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BRISBANE CITY COUNCIL

CPNTRACT NO: WD90552-89/09

LYTTON ROAD VACUUM PUMP STATION UPGRADE

OPERATION & MAINTENANCE MANUAL

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CONTRACT WD-90552-08/09
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SECTION 1

EQUIPMENT MANUALS

LYTTON ROAD VACUUM PUMP STATION UPGRADE
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BUSCH MINK MM 1320 AV VACUUM PUMPS

LYTTON ROAD VACUUM PUMP STATION UPGRADE
CONTRACT WD-90552-08/09
OPERATIONS & MAINTENANCE MANUAL

Installation and Operating Instructions

Vacuum Pumps

Mink MM 1324, 1202, 1252, 1322, 1200, 1250, 1320 AV

CE

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79689 Maulburg
Germany

0870133276 / 081029 / Modifications reserved

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Preface

Congratulations on your purchase of the Busch vacuum pump. With watchful observation of the field's requirements, innovation and steady development Busch delivers modern vacuum and pressure solutions worldwide.

These operating instructions contain information for

- product description,
- safety,
- transport,
- storage,
- installation and commissioning,
- maintenance,
- overhaul,
- troubleshooting and
- spare parts

of the vacuum pump.

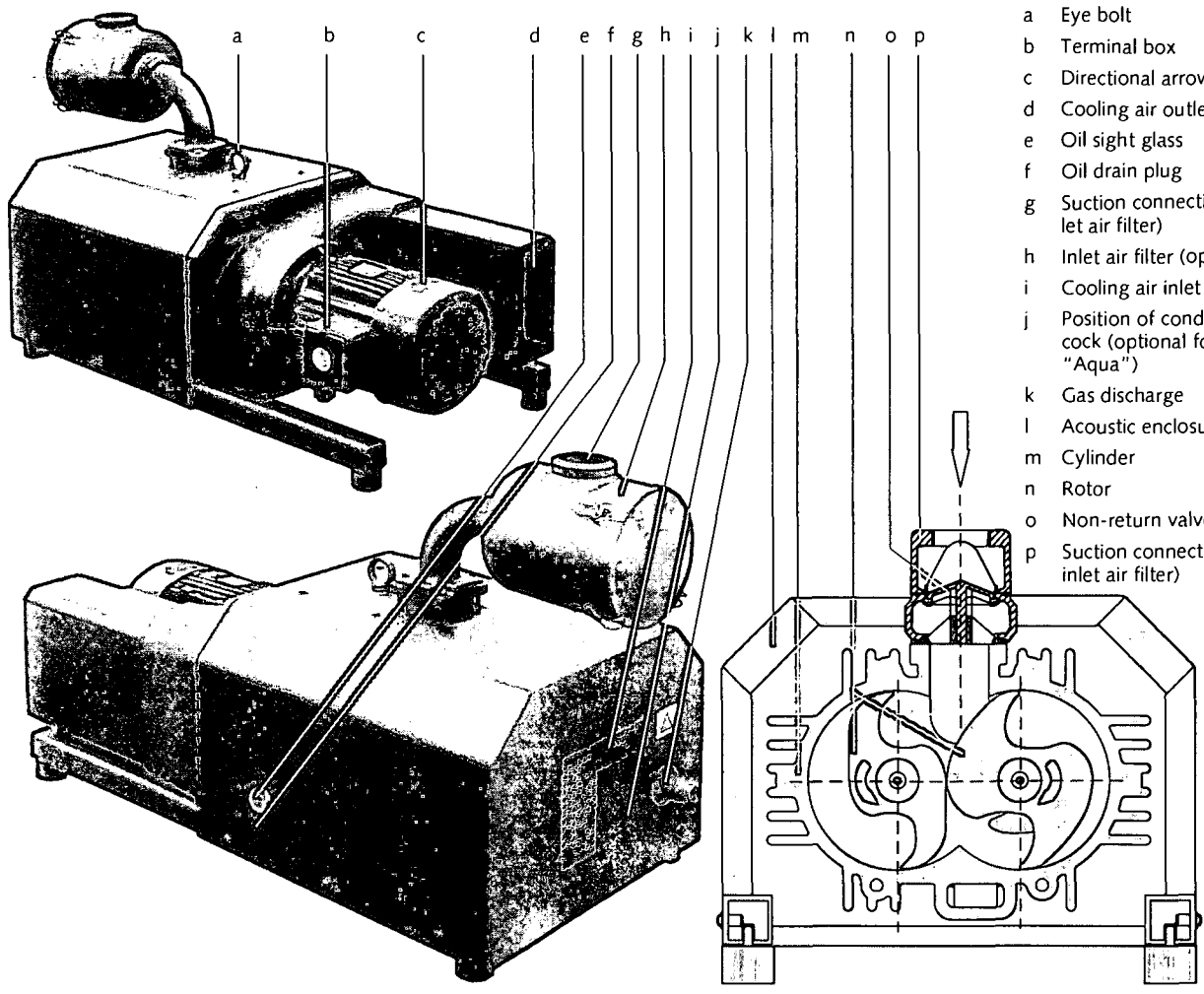
Version drive with integrated frequency inverter:

The drive with integrated frequency inverter is subject to a separate instruction manual.

For the purpose of these instructions, "handling" the vacuum pump means the transport, storage, installation, commissioning, influence on operating conditions, maintenance, troubleshooting and overhaul of the vacuum pump.

Prior to handling the vacuum pump these operating instructions shall be read and understood. If anything remains to be clarified please contact your Busch representative!

Keep these operating instructions and, if applicable, other pertinent operating instructions available on site.



a Eye bolt
b Terminal box
c Directional arrow
d Cooling air outlet
e Oil sight glass
f Oil drain plug
g Suction connection (with inlet air filter)
h Inlet air filter (optional)
i Cooling air inlet
j Position of condensate drain cock (optional for version "Aqua")
k Gas discharge
l Acoustic enclosure
m Cylinder
n Rotor
o Non-return valve
p Suction connection (without inlet air filter)

Product Description

Use

The vacuum pump is intended for

– the suction

of

– air and other dry, non-aggressive, non-toxic and non-explosive gases

Conveying media with a lower or higher density than air leads to an increased thermal and/or mechanical load on the vacuum pump and is permissible only after prior consultation with Busch.

Max. allowed temperature of the inlet gas: 40 °C

Standard-version:

The gas shall be free from vapours that would condensate under the temperature and pressure conditions inside the vacuum pump.

Version "Aqua":

The vacuum pump features the corrosion protection coating CPC and is capable of conveying water vapour (→ page 8: Conveying Condensable Vapours). Conveyance of other vapours shall be agreed upon with Busch. Conveyance of water or other liquids in liquid phase increases the power consumption and shall therefore be avoided (risk of drive overload).

The vacuum pump is intended for the placement in a non-potentially explosive environment.

Max. permissible number of startings per hour: 12

Vacuum pumps MM 1324 AV standard-version are thermally suitable for continuous operation down to ultimate pressure.

Vacuum pumps MM 1324 AV Version "Aqua" are thermally suitable for continuous operation at intake pressures down to 200 hPa abs (200 mbar abs). By means of process control and/or vacuum relief valves it must be made sure that the minimum allowed intake pressure will not be underrun.

Vacuum pumps MM 1202 AV, MM 1200 AV, MM 1252 AV and MM 1250 AV are thermally suitable for continuous operation at intake pressures down to 100 hPa abs (100 mbar abs). By means of process control and/or vacuum relief valves it must be made sure that the minimum allowed intake pressure will not be underrun.

Vacuum pumps MM 1322 AV and MM 1320 AV (version 600...3600 min^{-1}) are thermally suitable for continuous operation at intake pressures down to 150 hPa abs (150 mbar abs). MM 1320 AV (version 600...4200 min^{-1}) are thermally suitable for continuous operation at intake pressures down to 200 hPa abs (200 mbar abs). By means of process control and/or vacuum relief valves it must be made sure that the minimum allowed intake pressure will not be underrun.

Version "Aqua":

The safety valve on the vacuum pump protects the vacuum pump against overheating only. It is not designed for frequent use and must therefore not be used as a system pressure regulating valve.

Principle of Operation

The vacuum pump works on the claw principle.

The components are dimensioned such, that on the one hand there is never contact between the two claws or between a claw and the cylinder, on the other hand the gaps are small enough to keep the clearance loss between the chambers low.

In order to avoid the suction of solids, the vacuum pump is equipped with a screen (715) in the suction connection.

In order to avoid reverse rotation after switching off, the vacuum pump is equipped with a non-return valve (o, 714).

The vacuum pump compresses the inlet gas absolutely oil-free. A lubrication of the pump chamber is neither necessary nor allowed.

Cooling

The vacuum pump is cooled by

- radiation of heat from the surface of the vacuum pump
- the air flow from the fan wheel of the drive motor
- the process gas
- the air flow from the fan wheel on the shaft of the vacuum pump

Start Controls

The vacuum pump comes without start controls. The control of the vacuum pump is to be provided in the course of installation.

Safety

Intended Use

Definition: For the purpose of these instructions, "handling" the vacuum pump means the transport, storage, installation, commissioning, influence on operating conditions, maintenance, troubleshooting and overhaul of the vacuum pump.

The vacuum pump is intended for industrial use. It shall be handled only by qualified personnel.

The allowed media and operational limits (→ page 3: Product Description) and the installation prerequisites (→ page 5: Installation Prerequisites) of the vacuum pump shall be observed both by the manufacturer of the machinery into which the vacuum pump is to be incorporated and by the operator.

The maintenance instructions shall be observed.

Prior to handling the vacuum pump these installation and operating instructions shall be read and understood. If anything remains to be clarified please contact your Busch representative!

Safety Notes

The vacuum pump has been designed and manufactured according to state-of-the-art methods. Nevertheless, residual risks may remain. These operating instructions highlight potential hazards where appropriate. Safety notes are tagged with one of the keywords DANGER, WARNING and CAUTION as follows:

DANGER

Disregard of this safety note will always lead to accidents with fatal or serious injuries.

WARNING

Disregard of this safety note may lead to accidents with fatal or serious injuries.

CAUTION

Disregard of this safety note may lead to accidents with minor injuries or property damage.

Noise Emission

For the sound pressure level in free field according to EN ISO 2151 → page 19: Technical Data.

CAUTION

The vacuum pump emits noise of high intensity in a narrow band.

Risk of damage to the hearing.

Persons staying in the vicinity of a non noise insulated vacuum pump over extended periods shall wear ear protection.

Transport

Transport in Packaging

Packed on a pallet the vacuum pump is to be transported with a forklift.

Transport without Packaging

In case the vacuum pump is packed in a cardboard box with inflated cushions:

- Remove the inflated cushions from the box

In case the vacuum pump is in a cardboard box cushioned with rolled corrugated cardboard:

- Remove the corrugated cardboard from the box

In case the vacuum pump is laid in foam:

- Remove the foam

In case the vacuum pump is bolted to a pallet or a base plate:

- Remove the bolting between the vacuum pump and the pallet/base plate

In case the vacuum pump is fastened to the pallet by means of tightening straps:

- Remove the tightening straps

CAUTION

Do not walk, stand or work under suspended loads.

- Make sure that the eyebolt (a) is in faultless condition (replace a damaged, e.g. bent eyebolt with a new one)
- Make sure that the eyebolt (a) is fully screwed in and tightened by hand
- Attach lifting gear securely to the eyebolt (a) on the synchronising gear

When the vacuum pump is equipped with a very heavy drive motor and would hang very inclined (>10 °) on the synchronising gear eyebolt alone:

- Attach lifting gear securely to the eyebolts on the synchronising gear (a) and on the drive motor

In case the drive motor comes without an eyebolt or the eyebolt on the drive motor is located at an unfavourable position:

- Loop a belt/rope with suitable length and strength around the flange of the drive motor

- Attach the lifting gear to a crane hook with safety latch
- Lift the vacuum pump with a crane

In case the vacuum pump was bolted to a pallet or a base plate:

- Remove the stud bolts from the rubber feet

Storage

Short-term Storage

- Make sure that the suction connection and the gas discharge are closed (leave the provided plugs in)
- Store the vacuum pump

– if possible in original packaging,
– indoors,
– dry,
– dust free and
– vibration free

Conservation

In case of adverse ambient conditions (e.g. aggressive atmosphere, frequent temperature changes) conserve the vacuum pump immediately. In case of favourable ambient conditions conserve the vacuum pump if a storage of more than 3 months is scheduled.

- Make sure that all ports are firmly closed; seal all ports that are not sealed with PTFE-tape, gaskets or o-rings with adhesive tape

Note: VCI stands for "volatile corrosion inhibitor". VCI-products (film, paper, cardboard, foam) evaporate a substance that condenses in molecular thickness on the packed good and by its electro-chemical properties effectively suppresses corrosion on metallic surfaces. However, VCI-products may attack the surfaces of plastics and elastomers. Seek advice from your local packaging dealer! Busch uses CORTEC VCI 126 R film for the overseas packaging of large equipment.

- Wrap the vacuum pump in VCI film
- Store the vacuum pump
  - if possible in original packing,
  - indoors,
  - dry,
  - dust free and
  - vibration free.

For commissioning after conservation:

- Make sure that all remains of adhesive tape are removed from the ports
- Commission the vacuum pump as described in the chapter Installation and Commissioning (→ page 5)

Installation and Commissioning

Installation Prerequisites

CAUTION

In case of non-compliance with the installation prerequisites, particularly in case of insufficient cooling:

Risk of damage or destruction of the vacuum pump and adjoining plant components!

Risk of injury!

The installation prerequisites must be complied with.

- Make sure that the integration of the vacuum pump is carried out such that the essential safety requirements of the Machine Directive 98/37/EC are complied with (in the responsibility of the designer of the machinery into which the vacuum pump is to be incorporated; → page 16: note in the EC-Declaration of Conformity)

Mounting Position and Space

- Make sure that the environment of the vacuum pump is not potentially explosive
- Make sure that the following ambient conditions will be complied with:
  - ambient temperature: 0 ... 40 °C
  - ambient pressure: atmospheric
- Make sure that the environmental conditions comply with the protection class of the drive motor (according to the nameplate)
- Make sure that the vacuum pump will be placed or mounted horizontally
- Make sure that the base for placement / mounting base is even
- Make sure that in order to warrant a sufficient cooling there will be a clearance of minimum 1 m between the vacuum pump and nearby walls
- Make sure that no heat sensitive parts (plastics, wood, cardboard, paper, electronics) will touch the surface of the vacuum pump
- Make sure that the installation space or location is vented such that a sufficient cooling of the vacuum pump is warranted

CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.

Risk of burns!

- Make sure that the vacuum pump will not be touched inadvertently during operation, provide a guard if appropriate
- Make sure that the sight glass (e, 76) of the synchronising gear will remain accessible

In case the synchronising gear oil change is planned to be carried out on location:

- ◆ Make sure that the drain port (f, 80) and the filling port (72) of the synchronising gear will remain easily accessible

Suction Connection

CAUTION

Intruding foreign objects or liquids can destroy the vacuum pump.

In case the inlet gas can contain dust or other foreign solid particles:

- ◆ Make sure that a suitable filter (5 micron or less) is installed upstream the vacuum pump
- Make sure that the suction line fits to the suction connection (g/p) of the vacuum pump
- Make sure that the gas will be sucked through a vacuum-tight flexible hose or a pipe

In case of using a pipe:

- ◆ Make sure that the pipe will cause no stress on the vacuum pump's connection, if necessary use an expansion joint
- Make sure that the line size of the suction line over the entire length is at least as large as the suction connection (g/p) of the vacuum pump

In case the length of the suction line exceeds 2 m it is prudent to use larger line sizes in order to avoid a loss of efficiency and an overload of the vacuum pump. Seek advice from your Busch representative!

In case the vacuum shall be maintained after shutdown of the vacuum pump:

- ◆ Provide a manual or automatic operated valve (= non-return valve) in the suction line

Version "Aqua", if very humid process gases and/or adverse operating cycles bear the risk, that condensates remain in the vacuum pump:

- ◆ Provide a shut-off valve, a drip-leg and a drain cock in the suction line, so that condensates can be drained from the suction line
- ◆ Provide a valve for the unthrottled suction of ambient air (ambient air valve) between the shut-off valve and the vacuum pump (in order to dry the vacuum pump after process end).
- ◆ For non ultimate-pressure-proof vacuum pumps provide a vacuum relief valve (suitable for continuous operation) for the throttled aspiration of ambient air during warming up.
- ◆ Make sure that the anti-pulsation chamber is equipped with a condensate drain cock (j) (optional; if the condensate drain cock is missing contact the Busch service)
- Make sure that the suction line does not contain foreign objects, e.g. welding scales

Gas Discharge

The discharged gas must flow without obstruction. It is not permitted to shut off or throttle the discharge line or to use it at as a pressurised air source.

The following guidelines for the discharge line do not apply, if the aspirated air is discharged to the environment right at the vacuum pump.

- Make sure that the discharge line fits to the gas discharge (k) of the vacuum pump

In case of using a pipe:

  - Make sure that the pipe will cause no stress on the vacuum pump's connection, if necessary use an expansion joint

- Make sure that the line size of the discharge line over the entire length is at least 2"

In case the length of the discharge line exceeds 2 m it is prudent to use larger line sizes in order to avoid a loss of efficiency and an overload of the vacuum pump. Seek advice from your Busch representative!

- Make sure that the discharge line either slopes away from the vacuum pump or provide a liquid separator or a drip leg with a drain cock, so that no liquids can back up into the vacuum pump

Electrical Connection / Controls

- Make sure that the stipulations acc. to the EMC-Directive 89/336/EEC and Low-Voltage-Directive 73/23/EEC as well as the EN-standards, electrical and occupational safety directives and the local or national regulations, respectively, are complied with (this is in the responsibility of the designer of the machinery into which the vacuum pump is to be incorporated; → page 16: note in the EC-Declaration of Conformity).
- Make sure that the power supply for the drive motor is compatible with the data on the nameplate of the drive motor
- Make sure that an overload protection according to EN 60204-1 is provided for the drive motor
- Make sure that the drive of the vacuum pump will not be affected by electric or electromagnetic disturbance from the mains; if necessary seek advice from the Busch service

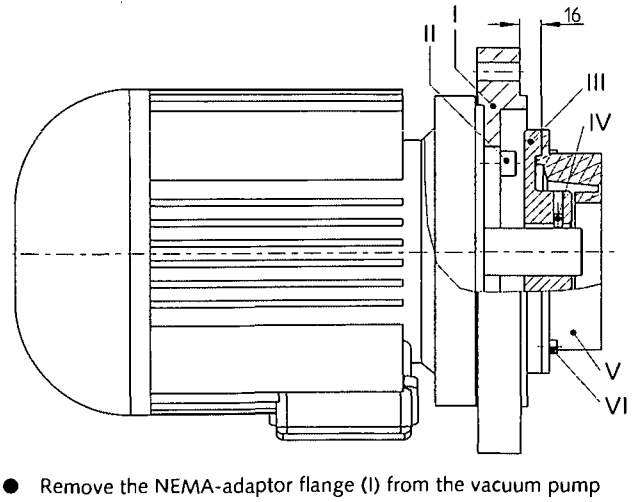
In case of mobile installation:

  - Provide the electrical connection with grommets that serve as strain-relief

Installation

Mounting a NEMA-Motor with BoWex-Coupling

For certain markets the vacuum pump is available without motor, but with a NEMA-adaptor flange and a BoWex-coupling.



- Remove the NEMA-adaptor flange (I) from the vacuum pump
- Pull the elastomer part (V) together with the hub (III) off the shaft of the vacuum pump
- Mount the NEMA-adaptor flange (I) on the motor (the bolts (II) are not part of the Busch scope of delivery)
- Undo the cylinder screws (VI) and remove the elastomer part (V) from the hub (III)
- Make sure that the parallel key is inserted into the motor shaft
- Push the hub (III) onto the motor shaft such that the mounting face of the hub (III) will be located 16±1 mm before the mounting face of the NEMA-adaptor flange (I) (→ sketch)
- Fasten the hub (III) on the motor shaft using the set screw (IV)
- Apply thread locking agent on the threads of the cylinder screws (VI)
- Mount the elastomer part (V) on the hub (III) with the cylinder screws (VI) and tighten the cylinder screws with 14 Nm
- Mount the motor on the vacuum pump

Mounting

- Make sure that the Installation Prerequisites (→ page 5) are complied with
- Set down or mount the vacuum pump at its location

Checking Synchronising Gear Oil

The vacuum pump is delivered with oil filled synchronising gear.

The level shall be slightly above the middle of the sight glass (e, 76).

- Check on the sight glass (e, 76) that the proper amount of oil is filled

Connecting Electrically

WARNING

Risk of electrical shock, risk of damage to equipment.

Electrical installation work must only be executed by qualified personnel that knows and observes the following regulations:
- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or corresponding national accident prevention regulation.

CAUTION

The connection schemes given below are typical. Depending on the specific order or for certain markets deviating connection schemes may apply.

Risk of damage to the drive motor!

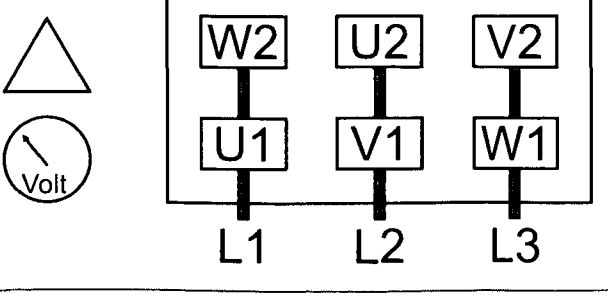
The inside of the terminal box shall be checked for drive motor connection instructions/schemes.

Note: For the connection of a drive with integrated frequency inverter see the separate operating instructions!

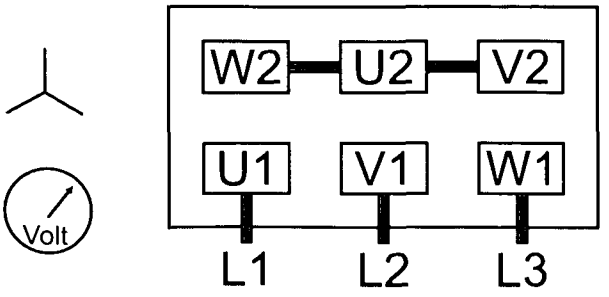
- Electrically connect the drive motor
- Connect the protective earth conductor

Connection Scheme Three-Phase Motor

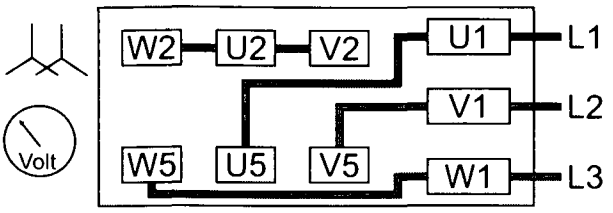
Delta connection (low voltage):



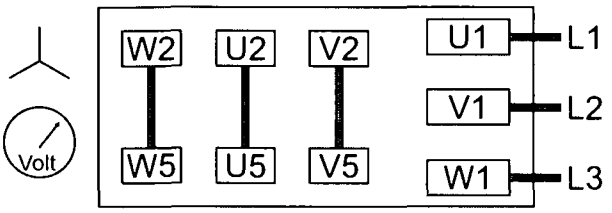
Star connection (high voltage):



Double star connection, multi-voltage motor (low voltage):



Star connection, multi-voltage motor (high voltage):



CAUTION

Operation in the wrong direction of rotation can destroy the vacuum pump in short time.

Prior to starting-up it must be made sure that the vacuum pump is operated in the proper direction.

Version with three-phase motor:

- Determine the intended direction of rotation with the arrow (c) (stuck on or cast)
- "Bump" the drive motor
- Watch the fan wheel of the drive motor and determine the direction of rotation just before the fan wheel stops

If the rotation must be changed:

- Switch any two of the drive motor wires (three-phase motor)

Connecting Lines/Pipes

- Connect the suction line
- Connect the discharge line

Installation without discharge line:

- Make sure that the gas discharge (k) is open

- Make sure that all provided covers, guards, hoods etc. are mounted
- Make sure that cooling air inlets and outlets are not covered or obstructed and that the cooling air flow is not affected adversely in any other way

Recording of Operational Parameters

As soon as the vacuum pump is operated under normal operating conditions:

- Measure the drive motor current and record it as reference for future maintenance and troubleshooting work

Operation Notes

Use

CAUTION

The vacuum pump is designed for operation under the conditions described below.

In case of disregard risk of damage or destruction of the vacuum pump and adjoining plant components!

Risk of injury!

The vacuum pump must only be operated under the conditions described below.

The vacuum pump is intended for

– the suction

of

– air and other dry, non-aggressive, non-toxic and non-explosive gases

Conveying media with a lower or higher density than air leads to an increased thermal and/or mechanical load on the vacuum pump and is permissible only after prior consultation with Busch.

Max. allowed temperature of the inlet gas: 40 °C

Standard-version:

The gas shall be free from vapours that would condensate under the temperature and pressure conditions inside the vacuum pump.

Version "Aqua":

The vacuum pump features the corrosion protection coating CPC and is capable of conveying water vapour (→ page 8: Conveying Condensable Vapours). Conveyance of other vapours shall be agreed upon with Busch. Conveyance of water or other liquids in liquid phase increases the power consumption and shall therefore be avoided (risk of drive overload).

The vacuum pump is intended for the placement in a non-potentially explosive environment.

Max. permissible number of startings per hour: 12

Vacuum pumps MM 1324 AV standard-version are thermally suitable for continuous operation down to ultimate pressure.

Vacuum pumps MM 1324 AV Version "Aqua" are thermally suitable for continuous operation at intake pressures down to 200 hPa abs (200 mbar abs). By means of process control and/or vacuum relief valves it must be made sure that the minimum allowed intake pressure will not be underrun.

Vacuum pumps MM 1202 AV, MM 1200 AV, MM 1252 AV and MM 1250 AV are thermally suitable for continuous operation at intake pressures down to 100 hPa abs (100 mbar abs). By means of process control and/or vacuum relief valves it must be made sure that the minimum allowed intake pressure will not be underrun.

Vacuum pumps MM 1322 AV and MM 1320 AV (version 600...3600 min^{-1}) are thermally suitable for continuous operation at intake pressures down to 150 hPa abs (150 mbar abs). MM 1320 AV (version 600...4200 min^{-1}) are thermally suitable for continuous operation at intake pressures down to 200 hPa abs (200 mbar abs). By means of process control and/or vacuum relief valves it must be made sure that the minimum allowed intake pressure will not be underrun.

Version "Aqua":

The safety valve on the vacuum pump protects the vacuum pump against overheating only. It is not designed for frequent use and must therefore not be used as a system pressure regulating valve.

CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.

Risk of burns!

The vacuum pump shall be protected against contact during operation, it shall cool down prior to a required contact or heat protection gloves shall be worn.

CAUTION

The vacuum pump emits noise of high intensity in a narrow band.

Risk of damage to the hearing.

Persons staying in the vicinity of a non noise insulated vacuum pump over extended periods shall wear ear protection.

- Make sure that all provided covers, guards, hoods etc. remain mounted
- Make sure that protective devices will not be disabled
- Make sure that cooling air inlets and outlets will not be covered or obstructed and that the cooling air flow will not be affected adversely in any other way
- Make sure that the installation prerequisites (→ page 5: Installation Prerequisites) are complied with and will remain complied with, particularly that a sufficient cooling will be ensured

Conveying Condensable Vapours

Version "Aqua":

CAUTION

Due to the corrosion protection coating CPC the vacuum pump is capable of conveying water vapour.

Very humid process gases and/or adverse operating cycles can lead to residual condensates, though, which cause corrosion.

If this is the case, it is necessary to counteract residual condensates by warming up the vacuum pump, conveyance of ambient air after process end and regular draining of the anti-pulsation chamber (j).

- ◆ Close the shut-off valve in the suction line
- ◆ Warm up the vacuum pump for approx. 10 minutes

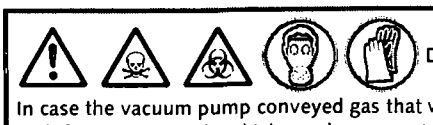
At process start:

- ◆ Open the shut-off valve in the suction line

At the process end:

- ◆ Close the shut-off valve in the suction line
- ◆ Open the ambient air valve
- ◆ Operate the vacuum pump for another approx. 10 minutes
- ◆ Close the ambient air valve
- ◆ Regularly drain condensate from the anti-pulsation chamber (j)

Maintenance



DANGER

In case the vacuum pump conveyed gas that was contaminated with foreign materials which are dangerous to health, harmful material can reside in filters.

Danger to health during inspection, cleaning or replacement of filters.

Danger to the environment.

Personal protective equipment must be worn during the handling of contaminated filters.

Contaminated filters are special waste and must be disposed of separately in compliance with applicable regulations.

CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.

Risk of burns!

- Prior to disconnecting connections make sure that the connected pipes/lines are vented to atmospheric pressure

Maintenance Schedule

Note: The maintenance intervals depend very much on the individual operating conditions. The intervals given below shall be considered as starting values which should be shortened or extended as appropriate. Particularly heavy duty operation, such like high dust loads in the environment or in the process gas, other contaminations or ingress of process material, can make it necessary to shorten the maintenance intervals significantly.

Monthly:

- Make sure that the vacuum pump is shut down and locked against inadvertent start up

In case an inlet air filter (h) is installed:

- ◆ Check the inlet air filter (h), if necessary replace

In case of operation in a dusty environment:

- ◆ Clean as described under → page 8: Every 6 Months:

Every 3 Months:

- Make sure that the vacuum pump is shut down
- Check the level of the synchronising gear oil

The level shall be slightly above the middle of the sight glass (e, 76).

The level of the synchronising gear should stay constant over the lifetime of the oil. If the level does fall, the gear is leaky and the vacuum pump requires repair (Busch service).

Every 6 Months:

- Make sure that the housing is free from dust and dirt, clean if necessary
- Make sure that the vacuum pump is shut down and locked against inadvertent start up
- Remove the acoustic enclosure

Note: Make sure that the foam mats do **not** get soaked with water

- Clean the fan cowlings, fan wheels, the ventilation grilles and cooling fins
- Mount the acoustic enclosure

Every Year:

- Make sure that the vacuum pump is shut down and locked against inadvertent start up

In case an inlet air filter (h) is installed:

- ◆ Replace the inlet air filter (h)

- Check the inlet screen (715), clean if necessary

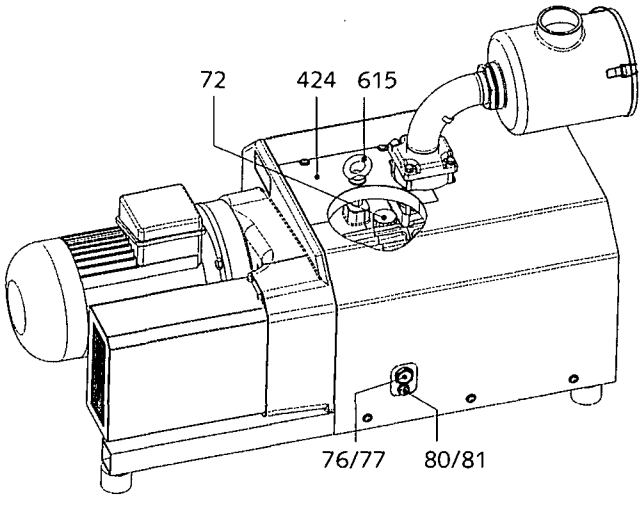
Every 20000 Operating Hours, At the Latest after 6 Years:

Note: The change interval of 20000 operating hours is valid for the gear oil Busch VE 101 only. Other gear oils reduce the change interval.

- Change the synchronising gear oil

Changing Synchronising Gear Oil

- Make sure that the vacuum pump is shut down and locked against inadvertent start up



- Remove the eyebolt (a)
- Remove the lid (424)
- Undo the venting valve (72) for venting
- Place a drain tray underneath the drain plug (f, 80)
- Open the drain plug (f, 80) and drain the oil
- Make sure that the seal ring on the drain plug (f, 80) is serviceable, replace if necessary
- Firmly reinsert the drain plug (f, 80) together with the seal ring
- Remove the venting valve (72) completely
- Fill in new gear oil until the level is slightly above the middle of the sight glass (e, 76)
- Make sure that the seal ring on the venting valve (72) is undamaged, if necessary replace the venting valve (72)
- Firmly reinsert the venting valve (72) together with the seal ring
- Mount the lid (424)
- Reinsert the eyebolt (a)
- Dispose of the used oil in compliance with applicable regulations

Overhaul

CAUTION

In order to achieve best efficiency and a long life the vacuum pump was assembled and adjusted with precisely defined tolerances.

This adjustment will be lost during dismantling of the vacuum pump.

It is therefore strictly recommended that any dismantling of the vacuum pump that is beyond of what is described in this manual shall be done by Busch service.

DANGER

In case the vacuum pump conveyed gas that was contaminated with foreign materials which are dangerous to health, harmful material can reside in pores, gaps and internal spaces of the vacuum pump.

Danger to health during dismantling of the vacuum pump.

Danger to the environment.

Prior to shipping the vacuum pump shall be decontaminated as good as possible and the contamination status shall be stated in a "Declaration of Contamination" (form downloadable from www.busch-vacuum.com).

Busch service will only accept vacuum pumps that come with a completely filled in and legally binding signed "Declaration of Contamination" (form downloadable from www.busch-vacuum.com).

Removal from Service

Temporary Removal from Service

- Prior to disconnecting pipes/lines make sure that all pipes/lines are vented to atmospheric pressure

Recommissioning

- Observe the chapter Installation and Commissioning (→ page 5)

Dismantling and Disposal

DANGER

In case the vacuum pump conveyed gas that was contaminated with foreign materials which are dangerous to health, harmful material can reside in pores, gaps and internal spaces of the vacuum pump.

Danger to health during dismantling of the vacuum pump.

Danger to the environment.

During dismantling of the vacuum pump personal protective equipment must be worn.

The vacuum pump must be decontaminated prior to disposal.

- Drain the oil
- Make sure that materials and components to be treated as special waste have been separated from the vacuum pump
- Make sure that the vacuum pump is not contaminated with harmful foreign material

According to the best knowledge at the time of printing of this manual the materials used for the manufacture of the vacuum pump involve no risk.

- Dispose of the used oil in compliance with applicable regulations
- Dispose of the vacuum pump as scrap metal

Troubleshooting

WARNING

Risk of electrical shock, risk of damage to equipment.

Electrical installation work must only be executed by qualified personnel that knows and observes the following regulations:
- IEC 364 or CENELEC HD 384 or DIN VDE 0100, respectively,
- IEC-Report 664 or DIN VDE 0110,
- BGV A2 (VBG 4) or equivalent national accident prevention regulation.

CAUTION

During operation the surface of the vacuum pump may reach temperatures of more than 70 °C.

Risk of burns!

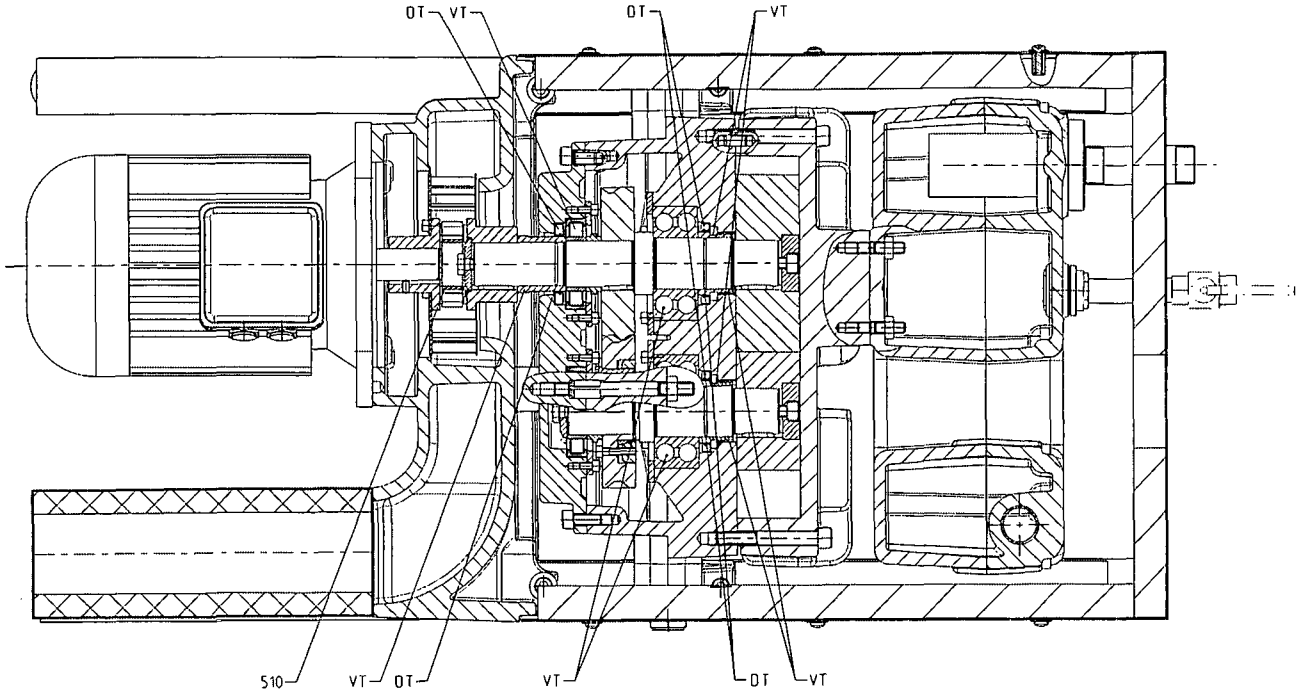
Let the vacuum pump cool down prior to a required contact or wear heat protection gloves.

