounting all types of pushbuttons and pilot lights)



Panel thickness: 1 to 6mm

Assembly – 3 simple steps

Schneider Electric

Illuminated Pushbuttons and Selector Switches
Unique, patented "Protected LED" technology
2 references ZB4BW• = 1 complete product

Head

+

Body

Illuminated Pushbuttons

			Old	New
	Flush	White	ZB2BW37	**ZB4BW313**
	Flush	Green	ZB2BW33	**ZB4BW333**
	Flush	Red	ZB2BW34	**ZB4BW343**
	Flush	Yellow	ZB2BW35	**ZB4BW353**
	Flush	Blue	ZB2BW36	**ZB4BW363**
	Booted	White	ZB2BW57	**ZB4BW513**
	Booted	Green	ZB2BW53	**ZB4BW533**
	Booted	Red	ZB2BW54	**ZB4BW543**
	Booted	Yellow	ZB2BW55	**ZB4BW553**
	Booted	Blue	ZB2BW56	**ZB4BW563**

Illuminated Selector Switches (2 position stay put (*))

		White	ZB2BK127	**ZB4BK1213**
		Green	ZB2BK123	**ZB4BK1233**
		Red	ZB2BK124	**ZB4BK124[illegible]**
		Yellow	ZB2BK125	**ZB4BK125[illegible]**
		Blue	ZB2BK126	**ZB4BK1263**

(*) other configurations are available.

Illuminated Selector Switches (3 position stay put (*))

		White	ZB2BK137	**ZB4BK1313**
		Green	ZB2BK133	**ZB4BK1333**
		Red	ZB2BK134	**ZB4BK1343**
		Yellow	ZB2BK135	**ZB4BK1353**
		Blue	ZB2BK136	**ZB4BK1363**

(*) other configurations are available.

Collar + LED module + Contact Block (1)

24VAC/DC	1 N/O	White	ZB2BW061+bulb	**ZB4BW0B11**
	1 N/O	Green	ZB2BW061+bulb	**ZB4BW0B31**
	1 N/C	Red	ZB2BW062+bulb	**ZB4BW0B42**
	1 N/O	Yellow	ZB2BW061+bulb	**ZB4BW0B51**
	1 N/O	Blue	ZB2BW061+bulb	**ZB4BW0B61**
48...120VAC	1 N/O	White	ZB2BW061+bulb	**ZB4BW0G11**
	1 N/O	Green	ZB2BW061+bulb	**ZB4BW0G31**
	1 N/C	Red	ZB2BW062+bulb	**ZB4BW0G42**
	1 N/O	Yellow	ZB2BW061+bulb	**ZB4BW0G51**
	1 N/O	Blue	ZB2BW061+bulb	**ZB4BW0G6[illegible]**
230...240VAC	1 N/O	White	ZB2BW071	**ZB4BW0M1[illegible]**
	1 N/O	Green	ZB2BW071	**ZB4BW0M31**
	1 N/C	Red	ZB2BW072	**ZB4BW0M42**
	1 N/O	Yellow	ZB2BW071	**ZB4BW0M51**
	1 N/O	Blue	ZB2BW071	**ZB4BW0M61**

(1) for 1 N/O + 1 N/C contacts, replace in ZB4BW01, the last digit "1" by "5"**

Schneider Electric

Control relays

CA2-D and CA3-D

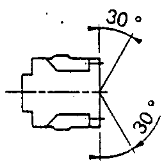
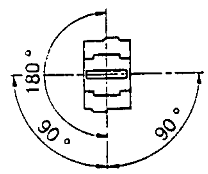
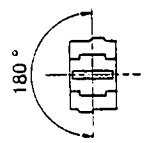
Characteristics

References:
pages 4/36 and 4/37
Dimensions:
page 4/44
Schemes:
page 4/45

4

Type			CA2-DN, DK, DC	CA3-DN, DK, DC

Environment

			CA2-DN, DK, DC	CA3-DN, DK, DC
Conforming to standards			IEC 337-1, 947-1, 947-5, NF C 63-140, VDE 0660, BS 4794	
Product approvals			ASE, UL, CSA, DEMKO, NEMKO, SEMKO, FI, (1), SNCF approval, **CA3-DN**	
Protective treatment			"TH"	
Degree of protection	Protection against direct finger contact		Conforming to VDE 0106	Conforming to VDE 0106
Ambient air temperature around the device	Storage	°C	- 60…+ 80	- 60…+ 80
	Operation, Conforming to IEC 255 (0.8…1.1 Uc)	°C	- 5…+ 55	- 5…+ 55
	For operation at Uc	°C	- 40…+ 70	- 40…+ 70
Maximum operating altitude	Without derating	m	3000	3000
Operating positions	Operation without derating in the following positions 			
Shock resistance (2) semi-sinusoidal wave for 11 ms	Control relay open		10 gn	8 gn
	Control relay closed		15 gn	11 gn
Vibration resistance (2) 5…300 Hz	Control relay open		2 gn	2 gn
	Control relay closed		4 gn	3 gn
Cabling	Flexible or rigid cable with or without cable end	mm²	Min: 1 x 1; max: 2 x 2.5	Min: 1 x 1; max: 2 x 2.5

(1) Conforming to INRS requirements in association with auxiliary contacts LA1-D.
(2) In the least favourable direction, without change of contact state, with coil supplied at Uc.

Control circuit characteristics

			CA2-DN, DK, DC	CA3-DN, DK, DC
Rated insulation voltage (Ui)	Conforming to IEC 337-1, 158-1 and BS 4794	V	660	660
	Conforming to IEC 947-1 and 947-5	V	690	690
	Conforming to VDE 0110 group C	V	750	750
	Conforming to CSA C22-2 n° 14	V	600	600
Rated control circuit voltage (Uc)		V	12…660	12…600
Permissible voltage variation	Operational		With 50 or 60 Hz coil: 0.8…1.1 Uc With 50/60 Hz coil: 0.85…1.1 Uc	With standard coil: 0.8…1.1 Uc With wide range coil: 0.7…1.25 Uc
Voltage limits	Drop-out		0.3…0.6 Uc	0.1…0.65 Uc
Average consumption at 20 °C	∼ 50 Hz	VA	Inrush: 60; Holding: 7	–
	∼ 60 Hz	VA	Inrush: 70; Holding: 7.5	–
	∼ 50/60 Hz (at 50 Hz)	VA	Inrush: 70; Holding: 8	–
	With standard coil	W	–	Inrush or Holding: 9
	With wide range coil	W	–	Inrush or Holding: 11
Operating time (at rated control circuit voltage and at 20 °C)	Between coil energisation and			
	- opening of the N/C contacts	ms	6…20	35…43
	- closing of the N/O contacts	ms	12…22	40…48
	Between coil de-energisation and			
	- opening of the N/O contacts	ms	4…12	6…14
	- closing of the N/C contacts	ms	6…17	11…19
Minimum pulse time	For latching or unlatching of the **CA•-DK**	ms	40	100
Short supply failures	Max. duration without affecting hold-in of device	ms	2	2
Maximum operating rate	In operating cycles per second		3	3

			CA2-DN,DC	CA2-DK	CA3-DN,DC	CA3-DK
Mechanical life at Uc (mechanical durability)	In millions of operating cycles					
	With: 50 or 60 coil		20	10	–	–
	50/60 Hz (at 50 Hz)		30	10	–	–
	standard ⎓ coil		–	–	30	10
	wide range ⎓ coil		–	–	30	10

Control relays

CA2-D and CA3-D

Characteristics

References:
pages 4/36 and 4/37
Dimensions:
page 4/44
Schemes:
page 4/45

Instantaneous contact characteristics

Number of contacts	On CA●-D		4
Rated operational voltage (Ue)	Up to	V	660
Rated insulation voltage (Ui)	Conforming to IEC 337-1, 158-1 and BS 4794	V	660
	Conforming to IEC 947-1 and 947-5	V	690
	Conforming to VDE 0110 group C	V	750
	Conforming to CSA C22-2 n° 14	V	600
Rated thermal current (Ith)	For ambient temperature ≤ 40 °C	A	10
Operating current frequency		Hz	25...400
Minimum switching capacity	U min	V	17
	I min	mA	5
Short-circuit protection	Conforming to IEC 337-1 and VDE 0660, gI fuse	A	10
Rated making capacity	Conforming to IEC 337-1, I rms	A	∼ : 140, ⎓ : 250
Short time rating	Permissible for 1 s	A	100
	500 ms	A	120
	100 ms	A	140
Insulation resistance		MΩ	> 10
Non-overlap time	Guaranteed between N/C and N/O contacts	ms	1.5 (on energisation and on de-energisation)
Tightening torques		N.m	1.2

Rated operating power of contacts
Conforming to IEC 947-5

a.c. supply, categories AC-14 and AC-15
Electrical life (up to 3600 operating cycles/hour) on an inductive load such as the coil of an electromagnet: making power (cos φ 0.7) = 10 times the power broken (cos φ 0.4).

	V	24	48	110/127	220/230	380/400	440	600
1 million operating cycles	VA	150	300	400	480	500	500	500
3 million operating cycles	VA	80	170	250	290	320	320	320
10 million operating cycles	VA	30	65	90	120	130	130	130
Occasional making capacity	VA	1200	2600	7000	13 000	15 000	13 000	9000

d.c. supply, category DC-13
Electrical life (up to 1200 operating cycles/hour) on an inductive load such as the coil of an electromagnet, without economy resistor, the time constant increasing with the power.

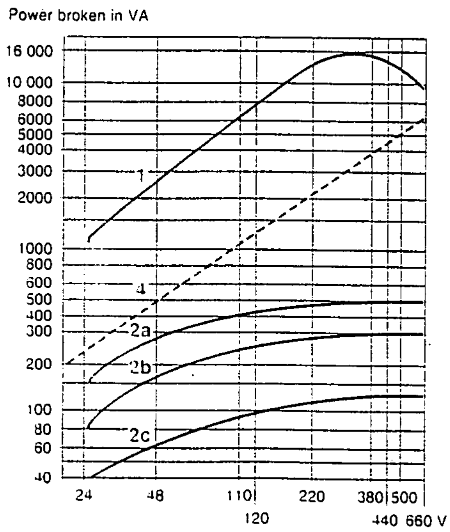
	V	24	48	110	220	440	600
1 million operating cycles	W	120	90	75	68	61	58
3 million operating cycles	W	70	50	38	33	28	27
10 million operating cycles	W	25	18	14	12	10	9
Occasional making capacity	W	1000	700	400	260	220	170

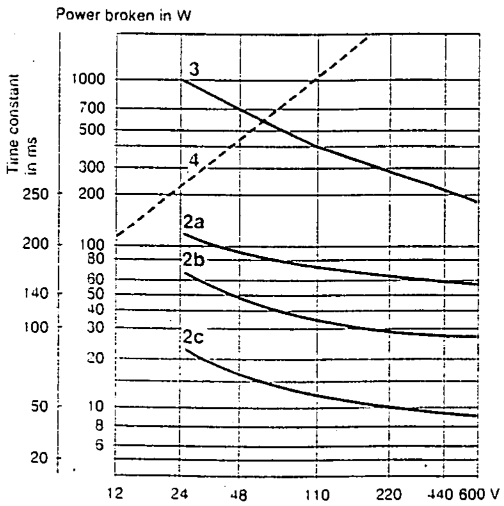
1 Breaking limit of contacts valid for: maximum of 50 operating cycles at 10s intervals (breaking power = making power x cos φ 0.7).

2 Electrical life of contacts:
- for 1 million operating cycles (2a)
- for 3 million operating cycles (2b)
- for 10 million operating cycles (2c).

3 Breaking limit of contacts valid for: maximum of 20 operating cycles at 10 s intervals and with current passing for 0.5 s per operating cycle.