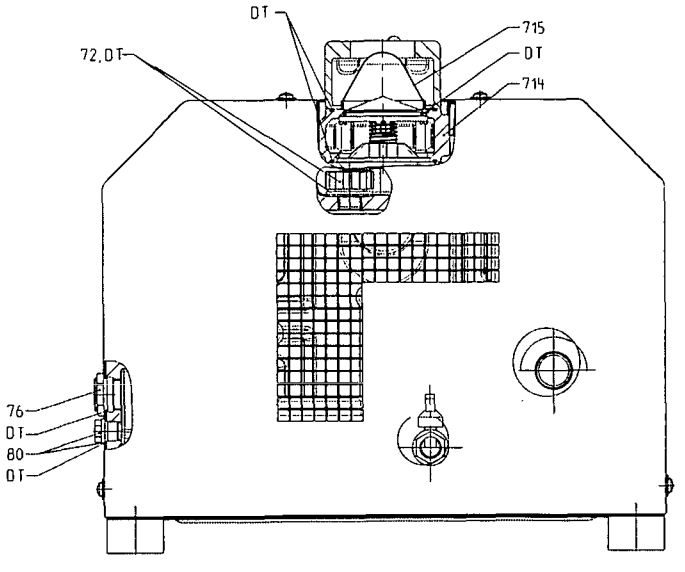
Problem	Possible Cause	Remedy
The vacuum pump does not reach the usual pressure The drive motor draws a too high current (compare with initial value after commissioning) Evacuation of the system takes too long	The vacuum system or suction line is not leak-tight	Check the hose or pipe connections for possible leak
	In case a vacuum relief valve/regulating system is installed: The vacuum relief valve/regulating system is misadjusted or defective	Adjust, repair or replace, respectively
	The screen (715) in the suction connection (g/p) is partially clogged	Clean the screen (715) If cleaning is required too frequently install a filter upstream
	In case a filter (h) is installed on the suction connection (g/p): The filter (h) on the suction connection (g/p) is partially clogged	Clean or replace the inlet air filter (h), respectively
	Partial clogging in the suction, discharge or pressure line	Remove the clogging
	Long suction, discharge or pressure line with too small diameter	Use larger diameter
	The valve disk of the inlet non-return valve is stuck in closed or partially open position	Disassemble the inlet, clean the screen (715) and the valve (o, 714) as required and reassemble
	Internal parts are worn or damaged	Repair the vacuum pump (Busch service)
The gas conveyed by the vacuum pump smells displeasing	Process components evaporating under vacuum	Check the process, if applicable
The vacuum pump does not start	The drive motor is not supplied with the correct voltage or is overloaded	Supply the drive motor with the correct voltage
	The drive motor starter overload protection is too small or trip level is too low	Compare the trip level of the drive motor starter overload protection with the data on the nameplate, correct if necessary In case of high ambient temperature: set the trip level of the drive motor starter overload protection 5 percent above the nominal drive motor current
	One of the fuses has blown	Check the fuses
	The connection cable is too small or too long causing a voltage drop at the vacuum pump	Use sufficiently dimensioned cable

	The vacuum pump or the drive motor is blocked	Make sure the drive motor is disconnected from the power supply Remove the fan cover Try to turn the drive motor with the vacuum pump by hand If the unit is still frozen: remove the drive motor and check the drive motor and the vacuum pump separately If the vacuum pump is blocked: Repair the vacuum pump (Busch service)
	The drive motor is defective	Replace the drive motor (Busch service) (the proper function of the fan wheel requires the precise adjustment of the coupling on the motor shaft and on the pump shaft; therefore the motor can be mounted by the Busch service only)
The vacuum pump is blocked	Solid foreign matter has entered the vacuum pump	Repair the vacuum pump (Busch service) Make sure the suction line is equipped with a screen If necessary additionally provide a filter
	Corrosion in the vacuum pump from remaining condensate	Repair the vacuum pump (Busch service) Check the process Observe the chapter Conveying Condensable Vapours (→ page 8)
	Version with three-phase motor: The vacuum pump was run in the wrong direction	Repair the vacuum pump (Busch service) When connecting the vacuum pump make sure the vacuum pump will run in the correct direction (→ page 6: Installation)
The drive motor is running, but the vacuum pump stands still	The coupling between the drive motor and the vacuum pump is defective	Replace the coupling element (the proper function of the fan wheel requires the precise adjustment of the coupling on the motor shaft and on the pump shaft; therefore the coupling element can be replaced by the Busch service only)
The vacuum pump starts, but labours or runs noisily or rattles The drive motor draws a too high current (compare with initial value after commissioning)	Loose connection(s) in the drive motor terminal box Version with three-phase-motor: Not all drive motor coils are properly connected The drive motor operates on two phases only	Check the proper connection of the wires against the connection diagram (particularly on motors with six coils) Tighten or replace loose connections
	Version with three-phase motor: The vacuum pump runs in the wrong direction	Verification and rectification → page 5: Installation and Commissioning
	Foreign objects in the vacuum pump Stuck bearings	Repair the vacuum pump (Busch service)
The vacuum pump runs very noisily	Defective bearings	Repair the vacuum pump (Busch service)
	Worn coupling element	Replace the coupling element
	Low oil level in the synchronising gear	The synchronising gear is leaky Repair the vacuum pump (Busch service)
	Synchronising gear damaged due to operation with low oil level	Repair the vacuum pump (Busch service)
The vacuum pump runs very hot	Insufficient air ventilation	Make sure that the cooling of the vacuum pump is not impeded by dust/dirt Clean the fan cowlings, the fan wheels, the ventilation grilles and the cooling fins Install the vacuum pump in a narrow space only if sufficient ventilation is ensured

Ambient temperature too high	Observe the permitted ambient temperatures
Temperature of the inlet gas too high	Observe the permitted temperatures for the inlet gas
Mains frequency or voltage outside tolerance range	Provide a more stable power supply
Partial clogging of filters or screens Partial clogging in the suction, discharge or pressure line	Remove the clogging
Long suction, discharge or pressure line with too small diameter	Use larger diameter

Sectional Drawing





Spare Parts

Note: When ordering spare parts or accessories acc. to the table below please always quote the type and the serial no. of the vacuum pump. This will allow Busch service to check if the vacuum pump is compatible with a modified or improved part.

The exclusive use of genuine spare parts and consumables is a prerequisite for the proper function of the vacuum pump and for the granting of warranty, guarantee or goodwill.

Your point of contact for service and spare parts in the United Kingdom:

Busch (UK) Ltd.
Hortonwood 30-35
Telford
Shropshire
TF1 7YB
Tel: 01952 677 432
Fax: 01952 677 423

Your point of contact for service and spare parts in Ireland:

Busch Ireland Ltd.
A10-11 Howth Junction Business Centre
Kilbarrack, Dublin 5
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Fax: +353 (0)1 8321470

Your point of contact for service and spare parts in the USA:

Busch Inc.
516-B Viking Drive
Virginia Beach, VA 23452
Tel: 1-800-USA-PUMP (872-7867)

Your point of contact for service and spare parts in Canada:

Busch Vacuum Technics Inc.
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Québec J7H 1N7
Tel: 450 435 6899
Fax: 450 430 5132

Your point of contact for service and spare parts in Australia:

Busch Australia Pty. Ltd.
30 Lakeside Drive
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Tel: (03) 93 55 06 00
Fax: (03) 93 55 06 99

Your point of contact for service and spare parts in New Zealand:

Busch New Zealand Ltd.
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North Harbour, Auckland 1330
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Find the list of Busch companies all over the world (by the time of the publication of these installation and operating instructions) on → page 20 (rear cover page).

Find the up-to-date list of Busch companies and agencies all over the world on the internet at **www.busch-vacuum.com**.

Pos.	Part	Qty	Part no.
72	Venting valve (=oil fill plug) with seal ring	1	0543 107 407
76	Sight glass	1	0583 000 001
77	Seal ring for sight glass	1	0480 000 271
80	Plug with magnet and seal ring	1	0415 134 870
81	Seal ring for plug with magnet	1	0482 137 352
714	Inlet flange, lower part, with non-return valve	1	0916 000 670
715	Screen	1	0534 000 041
—	Filter cartridge, paper, for inlet filter (optional)	1	0532 000 004
—	Filter cartridge, polyester, for inlet filter (optional)	1	0532 121 864

Spare Parts Kits

Spare parts kit	Part no.
Overhaul kit (incl. set of seals, marking "VT" and "DT"; insert for flexible coupling for Rotex only)	0993 134 022
Set of seals (marking "DT")	0990 134 021

Accessories

Accessories	Description	Part no.
Inlet air filter	inlet-side, horizontal, with paper cartridge, to separate solids	0945 000 071

Oil

Denomination	Busch VE 101
ISO-VG	100
Base	Diester
Density [g/cm³]	0.96
Kinematic viscosity at 40 °C [mm²/s]	95
Kinematic viscosity at 100 °C [mm²/s]	9.5
	255
Pourpoint [°C]	–30
Part no. 1 l packaging	0831 000 099
Part no. 5 l packaging	0831 000 100
Filling quantity, approx. [l]	1

EC-Declaration of Conformity

Note: This Declaration of Conformity and the CE-mark affixed to the nameplate are valid for the vacuum pump within the Busch-scope of delivery. When this vacuum pump is integrated into a superordinate machinery the manufacturer of the superordinate machinery (this can be the operating company, too) must conduct the conformity assessment process acc. to the Directive Machinery 98/37/EC for the superordinate machine, issue the Declaration of Conformity for it and affix the CE-mark.

We

Busch Produktions GmbH
Schauinslandstr. 1
79689 Maulburg
Germany

declare that vacuum pumps **MM 1324, 1202, 1252, 1322, 1200, 1250, 1320 AV**

in accordance with the European Directives:

- "Machinery" 98/37/EC,
- "Electrical Equipment Designed for Use within Certain Voltage Limits" (so called "Low Voltage") 73/23/EEC,
- "Electromagnetic Compatibility" 89/336/EEC,
- "Restriction of the use of certain hazardous substances in electrical and electronic equipment" ("RoHS") 2002/95/EC

have been designed and manufactured to the following specifications:

Standard	Title of the Standard
Harmonised Standards	
EN ISO 12100-1 EN ISO 12100-2	Safety of machinery - Basic concepts, general principles of design - Part 1 and 2
EN 294	Safety of machinery - Safety distance to prevent danger zones being reached by the upper limbs
EN 1012-1 EN 1012-2	Compressors and vacuum pumps - Safety requirements - Part 1 and 2
EN ISO 2151	Acoustics - Noise test code for compressors and vacuum pumps - Engineering method (grade 2)
EN 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61000-6-1 EN 61000-6-2	Electromagnetic compatibility (EMC) - Generic immunity standards
EN 61000-6-3 EN 61000-6-4	Electromagnetic compatibility (EMC) - Generic emission standards

Dr.-Ing. Karl Busch
General director

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Technical Data

For motor connection parameters see nameplate

Type	Frequency [Hz]	Ultimate pressure standard-version [hPa abs = mbar abs]	Ultimate pressure version "Aqua" [hPa abs = mbar abs]	Nominal motor rating [kW]	Nominal speed [min⁻¹]	Nominal suction capacity [m³/h]	Sound pressure level (EN ISO 2151) at 400 hPa (=mbar) abs. suction pressure [dB(A)]	Weight [kg]	Ambient temperature range [°C]	Ambient pressure	Synchronising gear oil qty [l]	Synchronising gear oil filled ex-works
MM 1324 AV	50	60	200*	3.0	1500	160	70	~245 ... 260	0 ... 40	atmospheric	1	Busch VE 101
	60			3.6	1800	192	74					
MM 1202 AV	50	100*		4.0	3000	200	75	~230				
	60			4.8	3600	240	79					
MM 1252 AV	50			4.5	3000	250	75	~240 ... 250				
	60			5.5	3600	300	79					
MM 1322 AV	50	150*		5.5	3000	300	77	~260 ... 285				
	60			6.5	3600	360	82					
MM 1200 AV	50/60	100*		5.5	600-3600**	max. 240	79	~240				
MM 1250 AV						max. 300		~250				
MM 1320 AV		150*		7.5		max. 360	82	~260				
MM 1320 AV		200*		7.5	600-4200**	max. 420	86					

*to be limited by means of process control and/or vacuum relief valves

**see nameplate of the vacuum pump

Busch – All over the World in Industry

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Semiconductor Vacuum Group Inc.
Morgan Hill, CA 95037
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Fax: (408) 955 0229

Drive with Integrated Frequency Inverter Danfoss

Short Installation and Operating Instructions

Edition 070419

Safety and Operating Instructions for Electrical Actuators

(In accordance with the Low Voltage Directive 73/23/EEC modified by 93/68/EEC)

General
Throughout the manual, this symbol warns of consequences which may arise from inappropriate use of the drive, since electrical risks may lead to material or physical damage as well as constituting a fire hazard.
Depending on their degree of protection, the drive may contain moving parts, as well as hot surfaces, during operation.
Unjustified removal of protection devices, incorrect use, faulty installation or inappropriate operation could represent a serious risk to personnel, animals and equipment.
For further information, consult this manual.
All work relating to transportation, installation, commissioning and maintenance must be performed by experienced, qualified personnel (see IEC 364 or CENELEC HD 384, or DIN VDE 0100 and national specifications for installation and accident prevention).
In these basic safety instructions, qualified personnel means persons competent to install, mount, commission and operate the product and possessing the relevant qualifications.

Use
It is also necessary to comply with standard EN 60204, which stipulates in particular that electrical actuators (which include the drive) cannot be regarded as circuit-breaking devices and certainly not as isolating switches.
Commissioning can take place only if the requirements of the Electromagnetic Compatibility Directive (89/336/EEC, modified by 92/31/EEC) are met.
The drive meets the requirements of the Low Voltage Directive 73/23/EEC, modified by 93/68/EEC. The harmonised standards of the DIN VDE 0160 series in connection with standard VDE 0660, part 500 and EN 60146/VDE 0558 are also applicable.
The technical characteristics and instructions concerning the connection conditions specified on the nameplate and in the documentation provided must be observed without fail.

Installation
The drive must be protected against excessive stress. In particular, there must be no damage to parts and/or modification of the clearance between components during transportation and handling. Avoid touching the electronic components and contact parts.
The drive contains parts which are sensitive to electrostatic stress and may be easily damaged if handled incorrectly. Electrical components must not be exposed to mechanical damage or destruction (risks to health!).

Electrical Connection
When work is performed on drives which are powered up, national accident prevention specifications must be respected.
The electrical installation must comply with the relevant specifications (for example conductor cross-sections, protection via fused circuit- breaker, connection of protective conductor). More detailed information is given in this manual.
Instructions for an installation which meets the requirements for electromagnetic compatibility, such as screening, earthing, presence of filters and correct insertion of cables and conductors, are given in this manual.
These instructions must be followed in all cases, even if the drive carries the CE mark.
Adherence to the limits given in the EMC legislation is the responsibility of the manufacturer of the installation or the machine.

Operation
Active parts of the device and live power connections must not be touched immediately after the drive is powered down, as the capacitors may still be charged (waiting time 5 minutes). In view of this, the warnings fixed to the drive must be observed. During operation, all protective covers must remain closed.

Power range:	3, 4, 5.5 and 7.5kW,	
Power supply:	380-480V, 50 and 60Hz +/-2%	
Size of cable glands:	P = 0.55 up to 3 kW	3 x M20 x 1,5
	P = 4 up to 7.5 kW	1 x M25 x 1,5, 2 x M20 x 1,5
Tightening torques:	L1, L2, L3: 0.55 up to 4 kW	0.5 ... 0.6 Nm
	5 up to 7.5 kW	1.2 ... 1.5 Nm
	Earth screws (at any powers)	3.4 Nm
Prefuses max.	P = 0.55 up to 2,2kW	10 A
	P = 3 up to 4kW	15 A
	P = 5,5 up to 7.5 kW	25 A
Protecting equipment:	Use ELCB relays of type B with leakage currents of 100mA (ELCB relays of type A are not allowed for direct current content (DC) in the fault current and power-up with short charging current to earth)	

Characteristics

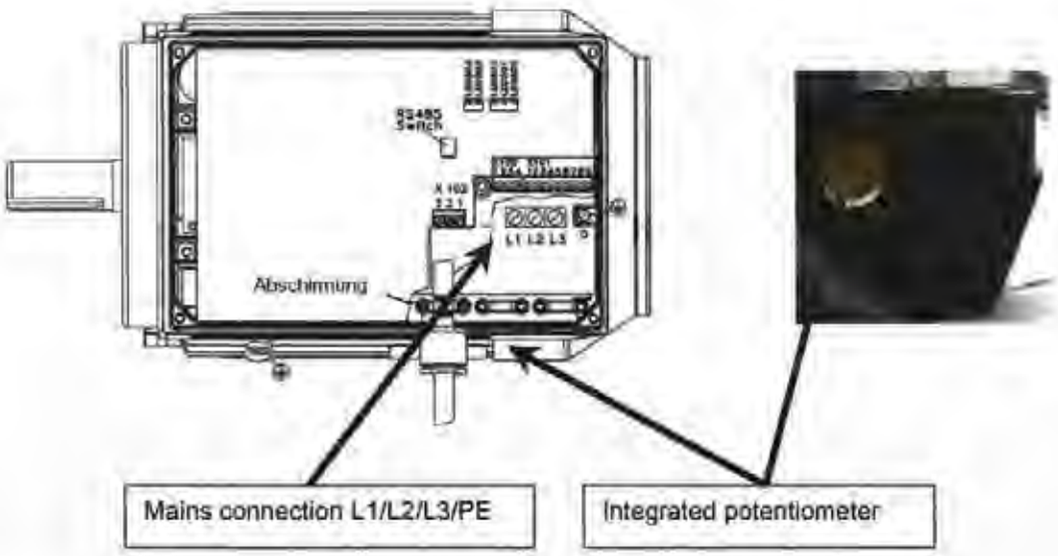
Protection index inverter	IP 65
Protection index motor	IP 55
Operating temperature	0...+40°C
Altitude	≤ 1000 m
Ambient humidity	max 93%
Vibration	IEC 68-2-34 (acceleration 0.01 g^2/Hz)
Shocks	IEC 68-2-27 (peak acceleration 20 g)

Special setting Busch

The drive is delivered by Busch preconfigurated for one of the following control modes:
- Speed control (Standard)
- Pressure control (on request)

Connection of the mains terminals:
All connection terminals are located in the lower part of FI box cover. Remove the inverter box cover, which is held by four screws, remove the detachable terminal plugs from the terminal blocks X100 (4-pole) and X101 (9-pole) and lift the corner of the black plastic cover to obtain access to the mains terminals L1, L2, L3 and PE. Make sure that the mains supply for the drive is identical with the voltage on the name plate of the drive. Use an unshielded cable for the mains connection.

The connection of the phases L1, L2 and L3 to the connectors is arbitrary. The motor will always rotate in the predefined direction. After connection to the power supply and, if applicable, turning up the potentiometer (reference) the drive will start.



- **Reference (speed, pressure):**
  - 2-10V with integrated potentiometer (standard) – behind plug (M20x1.5)
  - 2-10V with external reference
  - 4-20mA with external reference

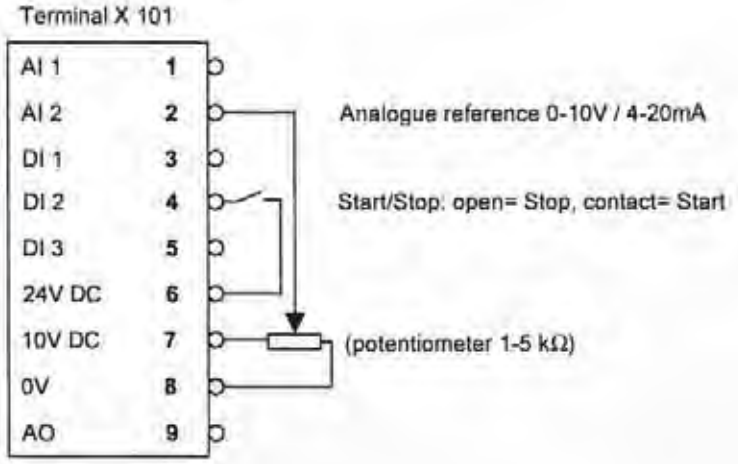
Switch 0-10V onto 4-20mA: insert resistance (inside FI, 525Ω) between terminal 2 and 8

- **Start/Stop:**
  - With the power supply (max. 1 x per 2 minutes)
  - By connecting terminal 4 and 6, or external signal on terminal 4 (starting release)
  - With reference (Potentiometer)

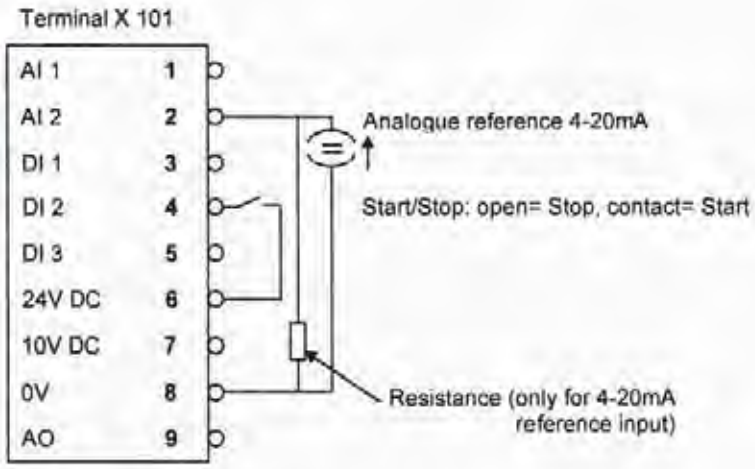
CAUTION: Frequent start/stop by means of switching the power supply on and off is permitted for a limited period of time only, e.g. in the course of the start-up (max. once per 2 minutes, i.e. max 30 times per hour). Frequent start/stop by means of switching the power supply on and off over extended periods of time damages or destroys the drive.
If the process requires frequent start/stop, this must be realised by means of the starting release or by means of a change of the reference.

Connection for speed control

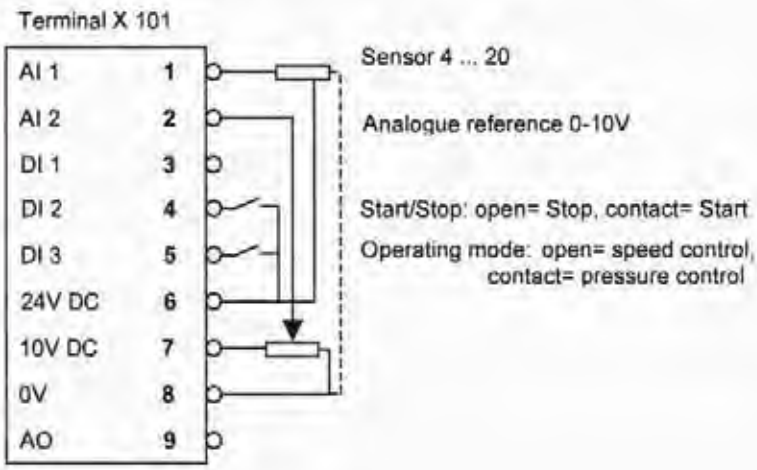
- Reference 2-10V



- Reference 4-20mA



- **Connection for pressure control**
  - Reference 2-10V



- Reference 4-20mA
  -> see connection description for speed control (connect sensor and resistance)

- **Terminal board X 101**

Pos.	Name	Functions
1	AI 1	Analogue input = signal from pressure sensor 4-20mA
2	AI 2	Analogue input = reference 2-10V (standard) or 4-20mA (insert resistance between terminal 2 and 8)
3	DI 1	-
4	DI 2	Logic input = Start (open = Stop)
5	DI 3	Logic input = Selection control mode open= sped control, contact= pressure control
6	24V	Source 24V DC (max. 150mA)
7	10V	Source 10V DC (max. 15mA)
8	0V	0 V
9	AO	Analogue output frequency signal (4-20mA)

All control cables must be shielded. The shielding must be grounded on both sides.

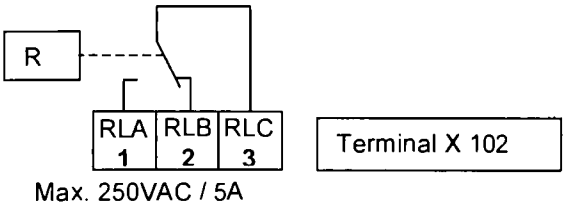
*** Explanations for AI 2- Reference**

- Speed control:
  10V/20mA= max. speed (100% max. speed)
  2V/4mA= Stop (0% max. speed)
- Pressure control at vacuum operation:
  10V/20mA= Stop (100% of the used sensor operating range, 1.1 bar abs for the 0-2bar-sensor)
  2V/4mA= min. pressure (0% od the used sensor operating range, 0 bar abs for the 0-2bar-sensor)
- Pressure control at pressure operation:
  10V/20mA= max. pressure (100% of the sensor operating range, 4 bar abs. for the 0-4bar-sensor)
  2V/4mA= Stop (0% of the sensor operating range, 4 bar abs. for the 0-4bar-sensor)

Sensor operating range at vaccum operation
In order to exactly set the reference (vacuum operation), the operating range of the sensor ist limited to the lower 50%, respectively 55%, i.e.
- in case of connection of a 0-2bar (4-20mA) absolute pressure sensor:
Evaluation of the range 0 bar (= 4mA) to 1.1 bar (12.8mA)
- in case of connection of a +/-1 bar differential pressure sensor:
Evaluation of the range -1 bar (= 4mA) to 0 bar (12mA) differential pressure

Status indicating relay

The relay output indicates whether the drive is ready for operation



Max. 250VAC / 5A

Terminal	Function	Name	Explanation
1	Contact	RLA	Contact closed: Faulty inverter, Contact open: Inverter without fault or without power
2	Opener	RLB	Contact closed: Inverter without fault or without power Contact open: Faulty inverter
3	Switching contact	RLC	Load max. 250 VAC / 5A bzw. 30V DC / 5A

LED-Status indication

LED 300 (red): Fault trip
LED 301 (yellow): Warning
LED 302 (green): Power on
LED 303-304 (green): Communication faulty

Fault trip - Reset

In case of a fault trip, the fault can be deleted by deconnecting the drive from the power supply (30s).

Paladin Transducers 250 Series Class 0.5

An extensive range of Class 0.5 transducers providing measurement, isolation and conversion of electrical parameters into industry standard DC output signals. The range offers protection against high voltage and overload, and resistance to vibration in harsh electrical environments. Transducers offer multiple analogue outputs from one housing, and individual measurement of most electrical parameters.

Features

Extensive range

High accuracy 0.5%

Up to 3 analogue outputs in one housing

Zero and span adjustments

DIN rail mounting

Single and 3 phase systems

Flame retardant cases

Screw clamp terminals

Benefits

Cost saving remote metering

Reduction of signal levels for ease of metering

Isolated output for safety

Protection against high voltage and overload

Applications

Switchgear

Distribution systems

Generator sets

Control panels

Energy management

Building management

Utility power monitoring

Process control

Motor control

Approvals

UL File No: E140758

CSA File No: LR52592

BV File No: 3896H-07425-AO PRSO BV

Introduction

Crompton transducers can be used for measuring most electrical parameters. The following transducers can be supplied:

- A.C. and D.C. current and voltage.
- Active, reactive and apparent power.
- Frequency.
- Power Factor and Phase Angle.
- Integrating current for maximum demand indication and Alarm Control.
- Suppressed zero voltage for monitoring a narrow voltage range.
- Tap position on a high voltage transformer.
- Temperature transmitters for thermocouples and resistance thermometer detectors (RTD's).
- Resistance (slidewire) transmitters.

Safety Features

Crompton transducers and transmitters are designed for use in harsh electrical environments and feature:

- High protection against overload - 20 x rated current for 1 second.
- High degree of mechanical shock and vibration resistance.
- Protection against high voltage.
  Inputs, outputs and power supply are galvanically isolated from one another (excluding Resistance transmitters).

Application

- Measurement of most electrical parameters.
- Conversion to standard d.c. output signals.
- Outputs suitable for indication, PLC's.
- For use in Control Cabinets, Switchboards, Motor Control Centres, Generating Sets, Energy Management & Building Management systems.

Ordering Information

When ordering please specify:

1. Product catalogue number.
2. Current and/or voltage.
3. Frequency.
4. Auxiliary voltage A.C. or D.C.
5. Options e.g. calibration at 30°C.
6. For power products:
   a. V.T. & C.T. ratios.
   b. System configuration i.e. Single Phase, 3 Phase 3 or 4 Wire, balanced or unbalanced load.
7. For slide wire transmitters quote R1, R2 and R3, see page G9.
8. National Specification:
   Indicated by 7th letter of part number.

Paladin Transducers 250 Series Class 0.5

Specification

Performance	Designed to comply with BS6253 part 1, EN60688, IEC688, AS1384 and ANSI. C37.
Temperature Range:	Storage -20°C to +70°C Operating 0°C to +60°C Calibrated at 23°C
Temperature Coefficient:	0.03%/ per °C
Humidity Range:	Up to 95% RH
Zero Adjustment:	±2% minimum (except TAA & TVA)
Span Adjustment:	±10% minimum
Accuracy Class:	0.5 unless otherwise specified
Accuracy Range:	0 to 125% (except self powered)
Stability:	+0.25% per annum (reducing with time)
Test Voltage:	2kV rms to ANSI. C37
Response Time:	<400ms from 0 to 99% of rated output, 250 ms to 90%
D.C. outputs (Typical):	0/1mA into 0-10kΩ 0/5mA into 0-2kΩ 0/10mA into 0-1kΩ 0/20mA into 0-500Ω (600Ω available on selected models) 4/20mA into 0-500Ω (600Ω available on selected models) 0/5V 1k ohm minimum load 0/10V 1K ohm minimum load - bipolar for some models
Current Output Protection:	Fully protected against open and short circuited output
Voltage Output Protection:	Fully protected against open circuit output
Maximum output:	20V d.c. when open circuit
Output Ripple:	<0.5% of full rated output
Overload Capacity:	2 x rated current continuous 1.25 x rated voltage continuous 20 x rated current for 1 second 1.5 x rated voltage for 10 seconds
Input Impedance: (d.c. I/P)	d.c. 1000 ohms/volt as standard 10k ohms/volt available on request
Input Burden:	a.c. <2VA
Auxiliary Burden:	<2VA a.c., <3.5W d.c. auxiliary voltage variation: ±20% a.c., ±15% d.c., maximum 14% ripple
Safety:	To IEC1010 with terminal cover, basic insulation category
Minimum Test Voltage:	2kV rms for 1 minute
Flammability:	Flame retardant
Isolation:	Input/Output/Supply/Case (except TRR, TRP, TRT and TRV with no input/output isolation)
Interference:	Electrical stress surge withstand to IEC 688 part of IEC 801 and ANSI C37 90a
Immunity:	Impulse test 5kV transient to IEC688 and IEC801
Enclosure:	IP50 to BS6490, IEC529 when the terminal cover is fitted. The case is UL94V0 and the terminal cover is UL94V2
Fixing:	EN50022
Approvals:	EMC and LVD UL recognised File No: E140758 CSA recognised File No: LR52592 BV File No: 3896H 07425 AO PRSO BV

Paladin Transducers 250 Series Class 0.5

A.C. Current Average Sensing - Self Powered

Current measuring applications to 0.5% accuracy. Average sensing and calibrated to indicate the RMS value of a sine wave with less than 1% distortion. Internal power is derived from the input signal. Input and output are isolated.

Specification

Inputs:	1, 5 or 10A A.C. 50 or 60 Hz
Auxiliary Power:	Self Powered
Output:	0/1mA, 0/5mA, 0/10mA and 0/20mA

Product Code – Single Phase Current Transducer - 1 D.C. Output

Input A.C.	Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
5A 60Hz	Self	0/1mA	253-TAA*-LSFA-C6	1

Product Code – 3 Phase Current Transducer - 3 D.C. Output

Input A.C.	Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
5A 60Hz	Self	0/1mA	256-TAA-LSFA-C6	47

A.C. Current Average Sensing - Auxiliary Powered

Single or three phase models offering current measurement down to zero input Model TAL provides a current output with a live zero (4-20mA). Average sensing and calibrated to indicate the RMS value of a sinewave with up to 1% distortion, isolation is provided between input, output and auxiliary.

Specification

Inputs:	1, 5 or 10A A.C 50 or 60 Hz
Output:	0/1mA, 0/5mA, 0/10mA, 0/20mA, 4/20mA
Auxiliary Power:	A.C.: 63.5, 100, 110, 120, 220, 240, 250, 380, 400, 415, 440 and 480V D.C.: 12, 24, 48, 110,120 or 135V nominal

Product Code – Single Phase Current Transducer - 1 D.C. Output

Input A.C.	A.C. Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
5A 60Hz	120V	4/20mA	253-TAL*-LSHG-C6-DG	6

Product Code – 3 Phase Current Transducers - 3 D.C. Outputs

Input A.C.	A.C. Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
5A 60 Hz	120V	0/1mA	256-TAS*-LSFA-C6-DG	2
5A 60 Hz	120V	4/20mA	256-TAL*-LSHG-C6-DG	2

With multiple analogue outputs, do not common the -ve terminals.

Paladin Transducers 250 Series Class 0.5

True RMS Current

True RMS measurement of the input current, measuring non standard and distorted waveforms. Calibration is correct for sine waves having up to 30% of 3rd harmonic distortion. Isolation is provided between input, output and auxiliary.

Specification

Inputs:	1.5 or 10A A.C., 50 or 60 Hz Refer to factory for other inputs
Output:	0/1mA, 0/5mA, 0/10mA, 0/20mA, 4/20mA
Auxiliary Power:	A.C. 63.5, 100, 110, 120, 220, 240, 250, 380, 400, 415, 440 and 480V D.C. 12, 24, 48, 110, 120, or 135V

Product Code – Single Phase Current Transducer

Auxiliary Powered - 1 D.C. output.

Input A.C.	A.C. Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
5A 60HZ	120V	0/1mA	253-TAR*-LSFA-C6-DG	6

Product Code – 3 Phase Current Transducers

Auxiliary Powered - 3 D.C. outputs.

Input A.C.	A.C. Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
5A 60HZ	120V	0/1mA	256-TAR*-LSFA-C6-DG	2

With multiple analogue outputs, do not common the -ve terminals.

Integrating Demand

RMS calibration, conveniently averages fluctuating input signals into a steady signal. The A.C. input model can provide a maximum demand monitor with 8, 15 or 30 minute integration periods. The D.C. input model can accept the output from other transducers e.g. Watt for indicating integrated power, or RTD for average temperature.

Specification

Inputs:	1 or 5A a.c., 50 or 60 Hz 0/1mA, 0/20mA, d.c. 0/5mA, 0/10mA, 0/20mA, 0/1V, 0/10V d.c.
Auxiliary Power:	63.5, 110, 120, 220, 240, 280, 415, 440, 480V a.c.

Product Code – Single Phase A.C. Integrating Demand Current Transducer

Auxiliary Powered - 1 D.C. Output.

Input A.C.	Time Constant	O/P D.C.	Catalogue No.	Connection Diag.
5A 60Hz	8 Minutes	0/1mA	253-TAP*-LSFA-C6-DG	8
5A 60Hz	15 Minutes	0/1mA	253-TAN*-LSFA-C6-DG	8
5A 60Hz	30 Minutes	0/1mA	253-TAM*-LSFA-C6-DG	8

Product Code – D.C. Integrating Demand Transducer

Auxiliary Powered - 1 D.C. Output.

Input D.C.	Time Constant	O/P D.C.	Catalogue No.	Connection Diag.
1mA	8 Minutes	0/1mA	253-TDP*-FAFA-DG	4
1mA	15 Minutes	0/1mA	253-TDN*-FAFA-DG	4
1mA	30 Minutes	0/1mA	253-TDM*-FAFA-DG	4

Paladin Transducers 250 Series Class 0.5

A.C. Current Bi-Directional

This transducer shows the magnitude and direction of an A.C. input current.

Specification

Inputs:	Voltage: 63.5, 100, 110, 120, 220, 240, 250, 380, 400, 415 and 480V a.c., 50 or 60 Hz Current: 1 or 5A, 50 or 60 Hz
Auxiliary Power:	Self powered
Outputs:	±1mA/5mA/10mA/20mA

Product Code – Single or 3 Phase System, Self Powered, 1 D.C. Output

Input A.C.	A.C. Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
120V, 5A, 60Hz	Self	+/-1mA	256-TAB*-LSM1-C6-PQ-T3	3

A.C. Voltage Average Sensing - Self Powered

Standard version for use in all voltage measuring applications. Average sensing for normal sinewave voltages, RMS calibrated for sinewave with up to 1% of 3rd harmonic distortion. Will allow measurement down to 20% of full input. The input signal provides operational power, thus avoiding the need for a separate supply. The input is isolated from the output.

Specification

Inputs:	63.5, 100, 110, 120, 220, 240, 250, 380, 400, 415, 440V and 480V a.c. 50 or 60 Hz
Range:	20 to 125%
Auxiliary Power:	Self Powered
Outputs:	0/1mA, 0/5mA, 0/10mA and 0/20mA

Product Code – Single Phase, Self Powered, 1 D.C. Output

Input A.C.	Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
120V 60Hz	Self	0/1mA	253-TVA*-PQFA-C6	10

Paladin Transducers 250 Series Class 0.5

A.C. Voltage Average Sensing - Auxiliary Powered

Auxiliary power allows measurement of voltages down to zero. Average sensing and calibrated to indicate the RMS value of a sinewave with up to 1% distortion. Model TVL provides a voltage input with a live zero (4-20mA). All models have input and output isolation.

Specification

Inputs:	63.5, 100, 110, 120, 220, 240, 250, 380, 400, 415, 440 and 480V a.c., 50 or 60 Hz
Output:	0/1mA, 0/5mA, 0/10mA, 0/20mA, 4/20mA
Auxiliary Power:	A.C. 100, 110, 120, 220, 240, 250, 380, 400, 415, 480V D.C. 12V, 24V, 48V, 110V, 120V or 135V

Product Code – Single Phase - Live Zero - A.C. Voltage Transducer, Auxiliary Powered - 1 D.C. Output

Input A.C.	A.C. Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
120V	120V	4/20mA	253-TVL*-PQHG-C6-DG	15

Product Code – 3 Phase - Live Zero - A.C. Voltage Transducer, Auxiliary Powered - 3 D.C. Outputs

Input A.C.	System	O/P D.C.	Catalogue No.	Connection Diag.
120V	3 Phase 3 wire	4/20mA	258-TVL*-PQHG-C6-DG	11
120V	3 Phase 4 wire	0/1mA	258-TVS*-PQFA-C6-DG	11

With multiple analogue outputs, do not common the -ve terminals.

A.C. Voltage Suppressed Zero - Expanded Scale

Allows 'expanded scale' measurements at critical voltage levels, indicating small changes within a large voltage span. Average sensing and RMS calibrated, isolation is provided between input and output.

Specification

Inputs:	Between ±10% and ±30% of nominal 63.5, 100, 110, 120, 139, 208, 220, 240, 250, 277, 380, 400, 415, 440V and 480V a.c. 50 or 60 Hz
Outputs:	0/1mA, 0/5mA, 0/10mA, 0/20mA d.c.

Product Code – Single Phase - Suppressed Zero - A.C. Voltage Transducer, Self Powered - 1 D.C. Output

Input A.C.	A.C.Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
108 - 132V	Self	0/1mA	253-TVZ*-A9FA-C6	15

Paladin Transducers 250 Series Class 0.5

True RMS A.C. Voltage

Single or 3 phase true RMS voltage measurement down to zero. Calibration is maintained for sinewaves having up to 30% of 3rd harmonic distortion. Isolation is provided between input and output.

Specification

Inputs:	63.5, 100, 110, 120, 220, 240, 250, 380, 400, 415, 440V and 480V A.C., 50 or 60 Hz
D.C. Outputs:	0/1mA, 0/5mA, 0/10mA, 0/20mA, 4/20mA
Auxiliary Power:	A.C.: 100, 110, 120, 220, 250, 380, 400, 415 and 480V. D.C.: 12V, 24V, 48V, 110V, 120V or 135V

Product Code – Single Phase. Voltage Transducer, Auxiliary Powered - 1 D.C. Output

Input A.C.	A.C.Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
120V 60Hz	120V	0/1mA	253-TVR*-PQFA-C6-DG	15

Product Code – 3 Phase. Voltage Transducers

Auxiliary Powered - 3 D.C. outputs.

Input A.C.	A.C.Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
120V 60Hz	120V	0/1mA	256-TVR*-PQFA-C6-DG	11

With multiple analogue outputs, do not common -ve terminals.

Frequency Transducer

A simple reliable transducer for the measurement of AC power frequencies, and to provide a DC output which is directly proportional to the change of input within a specified span. Isolation is provided between input and output. Ideally suited for process control monitoring, data acquisition, mains and genset applications.

Specification

Frequency:	45-55Hz, 55-65Hz, 45-65Hz, 360-440Hz
Inputs:	63.5, 100, 110, 120, 220, 230, 240, 380, 400, 415, 440, and 480V 50 or 60 Hz. Refer to factory for other inputs
Outputs:	0/1mA, 4/20mA, 0/5mA, 0/10mA, 0/20mA
Auxiliary Powered:	Self Powered
Accuracy:	0.1% of mid Frequency

Product Codes – Single Frequency Transducer, Self Powered - 1 D.C. Output

Input A.C.	Frequency	O/P D.C.	Catalogue No.	Connection Diag.
120V	45/55Hz	0/1mA	253-THZ*-PQFA-AG	10
120V	55/65Hz	0/1mA	253-THZ*-PQFA-AN	10
120V	45/65Hz	0/1mA	253-THZ*-PQFA-AJ	10
120V	360/440Hz	0/1mA	253-THZ*-PQFA-BI	10

Paladin Transducers 250 Series Class 0.5

Tap Position Transmitter

For accurate remote indication of tap position selection on a high voltage transformer. The variable tap position voltage is monitored, a D.C. output produced which is proportional to the tap position.

Specification

Input Span:	1-20k 5-50 taps at 400Ω each 10-50 taps at 30Ω each
Outputs:	0/1mA, 0/5mA, 0/10mA, 0/20mA, 4/20mA
Auxiliary Power:	A.C. 110, 120, 220, 240, 380, 415V 63.5, 139, 208, 277, 440, 480V D.C. 12, 24, 48, 120, 135V

Product Codes – Tap Position Transmitter, Auxiliary Powered

Taps	Ohm	O/P D.C.	Catalogue No.	Connection Diag.
10-50	30	0/1mA	253-TRT*-TIFA-DG	12
5-50	400	0/1mA	253-TRT*-T5FA-DG	12

Slide Wire Transmitter

Designed for accurate measurements and transmission of resistance ratio of a 3 wire potentiometer. A stabilised voltage is applied to the potentiometer and the voltage measured from the zero to the end of the wiper. This is amplified and the D.C. output produced is proportional to the resistance value.

Specification

Input Span:	Minimum 1kΩ Max 50kΩ Specify values of R1, R2, R3 Example for 1k Potentiometer: R1 = 1k, R2 = 0, R3 = 1k Example for 5k Potentiometer using only 4k; R1 = 5k, R2 = 1k, R3 = 4k (Remember R1 = R2 + R3)
Outputs:	0/1mA, 0/5mA, 0/10mA, 0/20mA or 4-20mA, 0/1, 0/5, 0/10V D.C.
Auxiliary Power:	A.C. 110, 120, 220, 240, 380, 415V, 63.5, 139, 208, 277, 440, 480V D.C. 12, 24, 48, 110, 120 or 135V

Note:
Not all applications provide for the slider to mechanically travel the full distance along the resistor track. Normally the first resistor step is inside the transducer and its value should be stated when ordering, as well as the total track resistance. End of track or connecting lead resistance, if significant, should also be considered. For satisfactory operation, the change in resistance should be greater than 20% of the total resistance.