4 Thermal limit.





Auxiliary contactors

Control relays types CA2-D and CA3-D
Auxiliary contact blocks (without dust and damp protected contacts)

References :
pages 4/38 and 4/39
Dimensions :
page 4/44
Schemes :
page 4/45

Characteristics

Environment

Conforming to standards			IEC 337-1, 947-1, 947-5, NF C 63-140, VDE 0660, BS 4794
Product approvals			ASE, UL, CSA, DEMKO, NEMKO, SEMKO, FI (1)
Protective treatment			"TH"
Degree of protection	Conforming to VDE 0106		Protection against direct finger contact
Ambient air temperature around the device	Storage	°C	- 60...+ 80
	Operation. Conforming to IEC 255 (0.8...1.1 Uc)	°C	- 5...+ 55
	Permissible for operation at Uc	°C	- 40...+ 70
Maximum operating altitude	Without derating	m	3000
Cabling	Flexible or rigid cable, with or without cable end	mm²	Min : 1 x 1; max : 2 x 2.5
Tightening torque		N.m	1.2

Instantaneous and time delay contact block characteristics

Types of contact block			LA1-D	LA2-D	LA3-D	LA8-D
Number of contacts			2 or 4	2	2	2
Rated operating voltage (Ue)	Up to	V	660			
Rated insulation voltage (Ui)	Conforming to IEC 337-1, 158-1 and BS 4794	V	660			
	Conforming to IEC 947-1 and 947-5	V	690			
	Conforming to VDE 0110 group C	V	750			
	Conforming to CSA C22-2 n° 14	V	600			
Rated thermal current (Ith)	Ambient temperature ≤ 40 °C	A	10			
Operating current frequency		Hz	25...400			
Minimum switching capacity	U min	V	17			
	I min	mA	5			
Short-circuit protection	Conforming to IEC 337-1 and VDE 0660, gl fuse	A	10			
Rated making capacity	Conforming to IEC 337-1, I rms	A	∿ : 140 ; ⎓ : 250			
Short time rating	Permissible for 1 s	A	100			
	500 ms	A	120			
	100 ms	A	140			
Insulation resistance		MΩ	>10			
Non-overlap time	Guaranteed between N/C and N/O contacts	ms	1.5 (on energisation and on de-energisation)			
Overlap time	Guaranteed between N/C and N/O contacts on **LA1-DC22**	ms	1.5	–	–	–
Time delay (LA2-D and LA3-D contact blocks) Accuracy only valid for setting range indicated on front face	Ambient air temperature for operation	°C	–	- 40...+ 70	- 40...+ 70	–
	Repeat accuracy		–	± 2 %	± 2 %	–
	Drift up to 0.5 million operating cycles		–	+ 15 %	+ 15 %	–
	Drift depending on ambient air temperature		–	0.25 % per °C	0.25 % per °C	–
Mechanical life	In millions of operating cycles		30	5	5	30
Operational power of contacts	The same as that of the control relay : see page 4/29.					

(1) LA1-D conforms to INRS requirements in association with a control relay CA●-D.

Auxiliary contactors

References :
pages 4/38 and 4/39
Dimensions :
page 4/44
Schemes :
page 4/45

Control relays types CA2-D and CA3-D
Mechanical latch blocks

Characteristics

Environment

Conforming to standards			IEC 337-1, 947-1, 947-5, NF C 63-140, VDE 0660, BS 4794
Product approvals			ASE, UL, CSA, DEMKO, NEMKO, SEMKO, FI
Protective treatment			"TH"
Degree of protection	Conforming to VDE 0106		Protection against direct finger contact
Ambient air temperature around the device	Storage	°C	- 60...+ 80
	Operation. Conforming to IEC 255 (0.8...1.1 Uc)	°C	- 5...+ 55
	Permissible for operation at Uc	°C	- 40...+ 70
Maximum operating altitude	Without derating	m	3000
Cabling	Flexible or rigid cable, with or without cable end	mm²	Min : 1 x 1; max : 2 x 2.5
Tightening torque		N.m	1.2

4

Mechanical latch block characteristics

Types			**LA6-DK1** 50-60 Hz	⎓	**LA6-DK2** 50-60 Hz	⎓
Rated insulation voltage (Ui)	Conforming to IEC 158-1	V	660	660	660	660
Rated control circuit voltage (Uc)		V	12...660	12...220	12...660	12...220
Power required for unlatching		VA	160	–	275	–
		W	–	190	–	330
Maximum operating rate	In operating cycles/hour		1200	1200	1000	1000
Mechanical life (at Uc)	In millions of operating cycles		1	1	1	1
Unlatching control	Pulsed or holding		Manual or electrical			
Operating precautions			**LA6-DK** and **CA●-D** must not be energised or held simultaneously			

Auto cut-out of the coil after 15 ms. Duration of control signal > 10 ms.
Block **LA6-DK2** also has 1 N/C contact which automatically cuts the supply to the contactor coil.
Signal duration = contactor operating time + 20 ms.

Control relays

Control relays types CA2-D and CA3-D

Characteristics :
pages 4/28 and 4/29
Dimensions :
page 4/44
Schemes :
page 4/45

References

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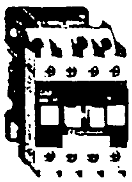
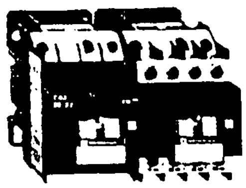
Control circuit: a.c.



CA2-DN31●●

Type	Number of contacts	Composition N/O	Composition N/C	Basic reference. Complete with code indicating control circuit voltage (2)	Normal voltages					Weight kg
Instantaneous	4	4	–	CA2-DN40●●	B7	E7	F7	M7	Q7	0.320
		3	1	CA2-DN31●●	B7	E7	F7	M7	Q7	0.320
		2	2	CA2-DN22●●	B7	E7	F7	M7	Q7	0.320
		2 including 1 N/O and 1 N/C make before break	2	CA2-DC22●●	B7	E7	F7	M7	Q7	0.320
Mechanical latch/memory	4	2	2	CA2-DK22●●	B7	E7	F7	M7	Q7	0.580



CA2-DK22●●

Specifications

Protective treatment	"TH" as standard
Fixing	On 35 mm ⌣ rail or screw fixing
Cabling	By screw clamp terminals
Terminals	Protected against direct finger contact with ready-to-tighten captive screws (1)

Marking and contact positions conforming to CENELEC EN 50005, EN 50011.

(1) Telemecanique patented system which prevents screws from tightening themselves (eg due to vibrations during transport).

(2) Standard control circuit voltages (for variable time delay, please consult your Regional Sales Office).

Volts ∼	24	42	48	110	220/230	230	240	380/400	400	415	440	500	660
50 Hz	B5	D5	E5	F5	M5	P5	U5	Q5	V5	N5	R5	S5	Y5
60 Hz	B6	–	E6	F6	M6	–	U6	Q6	–	N6	R6	–	–
50/60 Hz	B7	D7	E7	F7	M7	P7	U7	Q7	V7	N7	R7	–	–

Other versions Control relays CA2-D for other c voltages between 24 and 660 V. Please consult your Regional Sales Office.

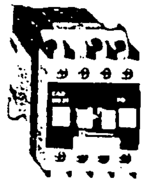
Control relays

Control relays types CA2-D and CA3-D

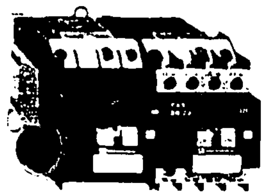
Characteristics:
pages 4/28 and 4/29
Dimensions:
page 4/44
Schemes:
page 4/45

References

Control circuit: d.c.



CA3-DN31●●



CA3-DK22●●

Type	Number of contacts	Composition N/O	Composition N/C	Basic reference. Complete with code indicating control circuit voltage (2)	Normal voltages	Weight kg
Instantaneous	4	4	–	CA3-DN40●●	BD ED FD	0.580
		3	1	CA3-DN31●●	BD ED FD	0.580
		2	2	CA3-DN22●●	BD ED FD	0.580
		2 Inc. 1 N/O and 1 N/C make before break	2	CA3-DC22●●	BD ED FD	0.580
Mechanical latch memory	4	2	2	CA3-DK22●●	BD ED FD	1.100

Specifications

Protective treatment	"TH" as standard
Fixing	On 35 mm ⌣ rail or screw fixing
Cabling	By screw clamp terminals
Terminals	Protected against direct finger contact with ready-to-tighten captive screws (1)

Marking and contact positions conforming to CENELEC EN 50005, EN 50011.

(1) Telemecanique patented system which prevents screws from tightening themselves (eg due to vibrations during transport).

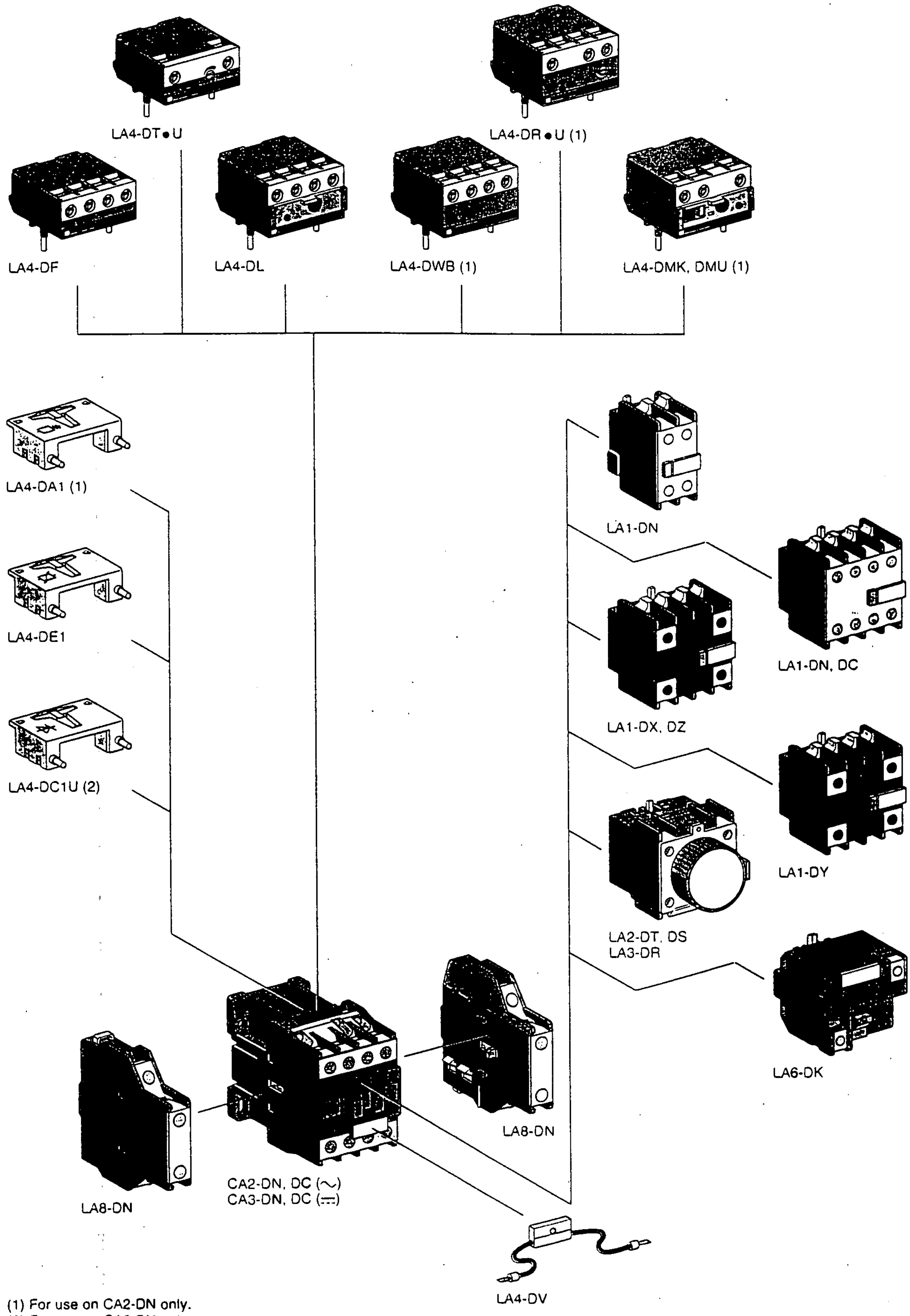
(2) Standard control circuit voltages (for variable time delay, please consult your Regional Sales Office).

Volts ⎓	12	24	36	48	60	72	110	125	220	250	440
U from 0.8 to 1.1 Uc	JD	BD	CD	ED	ND	SD	FD	GD	MD	UD	RD
U from 0.7 to 1.25 Uc	JW	BW	CW	EW	–	SW	FW	–	MW	–	–

Other versions

Control relays CA3-D for other ⎓ voltages between 12 and 660 V. Please consult your Regional Sales Office

4



(1) For use on CA2-DN only.
(2) For use on CA3-DN only.

MANN INDUSTRIES PTY LTD

DFI/SFI Series

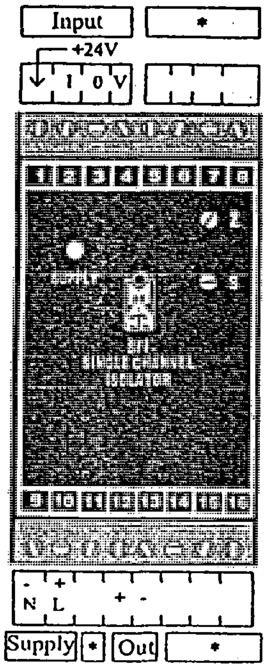
4-Wire Isolator and Signal Splitter with Power Supply

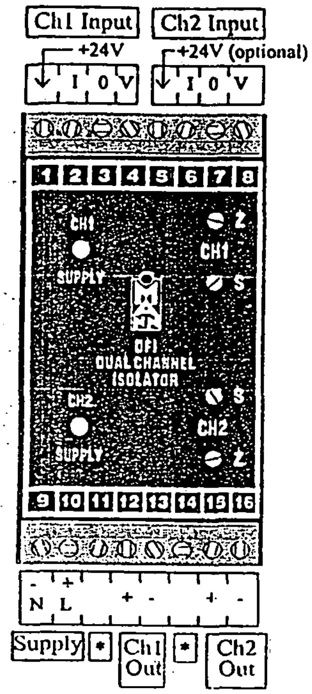
Calibration and Instruction Manual

(Version 1.01)

Quality Endorsed Company ISO 9001 Lic 1873

Introduction





* Not connected

Adjust the ZERO with the 'Z' screw and the SPAN with the 'S' screw

1.1 Scope

This manual contains all the information necessary to set up, calibrate, and install instruments from Mann Industries DFI/SFI range of Isolators/Splitters.

The inputs of instruments in the DFI/SFI series can be switch selected to mAdc or Vdc covering all the standard ranges in one channel type (SFI) or Two channel type (DFI).

All the instruments covered by this manual have a number of common features:

- 35 mm Top Hat mount
- Internally powered
- Compact metal enclosure
- 1500 Volts isolation
- Temperature stable operation
- Non-interacting zero and span controls
- Removable, screw type, terminal blocks

1.2 Revision history

Version 1.00 First issue	16/06/97
Version 1.01	24/09/97

Installation

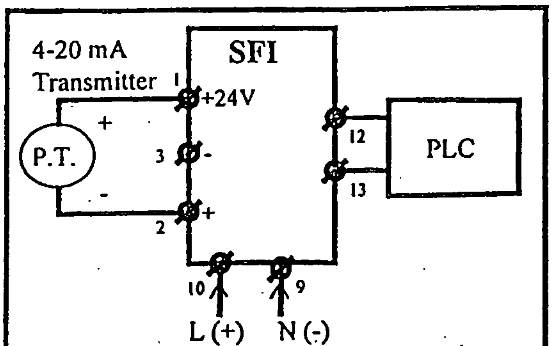
2.1 General description

All new units are fully calibrated at the factory, so you should not need to adjust them until the next scheduled calibration, unless you change the range. You should check your requirements against the model number before installation. The model number is given on the side panel and includes information on power supply, field supply, calibration, input type and output signal format. If no range is specified, the instrument will have been defaulted to 4-20 mA on both inputs and outputs.

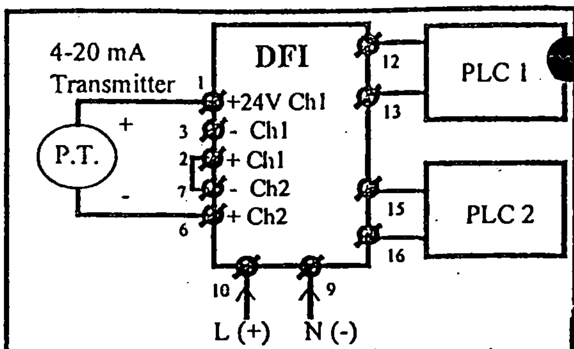
All models of Mann Industries DFI/SFI range are 4 Wire devices, ie the power supply is separate from the output. The instruments have an internal power supply used for internal power, output power, and field power supply. When set as a current transmitter the output is capable of driving up to 1500 Ω @ 20 mA. When set as a voltage transmitter the output is capable of driving receiving devices with input impedances of 500k Ω or above with a 10V span with no recalibration required. Lower input impedances can be handled on voltage outputs with minor recalibration. The DFI provides two fully isolated sourcing transmitters, while the SFI provides one fully isolated sourcing transmitter. The two inputs of the DFI can be externally linked (V in parallel or mA in series) to function as a signal splitter (one input and two isolated outputs). The standard DFI or SFI has one 24V supply (on channel 1) to drive a two wire transmitter on its input. A second 24V supply can be fitted to channel 2 of the DFI if required.

2.2 Electrical connections

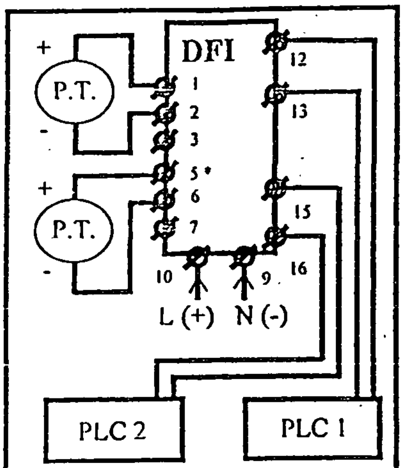
The diagram below shows the external connections for the DFI/SFI Series.



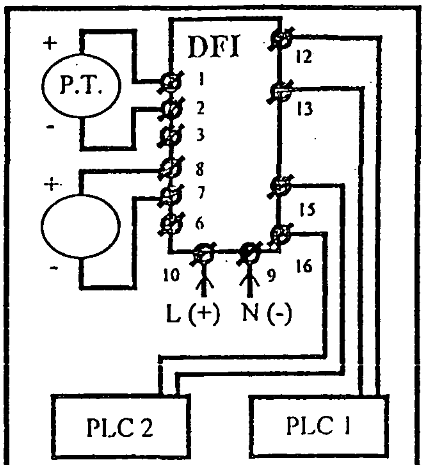
Example showing an SFI powering a two wire transmitter and transmitting an isolated 4-20 mA signal on its output to a PLC.



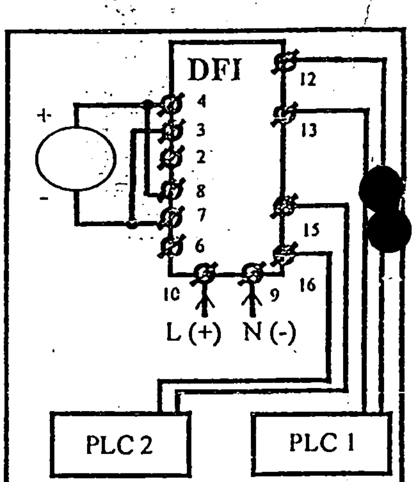
Example showing a DFI powering a two wire transmitter and transmitting 2 isolated 4-20 mA signals on its outputs to 2 independent PLCs.



Example showing a DFI powering 2 two-wire 4-20 mA transmitters and transmitting 2 isolated 1-5 V signals on its outputs to 2 independent PLCs.
* Note PS2 option fitted



Example showing a DFI powering a 4-20mA transmitter on Ch1 and a 0-10 V transmitter connected to Ch2, and 2 isolated 4-20 mA signals on its outputs to 2 independent PLCs.



Example showing a DFI connected to one 0-10 V transmitter and transmitting 2 isolated 0-10 V signals on its outputs to 2 independent PLCs.

Calibration

3.1 General description

This section covers the routine calibration for the DFI/SFI range of 4 wire transmitters. ***New units are calibrated and checked before being dispatched and should not require recalibration before installation (provided that they were ordered with the correct range).***

The calibration controls are:

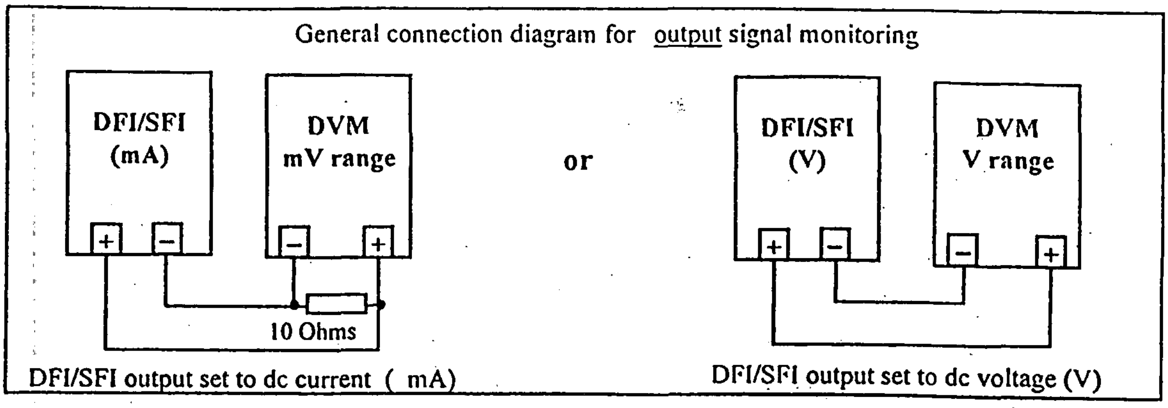
- ZERO, which you adjust for the lower value of the range, eg 4 mA or 0V.
- SPAN, which you adjust for the higher level of the range, eg 20 mA or 10V.

3.2 Equipment required

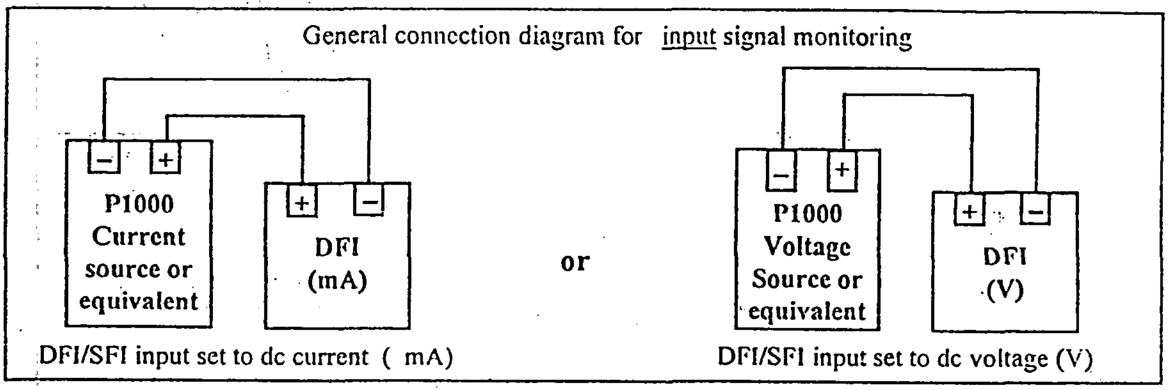
The equipment required to calibrate specific input types is listed below :

- 1 x 4 + ½ digit, digital voltmeter (for output signal monitoring)
- 1 x Mann Industries 'Portacal 1000' or similar current/voltage calibrator (for input signal generation).
- An accurate standard resistor (say 10 Ohms +/- 0.05%) is required for current output calibration
- 1 x Trimpot adjuster or flat blade screw driver (with blade less than 2.54mm wide)

3.3 Output signal monitoring



3.4 Input signal monitoring



3.5 ZERO adjustment

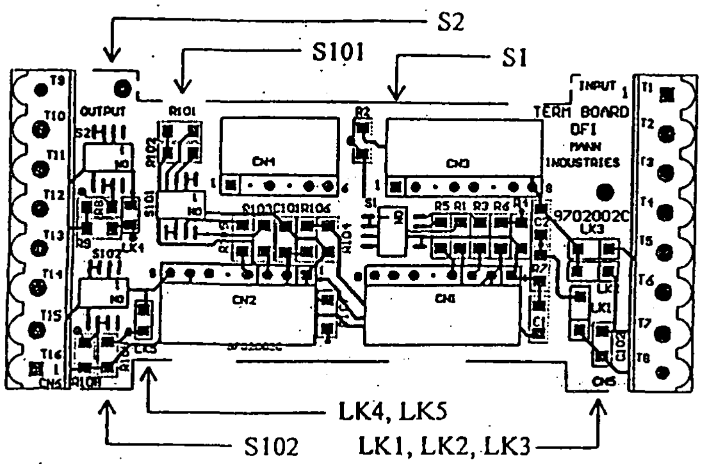
The ZERO adjustment allows you to set the output signal to the level that corresponds to the lower level of the input range (eg 4 mA or 0 V). The ZERO adjustment is marked "Z" beside the channel number on the front panel of the unit. To adjust the ZERO proceed as follows:

1. Connect up the instrument according to the previous diagrams.
2. Set the input signal source to the lowest value of the input range required.
3. Turn the ZERO adjustment until the output reaches the correct value.
4. This completes the ZERO adjustment.