Product Code – Side Wire Transmitter (3 wire), Auxiliary Powered

Input (Specify)	A.C. Aux Power	O/P D.C.	Catalogue No.	Connection Diag.
R1, R2, R3	120V	0/1mA	253-TRP*-TRFA-DG	12

Paladin Transducers 250 Series Class 0.5

Linear Integrator Pulsed Output Transducer

Typical applications result in pulses proportional to kilowatt-hours, ampere hours, litre-hours etc., depending on the transducer or transmitter used. Accepts inputs in the form of a process signal derived from transducers or transmitters and integrates them with respect to time, to produce a pulsed output via volt free relay contacts. Converts a D.C. input into a pulsed kilowatt hour and ampere hour measurement output.

Specification

Inputs:	0/1mA, 4/20mA, 0/5mA, 0/10mA, 0/20mA, 0/1V D.C., 0/10V D.C.
Output:	Volt free relay contacts.
Pulse rate:	Minimum 100/hour maximum 10,000/hour, specify.
Auxiliary Power:	63.5, 110, 120, 139, 208, 220, 240, 277, 380, 415, 440, 480V A.C.

Product Code – Linear Integrator

Input	Pulses per hour	A.C. Aux Power	Catalogue No.	Connection Diag.
0/1mA	Specify	120V	253-TIK*-FAPO-DG	13

Signal Isolator

The signal isolator is designed for use in signal transmission and processing applications to prevent noise and interference caused by ground loops between signal source and the measuring device. The isolator provides galvanic high voltage isolation between source and measuring device.

Specification

Input/Output Ratio:	1 to 1
Max Input/Output:	20mA D.C.
Accuracy:	0.2% at 250 ohms
Isolation:	660V A.C., 930V D.C. continuous
Test Voltage:	1.5kV at 50Hz for 1 minute
Load Range:	0-500 ohms @ 20mA D.C.
Output Voltage:	I out x R Load limited to 15V
Input Voltage:	Typically I x (load + 200Ω) limited to 18V
UL File Number:	E149713N
CSA File Number:	LR52592

Product Code – Signal Isolator

Input D.C.		O/P D.C.	Catalogue No.	Connection Diag.
20mA		0/20mA	250-ISA*-HF	5

Paladin Transducers 250 Series Class 0.5

D.C./D.C. & Temperature

D.C. Input versions accept signals over a wide range providing galvanic isolation between the input and output signal. Output is directly proportional to the input. Thermocouple models also incorporate cold junction compensation for all base metal Thermocouples, and Thermocouple break protection. Suitable for data acquisition and data control monitoring.

Specification

Inputs:	D.C. Voltage: Any value between 10mV to 600V D.C. Current: Any value between 100µA to 10A
Thermocouple Models:	A range of temperature transmitters suitable for use with a variety of thermocouples.
Inputs:	The most popular types are: J-Fe/Const 0-700°C K-NiCr/NiA 0-1200°C T-Cu/Cn0-200°C
Auxiliary Power:	A.C.: 63.5, 110, 120, 220, 240, 380, 415, 440 and 480V D.C.: 12, 24, 48, 110, 120 or 135V

Product Codes – D.C./D.C. and Temperature Transducer

Input	O/P D.C.	A.C. Aux Power	Catalogue No.	Connection Diag.
D.C. Current	0/1mA	120V	256-TTA*-**FA-DG	18
D.C. Millivolts	0/1mA	120V	256-TTM*-**FA-DG	18
D.C. Voltage	0/1mA	120V	256-TTV*-**FA-DG	18
Thermocouple				
Type K	0/1mA	120V	256-TTN*-KTFA-DG	18
Type T	0/1mA	120V	256-TTC*-TTFA-DG	18
Type J	0/1mA	120V	256-TTF*-JTFA-DG	18

Resistance Transmitter

A simple and convenient way of measuring and transmitting values of temperature in the form of a load independent D.C. signal. They detect varying resistance due to temperature change at the RTD (Resistance Temperature Detector). Designed for platinum (Vt.100), Copper (Cu 10) or Nickel (Ni100) RTDs.

Specification

Input:	100Ω Platinum - (Pt100), 10Ω Copper, 100Ω Nickel
Outputs:	0/1mA, 0/5mA, 0/10mA, 0/20mA, 4/20mA,
Auxiliary:	A.C.: 110, 120, 220, 240, 380, 415V D.C.: 12, 24, 48, 110, 120 or 135V

Product Codes – Resistance Transmitter

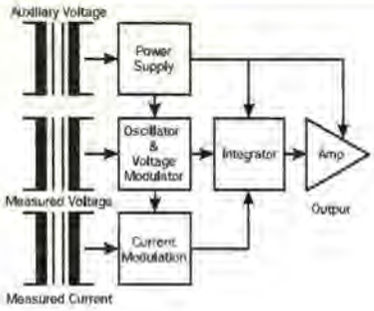
Input	O/P D.C.	A.C. Aux Power	Catalogue No.	Connection Diag.
10 Ohms copper RTD	0/1mA	120V	253-TRR*-R1FA-DG	17
100 Ohms VT RTD	0/1mA	120V	253-TRR*-R2FA-DG	17

Ordering Information

Input span can be specified in temperature or resistance. The resistance value between lowest and highest temperature being measured must be within limits stated.

Platinum:	20Ω minimum span, 200Ω maximum span
Copper:	2Ω minimum span, 20Ω maximum span
Nickel:	20Ω minimum span, 200Ω maximum span

Paladin Transducers 250 Series Class 0.5



Power Transducers

A wide range of transducers to measure all forms of power, in single or 3 phase balanced or unbalanced, 3 or 4 wire systems. These Transducers utilise the well proven 'time division multiplication' method of measuring instantaneous power over a wide range of input waveforms. In the self powered version the system voltage provides both power supply and an input to the voltage modulation circuit of an oscillator. Square wave pulses from a multi-vibrator circuit with a mark-space ratio varied by the measured voltage, and amplitude varied by the measured current, are fed to an integrator and an output amplifier circuit. The D.C. milliamp signal produced is therefore directly proportional to the power input. All inputs are isolated by the use of transformers. For large voltage variations use the auxiliary powered versions. Self powered units permit voltage variations up to +20% of the nominal input. Measures both import and export power.

Specification

Input Voltage:	63.5, 110, 120, 150, 208, 220, 240, 277, 380, 415, 480V
Current:	1, 5, 10A
Frequency:	50 or 60 or 400Hz
Outputs:	0/1mA, 0/5mA, 0/10mA, 0/20mA, 4/20mA
Auxiliary Power:	Self Powered
A.C.:	63.5, 110, 120, 150, 208, 220, 240, 277, 380, 415, 480V
D.C.:	12, 24, 48, 120, 135V

Product Codes – Watt Transducer

	Catalogue No.	Connection Diag.
Single Phase	256-TWK	14
3 Phase 3 Wire Balanced Load	256-TWL	19
3 Phase 4 Wire Balanced Load	256-TWH	24
3 Phase 3 Wire Unbalanced Load	256-TWM	20
3 Phase 4 Wire Unbalanced Load	256-TWN	35
3 Phase 3 Wire Balanced Load (2 Voltage connections)	256-TWS	38

Product Codes – VAr Transducer

Single Phase	256-TXK	14
3 Phase 3 Wire Balanced Load	256-TXG	34
3 Phase 4 Wire Balanced Load	256-TXH	42
3 Phase 3 Wire Unbalanced Load	256-TXM	20
3 Phase 4 Wire Unbalanced Load	256-TXN	40

Product Codes – VA Transducer

Single Phase	256-TYK	14
3 Phase 3 Wire Balanced Load	256-TYG	41
3 Phase 4 Wire Balanced Load	256-TYH	42
3 Phase 3 Wire Unbalanced Load	256-TYM	20
3 Phase 4 Wire Unbalanced Load	256-TYN	35

Paladin Transducers 250 Series Class 0.5

Power Factor and Phase Angle

A range of power factor and phase angle transducers with a linearised output.

Product Codes – Power Factor Transducer (for Digital Meters & Systems)

3 Phase 3 or 4 Wire Balanced Load.

Power Factor	Catalogue No.	Connection Diag.
Single Phase 0.5/1/0.5	256-TDSU	43
Single Phase 0/1/0	256-TDCU	43
Single Phase 1/0/1/0/1	256-TDAU	43
3 Phase 3 or 4 Wire Balance Load 0.5/1/0.5	256-TDTU	45
3 Phase 3 Wire Balance Load 0/1/0	256-TDEU	46
3 Phase 3 or 4 Wire Balance Load 1/0/1/0/1	256-TDBU	46

Note: These products are only suitable for 50Hz or 60Hz operation.

Product Codes – Phase Angle Transducers Single Phase

3 Phase 3/4 Wire Balanced Load 2 or 4 Quadrant

Phase Angle	Catalogue No.	Connection Diag.
Single Phase 60/0/60 75/0/36 0.5/1.0/0.5 or 0.2/1/0.8	256-TPSU	14
Single Phase -180°/0/180°	256-TPAU	14
3 Phase 3 or 4 Wire Balanced Load 0.5/1/0.5 or 0.2/1/0.8	256-TPTU	42
3 Phase 3 or 4 Wire Balanced Load -180°/0/180°	256-TPBU	19

Product Codes – Power Factor Transducer (Suits Analogue Indicators) Single Phase

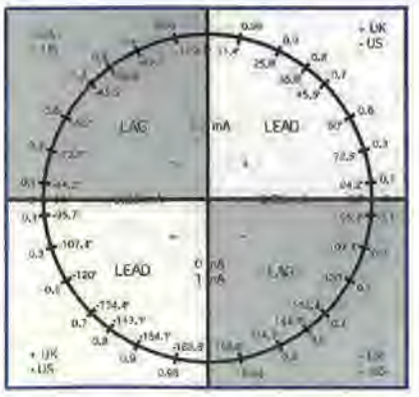
3 Phase 3 or 4 Wire Balanced Load.
Accuracy +/- 3% of Span, i.e. 0.03 counts on 0.5/1/1/0.5 model.

Power Factor	Catalogue No.	Connection Diag.
Single Phase - 0.5/1/0.5	256-TFSU	14
Single Phase - 0/1/0	256-TFCU	14
Single Phase - 1/0/1/0/1	256-TFAU	14
3 Phase 3 or 4 Wire Balanced Load 0.5/1/0.5	256-TFTU	42
3 Phase 3 Wire Balanced Load 0/1/0	256-TFEU	19
3 Phase 3 Wire or 4 Wire Balanced Load 1/0/1/0/1	256-TFBU	19

Note: These products are only suitable for 50Hz or 60Hz operation.

Product Code – Phase Relationship Transducer

Phase Relationship	Catalogue No.	Connection Diag.
Measures the phase relationship between two systems (voltage inputs)	256-TPDU	36



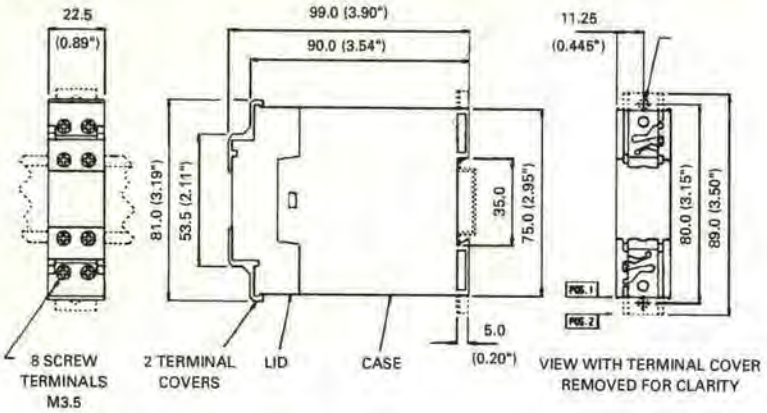
Conversion to P.F.

The transducer output, if displayed on an analogue meter, produces an inconvenient non-linear scale. Computer users may find the need for a linearising program. Other transducers are available from Crompton Instruments with a linearised output if required.

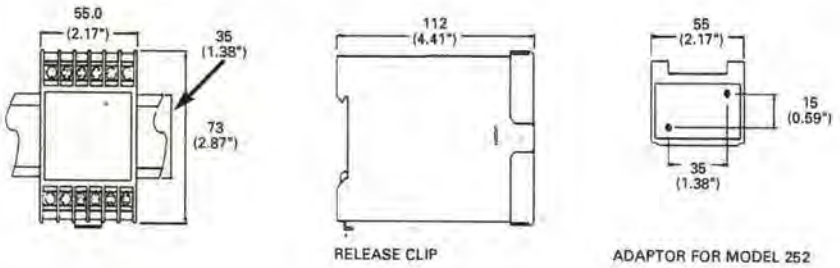
Paladin Transducers 250 Series

Dimensions

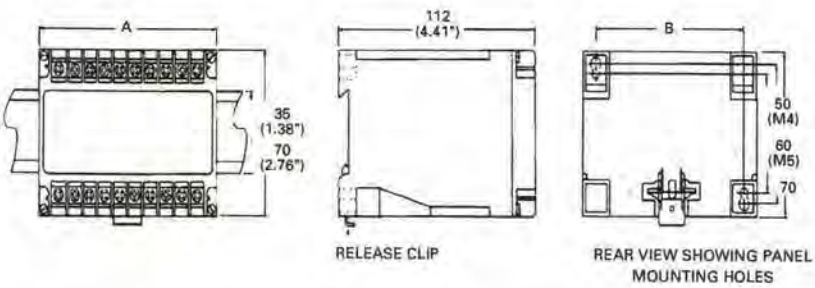
Model 250



Model 252



Model 253, 256



Model	A mm	A inches	B mm	B inches
250	22.5	0.88	-	-
252	55	2.17	-	-
253	75	2.96	60	2.36
256	150	5.90	135	5.31

Mounting Details

Position 1 - DIN Top Hat Rail Mounting (DIN ENS0022-35)
Position 2 - Screw Mounting To Suit M4 Fixings

Paladin Transducers 250 Series

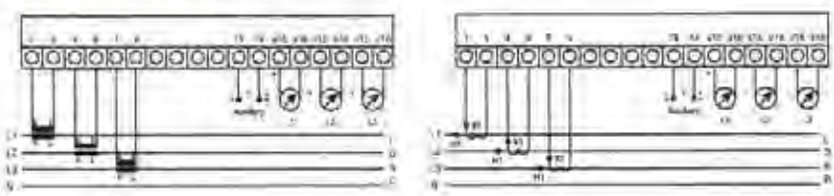
Notes on connection diagrams

1. When using more than one item via a Current Transformer, the inputs must be in series.
2. Auxiliary supply applies only if ordered. For maximum performance an A.C. or D.C. auxiliary is recommended. Self powering is achieveable for a voltage variation of less than 20%.
3. When there is more than one output the outputs are in the sequence of the description i.e. on a Watt, Var and VA transducer, output (a) is Watt, (b) is Var and (c) is VA.
4. Where more than one output is provided - please note there is no isolation between outputs. You may require a signal isolator (Module 250-ISA).

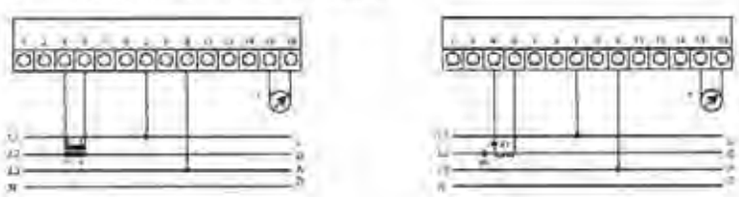
Connection Diagrams

Type 252-XAA, Type 253-TAA
Single Phase Current, Self Powered – Diagram 1

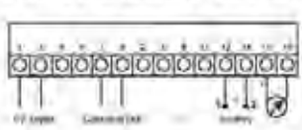
Type 256-XAS/XAR, Type 256-TAS, TAL, TAR
3 Ø Current, 3 Outputs – Diagram 2



Type 256-TAB
Bi-directional 3 Ø 3 Wire Current – Diagram 3

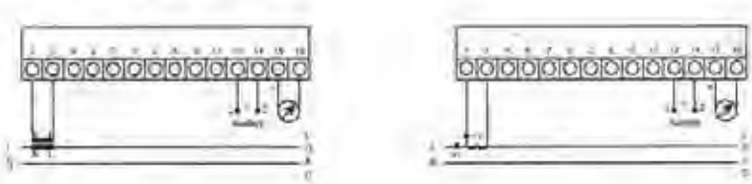


Type 253-TDP/TDN/TDM
Integrating D.C. Current – Diagram 4



Type 253-ISA
Single Isolator – Diagram 5

Type 252-XAS/XAR/XAL, Type 253-TAL/TAR
Single Phase Current – Diagram 6



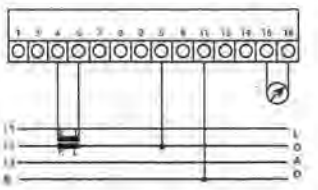
Paladin Transducers 250 Series

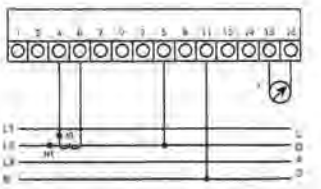
Notes on connection diagrams

1. When using more than one item via a Current Transformer, the inputs must be in series.
2. Auxiliary supply applies only if ordered. For maximum performance an A.C. or D.C. auxiliary is recommended. Self powering is achieveable for a voltage variation of less than 20%.
3. When there is more than one output the outputs are in the sequence of the description i.e. on a Watt, Var and VA transducer, output (a) is Watt, (b) is Var and (c) is VA.
4. Where more than one output is provided - please note there is no isolation between outputs. You may require a signal isolator (Module 250-ISA).

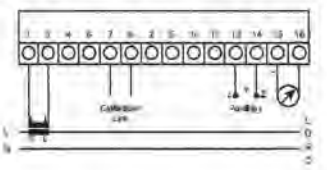
Connection Diagrams

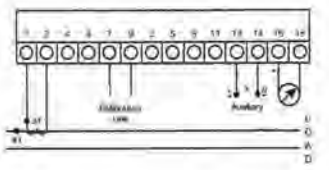
Type 256-TAB
Bi-directional Single Phase and 3 Ø 4 Wire Current – Diagram 7



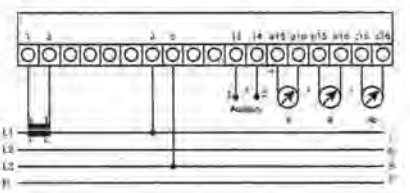


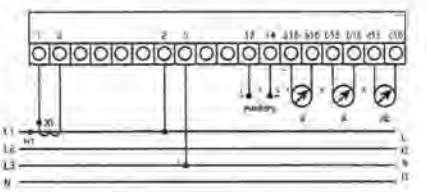
Type 253-TAP/TAN/TAM
Integrating A.C. Current – Diagram 8



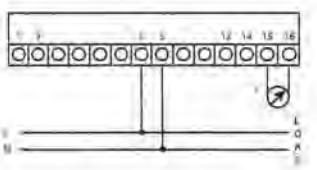


Type 256-XLK
Voltage, Current and Frequency, 3 Outputs – Diagram 9

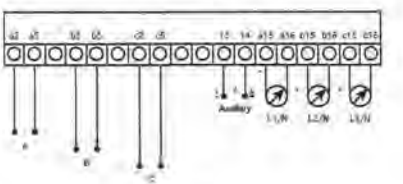




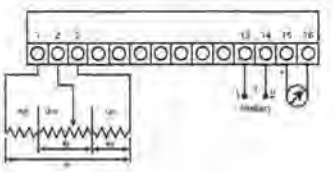
Type 252-XVA & Type 253-TVA
Single Phase Voltage Self Powered
Type 253-XHA, 253-THZ
Frequency – Diagram 10



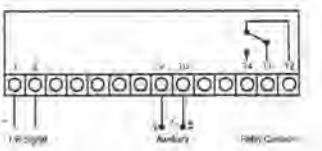
Type 256-TVL, TVR, TVS, TVW
Type 256-XVU, XVW, XVY, XVX
3 x 1Ø Voltages 3 Outputs – Diagram 11



Type 253-TIK
Tap Position and Slideware
Transmitter – Diagram 12



Type 253-TRP/TRT
Linear Integrator – Diagram 13



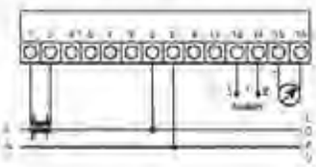
Paladin Transducers 250 Series

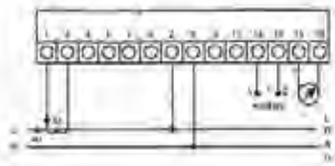
Notes on connection diagrams

1. When using more than one item via a Current Transformer, the inputs must be in series.
2. Auxiliary supply applies only if ordered. For maximum performance an A.C. or D.C. auxiliary is recommended. Self powering is achieveable for a voltage variation of less than 20%.
3. When there is more than one output the outputs are in the sequence of the description i.e. on a Watt, Var and VA transducer, output (a) is Watt, (b) is Var and (c) is VA.
4. Where more than one output is provided - please note there is no isolation between outputs. You may require a signal isolator (Module 250-ISA).
5. Model 256-XDK has 2 outputs (a) and (b).
6. Models 256-XEK and 256-XGK have 3 outputs (a), (b) and (c).

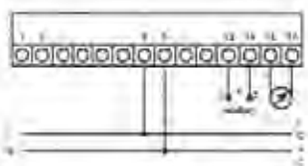
Connection Diagrams

Type 256-XWK/XXK/XYK/XDK/XEK/XGK/XFS/XFA/XPS/XPA
Type 256-TWK/TXK/TYK/TPS/TPA/TFA/TFS/TFC
Single Phase, Watts or Vars or VA or Phase Angle or Power Factor, Watt and Var: Watt, Var and VA: Watt, Var and Power Factor.
One Output - Diagram 14

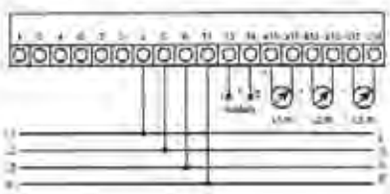




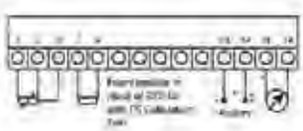
Type 252-XVS, XVZ, XVR, XVL, XHL, XHS
Type 253-TVL, TVR, TVZ
Single Phase Voltage – Diagram 15



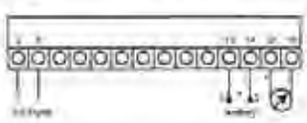
Type 256-XVS/XVR/XVZ/XVL
3 Ø 4W Voltage, 3 Outputs
Diagram 16



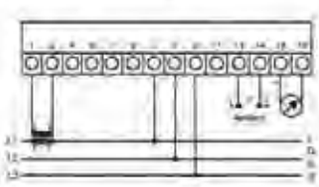
Type 253-TRR
Temperature Transmitter – Diagram 17

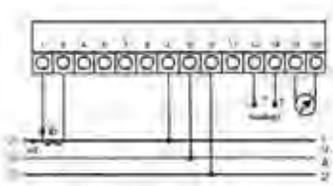


Type 256-TTA/M/V/F/C/N
D.C./D.C. Transducer and Temperature – Diagram 18

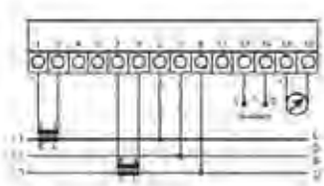


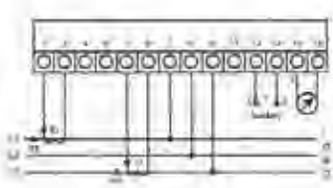
Type 256-XWL/XXL/XYL/XFW/XPW/XPG/XFG
Type 256-TWL/TPB/TFB/TFE
3 Ø 3W balanced load, Watts or Vars or VA or Phase Angle or Power Factor.
One Output - Diagram 19





Type 256-XWM/XXM/XYM/XZM/XFU/XFC/XPU/XPC
Type 256-TWM/TXM/TYM
3 Ø 3W unbalanced load, Watts or Vars or VA or Phase Angle or Power Factor.
One Output - Diagram 20





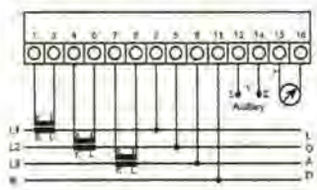
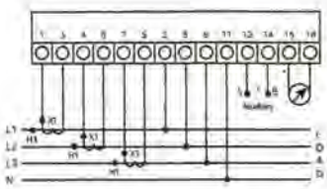
Paladin Transducers 250 Series

Notes on connection diagrams

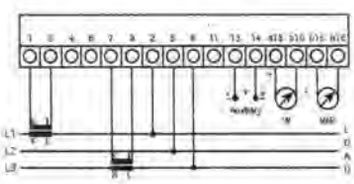
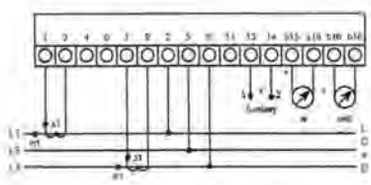
1. When using more than one item via a Current Transformer, the inputs must be in series.
2. Auxiliary supply applies only if ordered. For maximum performance an A.C. or D.C. auxiliary is recommended. Self powering is achieveable for a voltage variation of less than 20%.
3. When there is more than one output the outputs are in the sequence of the description i.e. on a Watt, Var and VA transducer, output (a) is Watt, (b) is Var and (c) is VA.
4. Where more than one output is provided - please note there is no isolation between outputs. You may require a signal isolator (Module 250-ISA).

Connection Diagrams

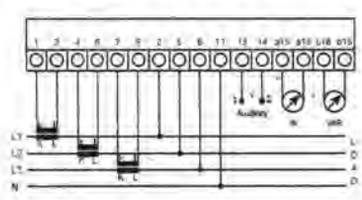
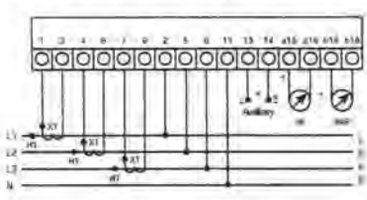
Type 256-XWW/XXW/XYW/XZW/XFT/XFB/XPT/XPB
3 Ø 4W unbalanced load, 3 elements,
Watts or Vars or VA or Phase Angle or Power Factor.
One Output – Diagram 21

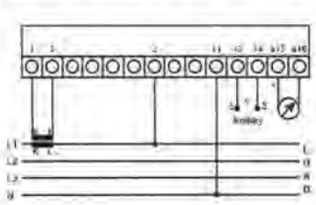
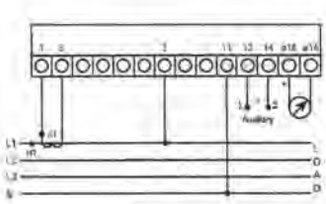
Type 256-XDM
3 Ø 3W unbalanced load, Watt and Var, 2 Outputs – Diagram 22

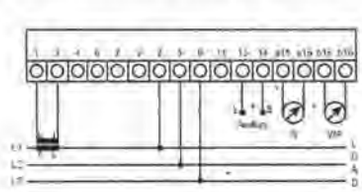
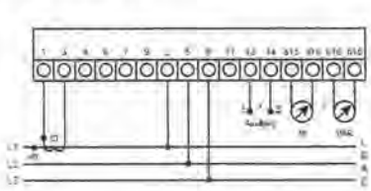
Type 256-XDW
3 Ø 4W unbalanced load, 3 elements, Watt and Var, 2 Outputs – Diagram 23

Type 256-XWH/XXH/XYH/XFV/XFD/XPV/XPD
Type 256-TWH/TXH/TYH
3 Ø 4W balanced load, WattS or Vars or VA or Phase Angle or Power Factor
1 Output – Diagram 24

Type 256-XDL
3 Ø 3W balanced load, Watt and Var, 2 Outputs – Diagram 25

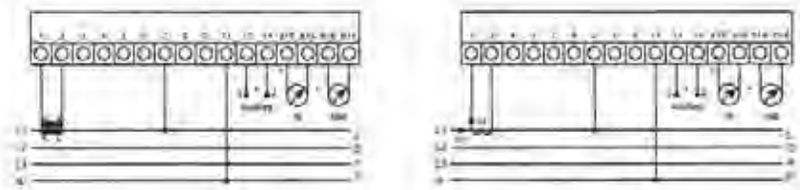
Paladin Transducers 250 Series

Notes on connection diagrams

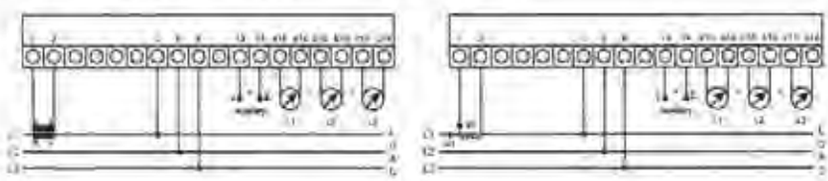
1. When using more than one item via a Current Transformer, the inputs must be in series.
2. Auxiliary supply applies only if ordered. For maximum performance an A.C. or D.C. auxiliary is recommended. Self powering is achieveable for a voltage variation of less than 20%.
3. When there is more than one output the outputs are in the sequence of the description i.e. on a Watt, Var and VA transducer, output (a) is Watt, (b) is Var and (c) is VA.
4. Where more than one output is provided - please note there is no isolation between outputs. You may require a signal isolator (Module 250-ISA).

Connection Diagrams

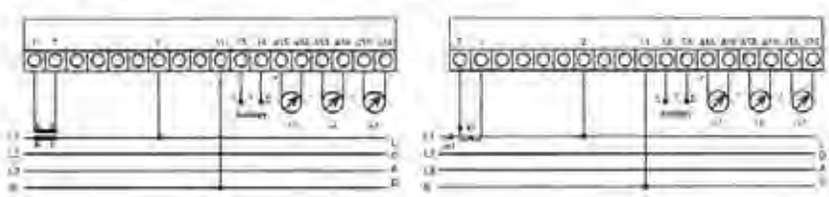
Type 256-XDH
3 Ø 4W balanced load, Watt and Var, 2 Outputs - Diagram 26



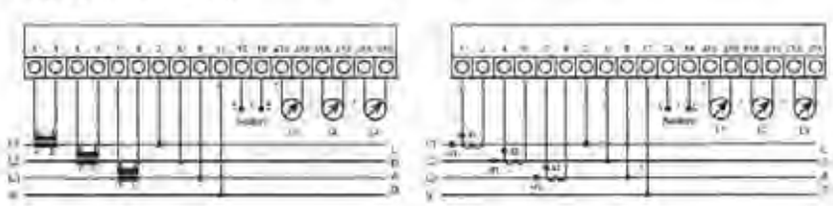
Type 256-XRL/XSL/XJL
3 Ø 3W balanced load, Watt, Var and VA:
Watt, Var and Power Factor, 3 Outputs - Diagram 27



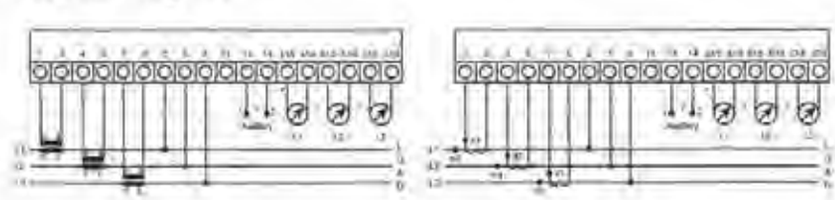
Type 256-XRH/XSH/XJH
3 Ø 4W balanced load, Watt, Var and VA:
Watt, Var and Power Factor, 3 Outputs - Diagram 28



Type 256-XWE/XXE/XYE/XFE/XFF/XPE/XPF
3 Ø 4W unbalanced load, Watts or Vars or VA or Phase Angle or Power Factor
3 Outputs - Diagram 29



Type 256-XRM/XSM/XJM
3 Ø 3W unbalanced load, Watt, Var and VA: Watt, Var and Power Factor,
3 Outputs - Diagram 31



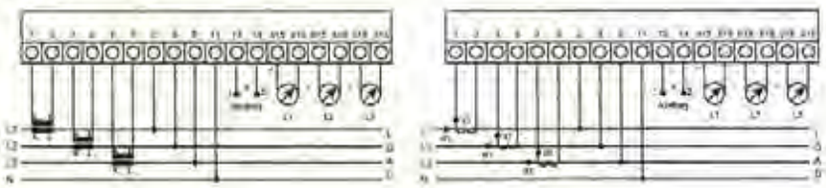
Paladin Transducers 250 Series

Notes on connection diagrams

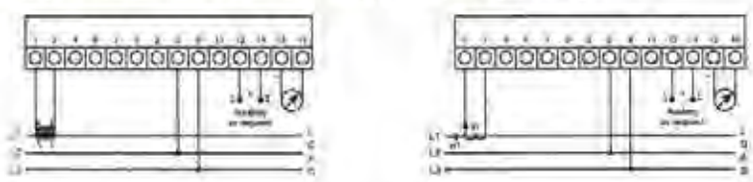
1. When using more than one item via a Current Transformer, the inputs must be in series.
2. Auxiliary supply applies only if ordered. For maximum performance an A.C. or D.C. auxiliary is recommended. Self powering is achieveable for a voltage variation of less than 20%.
3. When there is more than one output the outputs are in the sequence of the description i.e. on a Watt, Var and VA transducer, output (a) is Watt, (b) is Var and (c) is VA.
4. Where more than one output is provided - please note there is no isolation between outputs. You may require a signal isolator (Module 250-ISA).

Connection Diagrams

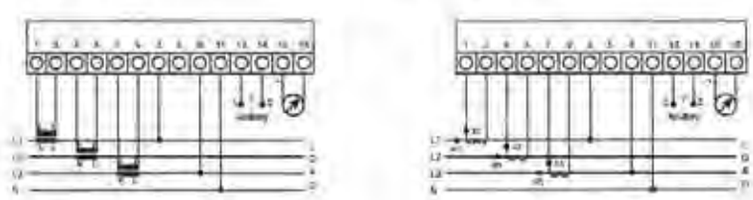
Type 256-XRW/XSW/XJW
3 Ø 4W unbalanced load, 3 elements, Watt, Var and VA: Watt, Var and Power Factor
3 Outputs – Diagram 32



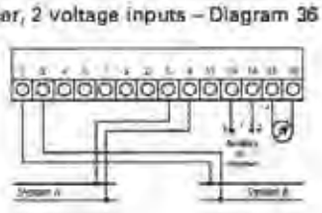
Type 256-TWE/TXG/TPT
3 Phase 3 wire balanced load, Watts, Vars or Phase Angle - Diagram 34



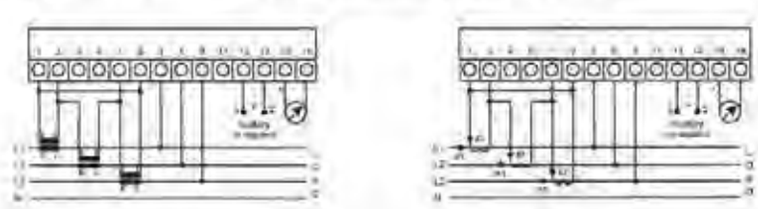
Type 256-TWN/TXP/TYN
3 Ø 4W unbalanced load, Watts or Vars, or VA – Diagram 35



Type 256-TPD
Phase difference transducer, 2 voltage inputs – Diagram 36



Type 256-TXJ
3 Ø 4W unbalanced load, Vars, Delta connected CT's - Diagram 37



Paladin Transducers 250 Series

Notes on connection diagrams

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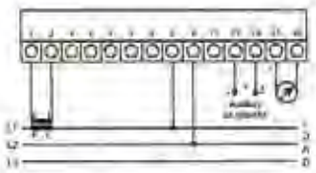
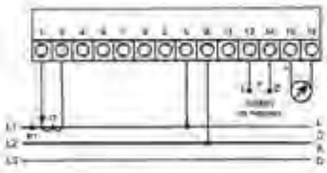
2. Auxiliary supply applies only if ordered. For maximum performance an A.C. or D.C. auxiliary is recommended. Self powering is achieveable for a voltage variation of less than 20%.
3. When there is more than one output the outputs are in the sequence of the description i.e. on a Watt, Var and VA transducer, output (a) is Watt, (b) is Var and (c) is VA.
4. Where more than one output is provided - please note there is no isolation between outputs. You may require a signal isolator (Module 250-ISA).

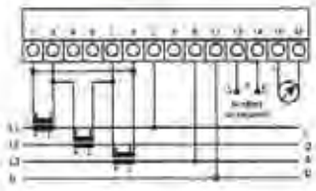
Connection Diagrams

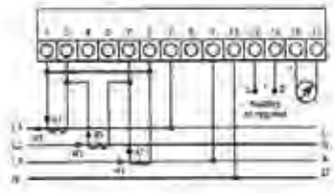
Type 256-TWS
3 Ø 3W balanced load, Watts – Diagram 38



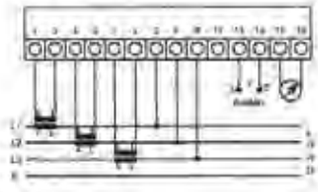


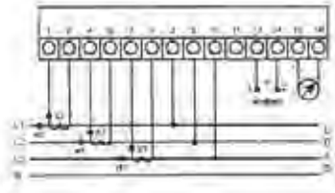
Type 256-TWJ/TYJ
3 Ø 4W unbalanced load, Watts or VA Delta connected CT's – Diagram 39





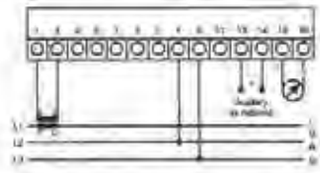
Type 256-TXN
3 Ø 4W, unbalanced load, Vars – Diagram 40

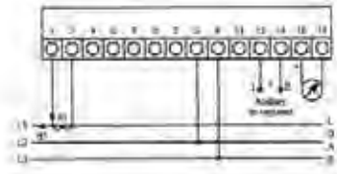




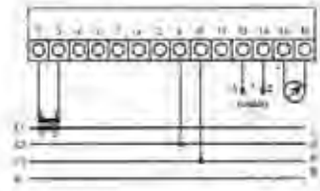
25D-ODA
Pin 2 = data, 4 and 5 = power for ODA, 9 and 20 = power for ODA, 7 = ground

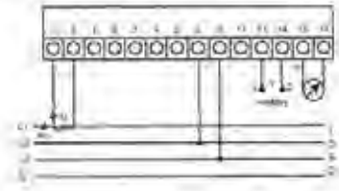
Type 256-TYG, XWL
3 Ø 3W balanced load, VA, WATT – Diagram 41





Type 256-TPT/TFT/TXH/TYH
3 Phase 3/4W, balanced load, Phase Angle or Power Factor – Diagram 42





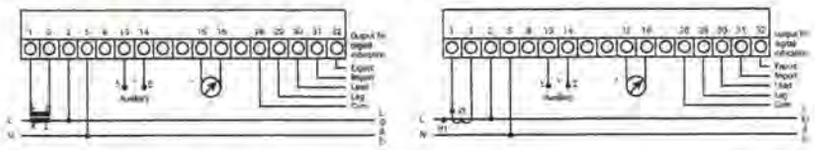
Paladin Transducers 250 Series

Notes on connection diagrams

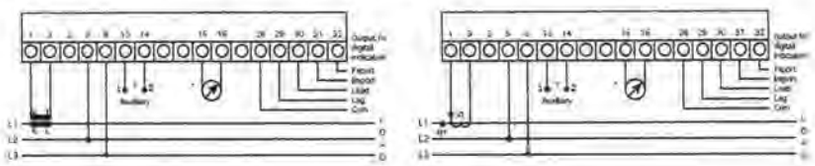
1. When using more than one item via a Current Transformer, the inputs must be in series.
2. Auxiliary supply applies only if ordered. For maximum performance an A.C. or D.C. auxiliary is recommended. Self powering is achieveable for a voltage variation of less than 20%.
3. When there is more than one output the outputs are in the sequence of the description i.e. on a Watt, Var and VA transducer, output (a) is Watt, (b) is Var and (c) is VA.
4. Where more than one output is provided - please note there is no isolation between outputs. You may require a signal isolator (Module 250-ISA).