3.6 SPAN adjustment

The SPAN adjustment allows you to set the output signal to the level that corresponds to the higher level of the input range (eg 20 mA or 10 V). The SPAN adjustment is marked "S" beside the channel number on the front panel of the unit. To adjust the SPAN proceed as follows:

1. Connect up the instrument according to the previous diagrams.
2. Set the ZERO adjustment according to section 3.5 above.
3. Set the input signal source to the highest value of the input range required.
4. Turn the SPAN adjustment until the output reaches the correct value.
5. Re-check the ZERO adjustment.
6. Do any final minor SPAN adjustment.
7. This completes the Calibration procedure.



To change the range for the input signals undo the 4 screws on the side panel which hold the front panel to the instrument. Slide the front panel out. Take care not to lose the white plastic bushes which fit over the potentiometer screws; they are necessary to maintain isolation as per the specifications. Inside the instrument you will find the terminal board which houses 4 switches and 5 links. Select the switches as per the table below to choose different input configurations.

Input	Channel 1				Channel 2			
	S1-1	S1-2	S1-3	S1-4	S101-1	S101-2	S101-3	S101-4
4 to 20 mA	ON	OFF	OFF	OFF	ON	OFF	OFF	OFF
0 to 20 mA	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON
0 to 10 V	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
-10 to 10 V	OFF	ON	ON	OFF	OFF	ON	ON	OFF

S2, S102, LK1, LK2, LK3, LK4 and LK5 for factory use only.

Procedure for returning equipment

Advise your local Mann Industries sales representative by phone that you intend to return the unit for service. You will need to supply the serial number and model number as well as the name and telephone number of a person to contact should more information be required. You will be asked to provide an order to cover the repair and return freight cost. If the repair is determined to be a warranty claim you will not be charged for the repair or return freight cost.

Pack the equipment to be returned carefully so that no damage occurs during transportation to the factory. Freight costs to the factory will always be to your account and must be arranged by you.

Enclose a return address and a telephone number.

Freight returns to you on warranty repairs will only be paid by Mann Industries on our own choice of couriers and method of transport.

Manufactured By:

Mann Industries Pty Ltd
4/26 Leighton Place
HORNSBY NSW 2077
AUSTRALIA

PH: 61-2-9477 5822
FAX: 61-2-9477 5819

DRAWINGS

Brisbane City

Brisbane Water

Professional Services — Engineering

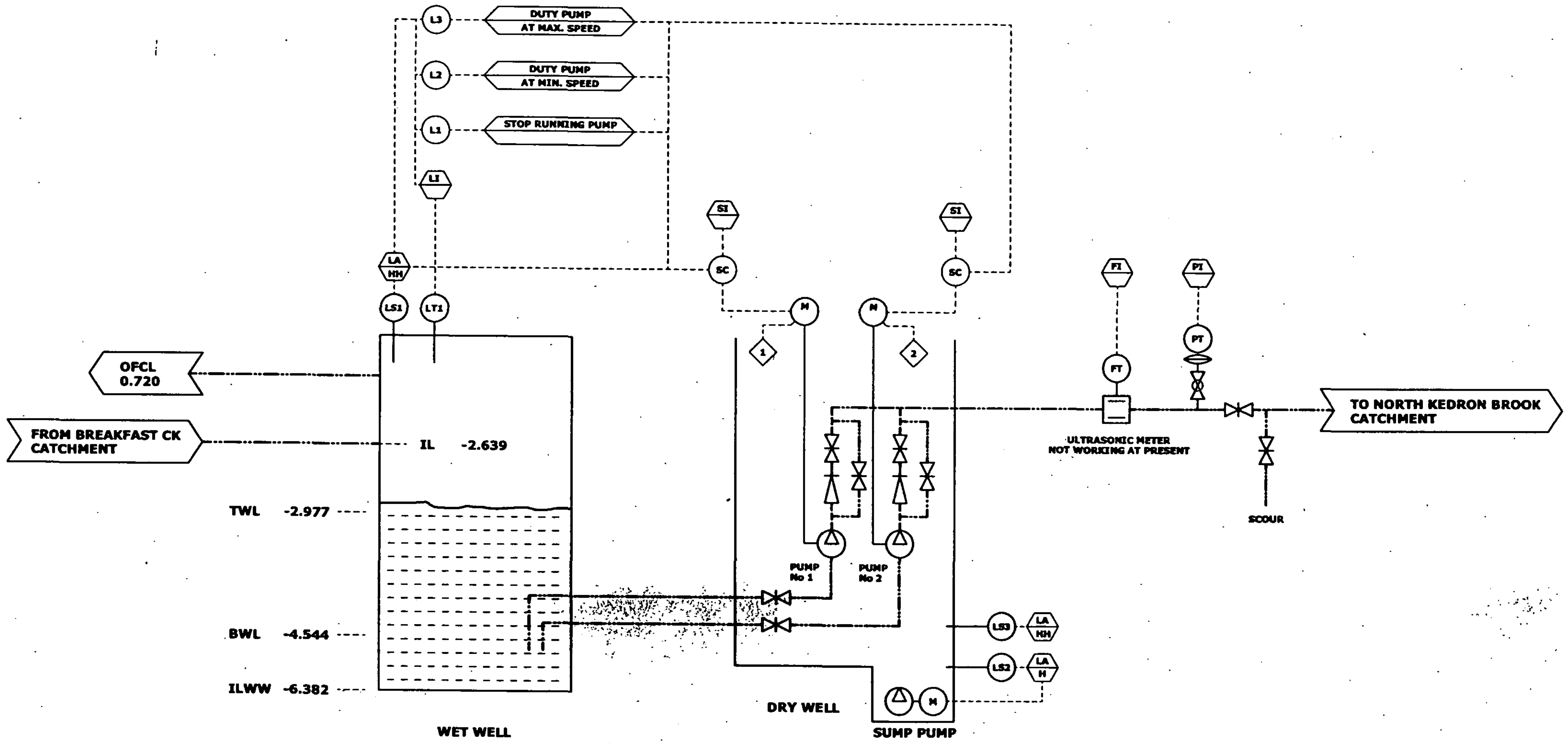
EDMONDSTONE STREET SEWAGE PUMPING STATION-SP23

ELECTRICAL UPGRADE

DRAWING LIST FOR ELECTRICAL DRAWINGS

DWG N°.	TITLE
486/5/7-MO002	COVER SHEET
486/5/7-MO003	PROCESS AND INSTRUMENTATION DIAGRAM
486/5/7-MO004	MAIN SWITCHBOARD - SINGLE LINE DIAGRAM
486/5/7-MO005	MAIN SWITCHBOARD - INCOMER SECTION - ELECTRICAL SCHEMATIC
486/5/7-MO006	MAIN SWITCHBOARD - PUMP 1 375A 224kW - ELECTRICAL SCHEMATIC
486/5/7-MO007	MAIN SWITCHBOARD - PUMP 2 375A 224kW - ELECTRICAL SCHEMATIC
486/5/7-MO008	MAIN SWITCHBOARD- DISTRIBUTION BOARD - ELECTRICAL SCHEMATIC
486/5/7-MO009	MAIN SWITCHBOARD- RTU DIGITAL INPUT - TERMINATION DIAGRAM
486/5/7-MO010	MAIN SWITCHBOARD- RTU DIGITAL OUTPUT - TERMINATION DIAGRAM
486/5/7-MO011	MAIN SWITCHBOARD- RTU ANALOG INPUT - TERMINATION DIAGRAM
06375-E001	EDMONDSTONE STREET SEWAGE PUMPING STATION MAIN SWITCHBOARD - FRONT VIEWS - GENERAL ARRANGEMENT
06375-E002	EDMONDSTONE STREET SEWAGE PUMPING STATION MAIN SWITCHBOARD - SECTIONAL VIEWS - GENERAL ARRANGEMENT
06375-E003	EDMONDSTONE STREET - GENERATOR TERMINAL BOX - GENERAL ARRANGEMENT
06375-E004	EDMONDSTONE STREET - ENERGEX METERING CUBICLE - GENERAL ARRANGEMENT

CADD FILE 57MO002	SUPERVISING ENGINEER
JOB FILE	N° 1 OF 1 SHEETS
DRAWING N° 486/5/7-MO002	AMEND. O



LIST OF INTERLOCKS

I1: PUMP 1 CAN NOT RUN IF PUMP 2 IS RUNNING
I2: PUMP 2 CAN NOT RUN IF PUMP 1 IS RUNNING

LEGEND

- DIAPHRAGM VALVE
- NON-RETURN VALVE
- PRESSURE RELIEF VALVE
- BALL VALVE
- GATE VALVE
- FLOAT VALVE
- DIAPHRAGM
- STRAINER
- BUTTERFLY VALVE
- PRESSURE CONTROL VALVE
- INSTRUMENT
- MAGNETIC FLOWMETER
- ELECTRIC MOTOR
- PUMP
- RTU
- CONTROL INTERLOCK
- EXISTING PIPEWORK
- SIGNAL

ABBREVIATIONS

FAL	FLOW ALARM LOW
FAR	FLOW ALARM RATE
FI	FLOW INDICATOR
FRC	FLOW RATE CONTROL
FS	FLOW SWITCH
FT	FLOW TRANSMITTER
I	INTERLOCK
II	CURRENT INDICATOR
IT	CURRENT TRANSMITTER
kW	KILO WATTS TRANSDUCER
LA	LEVEL ALARM
LAH	LEVEL ALARM HIGH
LAHH	LEVEL ALARM HIGH HIGH
LAL	LEVEL ALARM LOW
LALL	LEVEL ALARM LOW LOW
LAH	LEVEL ALARM HIGH
LC	LEVEL CONTROL
LFA	LOW FLOW ALARM
LI	LEVEL INDICATOR
LS	LEVEL SWITCH
LSL	LEVEL SWITCH LOW
LT	LEVEL TRANSMITTER
M	MOTORISED
PH	PRESSURE HIGH
PHA	PRESSURE HIGH ALARM
PHHA	PRESSURE HIGH HIGH ALARM
PI	PRESSURE INDICATOR
PS	PRESSURE SWITCH
PAL	PRESSURE ALARM LOW
PT	PRESSURE TRANSMITTER
SC	SPEED CONTROL
SI	SPEED INDICATOR

NO	DATE	AMENDMENT	INITIAL
A	21.11.01	VFD'S USED IN LIEU OF RESISTOR BANKS	VMU

MANAGER OF BUSINESS ASSET SERVICES		DATE
MANAGER OF OPERATIONS		DATE
MANAGER PROFESSIONAL SERVICES - ENGINEERING	ORIGINAL SIGNED K. LAM	DATE 20.06.00

SUPERVISING ENGINEER	ORIGINAL SIGNED A. MOONEY	R.P.E.Q. NO. 5596	DATE 06.00
CADD FILE			
JOB FILE	57MO003	SURVEY NO.	
SURVEYED		FIELD BOOK	

DESIGN	VMU	10.02.00
DESIGN CHECK	AM	10.05.00
DRAWN	MJL	15.02.00
DRAFTING CHECK	VMU	25.02.00

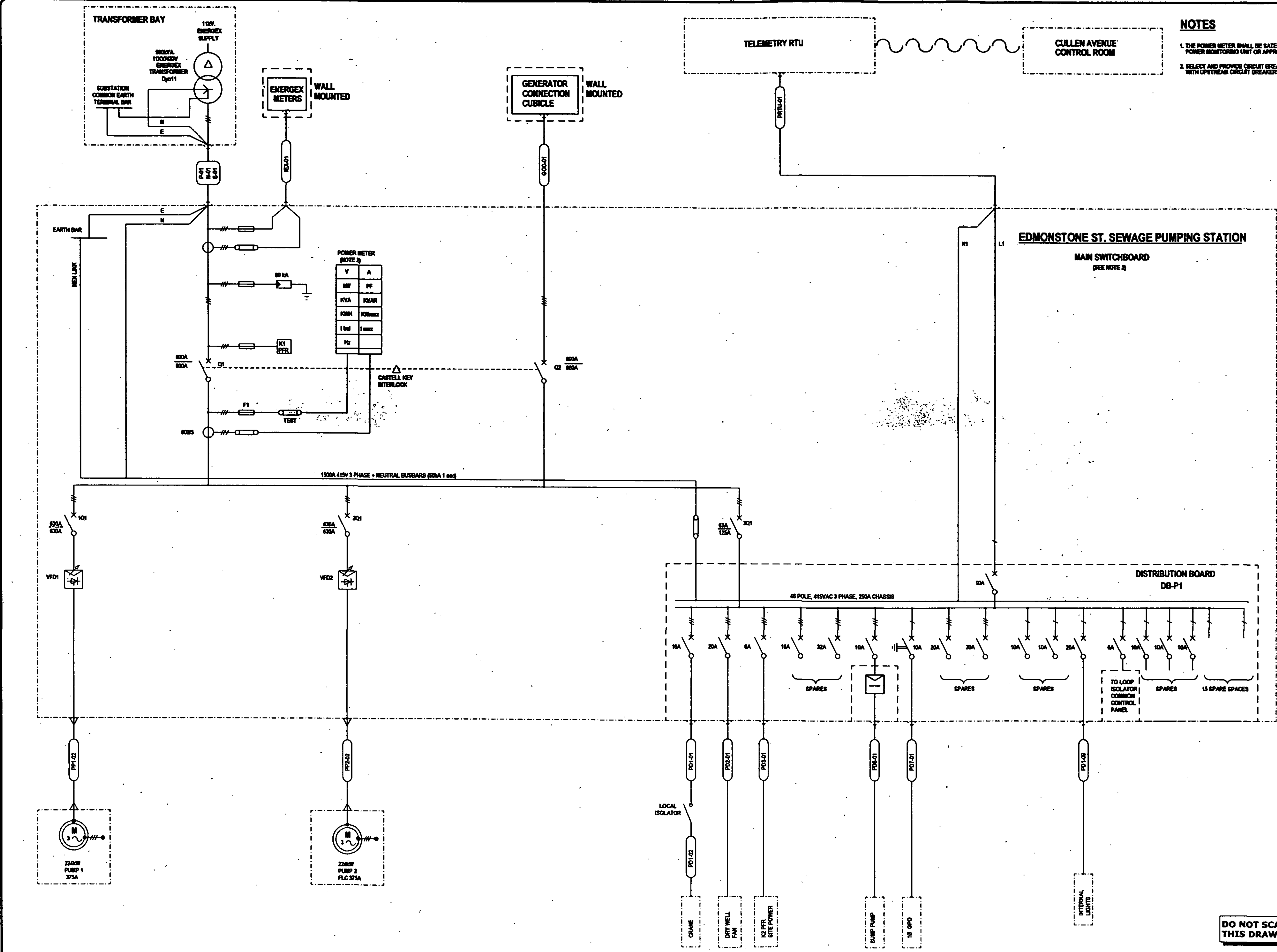
Brisbane City

Brisbane Water

PROJECT
EDMONDSTONE STREET
SEWAGE PUMPING STATION SP23
AUGMENTATION

TITLE
PROCESS AND INSTRUMENTATION DIAGRAM

SCALE NTS
A.H. DATUM
N° 1 OF 1 SHEETS
DRAWING N° 486/5/7-MO003
AMEND. A



NOTES

1. THE POWER METER SHALL BE SATEC [illegible] MICROPROCESSOR BASED POWER MONITORING UNIT OR APPROVED EQUIVALENT.
2. SELECT AND PROVIDE CIRCUIT BREAKERS TO ACHIEVE FULL DISCRIMINATION WITH UPSTREAM CIRCUIT BREAKERS.

DO NOT SCALE THIS DRAWING

AS CONSTRUCTED

NO	DATE	AMENDMENT	INITIALS
C	05.08.02	AS CONSTRUCTED	VMU
B	20.03.02	FOR CONSTRUCTION	VMU
A	21.11.01	VFD'S USED IN LIEU OF RESISTOR BANKS	VMU

MANAGER OF BUSINESS ASSET SERVICES		DATE
MANAGER OF OPERATIONS		DATE
MANAGER PROFESSIONAL SERVICES - ENGINEERING	ORIGINAL SIGNED K. LAM	DATE 16.11.01

SUPERVISING ENGINEER	ORIGINAL SIGNED A. MOONEY	R.P.E.Q. NO. 5596	DATE 16.11.01
CADD FILE	57MO004		
JOB FILE		SURVEY NO.	
SURVEYED		FIELD BOOK	

DESIGN	VMU	10.02.00
DESIGN CHECK	AM	10.05.00
DRAWN	MJL	10.02.00
DRAFTING CHECK	VMU	25.02.00

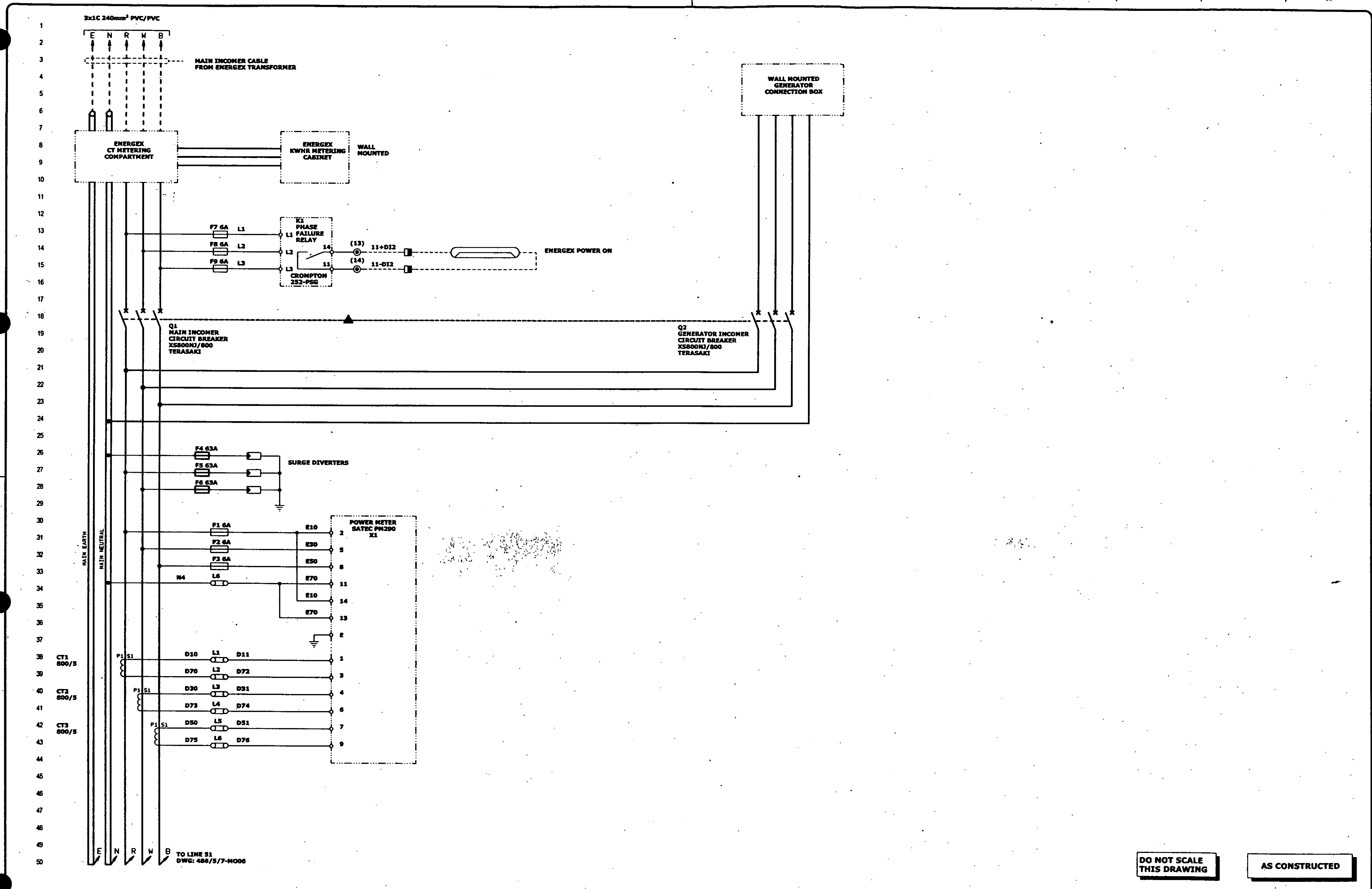
Brisbane Water

PROJECT
EDMONDSTONE STREET
SEWAGE PUMPING STATION SP23
AUGMENTATION

TITLE
MAIN SWITCHBOARD
SINGLE LINE DIAGRAM

SCALE NTS — A.H. DATUM — N° 1 OF 1 SHEETS

DRAWING N° 486/5/7-MO004 — AMEND. C



NO	DATE	AMENDMENT	INITIALS
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B	20.03.02	FOR CONSTRUCTION	VMU
A	21.11.01	VFD'S USED IN LIEU OF RESISTOR BANKS	VMU

MANAGER OF BUSINESS ASSET SERVICES	DATE	DESIGN	VMU 10.02.00
MANAGER OF OPERATIONS	DATE	DESIGN CHECK	AM 10.05.00
MANAGER PROFESSIONAL SERVICES - ENGINEERING	DATE	DRAWN	MJL 15.02.00
SUPERVISING ENGINEER	R.P.E.Q. NO. DATE	DRAFTING CHECK	VMU 25.02.00
CADD FILE			
JOB FILE	57MO005	SURVEY NO.	
SURVEYED		FIELD BOOK	