Connection Diagrams

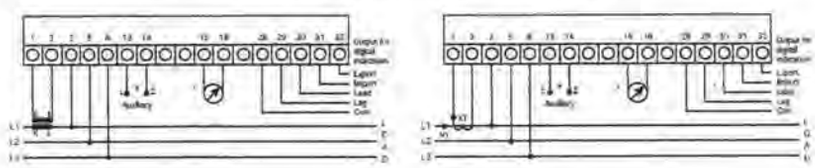
Type 256-TDA/TDC/TDS
4 Quadrant, single phase power factor with an output for a Digital Indicator – Diagram 43



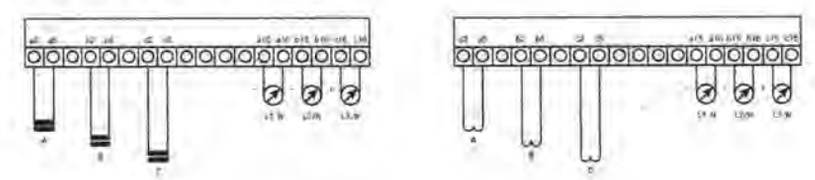
Type 256-TDT
3 Phase 3/4W, balanced load, Power Factor, with an output for a digital indicator – Diagram 45



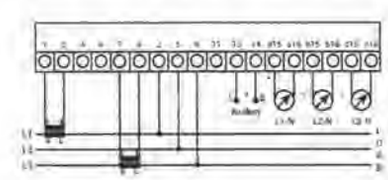
Type 256-TDB/TDE
4 Quadrant, 3 Phase 3/4W, Wire Balanced Load, Power Factor with an output for a digital indicator – Diagram 46



Type 256-TAA
3 x 1Ø Current, Outputs – Diagram 47



Type 256-XVW/XVY/XVX
3 Ø 3W Voltage, 3 Outputs – Diagram 48



SP270 Lytton Road Practical Completion Inspection

Date 01/12/2009
Inspected By John Clayton Commissioning Manager

Items that are defected are as follows.

1/Pump No.3 Ammeter scale is not correct, should be 0 to 50 amps as per the CT ratio 50/5

2/Vacuum Pump No.2 has the pump motor conduit held in place with cable ties, this is not acceptable.

3/ Vacuum Pump No.3 has the pump motor conduit held in place to the motor frame with cable ties, this is not acceptable.

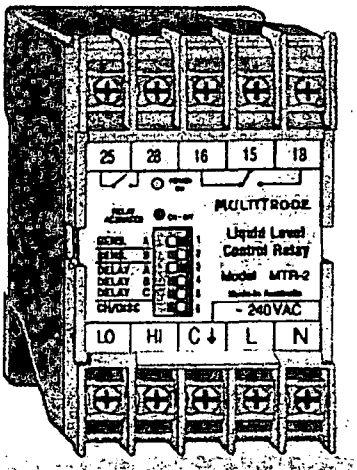
4/The vacuum tank pressure gauge poly pipe is too long at the tank connection point. This needs to be shortened to only one spare turn, (1 meter)

1 Introduction

The MultiTrode level control relay is a solid-state electronic module in a hi-impact plastic case with a DIN rail attachment on the back, making a snap-on-snap-off installation. Any number of relays can be easily added to the DIN metal rail then wired together to form a complex pumping system that other wise may have to be controlled and operated by a programmed PLC.

The relay is normally matched with the MultiTrode probe which works in conjunction with the relay and uses the conductivity of the liquid to complete an electrical circuit.

2 Electrical Overview



There are 10 screw terminals on the unit. Facing the relay as shown, we look at the bottom terminals (left to right):

- Lo – (Charge mode). This is the point when the probe is dry the relay will turn on.
- Lo – (Discharge mode). This is the point when the probe in the tank is dry the relay will turn off.
- Hi – (Charge mode). This is the point when the probe in the tank is wet a relay will turn off
- Hi – (Discharge mode). This is the point when the probe in the tank is wet a relay will turn on.
- C - is common earth. All earth bonding must be terminated here for correct operation.
- " L " is "live" (240V AC)
- " N " is "neutral" (240V AC)

If the tank is plastic, or if you are conducting tests in a plastic bucket, or the vessel has no earth point inside, you must install an earth rod within the tank, vessel or bucket and make sure that it is bonded back to C on the relay unit.

3 DIP Switches

3.1 DIP Switches

(See Wiring Diagram for full program functions.)

3.1.1 DIP 1 & 2

DIP 1 and 2 control the Sensitivity, in other words the cleaner the liquid the higher the sensitivity setting must be. Concentrated acids, minerals are by their own chemical composition highly conductive, so a low level of sensitivity is required, purified water is almost an insulator against electrical current flow so a higher sensitivity inside the relay is required.

3.1.2 DIP 3, 4 & 5

DIP switches 3, 4 and 5, control delay on activation. For example, in discharge mode with DIP switches 3, 4 and 5 set to 10 seconds, when the Hi point becomes wet it will activate the motor and it will take 10 seconds of continual coverage of the probe sensor to make the relay close and start the pump. This is invaluable when the probe is in a turbulent part of a well where fluid is splashing around touching the sensors momentarily, and false activation cannot be tolerated.

3.1.3 DIP 6

DIP switch 6 controls the charge/discharge function. Set "ON" for charge, and "OFF" for discharge

3.2 Relay Contacts & their Applications

3.2.1 Contacts 15, 16 & 18

Contacts 15, 16, and 18 are used for electronic or visual notification of a change in state at the pump itself. Contacts 15, 16, and 18 are used for more advanced applications because they are a changeover relay, their state may be the same as contacts 25, 28 or the opposite. Both sets of contactors are triggered simultaneously. An example is when in discharge mode, (see Figure 1).

You have a gravity flow coming in so the fluid reaches the lower sensor PB1, contacts 15 and 18 are open (15 being common to both contact 16 and 18) contacts 25 and 28 are also normally open but contacts 15 16 in this current situation are closed, whether PB1 is wet or dry is of no concern all will stay the same. The level now rises to PB2 and both relays change state, contacts 25 and 28 close to turn on the pump, contacts 15 and 16 are open, with 15 and 18 closed.

In advanced applications this state change may be fed into a logic device to indicate the pump is running or the pump has stopped and perhaps light an LED or incandescent light source for visual confirmation that a change has occurred in the relay.

3.2.2 Contacts 25 & 28

Contacts 25 and 28 are used to control pump states. Contacts 25 and 28 are mostly used for turning on motors via a starting relay or solenoid, so, these sets of contacts react to the rising or falling levels of the fluid inside the tank, they will operate to turn on a pump in discharge mode when the top sensor is wet and in charge mode turn on the pump when the bottom sensor is dry.

4 Practical Overview

4.1 Discharge Mode – DIP switch 6 set to "OFF"

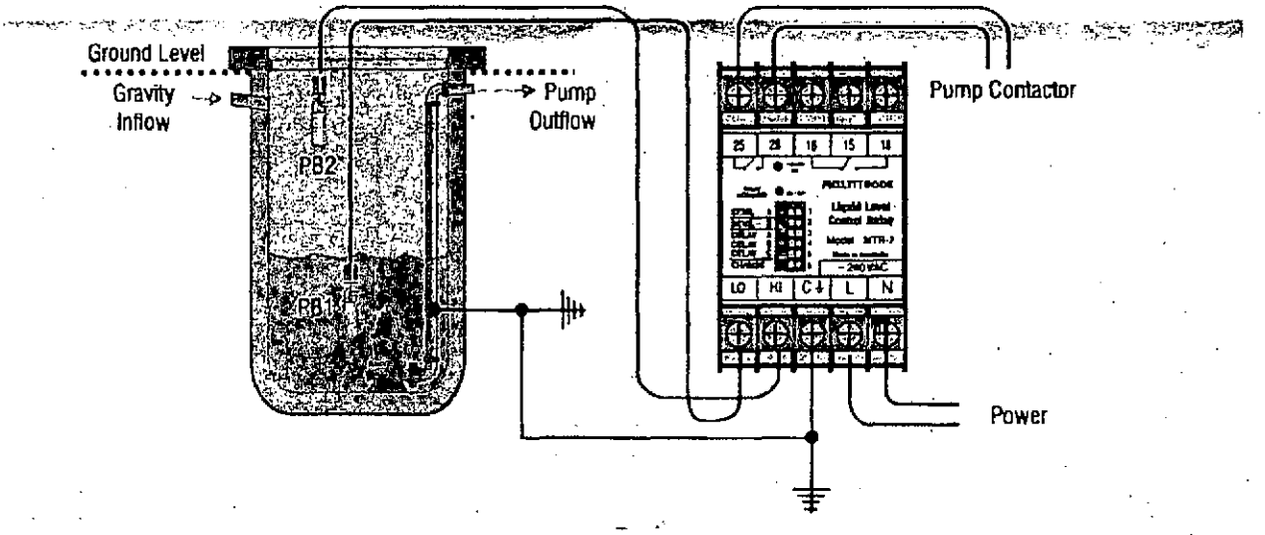
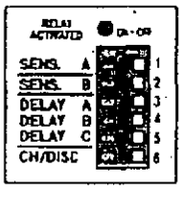


Figure 1 – Discharge Mode

Figure 1 shows two probes, (PB1 connected to Lo and PB2 connected to Hi). The pit is mostly underground and there is a gravity-fed inlet at the top left-hand side. The pit is empty with PB1 completely dry. Dipswitch 6 is set to "OFF."



The relay operation depends on the electrical conductivity of liquid in the pit, i.e. no liquid = no current flow. The level starts to rise and covers PB1.

This is a discharge operation so we do not want the relay to close and start a pump until the well is full so as the water rises it reaches PB2, the relay closes and the pump starts. The level now drops below PB2 but the pump still continues to run, the level continues to drop below PB1 the relay opens the pump stops.

4.2 Charge Mode – DIP switch 6 set to "On"

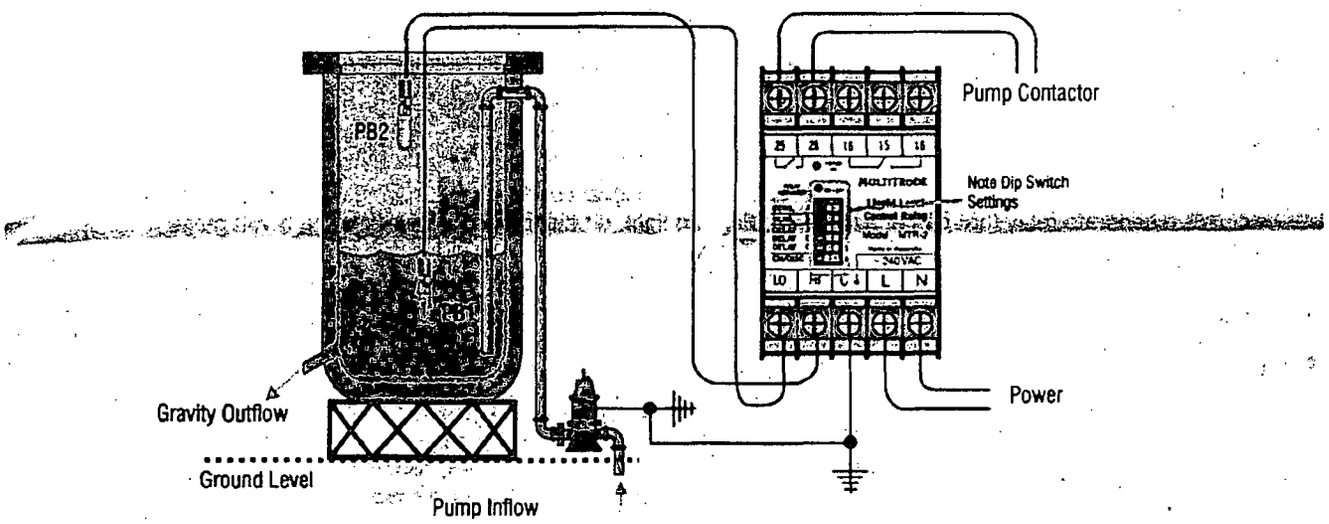
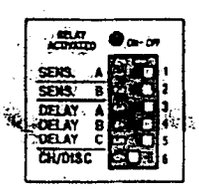


Figure 2 – Charge Mode

Note: "C" is connected to common bonded earth. The unit will not operate correctly if not earthed.



Let's look at the same relay but in a tank that is charging (DIP 6 is now on). See Figure 3, where liquid is being pumped into a tank, and discharging through a gravity feed; the tank is on steel stands "x" metres above the ground.

With the tank full, PB1 and PB2 will be wet, the relay is off, and the pump has stopped. Water is slowly fed out from the bottom, and now as PB2 (HI) becomes dry nothing happens; the water now drops to below PB1 (Lo), and the pumps restarts to fill the tank.

The pump will continue to fill the tank until PB2 (HI), becomes wet again.

4.3 MTRA Relay with Alarm (Discharge Applications Only)

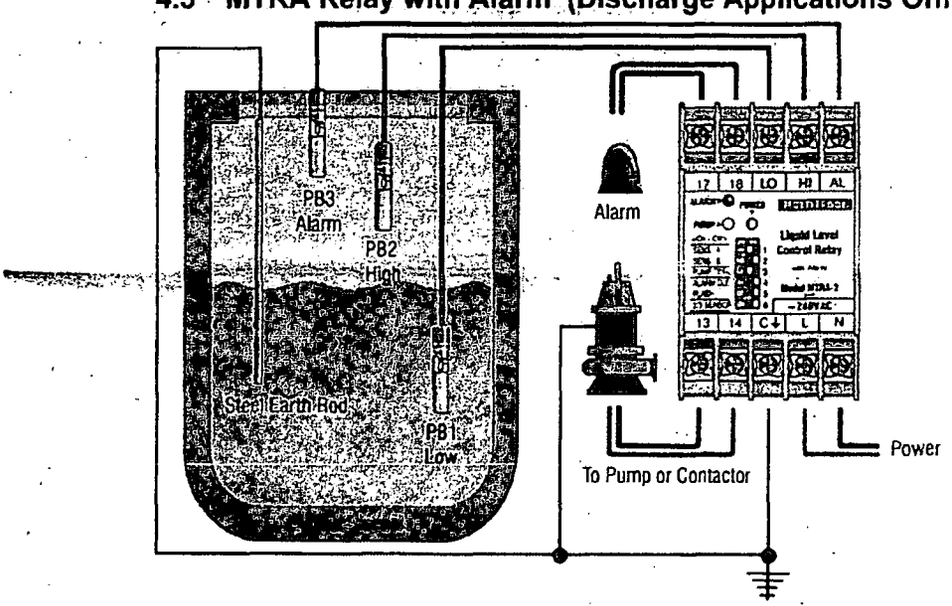


Figure 3 - MTRA Operation

The MTRA relay works in the same way as the MTR relay except the MTRA has a separate alarm output, and does not have a charge mode. The planned application is to close a contact to illuminate a warning alarm light. . Various other applications have included introducing a third probe to latch another relay.

In Figure 2 we see three probes in a pit that is plastic, note the steel rod in the tank. (In a plastic vessel a steel rod must be used to create an earth return in the liquid so probes can function.) PB1, PB2, and PB3 are dry, and the relay power LED is on. When water enters the pit and wets PB1, nothing happens, water now reaches PB2 causing contacts 13 and 14 to close, the pump LED to light, and the water to drop.

If, for example, the pump has its inlet partially blocked, the level continues to rise and wets PB3. This closes a separate relay that can activate a red flashing light, an audible fog horn or send a 5 volt pulse into another device with the common cause to warn human beings that a spill is due to occur. If the pumps become unclogged and PB3 becomes dry the alarm opens again and breaks the circuit that stops the light from flashing or the foghorn from sounding.

5 Most Common Installation Problems

The relay requires a path between the probes to earth through the liquid. If you are testing in a plastic bucket, have installed the probe in a plastic tank or have no good earthing in the vessel you will need to install a separate earth and make sure all earth bonding comes back to the C terminal. Most problems like these are traced back to a lack of or poor earthing, or open circuits in the probe wiring.

Now is the time to check the relay by using "the bridge testing line technique" remember you must simulate a fluid flow to correctly ascertain a good relay or a bad one. (All DIPswitch settings from 1 to 6 should be off.)

Cut two pieces of insulated flexible copper wire one black one red 250 mm long, strip both ends back 10 mm on both cables, and join one black end and one red end. Insert the joined ends into C on the relay box, observing all safe electrical practises. You should have one black wire and one red wire free.

Set your relay for discharge mode (DIP switch 6 is off) with no sensors connected to the unit, connect the red wire to Lo – nothing should happen (if it does return the relay for replacement or repair*). Now connect the black wire to the Hi terminal the relay activated LED should light instantly (if it does not, the relay should be returned for repair*).

6 Troubleshooting

I have checked all the DIPswitches and settings but in discharge mode as soon as the bottom sensor gets wet the pump turns on then turns off almost straight away.	• This is the most common problem encountered with relay set up and commissioning, the probe in the bottom of the tank is wired into the Hi terminal instead of the Lo terminal.
The installation went fine but now and again the pump will not turn on even though I am sure the probe is wet.	• Check the sensitivity level set on the relay, some times the level is set for foul water but due to changes in the flow the water becomes grey or clear, try changing the setting from 20KΩ to 80KΩ and monitor the results carefully.
All wiring is complete and all DIPswitches have been checked but the pump will not turn on at all.	• If you have completed the test schedule for the relay and it passed then check the wiring to the sensors – for this is now where the problem lies or in the earthing arrangements. If possible check the resistance between the sensor cable and the steel sensor on the probe to prove a solid connection.

*** Please contact your distributor or agent before returning any product for repair or warranty claim.**

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Controls either one pump, alarm or solenoid.

The MultiTrode MTR is a latching conductive liquid level relay. When connected to a MultiTrode probe, the MTR controls the activation and de-activation of pumps, alarms and other monitoring and control equipment.

The relay senses the liquid via a safe extra-low voltage signal and latches. This state is maintained until the circuit is broken when the liquid passes the selected stop sensor. The relay then resets for the next operation. A single sensor may be used for alarms.

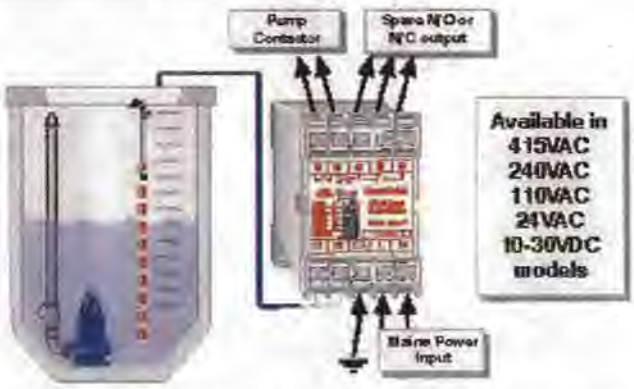
The MTR relay offers many features found in several discrete devices such as latching and time delay relays. Normally all of these devices must be installed individually. MultiTrode's MTR includes all of these features in one compact case, simplifying installation and reducing labour costs.

Use the MTR in any applications where level control is required, such as sumps, wells, bores, collection tanks, effluent pits, drainage ponds, pump stations, reservoirs, and sullage pits.

After many years of field use, the simplicity and reliability of these units is unquestionable.

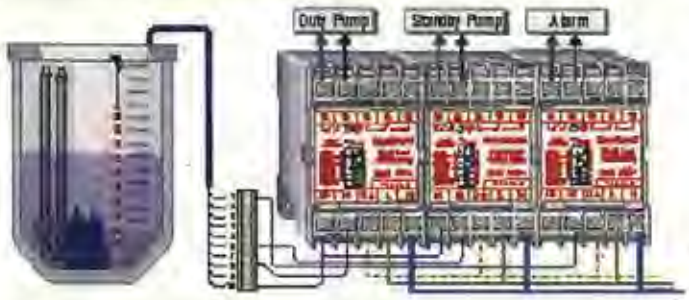
- Safe, extra-low, sensing voltage: Ensures safety for operators and maintenance personnel .
- Charge or discharge: The modes of operation are selectable to either fill or empty a tank.
- Dip Switch Programmable: All settings are easily selected from the front panel. Fixed settings ensure repetition and accuracy.
- 4 Sensitivities: Enable the relay to operate effectively in a wide range of conductive liquids.
- 8 Activation Delays. Used for staggering multiple pump starts or to overcome premature activation due to wave action or turbulence.
- LED Indication. Power On (green) and Relay Activation (red) via high intensity LED indicators.
- Battery Operation. As well as 24, 110, 240 and 415VAC, the MTR Relay is also available in 10-30 VDC.
- Proven Reliability. The proven design of the relay ensures long-term reliability of the MultiTrode system.
- I.S. application Perfect for I.S. application when used with MTISB.
- DIN rail or screw mounting
- Low installed cost

Sample MTR Application

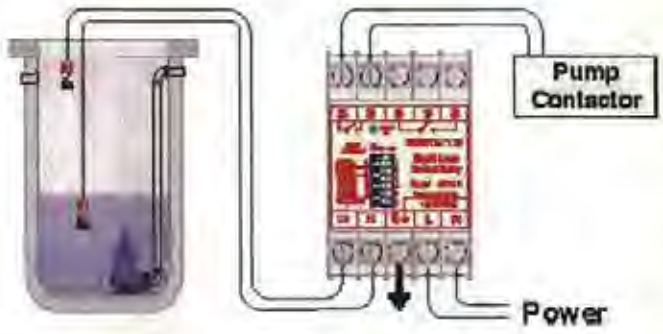


MTR | **Level Control Relay** | Page 2 | MULTITRODE

Sample MTR Application



Sample Application



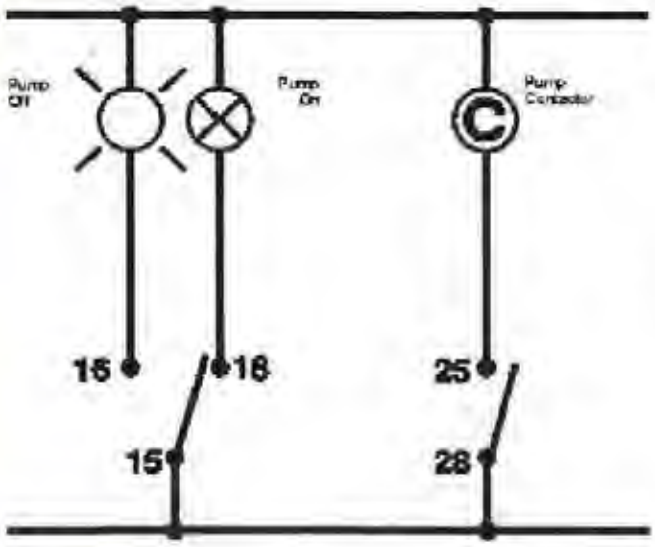
Dip Switch Settings

Sw 1&. 2 Sensitivity settings: 1k, 4k, 20k, 80k

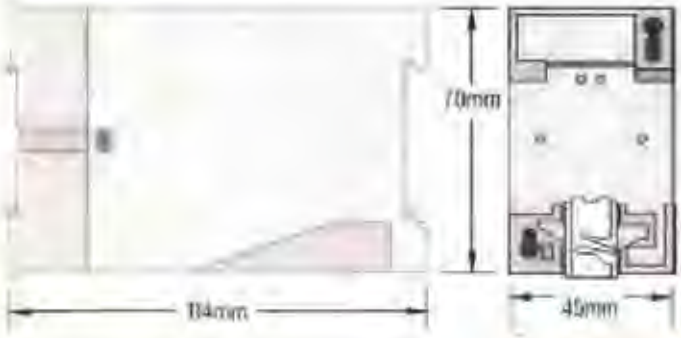
Sw 3, 4 & 5 Activation delays:
0, 2.5, 5, 10, 20, 40, 80, 160 sec

Sw 6 Mode settings: Charge & Discharge

Wiring Diagram



Physical Dimensions



Product Specifications

Mode of operation:

MTR	Charge/Discharge (Fill or Empty)

Probe Inputs:

Sensor inputs	MTR : 2 / MTRA : 3
Sensor voltage	10/12VAC Nominal
Sensor current	0.8mA max. (per sensor)
Sensitivity	1k, 4k, 20k, 80k

Relay Outputs:

MTR relay output	2 contact sets : 1 N/O & 1 C/O
MTR Output delay	0, 2.5, 5, 10, 20, 40, 80, 160 sec
Relay contact rating	250 VAC 5A Resistive, 2A Inductive
Relay contact life	10^5 Operations
Terminal size	2 x 2.5mm², #13

Display LEDs:

	Power On	Pump	Alarm
MTR	Green	Red	

Physical Product:

Dimensions (mm)	72H x 45W x 114D
Mounting	DIN Rail or 2 x M4 Screws #6
Enclosure	Makrolon (self extinguishing)

Power Supply:

Supply Voltage AC	24, 110, 240, 415VAC* - 50/60Hz
Power Consumption	3.5 Watts max *(MTR only)
Supply Voltage DC	12 or 24VDC,
Power Consumption	3 watts max

Environmental Range:

Centigrade	- 10° to +60°C
Fahrenheit	+14° to +140°F

N1653 LISTED ZPZT

AVAILABLE MODELS

415VAC	MTR1	n/a
240VAC	MTR2	MTRA2
110VAC	MTR3	MTRA3
24VAC	MTR4	MTRA4
24VDC	MTR5	MTRA5
12VDC	MTR6	MTRA6

Ordering Information & Example

Model: MTRA | Voltage: 2

This order code is for a 240VAC MTRA

All MultiTrode Products carry a two year warranty

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The MultiTrode Probe

MultiTrode probes are unsurpassed for rugged reliability, cost effectiveness and simplicity. Designed for the tough, turbulent conditions found in water, sewage and industrial tanks and sumps, the probes can be found in the simplest and the most complex water and wastewater management systems around the world.

- Low maintenance
- Simple installation
- Excellent in turbulence
- Short & long term cost savings
- Environmentally friendly
- Safe, low sensing voltage
- Unaffected by fat, grease, debris and foam
- Positive pump cut-out
- Safe – MTISB Barrier

Reliable in all conditions

Operation is unaffected by build up of fat, grease debris and foam, which causes other systems such as floats, bubblers, pressure and ultrasonic transducers to fail. Turbulence does not affect the probe operation. The rugged, streamlined design eliminates tangling and is ideal for confined spaces.

Positive pump cut-out

Operational consistency is important to longevity, low maintenance and cost control. The positive pump cut-out ensures pumps are turned off at the same level every time. This avoids damage due to pump over run and the cost of additional control equipment.

Safe for people and environment

The extra low sensing voltage ensures operators and maintenance staff are protected. All MultiTrode products are environmentally safe, containing no mercury or other harmful contaminants.

Cost savings

The low cost of equipment, installation and maintenance makes MultiTrode one of the most efficient level control systems available. Plus robust construction and longevity ensures continued cost savings when compared to other systems on the market.

Standard and custom probes

MultiTrode manufactures a wide range of standard probes, from a single sensor (200mm) to a ten-sensor probe (1000mm increasing to a maximum of nine metres). Custom probes can be manufactured to suit your requirements.

Installation

Installation is straightforward. Probes are easy to install without entering the wet area. The probe is simply lowered in from the top and suspended by its own cable, using the mounting kit supplied.

MTAK-1 Mounting Kit (Supplied)

The mounting bracket is a standard accessory supplied with all multi-sensor probes (not standard with 0.2/1-xx single sensor probe).

The MTAK-1 mounting bracket has an integral cleaning device. All metal components are stainless steel.

MTAK-2 Mounting Kit (Optional extra)

This extended bracket provides up to 300mm extra wall clearance. This bracket is not included as standard with probes.

Ordering Examples and Information

Model Code	Probe Length (m/in)	Sensor Separation (mm/in)	Cable Length* (m/ft)	Number of Sensors
0.2/1-10	0.2/8	N/A	10/33	1
0.5/3-10	0.5/16	150/6	10/33	3
1.0/10-10	1/40	100/4	10/33	10
1.5/10-30	1.5/60	150/6	30/100	10
2.0/10-30	2/80	200/8	30/100	10
2.5/10-30	2.5/96	250/10	30/100	10
3.0/10-30	3/115	300/12	30/100	10
6.0/10-30	6/224	600/24	30/100	10
9.0/10-30	9/368	900/40	30/100	10

*Cable Length 10m/33ft or 30m/100ft

Probe Length (meters)	Sensor Points	Cable Length (meters)
2.5	10	10

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0.5/3-10	0.5/16	150/6	10/33	3
1.0/10-10	1/40	100/4	10/33	10
1.5/10-30	1.5/60	150/6	30/100	10
2.0/10-30	2/80	200/8	30/100	10
2.5/10-30	2.5/96	250/10	30/100	10
3.0/10-30	3/115	300/12	30/100	10
6.0/10-30	6/224	600/24	30/100	10
9.0/10-30	9/368	900/40	30/100	10

*Cable Length 10m/33ft or 30m/100ft

Probe Length (meters)	Sensor Points	Cable Length (meters)
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MultiTrode Probe Immersion Table

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WATER • WASTEWATER • PUMP STATION • TECHNOLOGY

PVC and AVESTA 254-SMO stainless steel comprise the major, exposed surfaces of the MultiTrode probe, and have been operated and tested in the following chemicals.

ACETIC ACID	50% Aqueous
ADIPIC ACID	Saturated Aqueous
ALUMINIUM SULPHATE	27%
AMMONIUM CARBONATE	50% Aqueous
AMMONIUM HYDROXIDE	All Concentrations
AMMONIUM PHOSPHATE	All Concentrations
AMMONIUM SULPHATE	All Concentrations
AMMONIUM SULPHIDE	All Concentrations
AMYL ALCOHOL	
ANILINE HYDROCHLORIDE	All Concentrations
BARIUM HYDROXIDE	All Concentrations
BEER	
BORAX	All Aqueous
BORIC ACID	All Aqueous
CALCIUM NITRATE	50% Aqueous
CHLORIC ACID	10%
CHROMIC ACID	5%
FORMIC ACID	Up to 50% Aqueous
GELATINE	All Concentrations
GLUCOSE	All Concentrations
GLYCERINE	All Concentrations
HYDROBROMIC ACID	50% Aqueous
HYDROCYANIC ACID	100%
HYDROFLUORIC ACID	1%
HYDROGEN PEROXIDE	30% Aqueous
HYDROGEN SULPHIDE	Moist Gas or Saturated Aqueous solution
LACTIC ACID	18% Aqueous
LEAD ACETATE	All Concentrations
MERCURY	100%
MILK	Sour
NITRIC ACID	Up to 40% Aqueous

OXALIC ACID	5%
PHOSPHORIC ACID	Up to 30% Aqueous
POTASSIUM BICHROMATE	25%
POTASSIUM CHLORATE	36%
POTASSIUM CHROMATE	All Concentrations
POTASSIUM CYANIDE	All Concentrations
POTASSIUM PERMANGANATE	5-10%
POTASSIUM PERSULPHATE	Saturated
POTASSIUM SULPHATE	All Concentrations
SODIUM ACETATE	All Concentrations
SODIUM BICARBONATE	All Concentrations
SODIUM BISULPHATE	5%
SODIUM BISULPHITE	10%
SODIUM CHLORATE	30%
SODIUM FLUORIDE	5-10%
SODIUM NITRATE	All Concentrations
SODIUM PHOSPHATE	All Concentrations
SODIUM SILICATE	All Aqueous
SODIUM SULPHATE	All Concentrations
SODIUM SULPHIDE	5%
SODIUM SULPHITE	50%
SODIUM THIOSULPHATE	16-25%
SULPHUR DIOXIDE	Technically Pure Anhydrous
SULPHURIC ACID	98%
SULPHUROUS ACID	Saturated Aqueous
TANNIC ACID	All Aqueous
TARTARIC ACID	All Aqueous
TURPENTINE OIL	Technically Pure
VINEGAR	4-5%
YEAST	All Aqueous

Unless stated otherwise, all aqueous solutions are 100%.

Note: MultiTrode probes can be used in many other aggressive applications and the list above is by no means complete.

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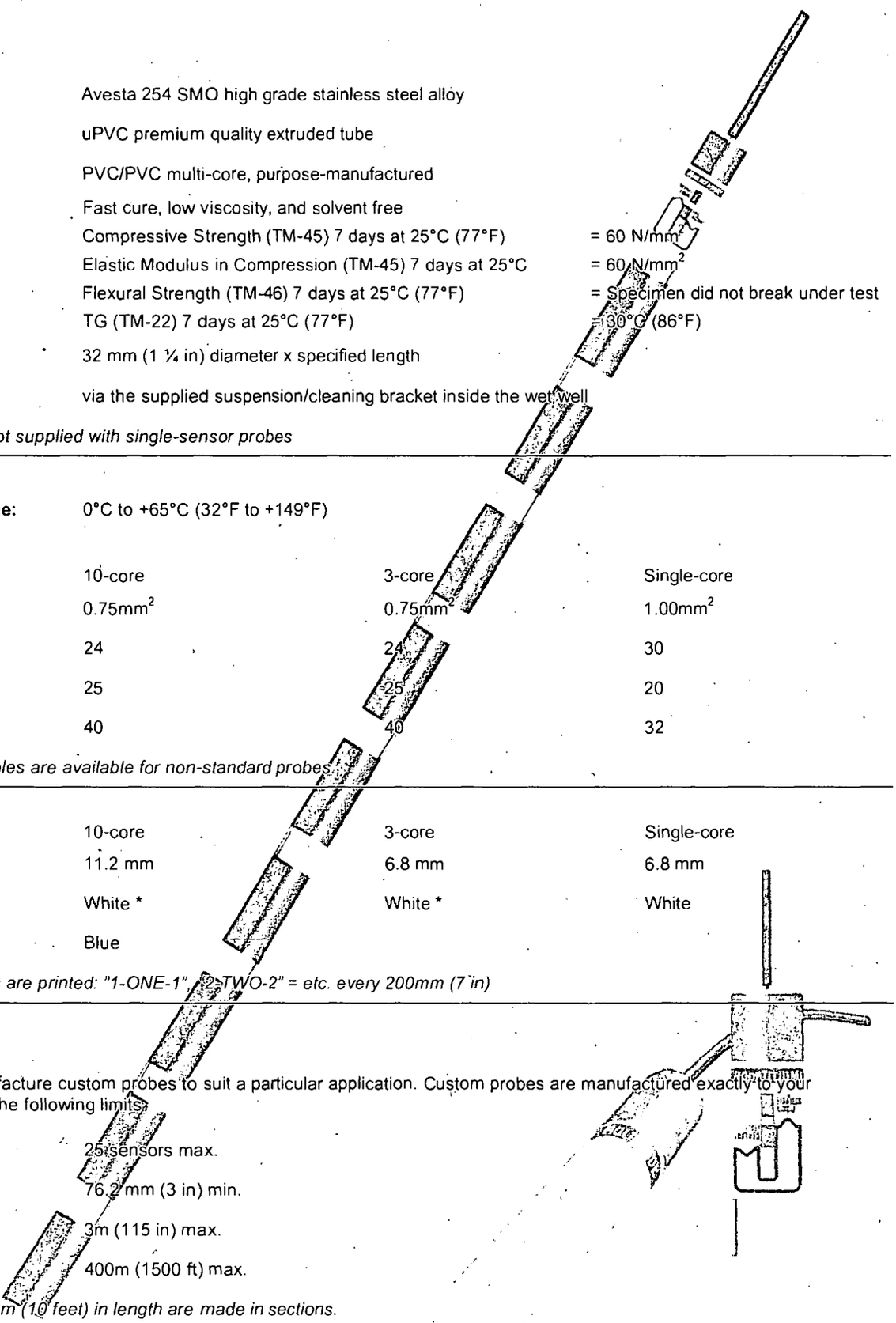
MultiTrode Probe Specifications



Materials:

Sensors:	Avesta 254 SMO high grade stainless steel alloy	
Casing:	uPVC premium quality extruded tube	
Cable:	PVC/PVC multi-core, purpose-manufactured	
Resin:	Fast cure, low viscosity, and solvent free	
	Compressive Strength (TM-45) 7 days at 25°C (77°F)	= 60 N/mm^2
	Elastic Modulus in Compression (TM-45) 7 days at 25°C	= 60 N/mm^2
	Flexural Strength (TM-46) 7 days at 25°C (77°F)	= Specimen did not break under test
	TG (TM-22) 7 days at 25°C (77°F)	= 30°C (86°F)
Dimensions:	32 mm (1 ¼ in) diameter x specified length	
Mounting:	via the supplied suspension/cleaning bracket inside the wet well	

** Mounting bracket not supplied with single-sensor probes*

Environmental Range: 0°C to +65°C (32°F to +149°F)

Cable:	10-core	3-core	Single-core
Conductor Size	0.75mm^2	0.75mm^2	1.00mm^2
Strands/Conductor	24	24	30
Ohms/km	25	25	20
Ohms/mile	40	40	32

** Other multi-core cables are available for non-standard probes*

Oversheath:	10-core	3-core	Single-core
Nominal diameter	11.2 mm	6.8 mm	6.8 mm
Core Colours:	White *	White *	White
Oversheath:	Blue		

** All multi-core cables are printed: "1-ONE-1", "2-TWO-2" = etc. every 200mm (7 in)*

Custom Probes:

MultiTrode can manufacture custom probes to suit a particular application. Custom probes are manufactured exactly to your requirements, within the following limits:

No. of Sensors	25 sensors max.
Sensor spacing	76.2 mm (3 in) min.
Section length*	3m (115 in) max.
Cable length	400m (1500 ft) max.