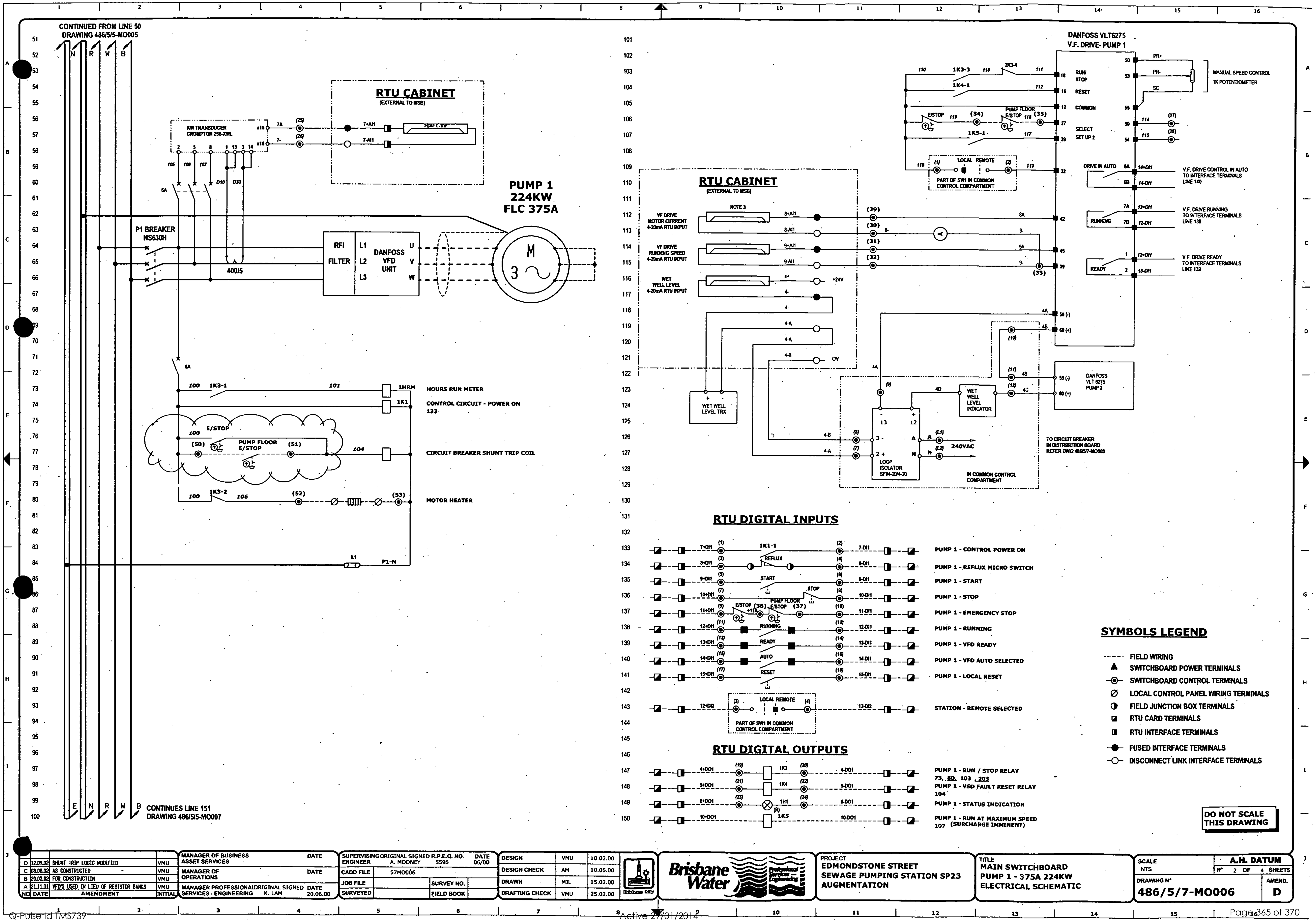
Brisbane Water

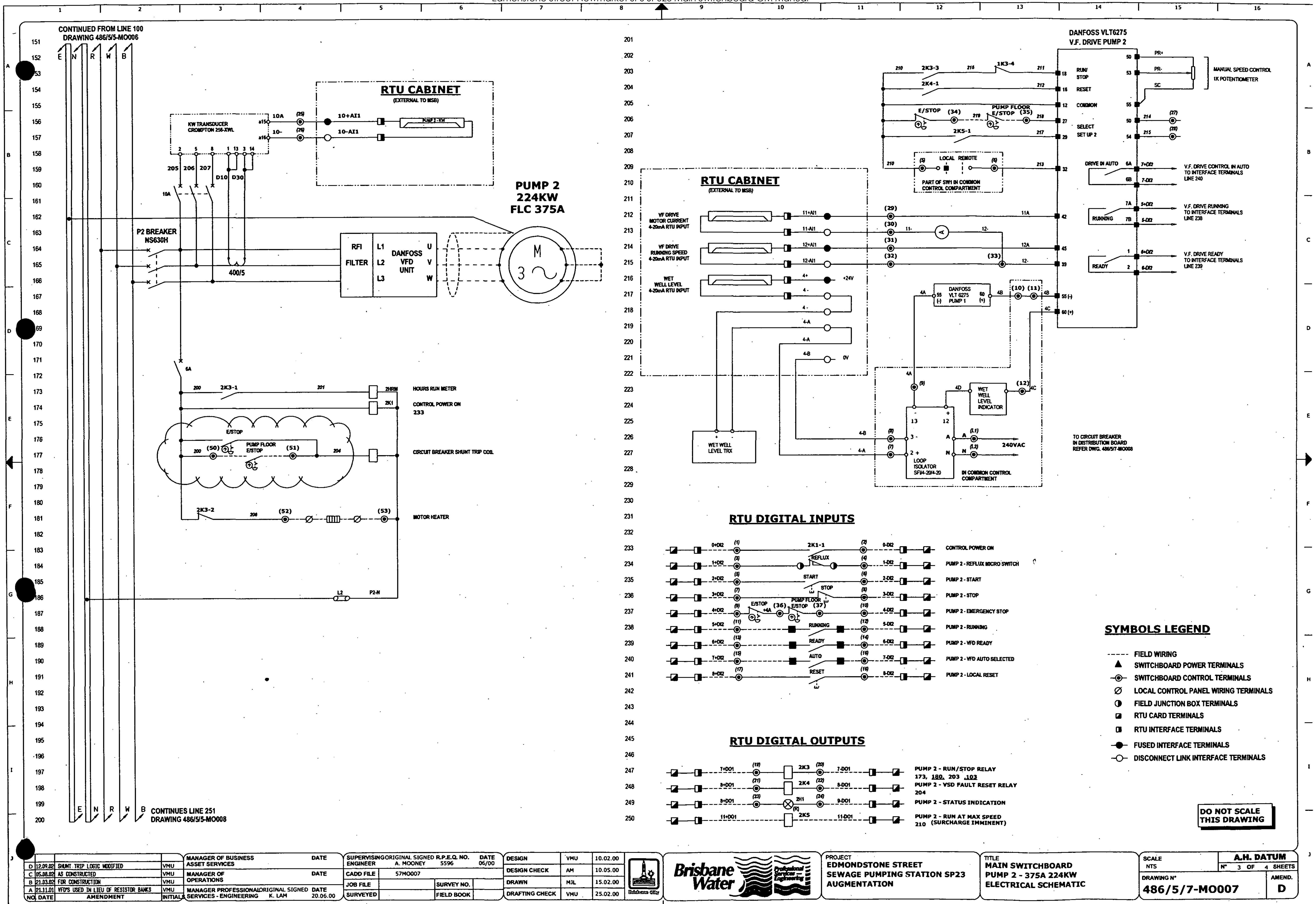
PROJECT: EDMONDSTONE STREET SEWAGE PUMPING STATION SP23 AUGMENTATION

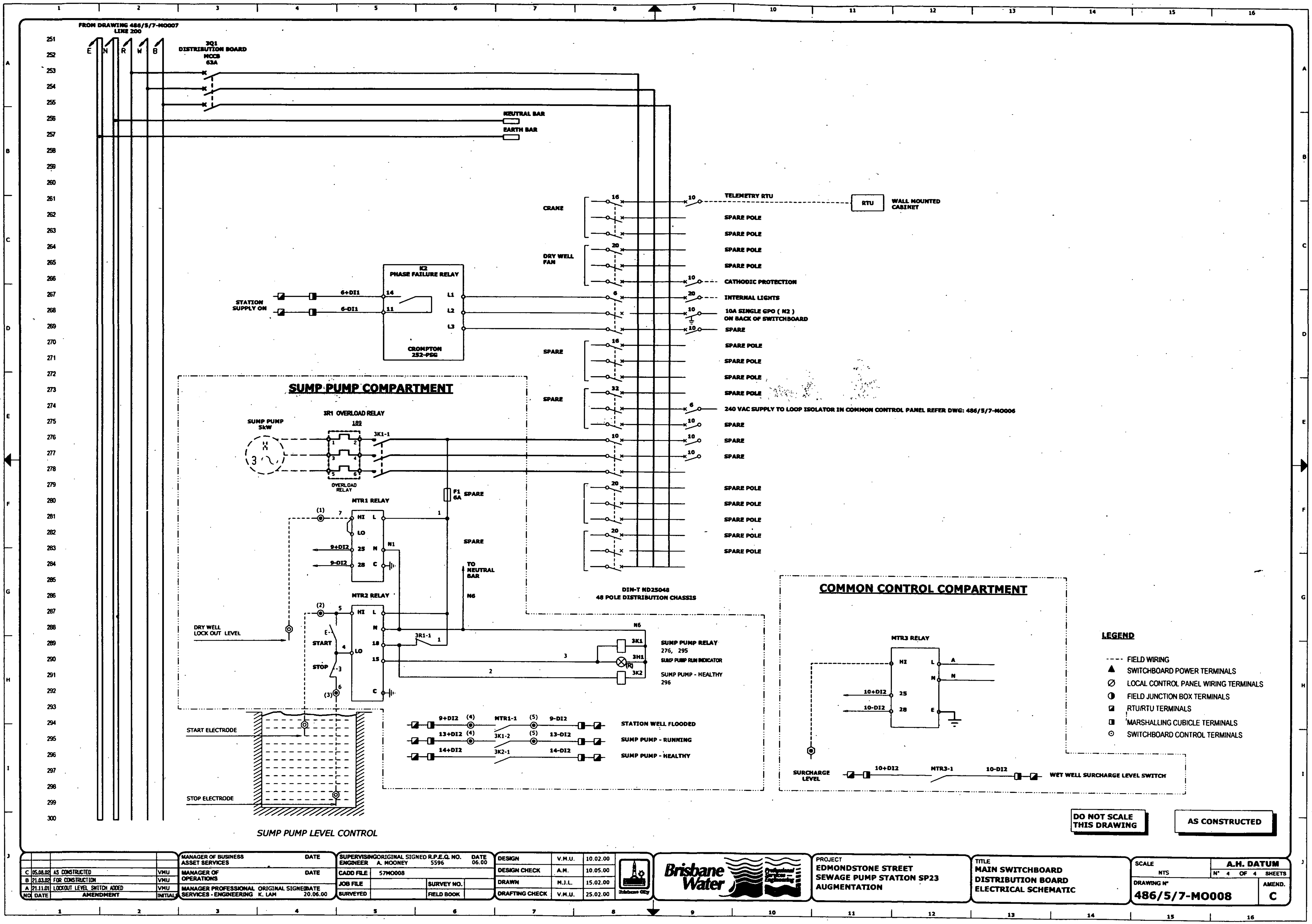
TITLE: MAIN SWITCHBOARD INCOMER SECTION ELECTRICAL SCHEMATIC

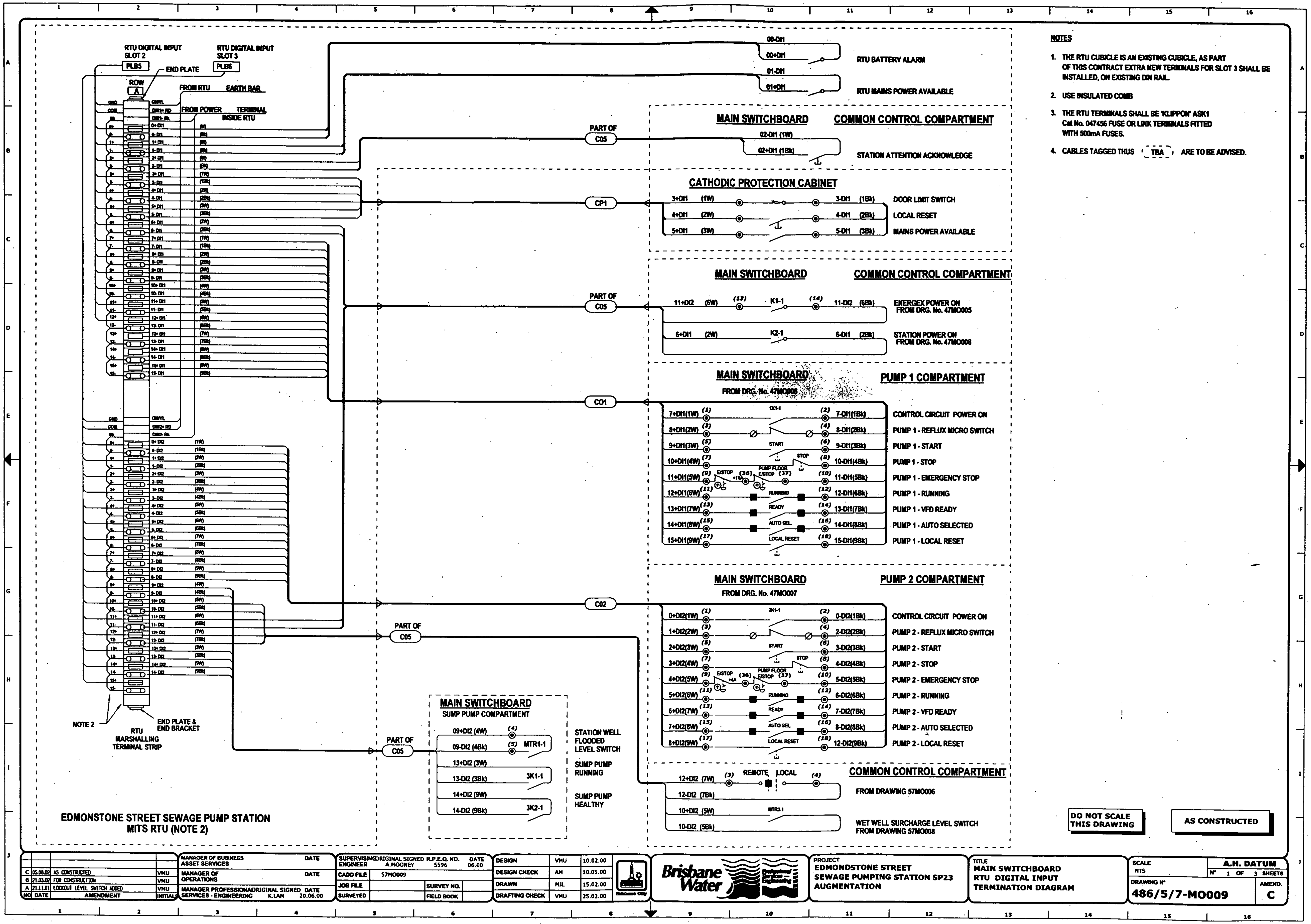
SCALE: NTS | A.H. DATUM | Nº 1 OF 4 SHEETS