** Note: Probes over 3m (10 feet) in length are made in sections.*

Electrical Data

			CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
Rated Insulation Voltage U_i												
IEC, AS, BS, SEV, VDE 0660		[V]	690V									
UL, CSA		[V]	600V									
Rated Impulse Voltage U_{imp}		[kV]	8 kV									
Rated Voltage U_e – Main Contacts												
AC 50/60Hz		[V]	115, 200, 208, 230, 240, 380, 400, 415, 460, 500, 575, 690V									
DC		[V]	24, 48, 110, 115, 220, 230, 300, 440V									
Operating Frequency for AC Loads		[Hz]	50...60Hz									
Switching Motor Loads												
Standard IEC Ratings												
AC-2, AC-3, AC-4	230V	[A]	12	15	20	26.5	35	38	44	62	72	85
DOL & Reversing	240V	[A]	12	15	20	26.5	35	38	44	62	72	85
50Hz/60° C	400V	[A]	9	12	16	23	30	37	43	62	72	85
	415V	[A]	9	12	16	23	30	37	43	60	72	85
	500V	[A]	7	10	14	20	25	30	38	55	67	80
	690V	[A]	5	7	9	12	18	21	25	34	42	49
	230V	[kW]	3	4	5.5	7.5	10	11	13	18.5	22	25
	240V	[kW]	3	4	5.5	7.5	10	11	13	18.5	22	25
	400V	[kW]	4	5.5	7.5	11	15	18.5	22	32	40	45
	415V	[kW]	4	5.5	7.5	11	15	20	22	32	40	45
	500V	[kW]	4	5.5	7.5	13	15	20	25	37	45	55
	690V	[kW]	4	5.5	7.5	10	15	18.5	22	32	40	45
UL/CSA/IEC												
DOL & Reversing	115 V	[A]	9.8	9.8	16	24	24	34	34	56	56	80
60Hz/60°C 1∅	230 V	[A]	10	12	17	17	28	28	40	50	68	68
	115 V	[HP]	1/2	1/2	1	2	2	3	3	5	5	7-1/2
	230 V	[HP]	1-1/2	2	3	3	5	5	7-1/2	10	15	15
	200 V	[A]	7.8	11	17.5	17.5	25.3	32.2	32.2	48.3	62.1	78.2
3∅	230 V	[A]	6.8	9.6	15.2	22	28	28	42	54	68	80
	460 V	[A]	7.6	11	14	21	27	34	40	52	65	77
	575 V	[A]	9	11	17	17	27	32	32	52	62	62
	200 V	[HP]	2	3	5	5	7-1/2	10	10	15	20	25
	230 V	[HP]	2	3	5	7-1/2	10	10	15	20	25	30
	460 V	[HP]	5	7-1/2	10	15	20	25	30	40	50	60
	575 V	[HP]	7-1/2	10	15	15	25	30	30	50	60	60
Maximum Operating Rate	AC2	[ops/hr]	450	450	450	400	400	400	400	300	250	200
(at max. amps)	AC3	[ops/hr]	700	700	700	600	600	600	600	500	500	500
	AC4	[ops/hr]	200	150	120	80	80	70	70	70	60	50

Electrical Data

				CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
Switching Motor Loads *(continued)*													
AC4 (200,000 Op. Cycles) 50Hz		230V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		240V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		400V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		415V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		500V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		690V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		230V	[kW]	0.75	1.5	2.2	2.2	3	3.7	4	6.3	7.5	11
		240V	[kW]	0.75	1.5	2.2	2.2	3	4	4	7.5	7.5	11
		400V	[kW]	1.8	3	4	4	5.5	6.3	7.5	13	15	20
		415V	[kW]	1.8	3	4	4	5.5	6.3	7.5	13	17	20
		500V	[kW]	2.2	3.7	5.5	5.5	7.5	7.5	10	15	20	25
		690V	[kW]	3	5.5	7.5	7.5	10	11	15	22	25	32
60Hz	1∅	115 V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		230 V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		115 V	[HP]	1/8	1/4	1/3	1/2	1/2	3/4	1	2	2	3
		230 V	[HP]	1/3	1/2	1	1-1/2	2	2	2	3	5	5
		200 V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
	3∅	230 V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		460 V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		575 V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		200 V	[HP]	3/4	1	2	2	3	3	3	7-1/2	7-1/2	10
		230 V	[HP]	1	1-1/2	2	3	3	3	5	7-1/2	10	10
		460 V	[HP]	2	3	5	5	7-1/2	10	10	15	20	25
		575 V	[HP]	3	5	7-1/2	7-1/2	10	10	10	20	25	30
Max. Operating Rate			[ops/hour]	250	250	220	200	200	200	200	120	120	120
Wye-Delta (Star Delta) 50 Hz		230V	[kW]	5.5	7.5	10	13	17	20	22	32	37	45
		240V	[kW]	5.5	7.5	10	13	18.5	20	22	32	40	50
		400V	[kW]	7.5	10	13	20	25	32	40	55	63	80
		415V	[kW]	7.5	11	15	22	25	37	40	55	63	80
		500V	[kW]	7.5	11	15	22	25	32	45	63	80	90
		690V	[kW]	7.5	10	13	18.5	25	32	40	55	63	80
60 Hz		200V	[HP]	5	5	7-1/2	7-1/2	10	15	20	30	40	50
		230V	[HP]	5	7-1/2	10	10	15	20	25	40	50	60
		460V	[HP]	10	15	20	25	30	40	50	75	100	125
		575V	[HP]	10	15	20	25	30	40	50	75	100	125
AC Elevator Control Ratings													
UL / CSA		Max FLC	[A]	8.0	11.0	16.0	21.0	27.0	31.0	37.0	43.0	54.0	62.0
500,000 operations		200V	[A]	7.8	11.0	11.0	17.5	25.3	25.3	32.2	32.2	48.3	62.1
		230V	[A]	6.8	9.6	15.2	15.2	22.0	28.0	28.0	42.0	54.0	68.0
		460V	[A]	7.6	11.0	14.0	21.0	27.0	27.0	34.0	40.0	52.0	65.0
		575V	[A]	6.1	9.0	11.0	17.0	22.0	27.0	32.0	41.0	52.0	62.0
		200V	[HP]	2	3	3	5	7-1/2	7-1/2	10	10	15	20
		230V	[HP]	2	3	5	5	7-1/2	10	10	15	20	25
		460V	[HP]	5	7-1/2	10	15	20	20	25	30	40	50
		575V	[HP]	5	7-1/2	10	15	20	25	30	40	50	60

Electrical Data

			CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
AC-1 Load, 3Ø Switching	I_e	[A]	32	32	32	32	65	65	85	100	100	100
Ambient Temperature 40°C	230V	[kW]	13	13	13	13	26	26	34	40	40	40
	240V	[kW]	13	13	13	13	27	27	35	42	42	42
	400V	[kW]	22	22	22	22	45	45	59	69	69	69
	415V	[kW]	23	23	23	23	46	47	61	72	72	72
	500V	[kW]	28	28	28	28	56	56	74	87	87	87
	690V	[kW]	38	38	38	38	77	78	102	120	120	120
	I_e	[A]	32	32	32	32	65	65	80	100	100	100
Ambient Temperature 60°C	230V	[kW]	13	13	13	13	26	26	32	40	40	40
	240V	[kW]	13	13	13	13	27	27	33	42	42	42
	400V	[kW]	22	22	22	22	45	45	55	69	69	69
	415V	[kW]	23	23	23	23	46	46	57	72	72	72
	500V	[kW]	28	28	28	28	56	56	69	87	87	87
	690V	[kW]	38	38	38	38	77	77	95	120	120	120
Max Operating Rate		[ops/hour]	1,000	1,000	1,000	1,000	1,000	1,000	300	600	600	600
Continuous Current (UL/CSA)												
General Purpose Rating (40°C)	Open	[A]	25	25	30	30	45	55	60	90	90	100
	Enclosed	[A]	25	25	30	30	45	55	60	90	90	100
Max. Operating Rate		[ops/hour]	1,400	1,400	1,200	1,200	1,200	1,000	1,000	700	700	600
Lighting Loads ❶												
Elec Dischrg Lamps-AC-5a,	Open	[A]	22.5	25	28	29	40.5	45	77	81	85	90
single compensated	Enclosed	[A]	22.5	25	28	29	37	41	57	77	81	90
Max. capacitance at prospective	10kA	[µF]	1,000	1,000	1,000	1,000	2,700	2,700	3,200	4,000	4,000	4,700
short circuit current available	20kA	[µF]	500	500	500	500	1,350	1,350	1,600	2,000	2,000	2,350
at the contactor	50kA	[µF]	200	200	200	200	540	540	640	800	800	940
Incandescent Lamps - AC-5b,												
Electrical endurance – 100,000 operations		[A]	12	16	18	22	30	37	43	60	70	76
Switching power transformers AC-6a												
50Hz												
Inrush / Rated transformer current	= n											
		[A]	10.9	10.9	10.9	10.9	20	20	23	40.8	40.8	40.8
n = 30	230 VAC	[kVA]	4.3	4.3	4.3	4.3	8	8	9.2	16	16	16
	240 VAC	[kVA]	4.5	4.5	4.5	4.5	8.3	8.3	10	17	17	17
	400 VAC	[kVA]	7.5	7.5	7.5	7.5	14	14	16	28	28	28
	415 VAC	[kVA]	7.8	7.8	7.8	7.8	14	14	16	29	29	29
	500 VAC	[kVA]	9.4	9.4	9.4	9.4	17	17	20	35	35	35
	690 VAC	[kVA]	13	13	13	13	24	24	27	49	49	49
		[A]	16.3	16.3	16.3	16.3	30	30	34.5	61.3	61.3	61.3
n = 20	230 VAC	[kVA]	6.5	6.5	6.5	6.5	12	12	13.7	24.4	24.4	24.4
	240 VAC	[kVA]	6.8	6.8	6.8	6.8	12.5	12.5	14.3	25.5	25.5	25.5
	400 VAC	[kVA]	11.3	11.3	11.3	11.3	20.8	20.8	23.9	42.5	42.5	42.5
	415 VAC	[kVA]	11.7	11.7	11.7	11.7	21.6	21.6	24.8	44.1	44.1	44.1
	500 VAC	[kVA]	14.1	14.1	14.1	14.1	26	26	29.9	53.1	53.1	53.1
	690 VAC	[kVA]	19.5	19.5	19.5	19.5	35.9	35.9	41.2	73.3	73.3	73.3
		[A]	22	22	22	22	40	40	46	82	82	82
n = 15	230 VAC	[kVA]	2.3	2.3	2.3	2.3	4.3	4.3	5.0	8.8	8.8	8.8
	240 VAC	[kVA]	2.4	2.4	2.4	2.4	4.5	4.5	5.2	9.2	9.2	9.2
	400 VAC	[kVA]	4.1	4.1	4.1	4.1	7.5	7.5	8.6	15.3	15.3	15.3
	415 VAC	[kVA]	4.2	4.2	4.2	4.2	7.8	7.8	8.9	15.9	15.9	15.9
	500 VAC	[kVA]	5.1	5.1	5.1	5.1	9.4	9.4	10.8	19.1	19.1	19.1
	690 VAC	[kVA]	7.0	7.0	7.0	7.0	12.9	12.9	14.9	26.4	26.4	26.4

❶ CA7 ratings for lighting loads are provided for technical reference. For cUL rated and labelled devices, see CAL7 contactors listed in this section.

Electrical Data

			CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
Switching power transformers AC-6a 60Hz												
Inrush / Rated transformer current = n												
		[A]	10.9	10.9	10.9	10.9	20	20	23	40.8	40.8	40.8
n = 30	200 VAC	[kVA]	3.8	3.8	3.8	3.8	6.9	6.9	8.0	14.1	14.1	14.1
	208 VAC	[kVA]	3.9	3.9	3.9	3.9	7.2	7.2	8.3	14.7	14.7	14.7
	240 VAC	[kVA]	4.5	4.5	4.5	4.5	8.3	8.3	9.6	17	17	17
	480 VAC	[kVA]	9.1	9.1	9.1	9.1	16.6	16.6	19.1	33.9	33.9	33.9
	600 VAC	[kVA]	11.3	11.3	11.3	11.3	20.8	20.8	23.9	42.4	42.4	42.4
	660 VAC	[kVA]	12.5	12.5	12.5	12.5	22.9	22.9	26.3	46.6	46.6	46.6
		[A]	16.3	16.3	16.3	16.3	30	30	34.5	61.3	61.3	61.3
n = 20	200 VAC	[kVA]	5.6	5.6	5.6	5.6	10.4	10.4	12	21.2	21.2	21.2
	208 VAC	[kVA]	5.9	5.9	5.9	5.9	10.8	10.8	12.4	22.1	22.1	22.1
	240 VAC	[kVA]	6.8	6.8	6.8	6.8	12.5	12.5	14.3	25.5	25.5	25.5
	480 VAC	[kVA]	13.6	13.6	13.6	13.6	24.9	24.9	28.7	51	51	51
	600 VAC	[kVA]	16.9	16.9	16.9	16.9	31.2	31.2	35.9	63.7	63.7	63.7
	660 VAC	[kVA]	18.6	18.6	18.6	18.6	34.3	34.3	39.4	70.1	70.1	70.1
		[A]	22	22	22	22	40	40	46	82	82	82
n = 15	200 VAC	[kVA]	7.5	7.5	7.5	7.5	13.9	13.9	15.9	28.4	28.4	28.4
	208 VAC	[kVA]	7.8	7.8	7.8	7.8	14.4	14.4	16.6	29.5	29.5	29.5
	240 VAC	[kVA]	9	9	9	9	16.6	16.6	19.1	34.1	34.1	34.1
	480 VAC	[kVA]	18.1	18.1	18.1	18.1	33.3	33.3	38.2	68.2	68.2	68.2
	600 VAC	[kVA]	22.6	22.6	22.6	22.6	41.6	41.6	47.8	85.2	85.2	85.2
	660 VAC	[kVA]	24.9	24.9	24.9	24.9	45.7	45.7	52.6	93.7	93.7	93.7
DC-1 Switching - 60°C												
	24VDC	[A]	25	25	32	32	45	45	50	70	80	80
	48VDC	[A]	20	20	20	20	25	25	30	40	40	40
1 Pole	60VDC	[A]	20	20	20	20	25	25	30	40	40	40
	110VDC	[A]	6	6	6	6	8	8	9	11	11	11
	220VDC	[A]	1.5	1.5	1.5	1.5	1.5	1.5	1.5	2	2	2
	440VDC	[A]	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5
	24VDC	[A]	25	25	32	32	45	45	50	70	80	80
	48VDC	[A]	25	25	32	32	45	45	50	70	80	80
2 Poles in Series	60VDC	[A]	25	25	32	32	45	45	50	70	80	80
	110VDC	[A]	25	25	32	32	45	45	50	70	80	80
	220VDC	[A]	8	8	8	10	10	10	10	15	15	15
	440VDC	[A]	1	1	1	1	1	1	1	1.5	1.5	1.5
	24VDC	[A]	25	25	32	32	45	45	63	90	90	100
	48VDC	[A]	25	25	32	32	45	45	63	90	90	100
3 Poles in Series	60VDC	[A]	25	25	32	32	45	45	63	90	90	100
	110VDC	[A]	25	25	32	32	45	45	63	90	90	100
	220VDC	[A]	25	25	32	32	45	45	50	70	80	80
	440VDC	[A]	3	3	3	3	3.5	3.5	4	5	5	5
DC-2, 3, 5 Switching - 60°C												
	24VDC	[A]	25	25	32	32	45	45	63	90	90	100
	48VDC	[A]	25	25	32	32	45	45	50	70	70	80
3 Poles in Series	60VDC	[A]	25	25	32	32	45	45	50	70	70	80
	110VDC	[A]	20	20	25	25	30	30	35	70	70	80
	220VDC	[A]	6	6	6	10	15	15	20	25	25	30
	440VDC	[A]	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6

Electrical Data

			CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
Capacitor Ratings ❶												
Capacitor Switching AC-6b – 50Hz												
Single Capacitor - 40°C	230 V	[kVar]	8	8	8.5	9	14	14	24	28	28	28
	240 V	[kVar]	8	8	8.5	9	14	14	24	29	29	29
	400 V	[kVar]	8	8	10	12.5	20	24	35	48	48	48
	415 V	[kVar]	8	8	10	12.5	20	25	35	50	50	50
	500 V	[kVar]	8	8	10	12.5	20	25	35	50	55	60
	690 V	[kVar]	8	8	10	12.5	20	25	35	50	55	60
Single Capacitor - 60°C	230 V	[kVar]	8	8	8.5	9	12.5	12.5	18	28	28	28
	240 V	[kVar]	8	8	8.5	9	12.5	12.5	18	29	29	29
	400 V	[kVar]	8	8	10	12.5	20	21.5	30	42	48	48
	415 V	[kVar]	8	8	10	12.5	20	22	30	42	50	50
	500 V	[kVar]	8	8	10	12.5	20	25	30	42	50	55
	690 V	[kVar]	8	8	10	12.5	20	25	30	42	50	55
Capacitor Bank - 40°C ❷	230 V	[kVar]	5	5	8	9	12.5	14	20	28	28	28
	240 V	[kVar]	5	5	8	9	12.5	14	20	29	29	29
	400 V	[kVar]	5	5	8	10	15	20	25	40	48	48
	415 V	[kVar]	5	5	8	10	15	20	25	40	50	50
	500 V	[kVar]	5	5	8	10	15	20	25	40	50	50
	690 V	[kVar]	5	5	8	10	15	20	25	40	50	50
Capacitor Bank - 60°C ❷	230 V	[kVar]	5	5	8	9	12.5	12.5	18	28	28	28
	240 V	[kVar]	5	5	8	9	12.5	12.5	18	29	29	29
	400 V	[kVar]	5	5	8	10	15	20	25	40	48	48
	415 V	[kVar]	5	5	8	10	15	20	25	40	50	50
	500 V	[kVar]	5	5	8	10	15	20	25	40	50	50
	690 V	[kVar]	5	5	8	10	15	20	25	40	50	50
Capacitor Switching - 60Hz												
Single Capacitor - 40°C	200 V	[kVar]	5	5	8	9	12.5	14	20	28	28	28
	230 V	[kVar]	5	5	8	9	12.5	14	20	29	29	29
	460 V	[kVar]	5	5	8	10	15	20	25	40	50	50
	600 V	[kVar]	5	5	8	10	15	20	25	40	50	60
Capacitor Bank - 40°C ❷	200 V	[kVar]	5	5	8	10	12.5	12.5	18	28	28	28
	230 V	[kVar]	5	5	8	10	12.5	12.5	18	29	29	29
	460 V	[kVar]	5	5	8	10	15	20	25	40	50	50
	600 V	[kVar]	5	5	8	10	15	20	25	40	50	50

❶ CA7 capacitor ratings are provided for technical reference. For cUL rated and labeled devices, see CAQ7 contactors listed in this section.
❷ CA7-9...CA7-30 = L min. 30 µH; CA7-37...CA7-85 = L min. 6 µH

Electrical Data

			CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
Resistance and Watt Loss I_e AC3												
Resistance per power pole		[mΩ]	2.7	2.7	2.7	2.0	2.0	2.0	1.5	0.9	0.9	0.9
Watt Loss - 3 power poles		[W]	0.66	1.2	2.1	3.2	5.4	8.2	8.3	9.7	14.0	19.5
Coil and 3 power poles	AC	[W]	3.3	3.8	4.7	6.2	8.4	11.2	11.5	11	13.8	17.5
	DC	[W]	6.7	7.2	8.1	12.4	14.6	17.4	18.4	11	13.8	17.5
Coil Only	AC	[W]	2.6	2.6	2.6	3.0	3.0	3.0	3.2	4.5	4.5	4.5
	DC	[W]	6.0	6.0	6.0	9.2	9.2	9.2	10.0	4.9	4.9	4.9
Short-Circuit Coordination												
Contactors, or Contactors with Solid-State and Bimetallic Overload Relays												
DIN Fuses - gG, gL												
Available Fault Current		[A]					100,000					
Type "1" (690V)		[A]	50	50	50	63	100	125	160	200	250	250
Type "2" (690V)		[A]	25	35	35	40	80	80	100	160	160	160
BS88 Fuses												
Available Fault Current		[A]					80,000					
Type "1" (690V)		[A]	25	32	35	50	63	80	100	100	125	160
Type "2" (690V)		[A]	25	32	35	50	63	80	100	100	125	160
UL Class K1, RK1, K5 and RK5 Fuses												
Available Fault Current		[A]	5000	5000	5000	5000	5000	5000	5000	5000	10000	10000
Max. Fuse (600V)		[A]	35	40	70	90	110	125	150	200	250	300
UL Class CC Fuses												
CSA HRCI-MISC Fuses												
Available Fault Current		[A]					100,000					
Type "2" (600V)		[A]	15	20	20	30	–	–	–	–	–	–
UL Class J Fuses												
UL Class K1, RK1 Fuses												
CSA HRCI- J Fuses												
Available Fault Current		[A]					100,000					
Type "2" (600V)		[A]	15	20	20	30	40	50	50	80	100	100
Short Time Current Withstand Ratings												
I_{cw} 60° C	1 s	[A]	210	210	290	380	480	525	650	1,110	1,150	1,250
	4 s	[A]	140	150	220	280	360	390	480	820	860	910
	10 s	[A]	100	120	175	220	290	310	375	640	680	710
	15 s	[A]	90	100	150	200	250	270	325	560	600	620
	60 s	[A]	60	60	90	125	170	175	200	350	370	380
	240 s	[A]	40	40	50	60	100	100	120	190	190	200
	900 s	[A]	30	30	38	38	524	60	75	108	108	120
Off Time Between Operations		[Min.]	20	20	20	20	20	20	20	20	20	20

❶ When used as a Branch Circuit Protection device, NEC 430-152 defines the maximum rating of an inverse-time circuit breaker to be sized at 250% of the motor nameplate FLA for most applications.

Electrical Data

Short Circuit Coordination / AC3

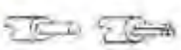
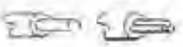
Type 2 Coordination Combinations (contactor, overload and fuses) — Per UL 508 and IEC 947-4-1

Contactor	Overload Relay	Withstand Rating	Maximum Voltage	Max. Amp Rating (UL Class CC or J Fuses)
CA7-9...	CEP7-M/A/B32-0.32...	100kA	600V	1
	CEP7-M/A/B32-1.0...	100kA	600V	2
	CEP7-M/A/B32-2.9...	100kA	600V	6
	CEP7-M/A/B32-5...	100kA	600V	10
	CEP7-M/A/B32-12...	100kA	600V	15
CA7-12...	CEP7-M/A/B32-12...	100kA	600V	20
CA7-16...	CEP7-M/A/B32-32...	100kA	600V	20
CA7-23...	CEP7-M/A/B32-32...	100kA	600V	30
CA7-30...	CEP7-M/A/B37-37...	100kA	600V	40
CA7-37...	CEP7-M/A/B37-37...	100kA	600V	50
CA7-43...	CEP7-M/A/B45-45...	100kA	600V	50
CA7-60...	CEP7-M/A/B85-85...	100kA	600V	80
CA7-72...	CEP7-M/A/B85-85...	100kA	600V	100
CA7-85...	CEP7-M/A/B85-85...	100kA	600V	100

UL Listed Combinations (contactor, overload and circuit breaker) – Per UL 508

Contactor	Overload Relay	Withstand Rating	Maximum Voltage	Max. Amp Rating (UL Listed Circuit Breaker)
CA7-9...12	CEP7-M/A32-2.9...12	5kA	480V	30
	CT7-24-0.16...10			
CA7-12	CT7-24-16			
CA7-16...23	CEP7-M/A32-2.9...32	5kA	480V	50
	CT7-24-0.16...16			
CA7-23	CT7-24-24			
CA7-30...37	CEP7-M/A37-12...37	5kA	600V	125
	CT7-24-16...CT7-45-30			
CA7-37	CT7-45-45			
CA7-43	CEP7-M/A45...45	5kA	600V	125
	CT7-45-30...45			
CA7-60	CEP7-M/A85...85	5kA	600V	250
	CT7-75-30...60			
CA7-72	CEP7-M/A85...85	10kA	600V	250
	CT7-75-30...75			
CA7-85	CEP7-M/A85...85	10kA	600V	250
	CT7-75-30...CT7-100-90			

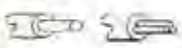
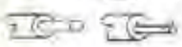
Mechanical Data

			CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
Service Life												
Mechanical	AC	[Mil.]	13	13	13	13	13	13	12	10	10	10
	DC	[Mil.]	13	13	13	13	13	13	13	10	10	10
Shipping Weights												
AC - CA7		[kg]	0.39	0.39	0.39	0.39	0.48	0.49	0.51	1.45	1.45	1.45
		[Lbs]	0.86	0.86	0.86	0.86	1.06	1.08	1.12	3.20	3.20	3.20
AC - CAU7		[kg]	0.85	0.85	0.85	0.85	1.08	1.08	1.16	3.14	3.14	3.14
		[Lbs]	1.89	1.89	1.89	1.89	2.39	2.39	2.54	6.92	6.92	6.92
DC - CA7		[kg]	0.60	0.60	0.60	0.73	0.85	0.85	1.00	1.47	1.47	1.47
		[Lbs]	1.32	1.32	1.32	1.61	1.87	1.87	2.20	3.24	3.24	3.24
DC - CAU7		[kg]	1.27	1.27	1.27	1.53	1.81	1.81	2.13	3.22	3.22	3.22
		[Lbs]	2.81	2.81	2.81	3.39	4.00	4.00	4.70	7.10	7.10	7.10
Terminations - Power												
Description												
			One saddleclamp per pole; cross, slotted or Pozidrive screw				Dual connection; one saddleclamp and one box lug per pole; cross, slotted or Pozidrive screw			Dual connection; two box lugs per pole Allen Head: 4mm, 5/32		
	1 Wire	[mm²]	1...4	1...4	1...4	1...4	2.5...10	2.5...10	2.5...16	2.5...35	2.5...35	2.5...35
	2 Wires	[mm²]	1...4	1...4	1...4	1...4	2.5...10	2.5...10	2.5...10	2.5...25	2.5...25	2.5...25
	1 Wire	[mm²]	1.5...6	1.5...6	1.5...6	1.5...6	2.5...16	2.5...16	2.5...25	2.5...50	2.5...50	2.5...50
	2 Wires	[mm²]	1.5...6	1.5...6	1.5...6	1.5...6	2.5...16	2.5...16	2.5...16	2.5...35	2.5...35	2.5...35
	1 Wire	[AWG]	16...10	16...10	16...10	16...10	14...6	14...6	14...4	14...1	14...1	14...1
	2 Wires	[AWG]	16...10	16...10	16...10	16...10	14...6	14...6	14...4	14...1	14...1	14...1
Torque Requirement		[Nm]	1...2.5	1...2.5	1...2.5	1...2.5	2.5...3.5	2.5...3.5	2.5...3.5	3.5...6	3.5...6	3.5...6
		[Lb-in]	9...22	9...22	9...22	9...22	22...31	22...31	22...31	31...52	31...52	31...52
Terminations - Control												
Description												
			Combination Screw Head: Cross, Slotted, Pozidrive									
Coils	1 or 2	[mm²]	1.5...6									
Wires		[AWG]	16...12									
Control Modules	1 or 2	[mm²]	1.5...6									
Wires		[AWG]	16...12									
Torque Requirement		[Nm]	1...2.5									
		[Lb-in]	9...13									
Degree of Protection - contactor			IP 2LX per IEC 529 and DIN 40 050 (with wires installed)									
Protection Against Accidental Contact			Safe from touch by fingers and back-of-hand per VDE 0106, Part 100									

Environmental and General Specifications

Ambient Temperature	
Storage	-55...+80° C (-67...176° F) – [CR17E Electronic Interface -50...+80° C (-58...175° F)]
Operation	-25...+60° C (-13...140° F)
Conditioned 15% current reduction after AC-1 at >60° C	-25...+70° C (-13...158° F)
Altitude at installed site	2000 meters above sea level per IEC 947-4
Resistance to Corrosion / Humidity	Damp-alternating climate cyclic to IEC 68-2, 56 cycles Dry heat: IEC 68-2, +100° C (212° F), relative humidity <50%, 7 days. Damp tropical: IEC 68-2, +40° C (104°F), relative humidity <95%, 56 days.
Shock Resistance	IEC 68-2: Half sinusoidal shock 11ms, 30g (in all three directions)
Vibration Resistance	IEC 68-2: Static >2g, in normal position no malfunction <5g
Pollution Degree	3
Operating Position	Refer to Dimension Pages
Standards	IEC947-1/4; EN 60947; UL 508; CSA 22.2, No. 14
Approvals	CE, UL, CSA

Lug Kit and Paralleling Link Specifications

			CA7-P-KN23 / KL23	CA7-P-K37	CA7-P-K43	CA7-P-K85	CA7-P-B23	CA7-P-B37
Approvals			UL Listed, CSA Certified, CE					
Conformity to Standards			UL508; CSA 22.2 No.14; IEC 60947-4					
Protection Against Accidental Contact			IP2LX Finger Protection					
Terminations								
Description			Cross, slotted or Pozidrive screw		Allen Head; 5mm, 3/16		Allen Head; 7mm, 15/32	
Wire Size								
	1 Wire	[mm²]	4...16	4..16	6...35	10...70	35...70	35...70
	1 Wire	[mm²]	4...25	4..25	6...50	10...95	35...95	35...95
	1 Wire	[AWG]	10...4	10...4	8...2	8...2/0	0...2/0	0...2/0
Torque Requirement		[Nm]	2...3	2...3	3...6	8...12	6...12	6...12
		[Lb-in]	18...27	18...27	27...54	72...108	54...108	54...108

Coil Data

			CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
Voltage Range												
AC: 50Hz, 60Hz, 50/60 Hz	Pickup	[x U_c]	0.65...1.1									
	Dropout	[x U_c]	0.3...0.6									
DC	Pickup	[x U_c]	0.8...1.1 (9V coils = 0.65...1.3; 24V coils = 0.7...1.25)									
	Dropout	[x U_c]	0.1...0.6									
Coil Consumption												
AC: 50Hz, 60Hz, 50/60 Hz	Pickup	[VA/W]	70/50	70/50	70/50	70/50	80/60	80/80	130/90	200/110	200/110	200/110
	Hold-in	[VA/W]	8/2.6	8/2.6	8/2.6	9/3	9/3	9/3	10/3.2	16/4.5	16/4.5	16/4.5
True DC Coils (CA7C)	Pickup	[W]	6.5	6.5	6.5	9.2	9.2	9.2	10.1	—	—	—
	Hold-in	[W]	6.5	6.5	6.5	9.2	9.2	9.2	10.1	—	—	—
Two Winding DC Coils	Pickup	[W]	120	120	120	200	200	200	200	200	200	200
(CA7Y & CA7D)	Hold-in	[W]	1.1	1.1	1.1	1.2	1.2	1.2	1.3	4.5	4.5	4.5
Operating Times												
AC: 50Hz, 60Hz, 50/60 Hz	Pickup	[ms]	15...30	15...30	15...30	15...30	15...30	15...30	15...30	20...40	20...40	20...40
	Dropout	[ms]	10...60	10...60	10...60	10...60	10...60	10...60	10...60	10...60	10...60	10...60
with RC Suppressor	Dropout	[ms]	10...60	10...60	10...60	10...60	10...60	10...60	10...60	10...60	10...60	10...60
True DC Coils (CA7C)	Pickup	[ms]	40...70	40...70	40...70	40...70	50...80	50...80	50...80	—	—	—
without Suppression	Dropout	[ms]	7...15	7...15	7...15	7...15	7...15	7...15	7...15	—	—	—
with Integrated Suppression	Dropout	[ms]	14...20	14...20	14...20	17...23	17...23	17...23	17...23	—	—	—
with External Suppression	Dropout	[ms]	70...95	70...95	70...95	80...125	80...125	80...125	80...125	—	—	—
Two Winding DC Coils (CA7Y/D)	Pickup	[ms]	17...26	17...26	15...27	15...27	15...27	15...27	15...27	20...40	20...40	20...40
with Internal Suppression	Dropout	[ms]	9...20	9...20	14...24	14...24	14...24	14...24	14...24	20...35	20...35	20...35

Auxiliary Contacts

			Built-in Auxiliary Contacts in Contactor CA7-9...CA7-23								Front Mouted Auxiliary Contacts CA7-PV, CS7-PV, CZE/A7, CV7								Side Mounted Auxiliary Contacts CA-PA, CM7							
Current Switching																										
AC-12 Ith	at 40°C	[A]					25							10									10			
	at 60°C	[A]					20							6									6			
AC-15, switching electromagnetic loads at:		[V]	24	48	120	240	400	500	600	690	24	48	120	240	400	500	600	690	24	48	120	240	400	500	600	690
		[A]	10	10	10	10	6	5	2.5	1	6	6	6	5	3	2.5	1.6	1	3	3	3	3	2	2	1.6	0.75
DC-13, switching DC electromagnets at:		[V]		24	48	110	220	440				24	48	110	220	440				24	48	110	220	440		
		[A]		5	3	1.2	0.6	0.15				5	3	1.2	0.6	0.15				5	3	1.2	0.6	0.15		
Continuous Current Rating per UL/CSA																										
Rated Voltage	AC	[V]					600 max.							600 max.									600 max.			
Continuous Rating	40°C	[A]					10A general purpose Heavy pilot duty (A600)							10A general purpose Heavy pilot duty (A600)									10A general purpose Heavy pilot duty (A600)			
Continuous Rating	DC	[A]					5A, 600 max. Standard pilot duty (P600)							2.5A, 600 max. Standard pilot duty (Q600)									2.5A, 600 max. Standard pilot duty (Q600)			
Short-Circuit Protection - gG Fuse																										
Type 2 Coordination		[A]					20							10									10			
Rated Impulse Voltage U_{imp}		[kV]					8							8									6			
Insulation Voltage (between control and load circuit) per DIN, VDE 0106, Part 101 (NAMUR recommendation)		[V]					380							440									440			
Contact Reliability (per DIN19240 without contamination, normal industrial atmosphere)							17V 10mA							17V 5mA									17V 10mA			
Mechanically Linked Contacts (per IEC 60947-5-1 Annex L (SUVA Third-party certified)							Mutually unrestricted between all NO and NC contacts							Mutually unrestricted between all NO & NC contacts. CZE & CV7 not mechanically linked with contactor main contacts									Mutually unrestricted between all NO and NC contacts			
Terminals																										
Terminal Type																										
Maximum Wire Size per IEC 947-1							2 x A4							2 x A4									2 x A4			
 Flexible with Wire-End Ferrule	1 Conductor	[mm²]					1...4							0.5...2.5									0.5...2.5			
	2 Conductor	[mm²]					1...4							0.75...2.6									0.75...2.6			
 Solid/Stranded-Conductor	1 Conductor	[mm²]					1.5...6							0.5...2.5									0.5...2.5			
	2 Conductor	[mm²]					1.5...6							0.75...2.6									0.75...2.6			
Recommended Tightening Torque		[Nm]					1...2.5							1...1.5									1...1.5			
Max. Wire Size per UL/CSA		[AWG]					16...10							18...14									18...14			
Recommended Tightening Torque		[lb-in]					9...22							9...13									9...13			

Accessories

Latch Attachment Release, CV7-11		
Coil Consumption	[VA/W]	AC 45 /40
	[W]	DC 25W
Contact Signal Duration	[min/max]	0.03...15s
Timing Attachment, CRZE7, CRZA7		
Reset Time		
at min. time setting	[ms]	10
at max. time setting	[ms]	70
Repeat Accuracy		± 10%

Contact Ratings *(Per NEMA/UL A600 & Q600)*

Standard	Circuit Voltage	Make (Amps/VA)	Break (Amps/VA)	Continuous Amps
A600	120AC	60A/7200VA	6A/720VA	10
	240AC	30A/7200VA	3A/720VA	
	480AC	15A/7200VA	1.5A/720VA	
	600AC	12A/7200VA	1.2A/720VA	
Q600	125DC	0.55A/69VA	0.55A/69VA	2.5
	250DC	0.27A/69VA	0.27A/69VA	
	301-600DC	0.1A/69VA	0.1A/69VA	

Determining Contact Life

To determine the contactor's estimated electrical life, follow these guidelines:

1. Identify the appropriate Utilization Category from Table A.
2. On the following pages, choose the graph for the Utilization Category selected.
3. Locate the Rated Operational Current (I_e) along the bottom of the chart and follow the graph lines up to the intersection of the appropriate contactor's life-load curve.
4. Read the estimated contact life along the vertical axis.

Table A – IEC Special Utilization Categories, AC Ratings ❶

	Category	Typical Applications	Rated Current	Conditions for testing electrical life						Ops.	Conditions for testing making and breaking capacity						Ops.
				Make			Break				Make			Break			
				I/Ie	*U/Ue*	cos	*Ic/Ie*	*Ur/Ue*	cos		*I/Ie*	*U/Ue*	cos	*Ic/Ie*	*Ur/Ue*	cos	
CONTACTORS	AC-1	Non-inductive or slightly inductive loads, resistance furnaces	All values	1	1	0.95	1	1	0.95	6000	1.5	1.05	0.8	1.5	1.05	0.8	50
	AC-2	Slip-ring motors: Starting, plugging	All values	2	1.05	0.65	2	1.05	0.65	6000	4	1.05	0.65	4	1.05	0.65	50
	AC-3	Squirrel-cage motors: Starting, switching off motors during running	*Ie* ≤ 17Amp 17Amp < *Ie* ≤ 100Amp *Ie* > 100Amp	6 6 6	1 1 1	0.65 0.35 0.35	1 1 1	0.17 0.17 0.17	0.65 0.35 0.35	6000	10 10 8 Ã	1.1 1.1 1.1	0.65 0.35 0.35	8 8 6Ã	1.1 1.1 1.1	0.65 0.35 0.35	50
	AC-4	Squirrel-cage motors: Starting, plugging, inching ❺	*Ie* ≤ 17Amp 17Amp < *Ie* ≤ 100Amp *Ie* > 100Amp	6 6 6	1 1 1	0.65 0.35 0.35	6 6 6	1 1 1	0.65 0.35 0.35	6000	12 12 10 Õ	1.1 1.1 1.1	0.65 0.35 0.35	10 10 8 Ã	1.1 1.1 1.1	0.65 0.35 0.35	50
	AC-5a	Switching of electric discharge lamp control		2	1.05	0.45	2	1.05	0.45	6000	3	1.05	0.45	3	1.05	0.45	50
	AC-5b	Switching of incandescent lamps		1	1.05		1	1.05		6000	1.5	1.05		1.5	1.05		50
	AC-6a	Switching of transformers									Rating derived from AC-3 rating (x 0.45)						
	AC-6b	Switching of capacity banks									Depends on circuit conditions of application						
	AC-12	Control of resistive loads and solid state loads with isolation by opto couplers	All values	1	1	0.9	1	1	0.9	6050							
CONTROL DEVICES	AC-13	Control of solid state loads with transformer isolation		2	1	0.65	1	1	0.65	6050	10	1.1	0.65	1.1	1.1	0.65	10
	AC-14	Control of small electromagnetic loads	≤ 72 VA	6	1	0.3	1	1	0.3	6050	6	1.1	0.7	6	1.1	0.7	10
	AC-15	Control of electromagnetic loads	≥ 72 VA	10	1	0.3	1	1	0.3	6050	10	1.1	0.3	10	1.1	0.3	10
	AC-20	Connecting and disconnecting under no load conditions		No testing required													
SWITCHES	AC-21	Switching of resistive loads, including moderate overloads	All values	1	1	0.95	1	1	0.95	10000	1.5	1.05	0.95	1.5	1.05	0.95	5
	AC-22	Switching of mixed resistive & inductive loads, including moderate overloads	All values	1	1	0.8	1	1	0.8	10000	3	1.05	0.65	3	1.05	0.65	5
	AC-23	Switching of motor loads or other highly inductive loads	All values	1	1	0.65	1	1	0.65	10000	10	1.05	0.45	8	1.05	0.45	5

Legend

- *Ue* Rated operational voltage
- *U* Voltage before make
- *Ur* Recovery voltage
- *Ie* Rated operational current
- *I* Making current
- *Ic* Breaking current
- L Inductance of test circuit
- R Resistance of test circuit

❶ Utilization categories and test conditions for AC & DC. For contactors according to IEC 158-1, starters according to IEC 292-1 ... 4 and control switches according to IEC 337-1 and IEC 337-1A.
❷ With a minimum value of 1000A for *I* or *Ic*.
❸ With a minimum value of 800A for *Ic*.
❹ With a minimum value of 1200A for *I*.
❺ Plugging is understood as stopping or reversing the motor rapidly by reversing the motor primary connections while the motor is running. Inching [or jogging] is understood as energizing a motor once or repeatedly for short periods to obtain small movements of the driven mechanism.

Determining Contact Life

To determine the contactor's estimated electrical life, follow these guidelines:

1. Identify the appropriate Utilization Category from Table A.
2. On the following pages, choose the graph for the Utilization Category selected.
3. Locate the Rated Operational Current (I_e) along the bottom of the chart and follow the graph lines up to the intersection of the appropriate contactor's life-load curve.
4. Read the estimated contact life along the vertical axis.

Table A – IEC Special Utilization Categories, DC Ratings ❶

Category	Typical Applications	Rated Current	Conditions for testing electrical life						Ops.	Conditions for testing making and breaking capacity						Ops.
			Make			Break				Make			Break			
			I/Ie	*U/Ue*	cos	*Ic/Ie*	*Ur/Ue*	cos		*I/Ie*	*U/Ue*	cos	*Ic/Ie*	*Ur/Ue*	cos	
DC-1	Non-inductive or slightly inductive loads, resistance furnaces	All values	1	1	1	1	1	1		1.5 ❷	1.1 ❷	1 ❷	1.5 ❷	1.1 ❷	1 ❷	
DC-2	Shunt-motors: Starting, switching off motors during running	All values	2.5	1	2	1	0.1	7.5		4	1.1	2.5	4	1.1	2.5	
DC-3	Shunt-motors: Starting, plugging, inching	All values	2.5	1	2	2.5	1	2		4	1.1	2.5	4	1.1	2.5	
DC-4	Series-motors: Starting, switching off motors during running	All values	2.5	1	7.5	1	0.3	10		4	1.1	15	4	1.1	15	
DC-5	Series-motors: Starting, plugging, inching	All values	2.5	1	7.5	2.5	1	7.5		4	1.1	15	4	1.1	15	
DC-15	Electromagnets for contactors, valves, solenoid actuators	All values	1	1	6 x P ❸	1	1	6 x P ❸		1.1	1.1	6 x P ❸	1.1	1.1	6 x P ❸	

Legend

- *Ue* Rated operational voltage
- *U* Voltage before make
- *Ur* Recovery voltage
- *Ie* Rated operational current
- *I* Making current
- *Ic* Breaking current
- L Inductance of test circuit
- R Resistance of test circuit

❶ Utilization categories and test conditions for AC & DC. For contactors according to IEC 158-1, starters according to IEC 292-1 ... 4 and control switches according to IEC 337-1 and IEC 337-1A.

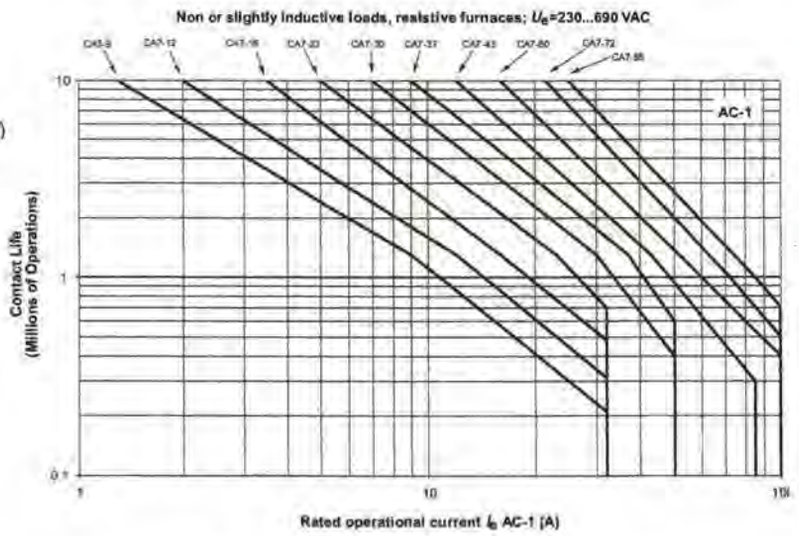
❷ Only according to VDE.