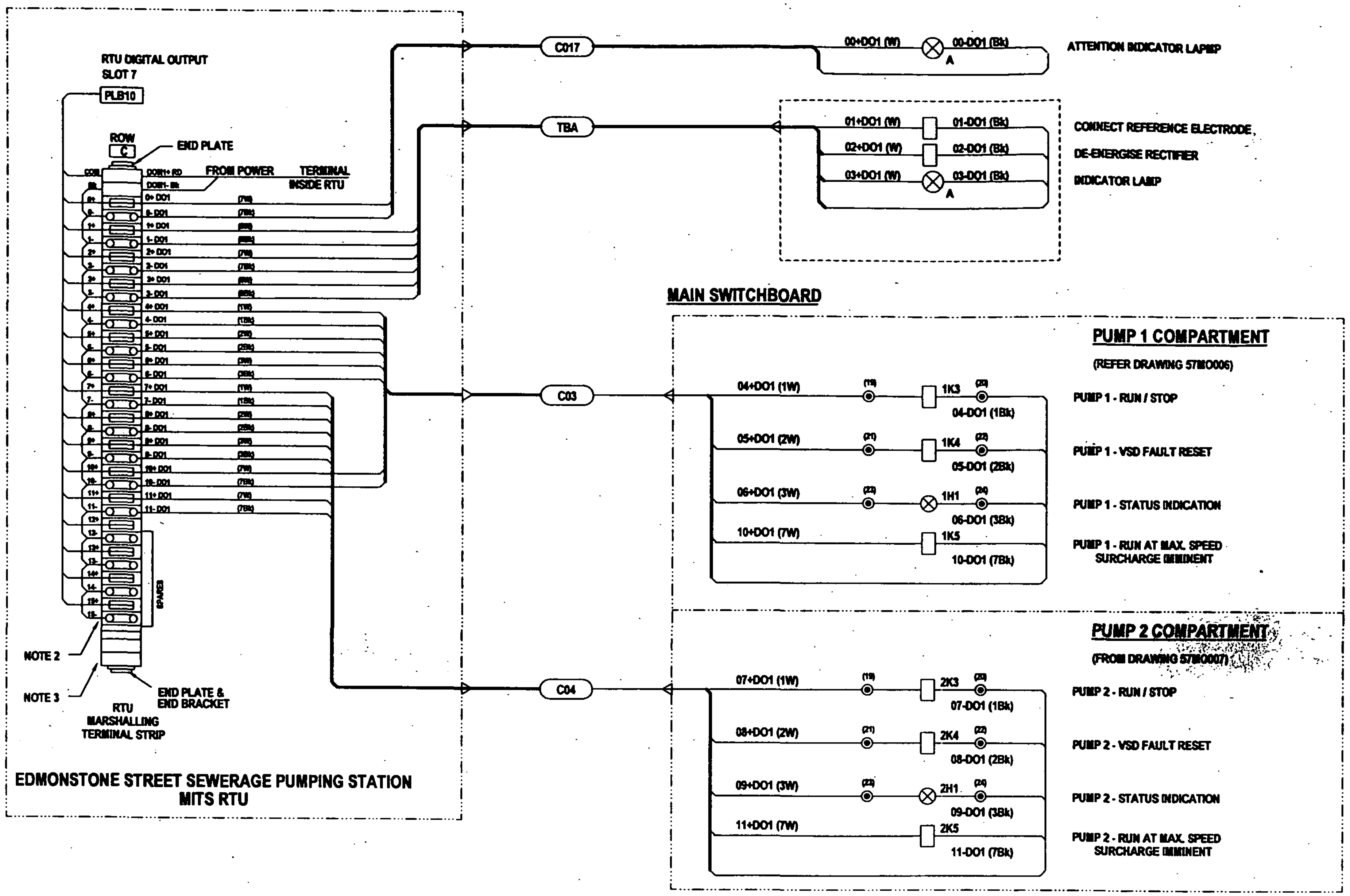
DRAWING Nº 486/5/7-MO005 | AMEND. C


CONTINUED FROM LINE 50
DRAWING 486/5/5-MO005
RTU CABINET
(EXTERNAL TO MSB)
KW TRANSDUCER
CROMPTON 256-XWL
PUMP 1
224KW
FLC 375A
P1 BREAKER
NS630H
RFI FILTER
DANFOSS VFD UNIT
400/5
HOURS RUN METER
CONTROL CIRCUIT - POWER ON
133
E/STOP
PUMP FLOOR E/STOP
CIRCUIT BREAKER SHUNT TRIP COIL
MOTOR HEATER
CONTINUES LINE 151
DRAWING 486/5/5-MO007
DANFOSS VLT6275
V.F. DRIVE- PUMP 1
RUN/STOP
RESET
COMMON
SELECT SET UP 2
MANUAL SPEED CONTROL
1K POTENTIOMETER
LOCAL REMOTE
PART OF SW1 IN COMMON CONTROL COMPARTMENT
DRIVE IN AUTO
V.F. DRIVE CONTROL IN AUTO TO INTERFACE TERMINALS LINE 140
RUNNING
V.F. DRIVE RUNNING TO INTERFACE TERMINALS LINE 138
READY
V.F. DRIVE READY TO INTERFACE TERMINALS LINE 139
VF DRIVE MOTOR CURRENT 4-20mA RTU INPUT
VF DRIVE RUNNING SPEED 4-20mA RTU INPUT
WET WELL LEVEL 4-20mA RTU INPUT
NOTE 3
WET WELL LEVEL TRX
DANFOSS VLT 6275 PUMP 2
WET WELL LEVEL INDICATOR
LOOP ISOLATOR SFI/4-20/4-20
240VAC
IN COMMON CONTROL COMPARTMENT
TO CIRCUIT BREAKER IN DISTRIBUTION BOARD REFER DWG:486/5/7-MO008
RTU DIGITAL INPUTS
PUMP 1 - CONTROL POWER ON
PUMP 1 - REFLUX MICRO SWITCH
PUMP 1 - START
PUMP 1 - STOP
PUMP 1 - EMERGENCY STOP
PUMP 1 - RUNNING
PUMP 1 - VFD READY
PUMP 1 - VFD AUTO SELECTED
PUMP 1 - LOCAL RESET
STATION - REMOTE SELECTED
RTU DIGITAL OUTPUTS
PUMP 1 - RUN / STOP RELAY
73, 80, 103 , 203
PUMP 1 - VSD FAULT RESET RELAY
104
PUMP 1 - STATUS INDICATION
PUMP 1 - RUN AT MAXIMUM SPEED
107 (SURCHARGE IMMINENT)
SYMBOLS LEGEND
FIELD WIRING
SWITCHBOARD POWER TERMINALS
SWITCHBOARD CONTROL TERMINALS
LOCAL CONTROL PANEL WIRING TERMINALS
FIELD JUNCTION BOX TERMINALS
RTU CARD TERMINALS
RTU INTERFACE TERMINALS
FUSED INTERFACE TERMINALS
DISCONNECT LINK INTERFACE TERMINALS
DO NOT SCALE THIS DRAWING
D 12.09.02 SHUNT TRIP LOGIC MODIFIED VMU
C 08.08.02 AS CONSTRUCTED VMU
B 20.03.02 FOR CONSTRUCTION VMU
A 21.11.01 VFD'S USED IN LIEU OF RESISTOR BANKS VMU
NO. DATE AMENDMENT INITIAL
MANAGER OF BUSINESS ASSET SERVICES
MANAGER OF OPERATIONS
MANAGER PROFESSIONAL SERVICES - ENGINEERING
ORIGINAL SIGNED K. LAM DATE 20.06.00
SUPERVISING ENGINEER ORIGINAL SIGNED A. MOONEY R.P.E.Q. NO. 5596 DATE 06/00
CADD FILE S7MO006
JOB FILE
SURVEY NO.
SURVEYED
FIELD BOOK
DESIGN VMU 10.02.00
DESIGN CHECK AM 10.05.00
DRAWN MJL 15.02.00
DRAFTING CHECK VMU 25.02.00
Brisbane Water
Professional Services - Engineering
PROJECT
EDMONDSTONE STREET
SEWAGE PUMPING STATION SP23
AUGMENTATION
TITLE
MAIN SWITCHBOARD
PUMP 1 - 375A 224KW
ELECTRICAL SCHEMATIC
SCALE NTS
A.H. DATUM
N° 2 OF 4 SHEETS
DRAWING N° 486/5/7-MO006
AMEND. D


CONTINUED FROM LINE 100
DRAWING 486/5/5-MO006
RTU CABINET
(EXTERNAL TO MSB)
KW TRANSDUCER
CROMPTON 256-XWL
P2 BREAKER
NS630H
RFI FILTER
DANFOSS VFD UNIT
PUMP 2
224KW
FLC 375A
HOURS RUN METER
CONTROL POWER ON
233
CIRCUIT BREAKER SHUNT TRIP COIL
MOTOR HEATER
E/STOP
PUMP FLOOR E/STOP
CONTINUES LINE 251
DRAWING 486/5/5-MO008
DANFOSS VLT6275
V.F. DRIVE PUMP 2
MANUAL SPEED CONTROL
1K POTENTIOMETER
RUN/STOP
RESET
COMMON
SELECT SET UP 2
LOCAL REMOTE
PART OF SW1 IN COMMON CONTROL COMPARTMENT
DRIVE IN AUTO
V.F. DRIVE CONTROL IN AUTO TO INTERFACE TERMINALS LINE 240
RUNNING
V.F. DRIVE RUNNING TO INTERFACE TERMINALS LINE 238
READY
V.F. DRIVE READY TO INTERFACE TERMINALS LINE 239
VF DRIVE MOTOR CURRENT 4-20mA RTU INPUT
VF DRIVE RUNNING SPEED 4-20mA RTU INPUT
WET WELL LEVEL 4-20mA RTU INPUT
WET WELL LEVEL TRX
WET WELL LEVEL INDICATOR
LOOP ISOLATOR
240VAC
IN COMMON CONTROL COMPARTMENT
TO CIRCUIT BREAKER IN DISTRIBUTION BOARD REFER DWG. 486/5/7-MO008
RTU DIGITAL INPUTS
CONTROL POWER ON
PUMP 2 - REFLUX MICRO SWITCH
PUMP 2 - START
PUMP 2 - STOP
PUMP 2 - EMERGENCY STOP
PUMP 2 - RUNNING
PUMP 2 - VFD READY
PUMP 2 - VFD AUTO SELECTED
PUMP 2 - LOCAL RESET
RTU DIGITAL OUTPUTS
PUMP 2 - RUN/STOP RELAY
173, 180, 203 ,103
PUMP 2 - VSD FAULT RESET RELAY
204
PUMP 2 - STATUS INDICATION
PUMP 2 - RUN AT MAX SPEED
210 (SURCHARGE IMMINENT)
SYMBOLS LEGEND
FIELD WIRING
SWITCHBOARD POWER TERMINALS
SWITCHBOARD CONTROL TERMINALS
LOCAL CONTROL PANEL WIRING TERMINALS
FIELD JUNCTION BOX TERMINALS
RTU CARD TERMINALS
RTU INTERFACE TERMINALS
FUSED INTERFACE TERMINALS
DISCONNECT LINK INTERFACE TERMINALS
DO NOT SCALE THIS DRAWING
D 12.09.02 SHUNT TRIP LOGIC MODIFIED VMU
C 05.08.02 AS CONSTRUCTED VMU
B 21.03.02 FOR CONSTRUCTION VMU
A 21.11.01 VFD'S USED IN LIEU OF RESISTOR BANKS VMU
NO. DATE AMENDMENT INITIALS
MANAGER OF BUSINESS ASSET SERVICES
MANAGER OF OPERATIONS
MANAGER PROFESSIONAL SERVICES - ENGINEERING
ORIGINAL SIGNED K. LAM 20.06.00
SUPERVISING ENGINEER ORIGINAL SIGNED A. MOONEY R.P.E.Q. NO. 5596 06/00
CADD FILE 57MO007
DESIGN VMU 10.02.00
DESIGN CHECK AM 10.05.00
DRAWN MJL 15.02.00
DRAFTING CHECK VMU 25.02.00
Brisbane Water
PROJECT
EDMONDSTONE STREET SEWAGE PUMPING STATION SP23 AUGMENTATION
TITLE
MAIN SWITCHBOARD
PUMP 2 - 375A 224KW
ELECTRICAL SCHEMATIC
SCALE NTS
A.H. DATUM
N° 3 OF 4 SHEETS
DRAWING N° 486/5/7-MO007
AMEND. D