❸ $P = Ue \times Ie$ rated power [W]. The value "6 x P" has been derived from an empiric relationship which covers most magnetic loads for DC up to an upper limit of P = 50W.

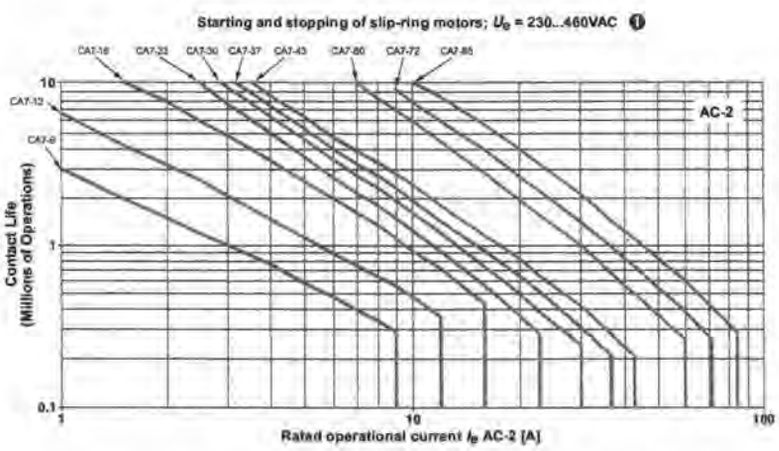
Life-Load Curves

- Locate the Rated Operational Current (I_e) along the bottom of the chart and follow the graph lines up to the intersection of the appropriate contactor's life-load curve.
- Read the estimated contact life along the vertical axis.

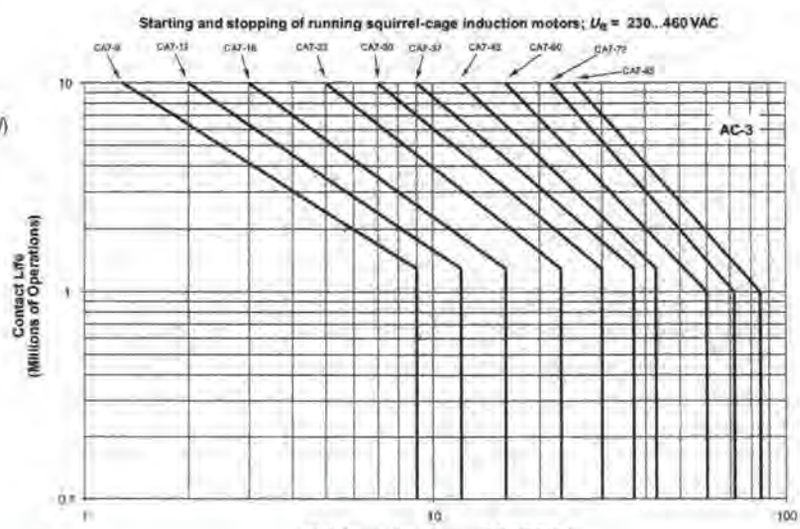
AC-1
(to 690V)



AC-2
(to 460V)



AC-3
(to 460V)



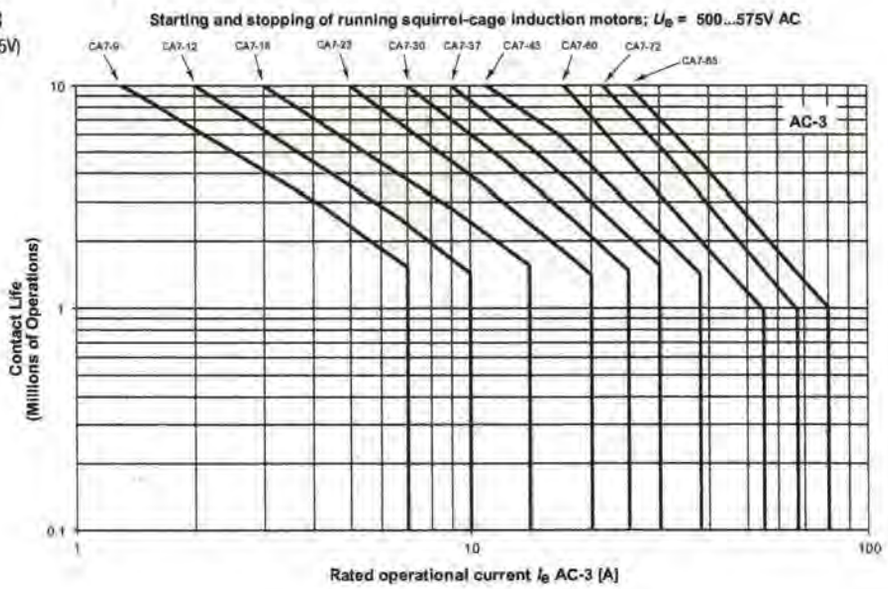
NOTE: The life-load curves shown here are based on Sprecher+Schuh tests according to the requirements defined in IEC 947-4-1. Since contact life in any given application is dependent on environmental conditions and duty cycle, actual application contact life may vary from that indicated by the curves shown here.

❶ 575V applications use 90% of curve value.

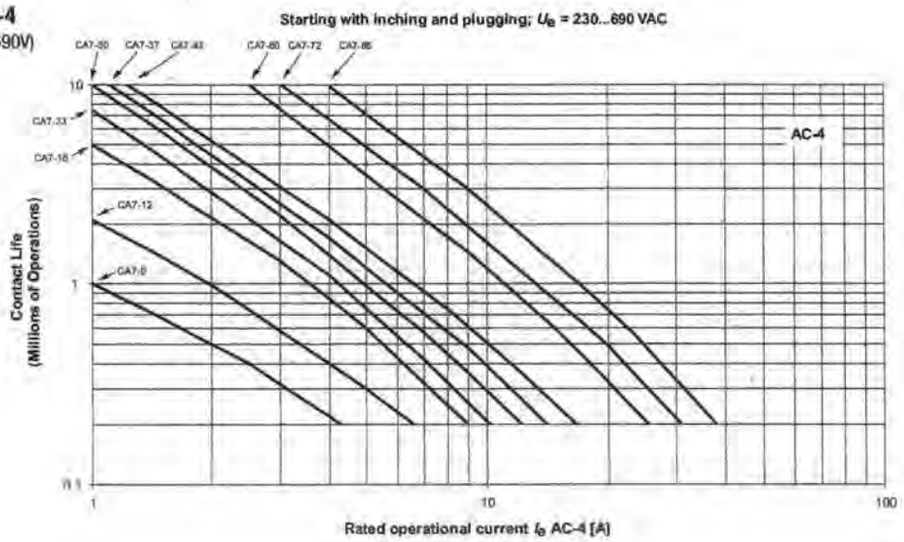
Life-Load Curves

- Locate the Rated Operational Current (I_e) along the bottom of the chart and follow the graph lines up to the intersection of the appropriate contactor's life-load curve.
- Read the estimated contact life along the vertical axis.

AC-3
(to 575V)



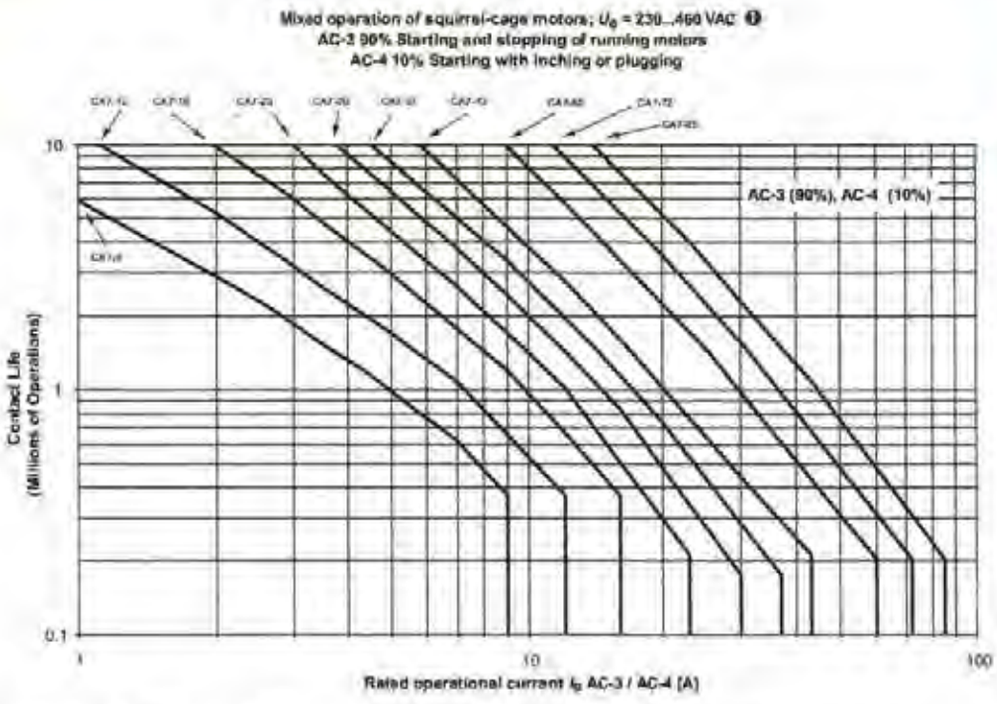
AC-4
(to 690V)



NOTE: The life-load curves shown here are based on Sprecher+Schuh tests according to the requirements defined in IEC 947-4-1. Since contact life in any given application is dependent on environmental conditions and duty cycle, actual application contact life may vary from that indicated by the curves shown here.

Life-Load Curves

AC-3 (90%), AC-4 (10%)

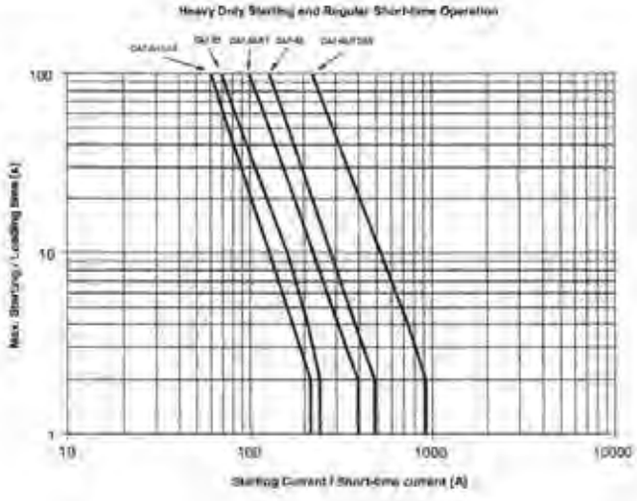


Contact Life for Mixed Utilization Categories AC-3 and AC-4

In many applications, the utilization category cannot be defined as either purely AC-3 or AC-4. In those applications, the electrical life of the contactor can be estimated with the following equation:

$$L_{mixed} = L_{ac3} / [1+P_{ac4} \times (L_{ac3}/L_{ac4}-1)]$$, where:

- L_{mixed} Appoximate contact life in operations for a mixed AC-3/AC-4 utilization category application
- L_{ac3} Approximate contact life in operations for a pure AC-3 utilization category (from the AC-3 life-load curve).
- L_{ac4} Approximate contact life in operations for a pure AC-4 utilization category (from the AC-4 life-load curve).
- P_{ac4} Percentage of AC-4 operations



NOTE: The life-load curves shown here are based on Sprecher+Schuh tests according to the requirements defined in IEC 947-4-1. Since contact life in any given application is dependant on environmental conditions and duty cycle, actual application contact life may vary from that indicated by the curves shown here.

❶ 575V applications use 85% of curve value

Operating Rates

The estimated contact life shown in the life-load curves is based on the standard operating rates shown in Table B below. For applications requiring a higher operating frequency, the maximum operating power (Pn in kW or HP) for a given contactor must be reduced to maintain the same contact life.

To find a contactor's maximum operating power, for an operating rate greater than shown in Table B, follow these guidelines:

1. Identify the appropriate curve for the contactor and utilization category from Table B.
2. Locate the appropriate Maximum Operating Rate curve on the following pages.
3. Locate the intersection of the curve with the application's operating rate (ops/hr.) found on the vertical axis.
4. Read the percent of maximum operating power (Pn) of the contactor from the horizontal axis.
5. Multiply the % maximum power by the standard power rating.

Example: The contactor selected for an AC-4 utilization category application is a CA7-16 (10HP at 460V), however, the application requires an operating rate of 200 ops/hr., compared to the standard operating rate of 120 ops/hr. as shown in Table B.

1. Locate the AC-4 Maximum Operating Rate curve on the following pages.
2. Locate the intersection of 200 ops/hr on the CA7-16 curve. The data shows that the maximum operating power of the CA7-16 contactor in this application is 60%.
3. Therefore, the maximum horsepower that can be switched by the CA7-16 contactor in this application is 6 HP (0.60 x 10HP).

Table B – Standard Operating Rates by Contactor and Utilization Category

Contactor	AC-1 Max. ops/hr.	AC-2 Max. ops/hr.	AC-3 Max. ops/hr.	AC-4 Max. ops/hr.	AC-4 @ $\frac{1}{6}$ for 200K ops. Max. ops/hr.
	Operating Parameters and Start Time				
			40% Duty Cycle 250ms ❶	250ms	250ms
CA7-9	1000	500	700	200	400
CA7-12	1000	500	700	150	300
CA7-16	1000	500	700	120	240
CA7-23	1000	400	600	80	160
CA7-30	1000	400	600	80	160
CA7-37	1000	400	600	70	140
CA7-43	1000	400	600	70	140
CA7-60	800	300	500	70	140
CA7-72	800	250	500	60	120
CA7-85	600	200	500	50	140

❶ *Duty Cycle or Load Factor* – Defined as the "on" time for a given operating cycle per hour including the "start time." A 40% Duty Cycle is calculated in the following manner:

Contactor switches six (6) times per minute (tpm), 250ms start time: 40% duty cycle

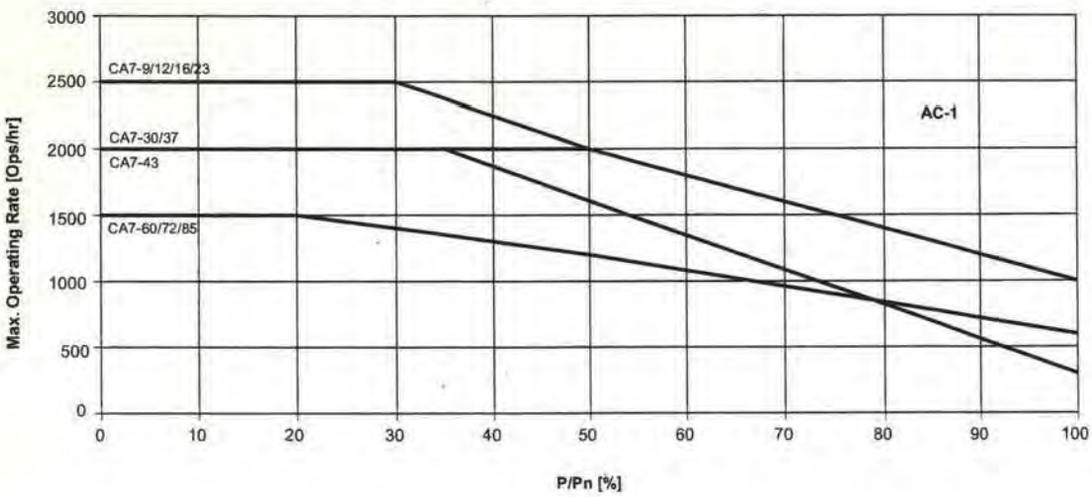
To determine the "on" time and "off" time:

- Operations per hour = 360; [60 min x 6 tpm = 360]
- One operating cycle = 10 sec; [60 min ÷ 6 tpm = 10 sec]
- "On" time at 40% duty cycle = 4 sec; [10 sec x 0.4 (40%) = 4 sec]
- 4 sec "on" time includes the start time of 250ms
- "Off" time at 40% duty cycle = 6 sec; [10 sec – 4 sec = 6 sec]

Operating Rate Curves

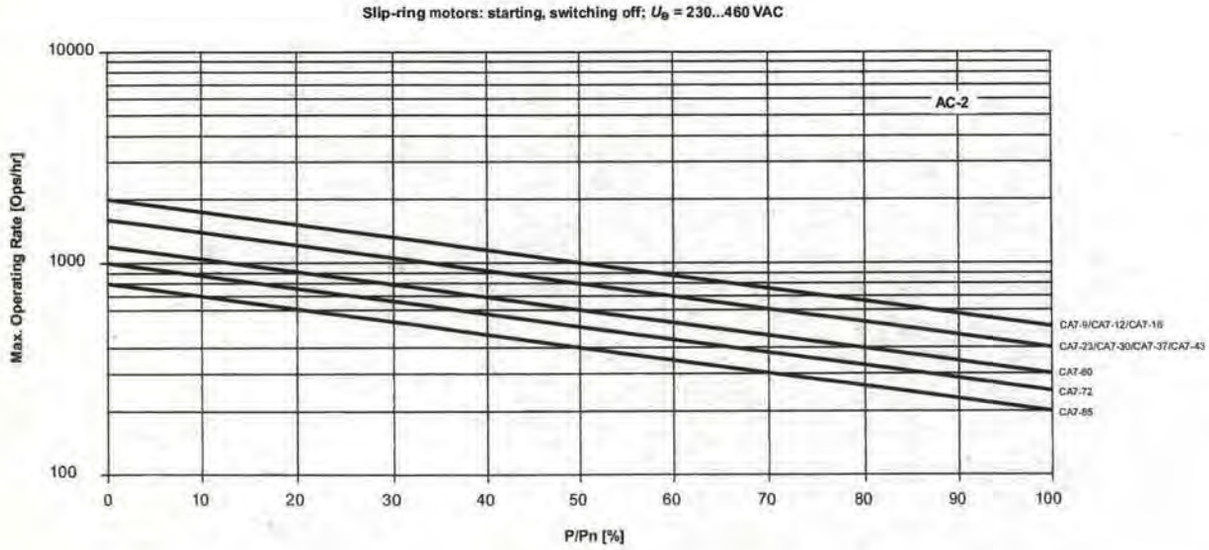
AC-1

Non or slightly inductive loads, resistance furnaces; U_e = 230...690 VAC



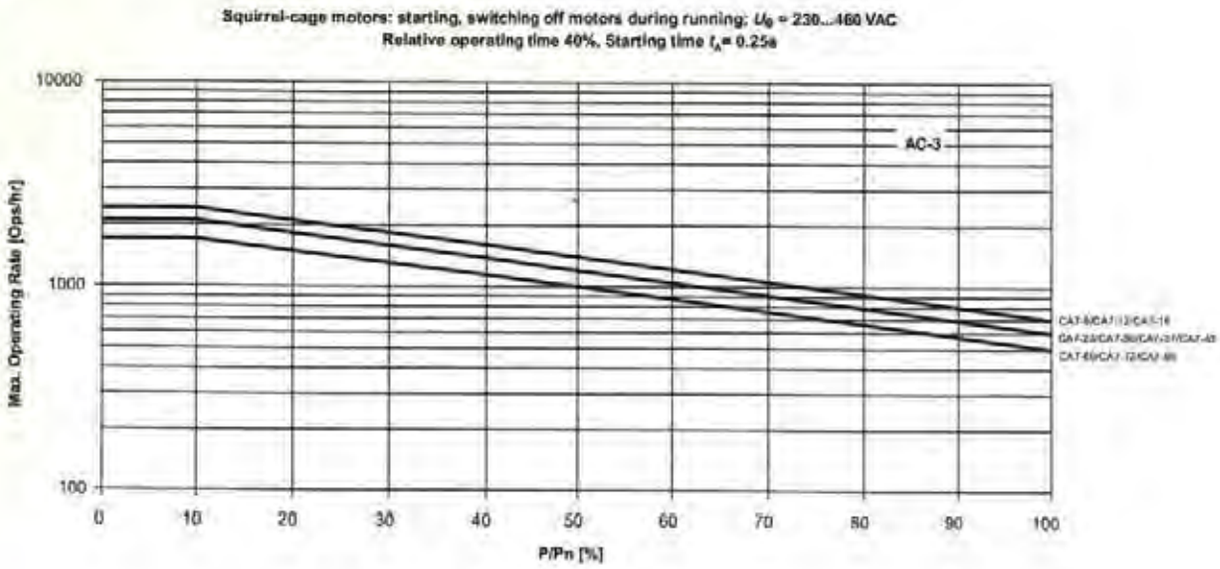
AC-2

Slip-ring motors: starting, switching off; U_e = 230...460 VAC

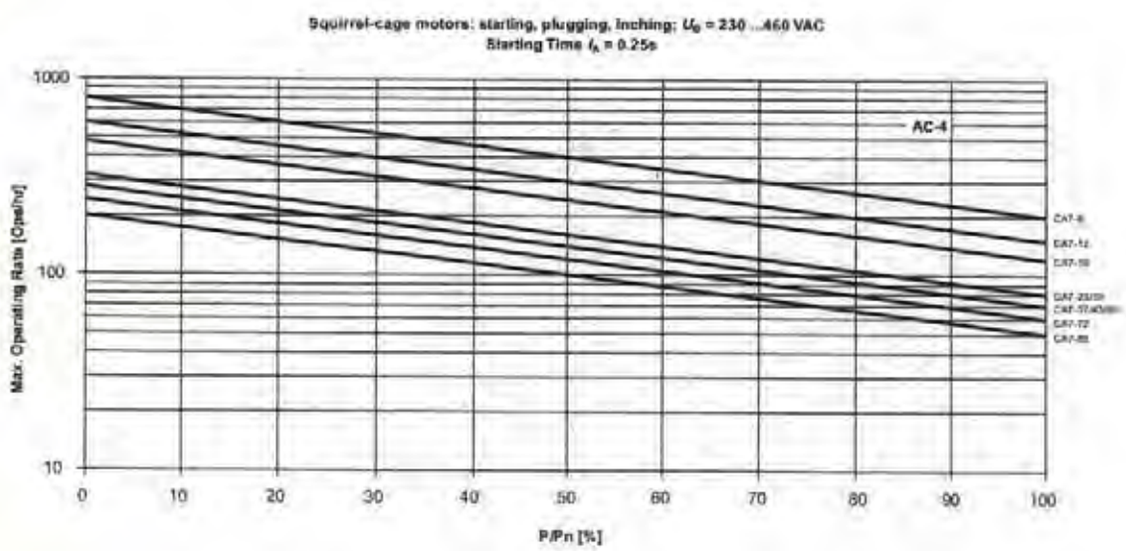


Operating Rate Curves

AC-3

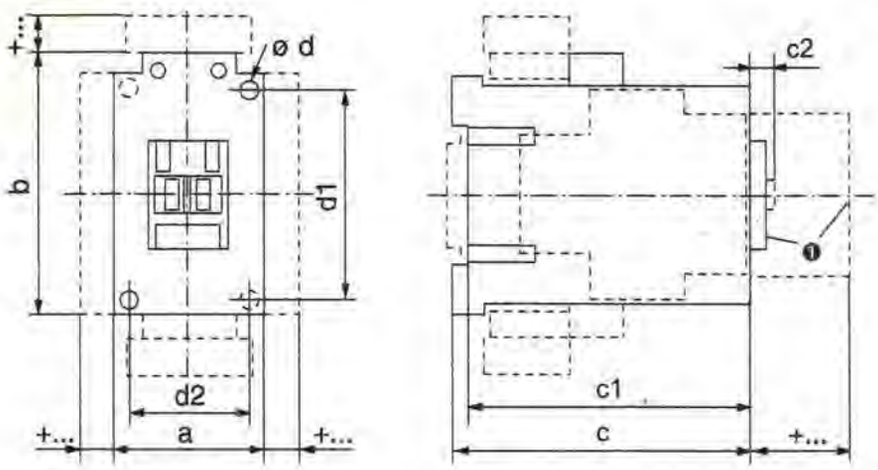


AC-4



Series CA7 & Series CAU7 (Contactors & Reversing Contactors)

- Dimensions are in millimeters (inches)
- Dimensions not intended for manufacturing purposes

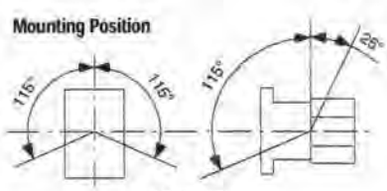


	Catalog Number	a	b	c	c1	c2	Ød	d1	d2
AC Contactors	CA7-9...CA7-23; CAN7-12, CNX-205...208	45 (1-25/32)	81 (3-3/16)	80.5 (3-11/64)	75.5 (3-3/32)	6 (1/4)	2 – 4.5 (2-3/16)	60 (2-23/64)	35 (1-25/64)
	CA(N)7-30...CA(N)7-37 CNX-209	45 (1-25/32)	81 (3-3/16)	97.5 (4)	92.6 (3-49/64)	6.5 (17/64)	2 – 4.5 (2-3/16)	60 (2-23/64)	35 (1-25/64)
	CA7-43, CNX-212	54 (2-1/8)	81 (3-3/16)	100.5 (4-7/64)	95.6 (3-7/8)	6.5 (17/64)	2 – 4.5 (2-3/16)	60 (2-23/64)	45 (1-25/32)
	CA7-60...CA7-85 CAN7-12, CNX-218	72 (2-53/64)	122 (4-51/64)	117 (4-49/64)	111.5 (4-35/64)	8.5 (21/64)	4 – 5.4 (4-7/32)	100 (3-15/16)	55 (2-11/64)
True DC Contactors	CA7-9C...CA7-16C, CAN7-12C, CNX-205C...206C	45 (1-25/32)	81 (3-3/16)	106.5 (4-3/16)	101.5 (4)	6 (1/4)	2 – 4.5 (2 – 3/16)	60 (2-23/64)	35 (1-25/64)
	CA7-23C CNX-207C...208C	45 (1-25/32)	81 (3-3/16)	123.5 (4-55/64)	119 (4-43/64)	6 (1/4)	2 – 4.5 (2 – 3/16)	60 (2-23/64)	35 (1-25/64)
	CA(N)7-30C...CA(N)7-37C CNX-209C	45 (1-25/32)	81 (3-3/16)	141.5 (5-37/64)	136.5 (5-3/8)	6.5 (17/64)	2 – 4.5 (2 – 3/16)	60 (2-23/64)	35 (1-25/64)
	CA7-43C, CNX-212C	54	81	144.5	140	6.5	2 – 4.5	60	45

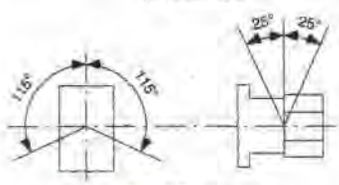
Reversing Contactors, Capacitor Contactors & Accessories (+...)

Contactors with...		Dim. [mm]	Dim. [inches]
auxiliary contact block - front mounting	2-, or 4-pole	c/c1 + 39	c/c1 + 1-37/64
(CAQ7) capacitor switching deck - front mounting		c/c1 + 39	c/c1 + 1-37/64
auxiliary contact block – side mounting	1-, or 2-pole	a + 9	a + 23/64
pneumatic timing module		c/c1 + 58	c/c1 + 2-23/64
electronic timing module	on coil terminal side	b + 24	b + 15/16
reversing contactor w/mech. interlock	on side of contactor	a+9+a	a+ 23/64+a
mechanical latch		c/c1 + 61	c/c1 + 2-31/64
interface module	on coil terminal side	b + 9	b + 23/64
surge suppressor	on coil terminal side	b + 3	b + 1/8
Labeling with...	label sheet marking tag sheet with clear cover marking tag adapter for V7 Terminals	+ 0 + 0 + 5.5	+ 0 + 0 + 7/32

Mounting Position



AC contactors



True DC contactors

1 NHP

Miniature circuit breakers

Din-T10 series 10 kA MCB

- Standard AS/NZS 4898 [1])
- Approval No. N17481
- Short circuit breaking capacity - 10000 Amps
- Current range 0.5 - 63 Amps 1, 2, 3 and 4 pole
- Sealable and lockable handle
- Modular design
- Available in curve type B, C and D
- Mounts on CD chassis (250 A and 355 A)

DTCB10
1 pole

1 pole 1 module

In (A)	C - Curve 5-10 I_n
0.5	DTCB10105C
1	DTCB10101C
2	DTCB10102C
3	DTCB10103C
4	DTCB10104C
6	DTCB10106C
10	DTCB10110C
13	DTCB10113C
16	DTCB10116C
20	DTCB10120C
25	DTCB10125C
32	DTCB10132C
40	DTCB10140C
50	DTCB10150C
63	DTCB10163C

Short circuit capacity 10 kA

In (A)	0.5 - 63
1 P	240 V AC
2 P	240/415 V AC
3 P	240/415 V AC
4 P	240/415 V AC

Use at DC

	1 P	2 P [2])
Short circuit	25 kA	30 kA
Max voltage	48 V DC	110 V DC

2 pole 2 modules

0.5	DTCB10205C
1	DTCB10201C
2	DTCB10202C
4	DTCB10204C
6	DTCB10206C
10	DTCB10210C
13	DTCB10213C
16	DTCB10216C
20	DTCB10220C
25	DTCB10225C
32	DTCB10232C
40	DTCB10240C
50	DTCB10250C
63	DTCB10263C

Notes: [1]) A range of UL standard MCBs is available on indent. (ref DTCBUL10____C).
[2]) 2 pole MCB connected in series.
The line side is the "OFF" (bottom) side of the MCB, and connects to CD chassis tee-offs.
[I] Available on indent only.

Miniature circuit breakers

Din-T10 series 10 kA MCB (cont.)

3 pole 3 modules

In (A)	C – Curve 5-10 In
0.5	i DTCB10305C
1	i DTCB10301C
2	DTCB10302C
4	DTCB10304C
6	DTCB10306C
10	DTCB10310C
13	i DTCB10313C
16	DTCB10316C
20	DTCB10320C
25	DTCB10325C
32	DTCB10332C
40	DTCB10340C
50	DTCB10350C
63	DTCB10363C

DTCB10
1 - 4 pole types

4 pole 4 modules [1])

6	DTCB10406C
10	DTCB10410C
13	i DTCB10413C
16	DTCB10416C
20	DTCB10420C
25	DTCB10425C
32	DTCB10432C
40	DTCB10440C
50	DTCB10450C
63	DTCB10463C

Notes: [1]) All poles include overcurrent and short circuit protection.
i Available on indent only.

TERASAKI

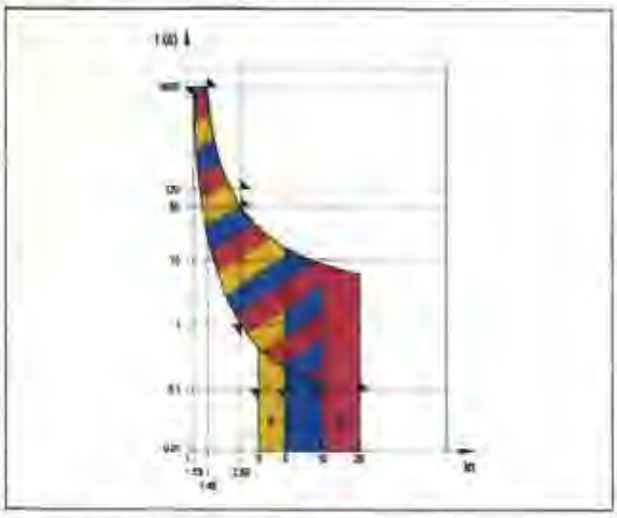
Din-T MCBs Technical data

Characteristics according to BS EN 60898

Miniature Circuit Breakers are intended for the protection of wiring installations against both overloads and short-circuits in **domestic** or **commercial** wiring installations where operation is possible by **uninstructed** people

3

Tripping characteristic curves



Magnetic release

An electromagnet with plunger ensures instantaneous tripping in the event of short-circuit. The NHP Din-T range has 3 different types, following the current for instantaneous release: types B, C and D curve.

Icn (A)	Test current	Tripping time	Applications
B	3 x In	0.1<t<45 s (In≤32 A)	Only for resistive loads eg: • electrical heating • water heater • stoves.
	5 x In	0.1<t<90 s (In>32 A)	
		t<0.1 s	
C	5 x In	0.1<t<15 s (In≤32 A)	Usual loads such as: • lighting • socket outlets • small motors
	10 x In	0.1<t<30 s (In>32 A)	
		t<0.1 s	
D	10 x In	0.1<t<4 s(**) (In≤32 A)	Control and protection of circuits having important transient inrush currents (large motors)
	20 x In	0.1<t<8 s (In>32 A)	
		t<0.1 s	

Thermal release

The release is initiated by a bimetal strip in the event of overload. The standard defines the range of releases for specific overload values. Reference ambient temperature is 30 °C.

Test current	Tripping time
1.13 x In	t ≥ 1 h (In ≤ 63 A) t ≥ 2 h (In > 63 A)
1.45 x In	t < 1 h (In ≤ 63 A) t < 2 h (In > 63 A)
2.55 x In	1 s < t < 60 s (In ≤ 32 A) 1 s < t < 120 s (In >32 A)

Rated short-circuit breaking capacity (Icn)

Is the value of the short-circuit that the MCB is capable of withstanding in the following test of sequence of operations: O-t-CO.

After the test the MCB is capable, without maintenance, to withstand a dielectric strength test at a test voltage of 900 V. Moreover, the MCB shall be capable of tripping when loaded with 2.8 In within the time corresponding to 2.55 In but greater than 0.1s.

Service short-circuit breaking capacity (Ics)

Is the value of the short-circuit that the MCB is capable of withstanding in the following test of sequence of operations: O-t-CO-t-CO.

After the test the MCB is capable, without maintenance, to withstand a dielectric strength test at a test voltage of 1500 V. Moreover, the MCB shall not trip at a current of 0.96 In. The MCB shall trip within 1h when current is 1.6 In.

O - Represents an opening operation

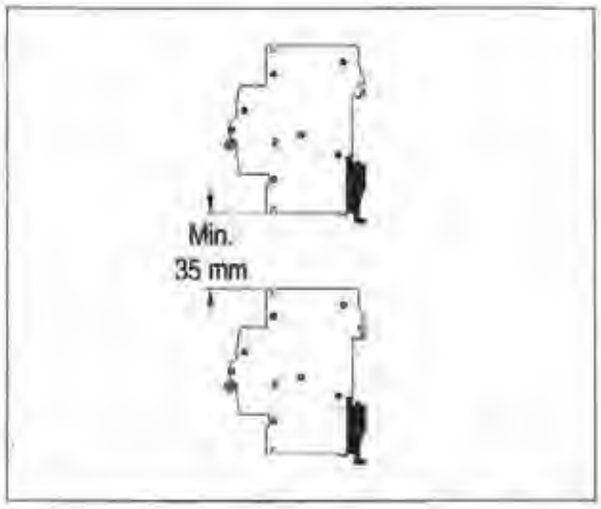
C - Represents a closing operation followed by an automatic opening.

t - Represents the time interval between two successive short-circuit operations: 3 minutes.

The relation between the rated short-circuit capacity (Icn) and the rated service short-circuit breaking capacity (Ics) shall be as follows:

Icn (A)	Ics (A)
≤ 6000	6000
> 6000 ≤ 10000	0.75 Icn min. 6000
> 10000	0.75 Icn min. 7500

In both sequences all MCBs are tested for emission of ionized gases during short-circuit (grid distance), in a safety distance between two MCBs of 35 mm when devices are installed in two different rows in the enclosure. This performance allows the use of any NHP/Terasaki enclosure.



TERASAKI
Innovators in Protection Technology

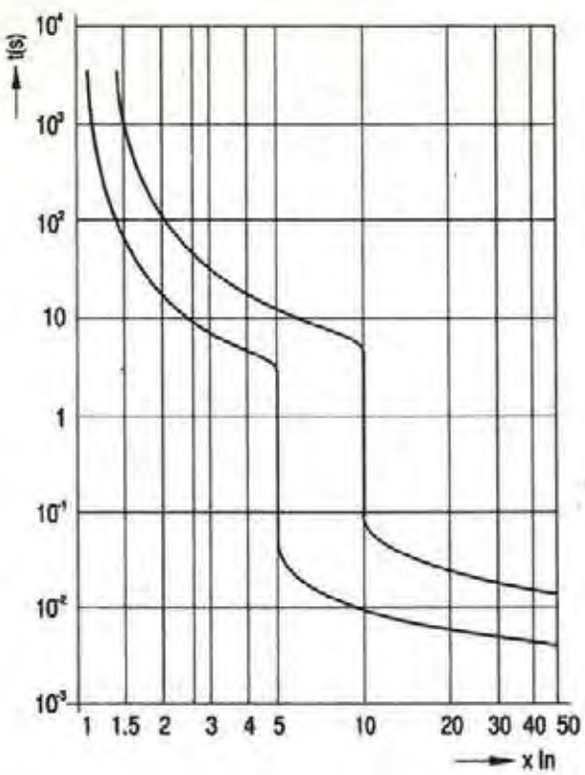
Din-T MCBs Technical data

Tripping curves according to EN 60898

The following tables show the average tripping curves of the Terasaki Din-T MCBs based on the thermal and magnetic characteristics.

3

Curve C



TERASAKI
Innovators in Protection Technology

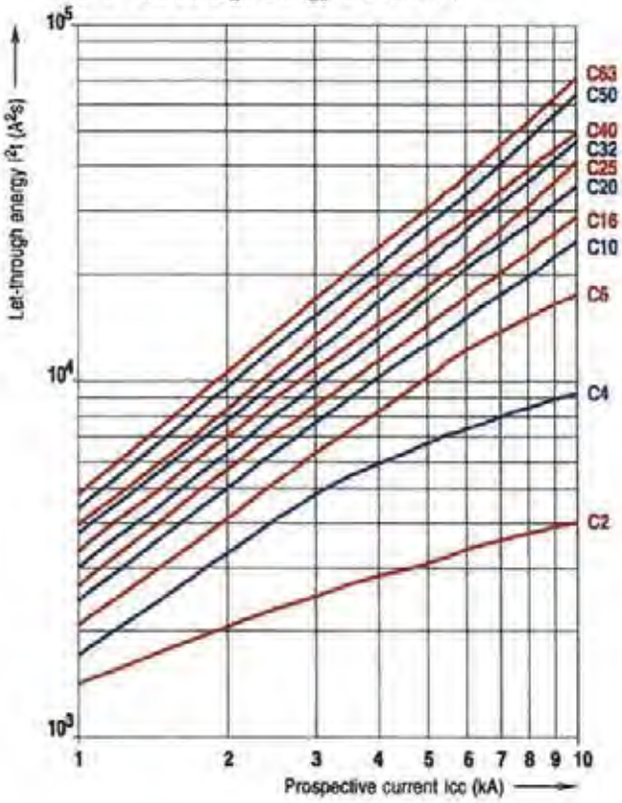
Din-T MCBs Technical data

Din-T 10

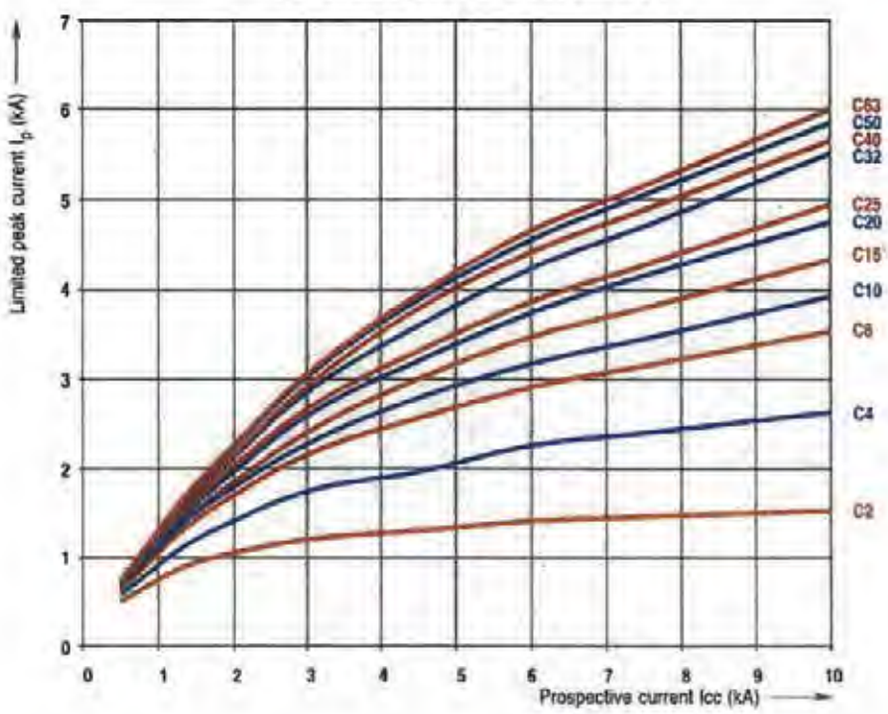
10 kA

C curve

I^2t Let-through energy at 240/415 V



Id Limited peak current at 230/400 V



WaterCon
Ingenious Solutions | Imaginative Engineering

SOLBERG STS SERIES VACUUM LIQUID SEPARATOR

LYTTON ROAD VACUUM PUMP STATION UPGRADE
CONTRACT WD-90552-08/09
OPERATIONS & MAINTENANCE MANUAL

SOLBERG

Inlet Vacuum Filters
Maintenance Manual

www.solbergmfg.com

Solberg Manufacturing, Inc., 1151 Ardmore Itasca, IL 60143 USA
Ph: 630.773.1363 Fax: 630.773.0727 Email: sales@solbergmfg.com Web: www.solbergmfg.com
Rev: MMVF-910

Note: Please read the maintenance instructions given by the OEM for the machinery first. The OEM's manual should be adhered to in order to protect the equipment. Solberg Manufacturing, Inc has made every effort to make sure that these instructions are accurate but is not responsible for any typos, slight variations or for human errors that may occur.

Maintenance Manual

SOLBERG Inlet Vacuum Filters

CONTENTS

**For Further Information Please Call: 630-773-1363*

Solberg Manufacturing, Inc., 1151 Ardmore Itasca, IL 60143 USA
Ph: 630.773.1363 Fax: 630.773.0727 Email: sales@solbergmfg.com Web: www.solbergmfg.com
Rev: MMVF-910

SOLBERG

Section A

INTRODUCTION

The purpose of this manual is instruction on the proper assembly and care of Solberg inlet vacuum filters.

WARNING

This manual must be read and thoroughly understood before using and caring for this air filter. Failure to comply could result in explosion, product/system contamination or personal injury.

This manual should be used as a supplement to the user's understanding of the proper care needed to maintain a safe and dependable air filter. It is the responsibility of the user to interpret and explain all instructions to persons who do not read or understand English BEFORE they are allowed to maintain and use this filter.

This manual should be readily available to all operators responsible for operation and maintenance of the vacuum inlet filters.

We thank you for selecting products from Solberg Manufacturing, Inc. We are confident that our superior filter designs will exceed your application requirements.

Section B

GENERAL INFORMATION

1. Identification of Solberg Vacuum Inlet Filters.

All Solberg inlet vacuum air filters should have an identification label/nameplate that gives the following information:

Assembly Model #
Replacement Element #

(The exception is OEM supplied units. In this case please enter the OEM part numbers below.)

Solberg Manufacturing, Inc., 1151 Ardmore Itasca, IL 60143 USA
Ph: 630.773.1363 Fax: 630.773.0727 Email: sales@solbergmfg.com Web: www.solbergmfg.com
Rev: MMVF-910

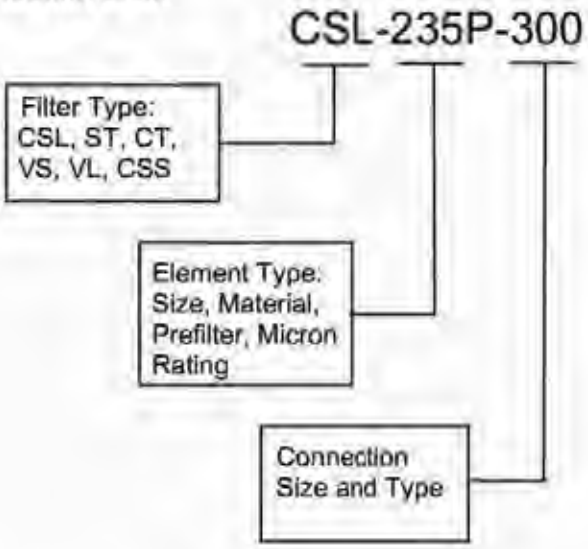
SOLBERG

Fill in the actual nameplate data from your new Solberg inlet filter(s):

No.	Filter Model Number	Replacement Element
1		
2		
3		
4		
5		

Table 1

The model number designates the filter type, the original element configuration and housing connection size. For example, the following part number identifies the filter as being a 'CSL' design filter with a 235 element with prefilter and 3" MPT connection size:



2. Filtration Rules of Thumb

General: For peak output performance from a compressor, blower, vacuum pump, engine, or any other machine that consumes air, one must have clean, unrestricted air. Proper filtration can help stabilize the working environment within rotating equipment even when the external conditions may be quite severe. A critical component in creating the right working conditions is filter sizing. With the properly sized filter, equipment will run smoothly over its entire expected operating life.

A major factor in filtration and filter sizing is air velocity through the filter media. Generally, the slower the velocity of air through a media the higher the filter efficiency and, conversely, the lower the pressure drop. Therefore, the primary

goal in filter sizing is to optimize the velocity of air through the media (sometimes called face velocity).

Rule of Thumb #1: Always begin with the filter cartridge requirements when sizing a filter. Once the appropriate element has been selected then move on to the housing requirements.

Rule of Thumb #2: Always ask or specify a filter based on a micron rating **with** filtration efficiencies. As an example, stating a requirement for a 1-micron filter is misleading because no efficiency rating has been specified. A 1-micron filter at 95-% efficiency may be less efficient than a 5-micron filter at 99% efficiency. For proper air system performance in light and industrial duty environments, a filter with a minimum of 99% filtration efficiency at 5 microns is required.

Rule of Thumb #3: Size your filter correctly by understanding the impact air velocity through a media has on efficiency and pressure drop. Maintain the suggested Air-to-Media ratios listed below based on the external environment listings and Filtration efficiency needs.

Filtration Efficiency Requirements (99+% efficiency)	**Environmental Conditions**	**Air to Media Ratio**	
Industrial Grade 2-micron **Paper**	Industrial Duty (clean, office/warehouse-like)	30 CFM/ft^2	(51m^3/h)/cm^2
	Severe Duty (workshop, factory-like)	15 CFM/ft^2	(25.5m^3/h)/cm^2
	Extreme Duty (Foundry, Construction-like)	10 CFM/ft^2	(17m^3/h)/cm^2
Industrial Grade 5-micron **Polyester**	Industrial Duty (clean, office/warehouse-like)	50 CFM/ft^2	(85m^3/h)/cm^2
	Severe Duty (workshop, factory-like)	40 CFM/ft^2	(68m^3/h)/cm^2
	Extreme Duty (Foundry, Construction-like)	25 CFM/ft^2	(42.5m^3/h)/cm^2
Industrial Grade 1-micron **Polyester**	Severe Duty (Foundry, Construction-like)	10 CFM/ft^2	(17m^3/h)/cm^2
Industrial Grade 0.3-micron **HEPA** Glass @ 99.97% efficiency	Industrial Duty (clean office/warehouse-like)	10 CFM/ft^2	(17m^3/h)/cm^2
	Severe Duty (workshop, factory-like)	7 CFM/ft^2	(12m^3/h)/cm^2
	Extreme Duty (Foundry, Construction-like)	5 CFM/ft^2	(8.5m^3/h)/cm^2

Table 2

Rule of Thumb #4: Pressure drop is also caused by the dirt holding capacity of the element. As the element fills up with dirt, the pressure drop increases. It is important to document the pressure drop across a given filter when it is new and then clean or replace it when the pressure drop increases by 10" to 15" / 250-380mm H_2O from the original reading.

Rule of Thumb #5: The inlet connection greatly influences the overall pressure drop of the filter system. To minimize the restriction contributed by an inlet filter, a velocity of 6,000 ft/min (10200m^3/h) or less is suggested through the outlet pipe. The table below lists the suggested flows based on pipe size:

Pipe Size (inches)	Max Airflow		Pipe Size (inches)	Max Airflow		Pipe Size (inches)	Airflow	
1/4"	6 CFM	10m^3/h	1 ¼"	60 CFM	102m^3/h	6"	1,100 CFM	1870m^3/h
3/8"	8 CFM	14m^3/h	1 ½"	80 CFM	136m^3/h	8"	1,800 CFM	3060m^3/h
1/2"	10 CFM	17m^3/h	2"	135 CFM	230m^3/h	10"	3,300 CFM	5610m^3/h
3/4"	20 CFM	34m^3/h	2 ½"	195 CFM	332m^3/h	12"	4,700 CFM	7990m^3/h
1"	35 CFM	60m^3/h	3"	300 CFM	510m^3/h	14"	6,000 CFM	10200m^3/h
			4"	520 CFM	884m^3/h			
			5"	800 CFM	1360m^3/h			

Table 3 **Note: This information is for general use only. A qualified engineer must properly design each system.*

3. Element Specifications

Temperature Range: -15° to 220°F / -26° to 105°C
Filter Change-Out Differential: 10" to 15" / 250-380mm H_2O Over Initial Delta P

Media	Micron Rating
Standard Paper	99+% @ 2 micron
Standard Polyester	99+% @ 5 micron
"S" Series Wire Mesh	Epoxy Coated Wire Mesh
"Z" Series Polyester	99+% @ 1 micron
"HE" Series HEPA	99.97% @ 0.3 microns
"U" Series Polyester	99+% @ 25 micron
"W" Series Polyester	99+% @ 100 micron
"S2" Series	Stainless Steel Wire Mesh
"AC" & "ACP" Series	N/A
"Y" Series Polypropylene	99+% @ 5 micron

Table 4

Temperature Range: -15° to 385°F / -26° to 196°C
Filter Change-Out Differential: 10" to 15" / 250-380mm H_2O Over Initial Delta P

Media	Micron Rating
"MX" & "MXD" Series – Nomex Cloth	99+% @ 5 micron

Table 5

4. **Element Cleaning - Inlet Filtration**

Solberg elements should be cleaned or replaced, once the pressure drop reaches 15 to 20-inches water column (380 - 500mm WC) above the initial pressure drop of the installation.

The decision to clean the element rather than replace it is left to the discretion of the operator. Any damage which results from by-pass or additional pressure drop created by element cleaning is the sole responsibility of the operator.

WARNING

The overall performance of a filter element is altered once cleaned.

The initial pressure drop after cleaning will be greater than the original, clean pressure drop of the element.

After each subsequent cleaning, the initial pressure drop will continue to increase.

Under all circumstances, the initial pressure drop of the element needs to be maintained at less than 20-inches water column (500mm WC).

Cleaned elements that exceed 20-inches water column (500mm WC) at start-up should be replaced with new elements.

With many types of equipment, the maximum pressure drop allowed will be dictated by the ability of the equipment to perform to its rated capacity. Under all

circumstances, the operator should avoid exceeding the manufacturer's recommended maximum pressure drop for their specific equipment.

A. ***Polyester Element***: The polyester element may be washed in warm soapy water, vacuumed, gently blown out or replaced. The element should be dry before reinstallation. The element should be replaced after a maximum of three cleanings.
B. ***Paper Element***: The paper element may be lightly blown with low pressure air. It is disposable and in most cases should be replaced with a new element.
C. ***Polyurethane Prefilter***: The prefilter may be washed as a sponge or replaced to give the element a longer service life.
D. ***Epoxy Coated Wire Mesh and Stainless Steel Wire Mesh Elements***: Cleaning instructions similar to polyester, except mild solvents may be used.
E. ***Activated Carbon Element***: Not cleanable
F. ***Polypropylene Element***: Cleaning instructions similar to polyester
G. ***Nomex Cloth Element***: Cleaning instructions similar to polyester

If you are not confident that the integrity of the element was maintained during cleaning, it is recommended that a new element be installed. Also, spare parts such as gaskets, wing nuts and washers can be supplied upon request.

Section C

PROCEDURES

1. Installation.

A. Maximum inlet gas stream temperature for most Solberg inlet vacuum filter products is 220°F / 105°C. Temperatures in excess of this could cause damage to elements, media and elastomers.

B. Direction of flow is typically from the outside of the element to the inside of the element. Most products have arrows indicating direction of flow on inlet and outlet ports.

C. Ensure that pipe/flange connections are adequately sealed so the potential for leaks is reduced to a minimum.

2. Disconnecting canister top from canister base.

A. ST/CT/Small CSL: Release wire-form clips or loosen wing nut on "claw" bolts.

B. Large CSL: Loosen wing nut or hex head on T-bolts.

C. CSS: Twist upper housing to release.

D. VS/VL: Remove V-clamp by loosening Hex Nut or T-bolt and releasing.

E. Lift off canister top.

3. **Removing element for service/maintenance.**

A. Remove retaining hex head/wing-nut and washer carefully, and then remove element. Some elements will have a top plate that should also be removed.

B. Clean sealing surfaces of housing, top & base plates, and element endcaps so that they are free of dirt or any other particulate.

WARNING

Failure to comply with these instructions may result in system or pump contamination.

4. **Securing Element.**

A. Place new or cleaned element evenly on base plate. Be sure element seats properly on base and there is no dirt or particulate present on sealing surfaces.

B. Place top plate (if necessary) on element by centering on tap bolt.

C. Secure washer and wing nut to end cap (or top plate) and tap bolt. Element must be tightly secured. Note: DO NOT over tighten!

WARNING

Defective installation may cause system or pump contamination. Use only genuine Solberg replacement parts.

5. **Securing canister top to canister base.**

A. Make sure all surfaces are free from dust and other particulate.

Solberg Manufacturing, Inc., 1151 Ardmore Itasca, IL 60143 USA
Ph: 630.773.1363 Fax: 630.773.0727 Email: sales@solbergmfg.com Web: www.solbergmfg.com

B. Hemisphere o-ring must rest evenly along canister/casting base o-ring groove.

C. ST/CT/Small CSL: Hold canister housing against o-ring or sealing ring on main filter head. Re-fasten wire-form clips or "claw" bolts.

D. Large CSL: Replace housing top plate. Feed T-bolts into corresponding slots and tighten evenly around perimeter. Note: Do NOT over tighten!

E. VS/VL: Secure V-clamp by disconnecting hex nut or T-bolt portion and placing V-clamp along the diameter of canister o-ring groove. Fasten T-bolt and secure tightly. V-CLAMP LEGS MUST REST UNIFORMLY ALONG ENTIRE O-RING GROOVE.

F. CSS: Reassemble top housing to bottom housing by aligning tabs and turning into place.

Section D

MAINTENANCE RECOMMENDATIONS

1. Pressure drop readings are recommended to have an effective air filter. Always document initial pressure drop during start-up when element is clean. Replacement cartridge is needed when system experiences 10" to 15" / 250-380mm H_2O higher pressure drop above the initial reading. Refer to page 4 for instructions.

2. Always check replacement cartridge gaskets to insure they are adhered uniformly along the end caps during handling. If not, contact Solberg Manufacturing, Inc. immediately. Do not modify or change from Solberg specified parts!

3. Always check inlets/outlets, element base and its components when replacing element to insure cleanliness. Wipe clean if necessary.

4. Operate only when a proper seal exists.

5. VS/VL: Never operate without absolute assurance that V-clamp is secured correctly along entire diameter of canisters. Check along V-clamp for wear. Replace if any distortion occurs due to handling and usage.

SPARE PARTS

Contact your Solberg Representative for spare part model numbers.

Solberg Manufacturing, Inc., 1151 Ardmore Itasca, IL 60143 USA
Ph: 630.773.1363 Fax: 630.773.0727 Email: sales@solbergmfg.com Web: www.solbergmfg.com

TECHNICAL DATA SHEET

For

VACUUM SEWERAGE PUMP STATION SP270
Lytton rd

Equipment Type:	Circuit Breaker
Location:	VACUUM PUMP No.3 CIRCUIT BRACKER 40A
Model Numbers:	DTCB10340C
Manufacturer:	Terasaki
Supplier:	NHP Pty Ltd 25 Turbo Drive Coorparoo QLD 4151 Ph: 07 3891 6008 Fx: 07 3891 6139

TECHNICAL DATA SHEET

For

VACUUM SEWERAGE PUMP STATION SP270 LYTTON rd

Equipment Type:	Transducer
Location:	Switchboard
Model Numbers:	253-TALW 0-50A 240VAC 4-20ma
Manufacturer:	Crompton
Supplier:	Crompton Instruments Tyco Electronics Unit 1/4 Reaghs Farm Rd Minto NSW 2566 Australia Tel:+61296032066

TECHNICAL DATA SHEET

For

VACCUM SEWERAGE PUMP STATION SP270 LYTTON rd

Equipment Type:	Contactor 3P 7.5Kw
Location:	Switchboard
Model Numbers:	CA7-16-10240VAC+CT 7K-17-7.5
Manufacturer:	Sprecher & Schuh
Supplier:	NHP Pty Ltd 25 Turbo Drive Coorparoo QLD 4151 Ph: 07 3891 6008 Fx: 07 3891 6139

TECHNICAL DATA SHEET

For

VACUUM SEWERAGE PUMP STATION SP270 LYTTON rd

Equipment Type:	Multitrode
Location:	Switchboard
Model Numbers:	MTR
Manufacturer:	Multitrode
Supplier:	Multitrode Pty Ltd. Australia Brisbane Technology Park 18 Brandl Street PO Box 4633 Eight Mile Plains QLD 4113 Tel:+61733407000 Fax:+61733407077 sales@multitrode.com.au

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SECTION 2

PROCEDURE FOR DRAINING THE AIR STORAGE VACUUM VESSEL AND SOLBERG FILTER

LYTTON ROAD VACUUM PUMP STATION UPGRADE
CONTRACT WD-90552-08/09
OPERATIONS & MAINTENANCE MANUAL

WaterCon
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TO ALLOW ANY ACCUMULATED WATER TO DRAIN FROM THE EXTERNAL AIR STORAGE VACUUM VESSEL AND THE IN-LINE 'SOLBERG' LIQUID SEPARATOR, IT IS CRITICAL THAT THE FOLLOWING PROCEDURE IS ADHERED TO WHEN CARRYING OUT THIS OPERATION:

1. Ensure that all vacuum pump isolator switches are switched to the 'OFF' position to prevent the vacuum pumps from starting up during the draining operation. All Isolator Switches should be 'Tagged Out' in accordance with Brisbane City Council 'Tagging and Isolation' Procedures.
2. Turn the Butterfly Valve on the vacuum pump suction line for ALL vacuum pumps to the 'CLOSED' position.
3. Turn the Butterfly Valve on the DN100 PVC pipe connecting the existing Vacuum Collection Vessel to the new Air Storage Vacuum Vessel (located immediately above the connection point to the existing Vacuum Collection Vessel) to the 'CLOSED' position.
4. Turn the Ball Valve on the external Air Storage Vacuum Vessel DN25 drainage line to the 'OPEN' position. This will initially suck any water that has collected in the vacuum pump station sump into the vessel, but when the vessel has equalised to atmospheric pressure, this water, and any other moisture that has accumulated in the vessel, will drain to the sump. When any water has drained out, return the Ball Valve to the 'CLOSED' position.
5. Turn the Ball Valve on the bottom of the Solberg Filter to the 'OPEN' position and allow any water that has accumulated to drain to the sump. When the filter is empty, return the Ball Valve to the 'CLOSED' position.
6. Return the Butterfly Valve on the DN100 PVC connecting pipe (Item 3 above) to the 'OPEN' position.
7. Return the Butterfly Valves on the vacuum pump suction line for ALL vacuum pumps to the 'OPEN' position.
8. Return the Isolator Switches for all vacuum pumps to the 'ON' position.
9. Remove all Isolation Tags and record in accordance with Brisbane City Council 'Tagging and Isolation' Procedures.

END OF PROCEDURE

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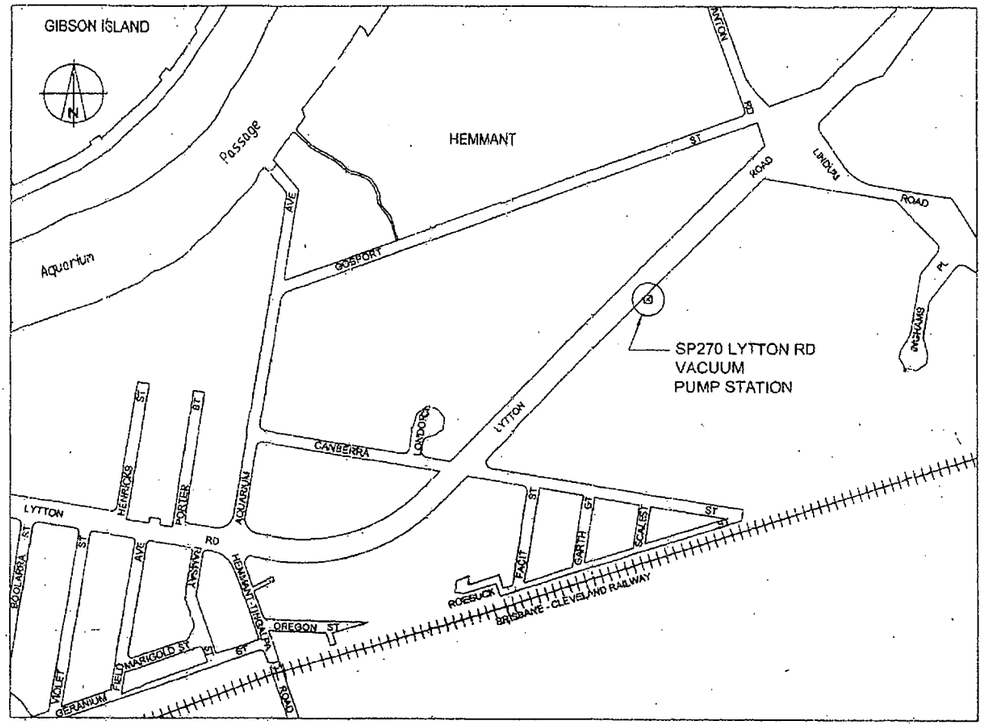
SECTION 3

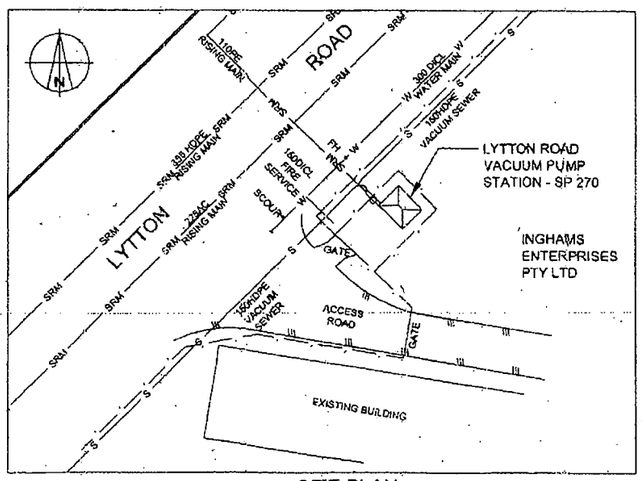
MECHANICAL 'AS CONSTRUCTED' PLANS

LYTTON ROAD VACUUM PUMP STATION UPGRADE
CONTRACT WD-90552-08/09
OPERATIONS & MAINTENANCE MANUAL

SP270 - LYTTON ROAD VACUUM SEWER PUMP STATION UPGRADE



LOCALITY PLAN
SCALE 1:5000 (A1)
UBD REF. MAP 142 J19



SITE PLAN
SCALE 1:500 (A1)

LEGEND

EXISTING WATER MAIN	W
EXISTING SEWERAGE	S
EXISTING SEWER RISING MAIN	SRM

DRAWING LIST	
DRAWING No	TITLE/DESCRIPTION
486/5/7-0075-001	LOCALITY & SITE PLANS
486/5/7-0075-002	GENERAL ARRANGEMENT
486/5/7-0075-003	PIPE & SUPPORT DETAILS

GENERAL:

G1 WORKS TO BE EXECUTED IN ACCORDANCE WITH UMD REFERENCE SPECIFICATION S140 EARTHWORKS & BRISBANE WATER RETICULATION STANDARDS

G2 CONNECTION OF THE WORKS TO THE LIVE SYSTEM SHALL BE DONE ONLY BY BRISBANE CITY COUNCIL. TO OBTAIN A QUOTATION AND ARRANGE A CONNECTION TELEPHONE 3403 3442 (WATER) OR 3403 7829 (SEWERAGE).

G3 SERVICES WHERE SHOWN ARE APPROXIMATE ONLY. EXACT LOCATION AND DEPTH TO SERVICES ARE TO BE CONFIRMED ON SITE PRIOR TO CONSTRUCTION.

G4 CONTRACTOR TO TAKE APPROPRIATE ACTION AS NECESSARY TO PROTECT AND MAINTAIN EXISTING SERVICES.

G5 RESTORE ALL SURFACES TO MATCH EXISTING SURFACES.

G6 TUNNEL BORE OR DIRECTIONAL DRILL UNDER EXISTING CONCRETE DRIVEWAYS WHERE THE EXISTING SURFACES CANNOT BE MATCHED.

G7 WORKS CONSTRUCTED BY PRIVATE CONTRACTORS MUST BE INSPECTED BY COUNCIL (DEVELOPMENT ASSESSMENT) DURING CONSTRUCTION. PHONE 3403 9724 FOR FURTHER INFORMATION & DETAILS OF CHARGES.

G8 BRISBANE WATER PERSONNEL ONLY TO OPERATE THE EXISTING WATER OR SEWERAGE SYSTEM.

G9 ALL FITTINGS ON ABANDONED PIPELINE TO BE REMOVED.

G10 WHERE A METALLIC WATER MAIN IS TO BE REPLACED WITH A PLASTIC MAIN A LICENSED ELECTRICIAN SHALL MAKE AN ASSESSMENT OF POTENTIALLY AFFECTED PROPERTY EARTHING SYSTEMS. WORK SHALL NOT COMMENCE UNTIL THE ELECTRICIAN DECLARES IN WRITING THAT IT IS SAFE TO PROCEED.

STRUCTURAL STEELWORK

S1. ALL STRUCTURAL STEELWORK SHALL COMPLY TO A.S. 4100-1998 AND OTHER RELEVANT CODES OF PRACTICE AND WS-SPEC.

S2. ALL STEELWORK SHALL BE IN ACCORDANCE WITH A.S. 3678.1-1998 OR A.S. 1163-1991.

S3. ALL BOLTS, NUTS AND WASHERS SHALL BE GALVANISED AND SHALL BE M20 GRADE 8.8/S UNLESS NOTED OTHERWISE. ALL MASONRY ANCHORS ARE TO BE STAINLESS STEEL AND FITTED WITH INSULATION BETWEEN SS AND GALVANISING.

S4. ALL WELDS SHALL BE 6mm CONTINUOUS FILLET WELDS (E48XX ELECTRODE OR W50X) UNLESS NOTED OTHERWISE. WELDING SHALL BE CARRIED OUT IN ACCORDANCE WITH A.S. 1554.1-2000. THE THROAT THICKNESS OF WELDS JOINING COLD FORMED SECTIONS SHALL BE EQUAL TO THE THICKNESS OF THE PARENT METAL.

S5. UNLESS NOTED OTHERWISE, GROUT SHALL BE G1:S3 WITH MINIMUM WATER CONTENT, AND SHALL BE PACKED TIGHT UNDER RELEVANT MEMBERS.

S6. UNLESS NOTED OTHERWISE ALL STEELWORK IS TO HAVE THE FOLLOWING PROTECTIVE COATING SYSTEM:-
- * HOT-DIP GALVANISING COMPLYING WITH SSMO68 SYSTEM 15
- * MINIMUM AVERAGE COATING THICKNESS SHALL BE 600g/m²
- * AFTER ERECTION OF STEELWORK, ALL DAMAGED AREAS TO BE TOUCHED UP TO MATCH ORIGINAL COATING SYSTEM.

STAINLESS STEEL

SS1. STAINLESS STEEL MATERIAL SHALL BE AISI GRADE 316 OR GRADE 316L

SS2. WELDING SHALL COMPLY TO AUSTRALIAN WELDING RESEARCH ASSOCIATION TECHNICAL NOTE 18 "WELDING STAINLESS STEELS

SS3. ALL WELDS ARE TO BE 6MM CONTINUOUS FILLET WELDS OR CONTINUOUS FULL PENETRATION BUTT WELDS.

SS4. ALL WELDS ARE TO BE PASSIVATED.

SS5. ALL STORAGE, FABRICATION AND WELDING OF STAINLESS STEEL SHALL BE CARRIED OUT IN AN AREA SPECIFICALLY DEDICATED TO THE PARTICULAR GRADE OF STAINLESS STEEL BEING USED.

GALVANISING

GV1. ALL MILD STEEL IS TO BE HOT DIPPED GALVANISED AFTER FABRICATION. MINIMUM AVERAGE COATING THICKNESS SHALL BE 600 g/m2

BOLTS

B1. ALL BOLTS ARE TO GRADE 316 STAINLESS STEEL

B2. ALL STAINLESS STEEL BOLTS ARE TO BE INSTALLED WITH ANTI GALLING COMPOUND

WaterCon
AS CONSTRUCTED
NAME: PHIL DIXON
SIGNED:
DATE: 25.5.2010

40 0 40 80 120 160 200
SCALE OF METRES
1 : 5000 FULL SIZE A1 SHEET

4 0 4 8 12 16 20
SCALE OF METRES
1 : 500 FULL SIZE A1 SHEET

AS CONSTRUCTED
PLOTTED _____ DATE _____
CHECKED _____ DATE _____

No.	DATE	AMENDMENT	DRAFTED	APPROVED

FUNDING: DESIGN W.O. No. SQSE/PB00705; FUNDED BY B.C.C. (3) EXTERNAL ( )

DRAFTED	T.A.B. JAN. 2008		
DRAFTING CHECK	A.K.D. MAY 2008		
CAD FILE	S:\00\5001.DWG		
B.C.C. FILE No.			

* DENOTES THE SIGNATURE ON THE ORIGINAL DRAWING

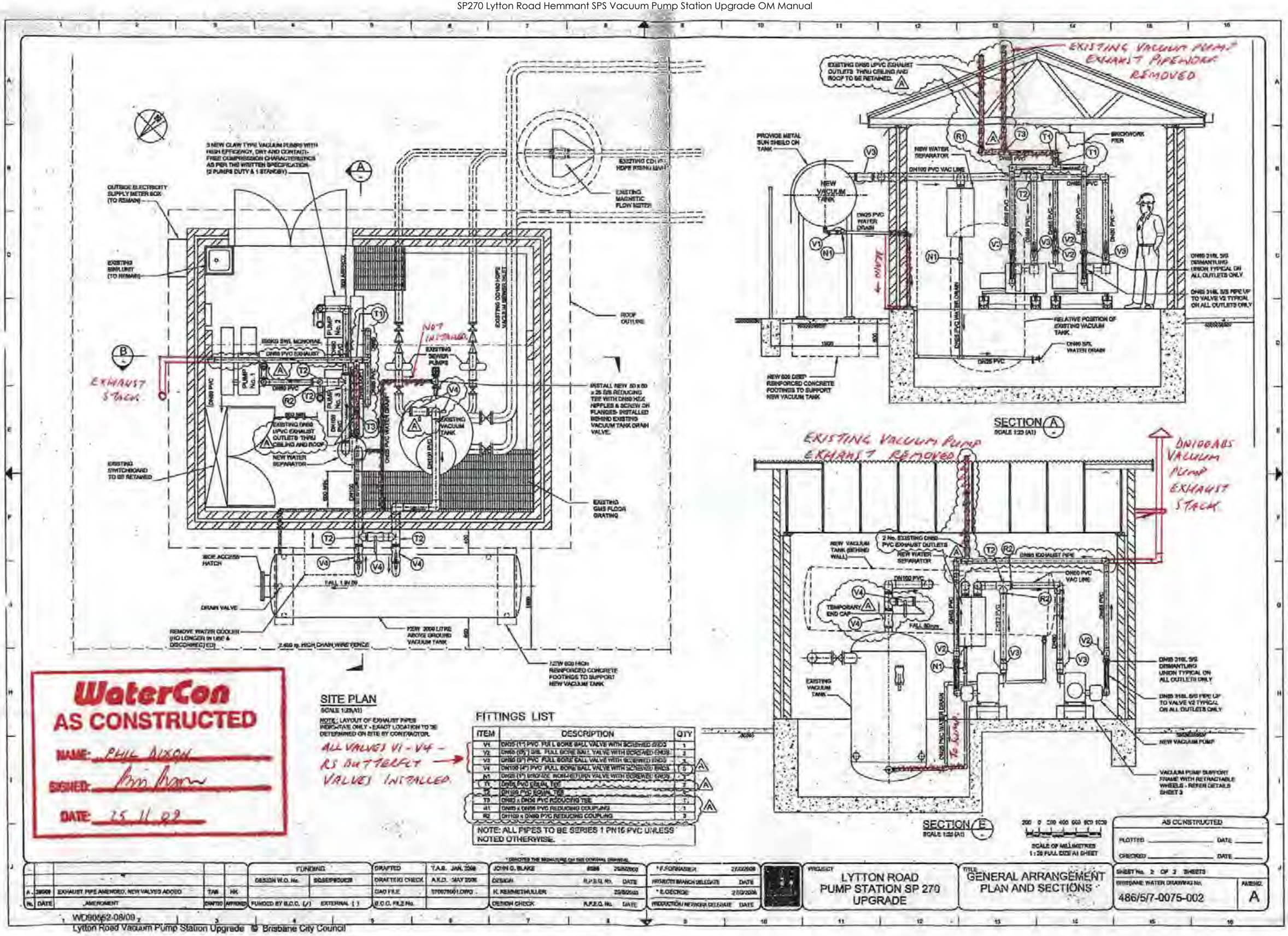
JOHN G. BLAKE	8588	29/5/2008	
DESIGN	R.P.E.Q. No.	DATE	
H. KEMMETMULLER		29/5/2008	
DESIGN CHECK	R.P.E.Q. No.	DATE	

* F.FORNASIER	27/5/2008	
PROJECTS BRANCH DELEGATE	DATE	
* E.GEORGE	27/5/2008	
PRODUCTION / NETWORK DELEGATE	DATE	

PROJECT: LYTTON ROAD PUMP STATION SP 270 UPGRADE

TITLE: LOCALITY PLAN, AND NOTES

SHEET No. 1 OF 3 SHEETS
BRISBANE WATER DRAWING No. 486/5/7-0075-001
AMEND. 0



SITE PLAN

SCALE 1:25(A1)

NOTE: LAYOUT OF EXHAUST PIPES INDICATIVE ONLY - EXACT LOCATION TO BE DETERMINED ON SITE BY CONTRACTOR.

ALL VALVES V1 - V4 - RS BUTTERFLY VALVES INSTALLED

FITTINGS LIST

ITEM	DESCRIPTION	QTY	
V1	DN25 (1") PVC FULL BORE BALL VALVE WITH SCREWED ENDS	1	
V2	DN80 (3") S/S FULL BORE BALL VALVE WITH SCREWED ENDS	3	
V3	DN80 (3") PVC FULL BORE BALL VALVE WITH SCREWED ENDS	3	
V4	DN100 (4") PVC FULL BORE BALL VALVE WITH SCREWED ENDS	5	A
N1	DN25 (1") BRONZE NON-RETURN VALVE WITH SCREWED ENDS	1	
T1	DN80 PVC EQUAL TEE	3	A
T2	DN100 PVC EQUAL TEE	5	
T3	DN80 x DN50 PVC REDUCING TEE	1	
R1	DN80 x DN50 PVC REDUCING COUPLING	1	A
R2	DN100 x DN80 PVC REDUCING COUPLING	3	

NOTE: ALL PIPES TO BE SERIES 1 PN16 PVC UNLESS NOTED OTHERWISE.

WaterCon
AS CONSTRUCTED
NAME: PHIL NIXON
SIGNED:
DATE: 25/11/09

AS CONSTRUCTED
PLOTTED _____ DATE _____
CHECKED _____ DATE _____

No.	DATE	AMENDMENT	DWN	APPROVED
A	28/08	EXHAUST PIPE AMENDED, NEW VALVES ADDED	TAB	HK

FUNDING: DESIGN W.O. No. _____ SCHEDULE No. _____ FUNDED BY B.C.C. (✓) EXTERNAL ( )

DRAFTED T.A.B. JAN. 2008
DRAFTING CHECK A.K.D. MAY 2008
CAD FILE 370078501.DWG
B.C.C. FILE No. _____

JOHN G. BLAKE 4586 25/02/2009 — DESIGN R.P.E.Q. No. DATE
K. KENNETMULLER 25/02/2009 — DESIGN CHECK R.P.E.Q. No. DATE

* F.FORMAN 27/02/2009 — PROJECTS BRANCH DELEGATE DATE
* E.DEDRICK 27/02/2009 — PRODUCTION / NETWORK RELEASE DATE

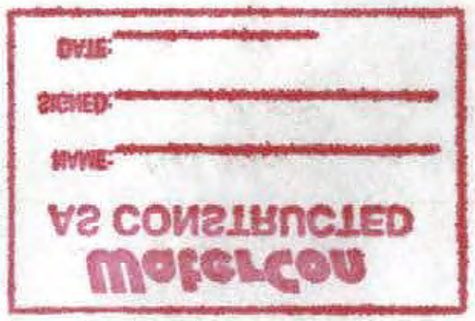
* DENOTES THE SIGNATURE OF THE ORIGINAL DRAWING

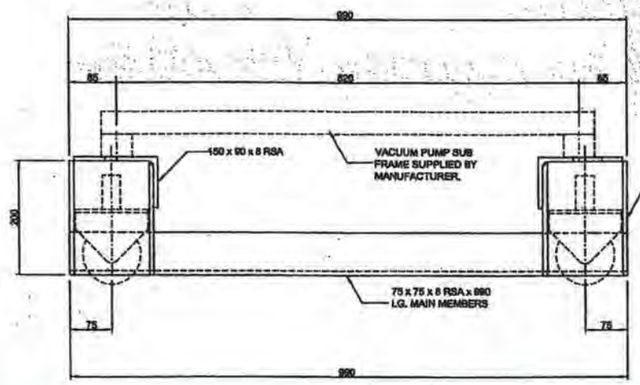
PROJECT: LYTTON ROAD PUMP STATION SP 270 UPGRADE

TITLE: GENERAL ARRANGEMENT PLAN AND SECTIONS

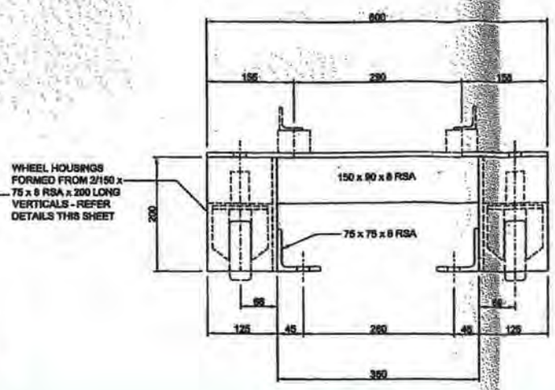
SHEET No. 2 OF 3 SHEETS
BRISBANE WATER DRAWING No. 486/5/7-0075-002
PATENO. A

WD90552-08/09
Lytton Road Vacuum Pump Station Upgrade © Brisbane City Council

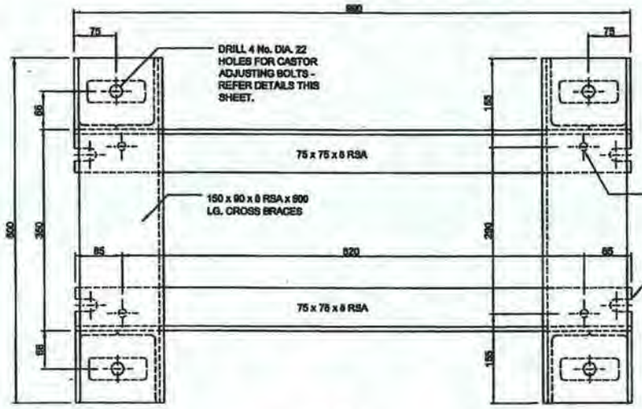

DATE:
SIGNED:
NAME:
AS CONSTRUCTED
Metrofco



SIDE VIEW



END VIEW

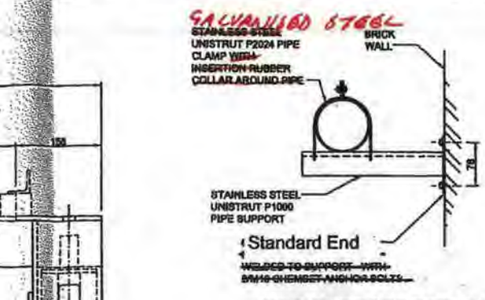


PLAN

DETAIL OF VACUUM PUMP SUPPORT FRAME

SCALE 1:5 (A1)

NOTE : IMPORTANT - SUPPORT FRAME DESIGNED TO SUIT "ZEPHYR VLR 400" CLAW TYPE VACUUM PUMP. TENDERER REQUIRED TO PROVIDE DESIGN FOR PUMP IF AN ALTERNATIVE IS CHOSEN.