FROM DRAWING 486/5/7-M0007 LINE 200
3Q1 DISTRIBUTION BOARD MCCB 63A
NEUTRAL BAR
EARTH BAR
CRANE
DRY WELL FAN
SPARE
TELEMETRY RTU
RTU
WALL MOUNTED CABINET
SPARE POLE
CATHODIC PROTECTION
INTERNAL LIGHTS
10A SINGLE GPO (N2) ON BACK OF SWITCHBOARD
240 VAC SUPPLY TO LOOP ISOLATOR IN COMMON CONTROL PANEL REFER DWG: 486/5/7-M0006
K2 PHASE FAILURE RELAY
CROMPTON 252-PSG
STATION SUPPLY ON
SUMP PUMP COMPARTMENT
SUMP PUMP 5kW
3R1 OVERLOAD RELAY
OVERLOAD RELAY
MTR1 RELAY
MTR2 RELAY
F1 6A SPARE
TO NEUTRAL BAR
DRY WELL LOCK OUT LEVEL
START
STOP
SUMP PUMP RELAY 276, 295
SUMP PUMP RUN INDICATOR
SUMP PUMP - HEALTHY 296
DIN-T ND25048 48 POLE DISTRIBUTION CHASSIS
START ELECTRODE
STOP ELECTRODE
SUMP PUMP LEVEL CONTROL
STATION WELL FLOODED
SUMP PUMP - RUNNING
SUMP PUMP - HEALTHY
COMMON CONTROL COMPARTMENT
MTR3 RELAY
SURCHARGE LEVEL
WET WELL SURCHARGE LEVEL SWITCH
LEGEND
FIELD WIRING
SWITCHBOARD POWER TERMINALS
LOCAL CONTROL PANEL WIRING TERMINALS
FIELD JUNCTION BOX TERMINALS
RTU/RTU TERMINALS
MARSHALLING CUBICLE TERMINALS
SWITCHBOARD CONTROL TERMINALS
DO NOT SCALE THIS DRAWING
AS CONSTRUCTED
C 05.08.02 AS CONSTRUCTED VMU
B 21.03.02 FOR CONSTRUCTION VMU
A 21.11.01 LOCKOUT LEVEL SWITCH ADDED VMU
NO DATE AMENDMENT INITIALS
MANAGER OF BUSINESS ASSET SERVICES DATE
MANAGER OF OPERATIONS DATE
MANAGER PROFESSIONAL SERVICES - ENGINEERING ORIGINAL SIGNED K. LAM DATE 20.06.00
SUPERVISING ENGINEER ORIGINAL SIGNED A. MOONEY R.P.E.Q. NO. 5596 DATE 06.00
CADD FILE 57M0008
JOB FILE
SURVEY NO.
SURVEYED
FIELD BOOK
DESIGN V.H.U. 10.02.00
DESIGN CHECK A.M. 10.05.00
DRAWN M.J.L. 15.02.00
DRAFTING CHECK V.H.U. 25.02.00
Brisbane Water
PROJECT EDMONDSTONE STREET SEWAGE PUMP STATION SP23 AUGMENTATION
TITLE MAIN SWITCHBOARD DISTRIBUTION BOARD ELECTRICAL SCHEMATIC
SCALE NTS
A.H. DATUM
Nº 4 OF 4 SHEETS
DRAWING Nº 486/5/7-M0008
AMEND. C


RTU DIGITAL INPUT SLOT 2
RTU DIGITAL INPUT SLOT 3
PLB5
PLB6
END PLATE
ROW A
FROM RTU EARTH BAR
FROM POWER TERMINAL INSIDE RTU
00-DI1
00+DI1
RTU BATTERY ALARM
01-DI1
01+DI1
RTU MAINS POWER AVAILABLE
MAIN SWITCHBOARD
COMMON CONTROL COMPARTMENT
PART OF C05
02-DI1 (1W)
02+DI1 (1Bk)
STATION ATTENTION ACKNOWLEDGE
CATHODIC PROTECTION CABINET
CP1
DOOR LIMIT SWITCH
LOCAL RESET
MAINS POWER AVAILABLE
ENERGEX POWER ON FROM DRG. No. 47MO005
STATION POWER ON FROM DRG. No. 47MO008
PUMP 1 COMPARTMENT
C01
CONTROL CIRCUIT POWER ON
PUMP 1 - REFLUX MICRO SWITCH
PUMP 1 - START
PUMP 1 - STOP
PUMP 1 - EMERGENCY STOP
PUMP 1 - RUNNING
PUMP 1 - VFD READY
PUMP 1 - AUTO SELECTED
PUMP 1 - LOCAL RESET
PUMP 2 COMPARTMENT
FROM DRG. No. 47MO007
C02
CONTROL CIRCUIT POWER ON
PUMP 2 - REFLUX MICRO SWITCH
PUMP 2 - START
PUMP 2 - STOP
PUMP 2 - EMERGENCY STOP
PUMP 2 - RUNNING
PUMP 2 - VFD READY
PUMP 2 - AUTO SELECTED
PUMP 2 - LOCAL RESET
COMMON CONTROL COMPARTMENT
REMOTE
LOCAL
FROM DRAWING 57MO006
WET WELL SURCHARGE LEVEL SWITCH FROM DRAWING 57MO008
MAIN SWITCHBOARD SUMP PUMP COMPARTMENT
STATION WELL FLOODED LEVEL SWITCH
SUMP PUMP RUNNING
SUMP PUMP HEALTHY
NOTE 2
RTU MARSHALLING TERMINAL STRIP
END PLATE & END BRACKET
EDMONSTONE STREET SEWAGE PUMP STATION MITS RTU (NOTE 2)
NOTES
1. THE RTU CUBICLE IS AN EXISTING CUBICLE, AS PART OF THIS CONTRACT EXTRA NEW TERMINALS FOR SLOT 3 SHALL BE INSTALLED, ON EXISTING DIN RAIL.
2. USE INSULATED COMB
3. THE RTU TERMINALS SHALL BE 'KLIPPON' ASK1 Cat No. 047456 FUSE OR LINK TERMINALS FITTED WITH 500mA FUSES.
4. CABLES TAGGED THUS TBA ARE TO BE ADVISED.
DO NOT SCALE THIS DRAWING
AS CONSTRUCTED
C 05.08.02 AS CONSTRUCTED VHU
B 21.03.02 FOR CONSTRUCTION VHU
A 21.11.01 LOCKOUT LEVEL SWITCH ADDED VHU
NO DATE AMENDMENT INITIALS
MANAGER OF BUSINESS ASSET SERVICES
MANAGER OF OPERATIONS
MANAGER PROFESSIONAL SERVICES - ENGINEERING ORIGINAL SIGNED K.LAN 20.06.00
SUPERVISING ENGINEER ORIGINAL SIGNED A.MOONEY R.P.E.Q. NO. 5596 DATE 06.00
CADD FILE 57MO009
DESIGN VMU 10.02.00
DESIGN CHECK AM 10.05.00
DRAWN MJL 15.02.00
DRAFTING CHECK VMU 25.02.00
Brisbane Water
PROJECT EDMONSTONE STREET SEWAGE PUMPING STATION SP23 AUGMENTATION
TITLE MAIN SWITCHBOARD RTU DIGITAL INPUT TERMINATION DIAGRAM
SCALE NTS
A.H. DATUM
N° 1 OF 3 SHEETS
DRAWING N° 486/5/7-MO009
AMEND. C



NOTES

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DO NOT SCALE THIS DRAWING

AS CONSTRUCTED

NO	DATE	AMENDMENT	INITIALS
C	05.08.02	AS CONSTRUCTED	VMU
B	21.03.02	FOR CONSTRUCTION	VMU
A	21.11.01	AMENDED TO VSD CONTROL	VMU

MANAGER OF BUSINESS ASSET SERVICES			DATE
MANAGER OF OPERATIONS			DATE
MANAGER PROFESSIONAL SERVICES - ENGINEERING	ORIGINAL SIGNED K. LAM		DATE 20.06.00

SUPERVISING ENGINEER	ORIGINAL SIGNED A.MOONEY	R.P.E.Q. NO. 5596	DATE 06.00
CADD FILE	57MO010		
JOB FILE		SURVEY NO.	
SURVEYED		FIELD BOOK	

DESIGN	VMU	10.02.00
DESIGN CHECK	AM	10.05.00
DRAWN	MJL	15.02.00
DRAFTING CHECK	VMU	25.02.00

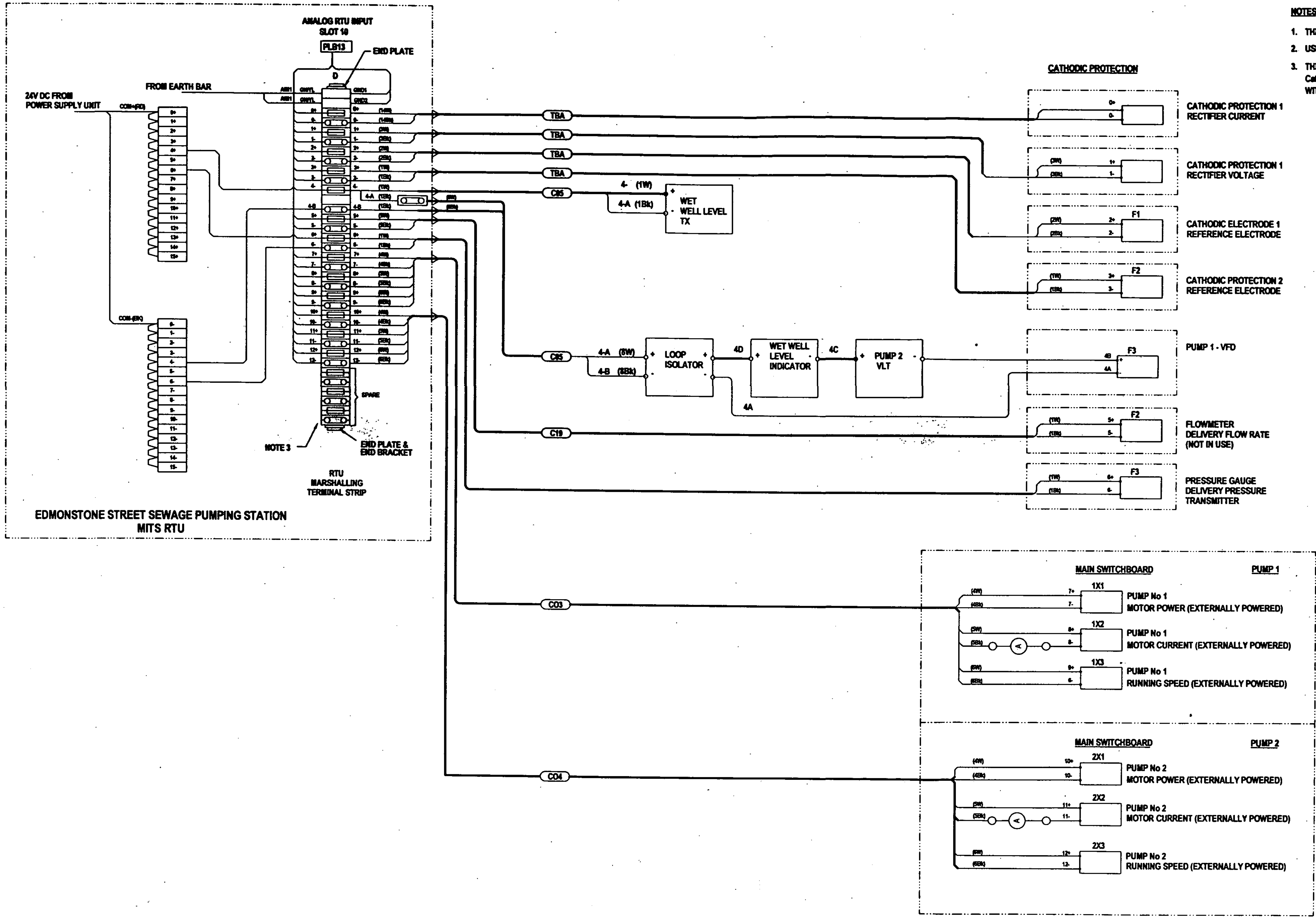
Brisbane City

Brisbane Water — Professional Services — Engineering

PROJECT
EDMONDSTONE STREET
SEWAGE PUMPING STATION SP23
AUGMENTATION

TITLE
MAIN SWITCHBOARD
RTU DIGITAL OUTPUT
TERMINATION DIAGRAM

SCALE NTS | A.H. DATUM | N° 2 OF 3 SHEETS
DRAWING N° 486/5/7-MO010 | AMEND. C



NOTES

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DO NOT SCALE THIS DRAWING

AS CONSTRUCTED

AMEND.	DATE	AMENDMENT	INITIAL
C	08.08.02	AS CONSTRUCTED	VMU
B	21.03.02	FOR CONSTRUCTION	VMU
A	21.11.01	AMENDED TO VSD CONTROL	VMU

MANAGER OF BUSINESS ASSET SERVICES		DATE
MANAGER OF OPERATIONS		DATE
MANAGER PROFESSIONAL SERVICES - ENGINEERING	ORIGINAL SIGNED A. MOONEY	DATE 20.06.00
SUPERVISING ENGINEER	ORIGINAL SIGNED A. MOONEY R.P.E.Q. NO. 5596	DATE 06.00
CADD FILE	57MO011	
JOB FILE		SURVEY NO.
SURVEYED		FIELD BOOK

DESIGN	VMU	10.02.00
DESIGN CHECK	AM	10.05.00
DRAWN	VMU	15.02.00
DRAFTING CHECK	MJL	25.02.00

Brisbane Water

PROJECT
EDMONDSTONE STREET
SEWAGE PUMPING STATION SP23
AUGMENTATION

TITLE
MAIN SWITCHBOARD
RTU ANALOG INPUT
TERMINATION DIAGRAM

SCALE NTS

A.H. DATUM

N° 3 OF 3 SHEETS

DRAWING N° 486/5/5-MO011

AMEND. C