PIPE SUPPORT DETAILS

SCALE 1:5 (A1)

NOTE : PLACE PIPE SUPPORTS AT 1500MM MAX. CENTRES BOTH VERTICALLY AND HORIZONTALLY

NOTES

STAINLESS STEEL

SS1. STAINLESS STEEL MATERIAL SHALL BE AISI GRADE 316 OR GRADE 316L.

SS2. WELDING SHALL COMPLY TO AUSTRALIAN WELDING RESEARCH ASSOCIATION TECHNICAL NOTE 16 "WELDING STAINLESS STEELS

SS3. ALL WELDS ARE TO BE 5MM CONTINUOUS FILLET WELDS OR CONTINUOUS FULL PENITRATION BUTT WELDS.

SS4. ALL WELDS ARE TO BE PASSIVATED.

SS5. ALL STORAGE, FABRICATION AND WELDING OF STAINLESS STEEL SHALL BE CARRIED OUT IN AN AREA SPECIFICALLY DEDICATED TO THE PARTICULAR GRADE OF STAINLESS STEEL BEING USED.

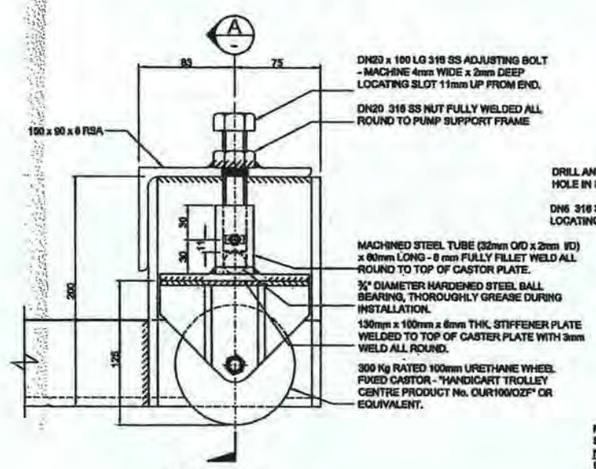
GALVANISING

GV1. ALL MILD STEEL IS TO BE HOT DIPPED GALVANISED AFTER FABRICATION. MINIMUN AVERAGE COATING THICKNESS SHALL BE 600 g/m2

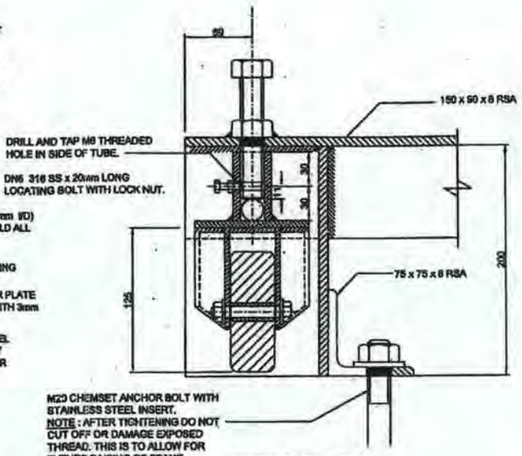
BOLTS

B1. ALL BOLTS ARE TO GRADE 316 STAINLESS STEEL.

B2. ALL STAINLESS STEEL BOLTS ARE TO BE INSTALLED WITH ANTI GALLING COMPOUND

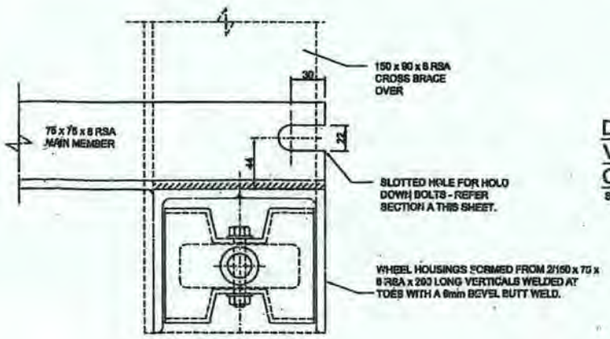


SIDE VIEW
(WHEEL DEPICTED IN LOWERED POSITION)



(WHEEL DEPICTED IN RETRACTED POSITION)

SECTION (A)
SCALE 1:25 (A1)



PLAN DETAIL

DETAIL OF ADJUSTABLE VACUUM PUMP SUPPORT CASTER WHEELS

SCALE 1:2.5 (A1)

200 0 200 400 600 800 1000
SCALE OF MILLIMETRES
1 : 25 FULL SIZE A1 SHEET

20 0 20 40 60 80 100
SCALE OF METRES
1 : 10 FULL SIZE A1 SHEET

40 0 40 80 120 160 200
SCALE OF METRES
1 : 5 FULL SIZE A1 SHEET

20 0 20 40 60 80 100
SCALE OF MILLIMETRES
1 : 2.5 FULL SIZE A1 SHEET

WaterCon
AS CONSTRUCTED
NAME: PHIL SIXON
SIGNED:
DATE: 25.11.09

AS CONSTRUCTED
PLOTTED _____ DATE _____
CHECKED _____ DATE _____

No.	DATE	AMENDMENT	DRAFTED	APPROVED

FUNDING: DESIGN W.O. No. SQSS/PB00785; FUNDED BY B.C.C. (3) EXTERNAL ( )

DRAFTED	T.A.B. JAN. 2008	JOHN G. BLAKE	29/5/2008
DRAFTING CHECK	A.K.D. MAY 2008	DESIGN	R.P.E.Q. No. DATE
CAD FILE	570075001.DWG	H. KEMMETMULLER	29/5/2008
B.C.C. FILE No.		DESIGN CHECK	R.P.E.Q. No. DATE

* DENOTES THE SIGNATURE ON THE ORIGINAL DRAWING.

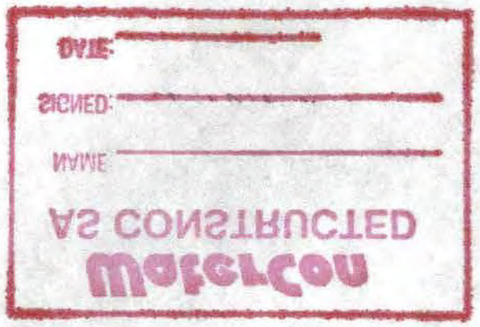
* F.FORNASIER	27/6/2008
PROJECTS BRANCH DELEGATE	DATE
* E.GEORGE	27/6/2008
PRODUCTION / NETWORK DELEGATE	DATE

PROJECT: LYTTON ROAD PUMP STATION SP 270 UPGRADE

TITLE: DETAILS OF PIPEWORK & PUMP SUPPORT FRAME

SHEET No. 3 OF 3 SHEETS
BRISBANE WATER DRAWING No. 486/5/7-0075-003
AMEND. O

WD90552-08/09 2
Lytton Road Vacuum Pump Station Upgrade © Brisbane City Council


DATE:
SIGNED:
NAME
AS CONSTRUCTED
Matcon

WaterCon
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SECTION 4

ELECTRICAL EQUIPMENT SCHEDULES AND INSTALLATION TEST SHEETS

LYTTON ROAD VACUUM PUMP STATION UPGRADE
CONTRACT WD-90552-08/09
OPERATIONS & MAINTENANCE MANUAL

SJ ELECTRIC PTY LTD

TEST BEFORE YOU TOUCH

15852

TEST SHEET

CUSTOMER NAME: WATERCORP **SWITCHBOARD ID:** **DATE:** 25-11-09

CUSTOMERS ADDRESS: LYTTON ROAD HEMMANT **JOB No.:** WT 4000

C/B NO.	CABLE SIZE	C/B SIZE	N NO.	CIRCUIT DESCRIPTION	VISUAL INSPECTION	CORRECT CIRCUIT CONNECTION	EARTH CONT.	A - E MΩ	N - E MΩ	A - E VOLTS	A - N VOLTS	Ø - Ø VOLTS	RCD TEST mA	RCD TEST mS	Fault loop impendance measurement
3	6	40	N/A	VAC PUMP 1	✓	Y	.2Ω	>200M	✓	240	✓	415			
4	6	40	N/A	VAC PUMP 2	✓	Y	.2Ω	>200M	✓	240	✓	415			
5	6	40	N/A	VAC PUMP 3	✓	Y	.2Ω	>200M	✓	240	✓	415			

TEST EQUIPMENT: Megger

SERIAL NO: 512306O

TEST DUE DATE: 9-4-10

NAME: Andy Worsley

LIC NO: A30223

SIGNATURE:

SJ-61 ISSUE 2

WT[redacted]59 -CS-001 Rev1

Lytton Rd Cable Schedule

CABLE SCHEDULE

Cable No.	From	To	Type	Cable Type	Voltage	Size (sq mm)	Length (m)	Comments
P01	main switchboard	Vac pump 1	Power 3 core & E	PVC/PVC	415v	2.5mm	15	
P02	main switchboard	Vac pump 2	Power 3 core & E	PVC/PVC	415v	2.5mm	15	
P03	main switchboard	Vac pump 3	Power 3 core & E	PVC/PVC	415v	2.5mm	15	
C01	main switchboard	No1 vac tank	mulittode	special	24v	1.5mm	15	
C02	main switchboard	No1 vac tank High level	mulittode	special	24v	1.5mm	15	
C03	main switchboard	Sump level multitrode	mulittode	special	24v	1.5mm	15	
C05	main switchboard	New vac tank level	mulittode	special	24v	1.5mm	15	

SJ Electric Group Pty Ltd

Appendix C & D Motor Testsheet
In process
Appendix C

Ref: SJQF 538
24/11/2009

Cables only tested VSD on Motors.

Tag	DRIVE or ITEM	Voltage	"In Process " Test Report 240/415 Volt Motors — Test insulation resistance IR value for all 240v at 500vdc and 415v motors at 1000vdc Prior to energising. Record results below.																
			Motor Nameplate Details					Tested Between						Test Eqpt.					
			Brand Name	Serial No.	Watts	Conn. S/D	FLA	U-Eth	V-Eth	W-Eth	U-V Ohms	U-W Ohms	V-W Ohms	Type	Ser. No.	Calbration Due	Tested By	Licence No.	Date	Signed
Pump1	Vacuum Pump 1	415	DANFOSS	[illegible]	7.5 Kw	D	18	>200M	>200M	>200M	✓	✓	✓	MEGGER	S123060	9-4-10	ANDY	A30725	25-11-09	
Pump2	Vacuum Pump 2	415	DANFOSS	[illegible]	7.5kw	D	18	>200M	>200M	>200M	✓	✓	✓	MEGGER	S123060	9-4-10	ANDY	A30725	25-11-09	
Pump3	Vacuum Pump 3	415	DANFOSS.	[illegible]	7.5kw	D	18	>200M	>200M	>200M	✓	✓	✓	MEGGER	S123060	9-4-10	ANDY	A30725	25-11-09	

SJ Electric Group Pty Ltd

Appendix C & D Motor Testsheet
Final
Appendix D

Ref: SJQF 538
24/11/2009

Tag	DRIVE or ITEM	Voltage	"Final" Test Report 240/415 Motors Readings to be taken under operating conditions										
			FLC		Test Eqpt.								
			Test Eqt. Read	Ammeter Read	Type	Ser. No.	Calibration Date	Overload Setting	Seal Fail Operation	Thermistor operation	Date	Signed	Comment
Pump1	Vacuum Pump 1	415	12.5A	17A	CLAMP	S9509017L	9-4-10	23A	N/A	N/A	25-11-09		AMMETER RATIO INCORRECT
Pump2	Vacuum Pump 2	415	12.5A	15A	CLAMP	S9509017L	9-4-10	18A	N/A	N/A	25-11-09		AMMETER RATIO INCORRECT
Pump3	Vacuum Pump 3	415	12.5A		CLAMP	S9509017L	9-4-10	18A	N/A	N/A	25-11-09		

VACUUM SEWAGE PUMP STATION

ADDITIONAL VACUUM PUMP COMMISSIONING PLAN

Site ID and Name	SP 270 LYTTON RD
Commissioning Date	26/11/09

In Attendance

Name	Role During Commissioning	Company
John Clayton	Commissioning Manager	BWD Projects
ANDY WALMSLY.	ELECTRICIAN	SJ Electric

1 PRE – COMMISSION WORKS CHECKLIST

The following checklist is to be completed and signed by the electrical contractor.

Switchboard Contractor Task	Completed
Check all point to point checks have been completed and any faults rectified. ✓	1/1 09
Check all test sheets are completed. Civil not Ready Motor Ready to Run	1/1 09

1.1.1 Register with Control Room

Contractor Task	Outcome
Call the Brisbane Water Control Room Operator (CRO) and inform him that you are on site. Record the CRO's Name and Officer Code and record the time of the call. Advise CRO that you are performing a switchboard changeover and that you will initially be taking one pump off line. Give the operator a contact name and number and ask that he contact you if any level alarm is activated on site.	Name: BOB CRO: _____ Time: 0700.

1.1.2 New Pump Switchboard Parameters

Contractor Task	Outcome
Ensure that the station is fully functional (pump can run)	OK ☐
Record 3 phase motor currents of name plate pump #3	U.___ V.___ W.___ 12.5 amps
Record pump rotation **Mains** Supply C'wise (RWB) ☐ Anti C'wise ☐ ✓ Pump #3 Pump Running in Correct Direction	C'wise (RWB) Anti C'wise ☐ ✓ ☐

1.2 STEP 2 – RUN NEW PUMP

Contractor Task	Outcome
At the beginning of this procedure, Pump #1 and #2 are operatoring under the control of the RTU	OK ☑
Isolate Vacuum Pump #1 and Pump #2 at the **switchboard**, as per BW Isolation and Lock Out procedure.	OK ☐
Before beginning the next step ensure that the pressure is between 'Start' and 'Stop' level and Pumps are not running.	OK ☐
Check the rotation by starting the pump manually. Monitor pump / vacuum level operating parameters.	OK ☐
Check the 3 phase motor current and compare with parameter readings. ✓	A _____ Amps B _____ Amps C _____ Amps
De-isolate Pump #1 and #2 so that the station is again under the control of the RTU	OK ☐

Electrical Contactor's Supervisor

Name: Barry Mawhinney Date: 26-11-09.

Signature: .....

BW Commissioning Manager

Name: John Clayton..... Date: 26/11/09

Signature: J Clayton

1.3 STEP 3 - CONNECT FIELD INSTRUMENTATION TO THE SWITCHBOARD

1.3.1 Field Devices

Contractor Task	Outcome
Multitrode vessel high level relay Probe	OK ☑ at ___ Mtrs
	100mm from Bottom of Tank

1.3.2 Telemetry and SCADA Communications Checks

BW Programmer Task	Outcome
Brisbane Water programmer must complete the following procedures *From the _____ vacuum Sewage Pumping Station (S.A.T.)* *Section 1: Setup and Pre-Commissioning Checks*	OK ☐

1.4 STEP 4 - COMMISSIONING PUMP #3

BW Programmer & Contractor Task	Outcome
Before doing the next step ensure that the vacuum level is between 'Start' and 'Stop' level and Pump #1 and 2 are not running. **Isolate Pump #1 and 2 to prevent it from running during the next test.**	OK ☐
At this stage the Brisbane Water Programmer must complete the following procedures *From the _____ vacuum Pumping Station (S.A.T.)* *Section2 : On Site Commissioning Procedure (Pump #1 Only)*	OK ☐
Once Pump #3 has been commissioned, leave the switchboard controlled be the RTU	OK ☐

Electrical Contactor's Supervisor

Name:..... ..... Date: ....

Signature: ....

BW Commissioning Manager

Name:...John Clayton..... Date: 26/11/09

Signature: J Clayton

1.5 STEP 5 - COMPLETE TESTING

1.5.1 Site Acceptance Testing (S.A.T) – Remaining Tests

BW Programmer & Contractor Task	Outcome
Once pump 3 has been commissioned Complete any **remaining procedures in Section 2** ***from the _____ vacuum Sewage Pumping Station (S.A.T.)***	OK ☐
Check operation of the vessel high level with the probe to prove to the RTU	OK ☐
Confirm automatic control of pumps.	OK ☐

1.5.2 SCADA Testing

BW Programmer & Contractor Task	Outcome
The Brisbane Water Programmer must complete the following procedures with the assistance from the Commissioning Engineer and SCADA Commissioning Engineer in the Control Room. ***From the _____ vacuum Sewage Pumping Station (S.A.T.)*** ***Section3 :* SCADA Commissioning Procedure**	OK ☐

1.5.3 Preliminary Work Completion by Electrical Contractors

Contractor Task	Outcome
Leave the site clean and tidy and hazard free.	OK ☐
Confirm with BW that the job is complete and their staff can leave.	OK ☐
Confirm with BW that BW staff will lock up the site on completion of the switchboard work.	OK ☐
Note: If there is a problem with finishing the work due to unforeseen circumstance refer to **the Risk Analysis attached.**	OK ☐

1.5.4 Register Control Room

BW Programmer & Contractor Task	Outcome
Commissioning Engineer to call the Control Room Operator (CRO) and inform him that the site works is complete and that the site is now fully in "Remote" control and that all alarms are to be acted on as per the alarm instructions. C.R.O. to confirm that the site is healthy and that there are no alarms active. Record the C.R.O.'s name and Officer Code and record the time of the call.	Name._____ CRO _____ TIME: _____

BW Commissioning Manager

Name:.....John Clayton..... Date: 26/11/09

Signature: J. Clayton

2 POST CHANGE OVER CHECKLIST

2.1 DELIVERABLES FROM RTU PROGRAMMER

BW Programmer	Date Completed
Within 7 days of the change over the following must be completed and signed off by the BW Programmer0 Complete Section 4: Post Commissioning *from the _____ vacuum Sewage Pumping Station (S.A.T.)*	/ /
The BW Programmer will ensure that the Control Room Acceptance (CRA) form is signed by the Manager of the Control Room Officers. The form is to be handed to the Contracts Manager (CM).	/ /

2.2 DELIVERABLES FROM ELECTRICAL CONTRACTOR

Contractor Task	Date Completed
All documentation required under the contract is to be provided with the time specified (AS BUILT's, Electrical Certificates etc).	/ /

2.3 DELIVERABLES FROM COMMISSIONING MANAGER

Commissioning Manager	Date Completed
All documentation is handed to the Project Manager to that the switchboard asset can be capitalised and handed over to the customer.	
Electrical Inspection Sheet – Completed & signed off.	OK ☐
Site Acceptance Test Sheet – Completed & signed off.	OK ☐
Commissioning Plan – Completed & signed off.	OK ☐
Control Room Acceptance Form – Completed & signed off	OK ☐
As built Drawings have been updated, drafted and taken to site along with the Site Specific Functional Specification,	/ /

2.4 SUGGESTIONS FOR IMPROVEMENT

Suggestion	Recommended By

BW Commissioning Manager

Name:.....John Clayton..... Date: 26/11/09

Signature: .....J. Clayton.....

SJ ELECTRIC PTY LTD
Queensland

Ref: Test Certificate P270.doc

TEST CERTIFICATE

SJ Electric (Qld) Pty. Ltd.
19 Elliot Street.
Albion Qld. 4010
R.E.C. 7623

Attention: Wendy Wong

Level 2 TC Beirne Centre, 315 Brunswick Street Mall, Fortitude Valley Q 4006

Work performed for Brisbane Water at SP270 at Lytton Road under contract WD90552-08/09 (SJ Electric Job Number WT400059)

Installation Tested.
Switchboard modifications and new vacuum sewage pump.

Test Date
26/11/09

Testing.
The certificate certifiy's that the electrical installation to the extent it is affected by the electrical work has been tested to ensure it is electrically safe and is in accordance with the requirements of the wiring rules and the electrical safety regulation 2002. C.J. Holmes (endorsee to electrical contracting license 7623)

Signed.

TECHNICAL DATA SHEET

For

VACUUM SEWERAGE PUMP STATION SP270
Lytton rd

Equipment Type:	Circuit Breaker
Location:	VACUUM PUMP No.3 CIRCUIT BRACKER 40A
Model Numbers:	DTCB10340C
Manufacturer:	Terasaki
Supplier:	NHP Pty Ltd 25 Turbo Drive Coorparoo QLD 4151 Ph: 07 3891 6008 Fx: 07 3891 6139

TECHNICAL DATA SHEET

For

VACUUM SEWERAGE PUMP STATION SP270 LYTTON rd

Equipment Type:	Transducer
Location:	Switchboard
Model Numbers:	253-TALW 0-50A 240VAC 4-20ma
Manufacturer:	Crompton
Supplier:	Crompton Instruments Tyco Electronics Unit 1/4 Reaghs Farm Rd Minto NSW 2566 Australia Tel:+61296032066

TECHNICAL DATA SHEET

For

VACCUM SEWERAGE PUMP STATION SP270 LYTTON rd

Equipment Type:	Contactor 3P 7.5Kw
Location:	Switchboard
Model Numbers:	CA7-16-10240VAC+CT 7K-17-7.5
Manufacturer:	Sprecher & Schuh
Supplier:	NHP Pty Ltd 25 Turbo Drive Coorparoo QLD 4151 Ph: 07 3891 6008 Fx: 07 3891 6139

TECHNICAL DATA SHEET

For

VACUUM SEWERAGE PUMP STATION SP270 LYTTON rd

Equipment Type:	Multitrode
Location:	Switchboard
Model Numbers:	MTR
Manufacturer:	Multitrode
Supplier:	Multitrode Pty Ltd. Australia Brisbane Technology Park 18 Brandl Street PO Box 4633 Eight Mile Plains QLD 4113 Tel:+61733407000 Fax:+61733407077 sales@multitrode.com.au

WT4(CS-001 Rev1·

Lytton Rd Cable Schedule

CABLE SCHEDULE

Cable No.	From	To	Type	Cable Type	Voltage	Size (sq mm)	Length (m)	Comments
P01	main switchboard	Vac pump 1	Power 3 core & E	PVC/PVC	415v	2.5mm	15	
P02	main switchboard	Vac pump 2	Power 3 core & E	PVC/PVC	415v	2.5mm	15	
P03	main switchboard	Vac pump 3	Power 3 core & E	PVC/PVC	415v	2.5mm	15	
C01	main switchboard	No1 vac tank	mulittode	special	24v	1.5mm	15	
C02	main switchboard	No1 vac tank High level	mulittode	special	24v	1.5mm	15	
C03	main switchboard	Sump level multitrode	mulittode	special	24v	1.5mm	15	
C05	main switchboard	New vac tank level	mulittode	special	24v	1.5mm	15	

VACUUM SEWAGE PUMP STATION

ADDITIONAL VACUUM PUMP COMMISSIONING PLAN

Site ID and Name	SP 270 LYTTON RD
Commissioning Date	26/11/09

In Attendance

Name	Role During Commissioning	Company
John Clayton	Commissioning Manager	BWD Projects
ANDY WALMSLY.	ELECTRICIAN	SJ Electric

1 PRE – COMMISSION WORKS CHECKLIST

The following checklist is to be completed and signed by the electrical contractor.

Switchboard Contractor Task	Completed
Check all point to point checks have been completed and any faults rectified. ✓	11/1 09
Check all test sheets are completed. Could not Megga motor as it's VFD. Meggy test run	11/1 09

1.1.1 Register with Control Room

Contractor Task	Outcome
Call the Brisbane Water Control Room Operator (CRO) and inform him that you are on site. Record the CRO's Name and Officer Code and record the time of the call. Advise CRO that you are performing a switchboard changeover and that you will initially be taking one pump off line. Give the operator a contact name and number and ask that he contact you if any level alarm is activated on site.	Name: Bob CRO: ____ Time: 0700.

1.1.2 New Pump Switchboard Parameters

Contractor Task	Outcome
Ensure that the station is fully functional (pump can run)	OK ☐
Record 3 phase motor currents of name plate pump #3	U.___ V.___ W.___ 12.5 amps
Record pump rotation **Mains** Supply C'wise (RWB) ☐ Anti C'wise ☐ ✓ Pump #3 — Pump Running in Correct Direction	C'wise (RWB) ☐ ✓ Anti C'wise ☐

1.2 STEP 2 – RUN NEW PUMP

Contractor Task	Outcome
At the beginning of this procedure, Pump #1 and #2 are operatoring under the control of the RTU	OK ☑
Isolate Vacuum Pump #1 and Pump #2 at the **switchboard**, as per BW Isolation and Lock Out procedure.	OK ☐
Before beginning the next step ensure that the pressure is between 'Start' and 'Stop' level and Pumps are not running.	OK ☐
Check the rotation by starting the pump manually. Monitor pump / vacuum level operating parameters.	OK ☐
Check the 3 phase motor current and compare with parameter readings. ✓	A ______ Amps B ______ Amps C ______ Amps
De-isolate Pump #1 and #2 so that the station is again under the control of the RTU	OK ☐

Electrical Contactor's Supervisor	BW Commissioning Manager
Name: Andy Walmsley Date: 25-11-09.	Name: John Clayton Date: 26/11/09
Signature: [signature]	Signature: J. Clayton

1.3 STEP 3 - CONNECT FIELD INSTRUMENTATION TO THE SWITCHBOARD

1.3.1 Field Devices

Contractor Task	Outcome
Multitrode vessel high level relay Probe	OK ☑ at ___ Mtrs
	100mm FROM Bottom of Tank

1.3.2 Telemetry and SCADA Communications Checks

BW Programmer Task	Outcome
Brisbane Water programmer must complete the following procedures ***From the _____ vacuum Sewage Pumping Station (S.A.T.)*** ***Section 1: Setup and Pre-Commissioning Checks***	OK ☐

1.4 STEP 4 - COMMISSIONING PUMP #3

BW Programmer & Contractor Task	Outcome
Before doing the next step ensure that the vacuum level is between 'Start' and 'Stop' level and Pump #1 and 2 are not running. **Isolate Pump #1 and 2 to prevent it from running during the next test.**	OK ☐
At this stage the Brisbane Water Programmer must complete the following procedures ***From the _____ vacuum Pumping Station (S.A.T.)*** ***Section2 : On Site Commissioning Procedure (Pump #1 Only)***	OK ☐
Once Pump #3 has been commissioned, leave the switchboard controlled be the RTU	OK ☐

Electrical Contactor's Supervisor

Name:..... ..... Date: ....

Signature: ....

BW Commissioning Manager

Name:...John Clayton..... Date: 26/11/09

Signature: J Clayton

1.5 STEP 5 - COMPLETE TESTING

1.5.1 Site Acceptance Testing (S.A.T) – Remaining Tests

BW Programmer & Contractor Task	Outcome
Once pump 3 has been commissioned Complete any **remaining procedures in Section 2** ***from the _____ vacuum Sewage Pumping Station (S.A.T.)***	OK ☐
Check operation of the vessel high level with the probe to prove to the RTU	OK ☐
Confirm automatic control of pumps.	OK ☐

1.5.2 SCADA Testing

BW Programmer & Contractor Task	Outcome
The Brisbane Water Programmer must complete the following procedures with the assistance from the Commissioning Engineer and SCADA Commissioning Engineer in the Control Room. ***From the _____ vacuum Sewage Pumping Station (S.A.T.)*** ***Section3 :* SCADA Commissioning Procedure**	OK ☐

1.5.3 Preliminary Work Completion by Electrical Contractors

Contractor Task	Outcome
Leave the site clean and tidy and hazard free.	OK ☐
Confirm with BW that the job is complete and their staff can leave.	OK ☐
Confirm with BW that BW staff will lock up the site on completion of the switchboard work.	OK ☐
Note: If there is a problem with finishing the work due to unforeseen circumstance refer to **the Risk Analysis attached**.	OK ☐

1.5.4 Register Control Room

BW Programmer & Contractor Task	Outcome
Commissioning Engineer to call the Control Room Operator (CRO) and inform him that the site works is complete and that the site is now fully in "Remote" control and that all alarms are to be acted on as per the alarm instructions. C.R.O. to confirm that the site is healthy and that there are no alarms active. Record the C.R.O.'s name and Officer Code and record the time of the call.	Name._____ CRO _____ TIME: _____

BW Commissioning Manager

Name:.....John Clayton..... Date: 26/11/09

Signature: J. Clayton

2 POST CHANGE OVER CHECKLIST

2.1 DELIVERABLES FROM RTU PROGRAMMER

BW Programmer	Date Completed
Within 7 days of the change over the following must be completed and signed off by the BW Programmer0 Complete Section 4: Post Commissioning *from the _____ vacuum Sewage Pumping Station (S.A.T.)*	/ /
The BW Programmer will ensure that the Control Room Acceptance (CRA) form is signed by the Manager of the Control Room Officers. The form is to be handed to the Contracts Manager (CM).	/ /

2.2 DELIVERABLES FROM ELECTRICAL CONTRACTOR

Contractor Task	Date Completed
All documentation required under the contract is to be provided with the time specified (AS BUILT's, Electrical Certificates etc).	/ /

2.3 DELIVERABLES FROM COMMISSIONING MANAGER

Commissioning Manager	Date Completed
All documentation is handed to the Project Manager to that the switchboard asset can be capitalised and handed over to the customer.	
Electrical Inspection Sheet – Completed & signed off.	OK ☐
Site Acceptance Test Sheet – Completed & signed off.	OK ☐
Commissioning Plan – Completed & signed off.	OK ☐
Control Room Acceptance Form – Completed & signed off	OK ☐
As built Drawings have been updated, drafted and taken to site along with the Site Specific Functional Specification,	/ /

2.4 SUGGESTIONS FOR IMPROVEMENT

Suggestion	Recommended By

BW Commissioning Manager

Name:.....John Clayton..... Date: 26/11/09

Signature: .....J. Clayton.....

SJ ELECTRIC PTY LTD
Queensland

Ref: Test Certificate P270.doc

TEST CERTIFICATE

SJ Electric (Qld) Pty. Ltd.
19 Elliot Street
Albion Qld. 4010
R.E.C. 7623

Attention: Wendy Wong

Level 2 TC Beirne Centre, 315 Brunswick Street Mall, Fortitude Valley Q 4006

Work performed for Brisbane Water at SP270 at Lytton Road under contract WD90552-08/09 (SJ Electric Job Number WT400059)

Installation Tested.
Switchboard modifications and new vacuum sewage pump.

Test Date
26/11/09

Testing.
The certificate certifiy's that the electrical installation to the extent it is affected by the electrical work has been tested to ensure it is electrically safe and is in accordance with the requirements of the wiring rules and the electrical safety regulation 2002. C.J. Holmes (endorsee to electrical contracting license 7623)

Signed.

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SECTION 5

ELECTRICAL 'AS CONSTRUCTED' PLANS

LYTTON ROAD VACUUM PUMP STATION UPGRADE
CONTRACT WD-90552-08/09
OPERATIONS & MAINTENANCE MANUAL

SP270
LYTTON ROAD, MURRARIE
SEWAGE PUMPING STATION
SITE COVER SHEET

Drg	Rev	Title - STANDARD SEWAGE VACUUM PUMP STATION -	SHT OF 14
486/5/7-0075-008	A	SP270 COVER SHEET	0
486/7/25-AA1C0051E	B	SP270 ELECTRICAL SCHEMATIC & THREE LINE DIAGRAM 1/5	1
486/7/25-AA1C0052E	C	SP270 ELECTRICAL SCHEMATIC & THREE LINE DIAGRAM 2/5	2
486/7/25-AA1C0053E	C	SP270 ELECTRICAL SCHEMATIC & THREE LINE DIAGRAM 3/5	3
486/7/25-AA1C0054E	B	SP270 ELECTRICAL SCHEMATIC & THREE LINE DIAGRAM 4/5	4
486/7/25-AA1C0055E	B	SP270 ELECTRICAL SCHEMATIC & THREE LINE DIAGRAM 5/5	5
486/7/25-AA1C0056E	B	SP270 TERMINATION DIAGRAM - 24VDC DISTRIBUTION	6
486/7/25-AA1C0057E	C	SP270 TERMINATION DIAGRAM - SLOT 1 - DIGITAL INPUTS	7
486/7/25-AA1C0058E	C	SP270 TERMINATION DIAGRAM - SLOT 2 - DIGITAL INPUTS	8
486/7/25-AA1C0059E	B	SP270 TERMINATION DIAGRAM - SLOT 3 - DIGITAL INPUTS	9
486/7/25-AA1C0060E	B	SP270 TERMINATION DIAGRAM - SLOT 4 - DIGITAL INPUTS	10
486/7/25-AA1C0061E	C	SP270 TERMINATION DIAGRAM - SLOT 5 - DIGITAL OUTPUTS	11
486/7/25-AA1C0062E	B	SP270 TERMINATION DIAGRAM - SLOT 6 - ANALOG INPUTS	12
486/5/7-0075-006	A	SP270 TERMINATION DIAGRAM - SLOT 7 - DIGITAL I/O	13
486/5/7-0075-007	B	SP270 SWITCHBOARD LAYOUT	14

ELECTRICAL AS BUILT DETAILS
REV COMPANY
CONTRACTOR LICENCE No.
ELECTRICIAN DATE:

AS BUILT

No	DATE	AMENDMENT	DRN.	APD.
B	01.10	AS BUILT	EP	.
A	09.09	ISSUED FOR CONSTRUCTION	DPM	AW
0	27.05.09	ISSUED FOR TENDER	DPM	AW

FUNDING
DESIGN W.O. No.
CONSTRUCTION W.O. No.
FUNDED BY B.C.C. (✓) EXTERNAL ( )

DRAFTED	P.MOSTERT	05.09	
DRAFTING CHECK	P.HAGUE	05.09	
CAD FILE	570075008		
B.C.C. FILE No.			

DESIGN R.P.E.Q. No. DATE
DESIGN CHECK R.P.E.Q. No. DATE
PRINCIPAL DESIGN MANAGER DATE
CLIENT DELEGATE DATE

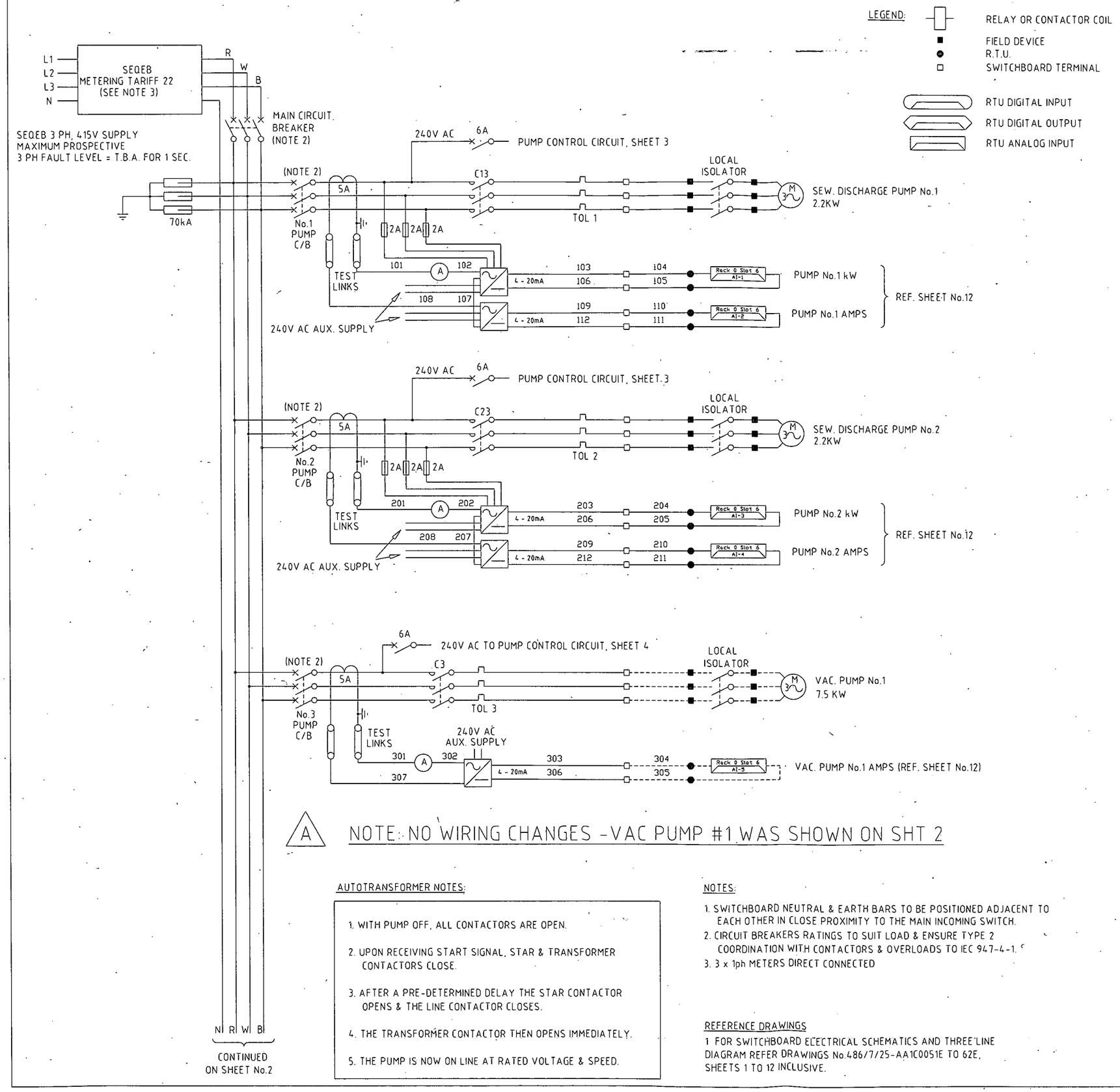
BRISBANE WATER

PROJECT
VACUUM SEWAGE PUMP STATION
VAC PUMP #3 UPGRADE

TITLE
SP270 SWITCHBOARD
SITE COVER SHEET

SHEET No. 0
BRISBANE WATER DRAWING No. 486/5/7-0075-008
AMEND. B

G:\194 WATER SUPPLY\68 Drafting\6348 Plans\Electrical\2. SEWERAGE\NETWORKS\SP270 Lyton Rd #3\VacPump#3Upgrade\Construction\570075008S.dwg Last Saved by 062870 on Tuesday, 5 January 2010 4:01:40 PM



A NOTE: NO WIRING CHANGES - VAC PUMP #1 WAS SHOWN ON SHT 2

AUTOTRANSFORMER NOTES:

1. WITH PUMP OFF, ALL CONTACTORS ARE OPEN.
2. UPON RECEIVING START SIGNAL, STAR & TRANSFORMER CONTACTORS CLOSE.
3. AFTER A PRE-DETERMINED DELAY THE STAR CONTACTOR OPENS & THE LINE CONTACTOR CLOSES.
4. THE TRANSFORMER CONTACTOR THEN OPENS IMMEDIATELY.
5. THE PUMP IS NOW ON LINE AT RATED VOLTAGE & SPEED.

NOTES:

1. SWITCHBOARD NEUTRAL & EARTH BARS TO BE POSITIONED ADJACENT TO EACH OTHER IN CLOSE PROXIMITY TO THE MAIN INCOMING SWITCH.
2. CIRCUIT BREAKERS RATINGS TO SUIT LOAD & ENSURE TYPE 2 COORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.
3. 3 x 1ph METERS DIRECT CONNECTED

REFERENCE DRAWINGS

1 FOR SWITCHBOARD ELECTRICAL SCHEMATICS AND THREE LINE DIAGRAM REFER DRAWINGS No.486/7/25-AA1C0051E TO 62E, SHEETS 1 TO 12 INCLUSIVE.

NOTES

No	DATE	AMENDMENT	INITIALS	
C	02.01.10	AS BUILT	EP	
B	11.09.09	ISSUED FOR CONSTRUCTION	DPM	AW
A	27.05.09	VAC PUMP #3 UPGRADE	DPM	AW
1	10/9/96	WAE	GB	DS
0	28.8.95	ISSUED FOR CONSTRUCTION	R.L.	

AMENDMENT & ISSUE REGISTER

MANAGER DATE:		DIRECTOR OF PLANNING & DESIGN DATE:	
DIRECTOR OF CONSTRUCTION DATE:	DIRECTOR OF M & E SERVICES DATE:	DIRECTOR OF SEW. OPERATIONS/W.S. DISTRIBUTION DATE:	
DESIGN	R.L.	21.11.94	ENGINEER IN CHARGE
DRAWN	R.L.	7.8.95	SUPERVISING ENGINEER.
CHECKED			CADD FILE No. 725C051C.dwg
SURVEYOR			FIELD BOOK
SURVEY JOB No.			A.H.DATUM

REFERENCES

BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY & SEWERAGE
PLANNING & DESIGN BRANCH
Brisbane City

PROJECT

STANDARD SEWAGE VACUUM PUMP STATION.

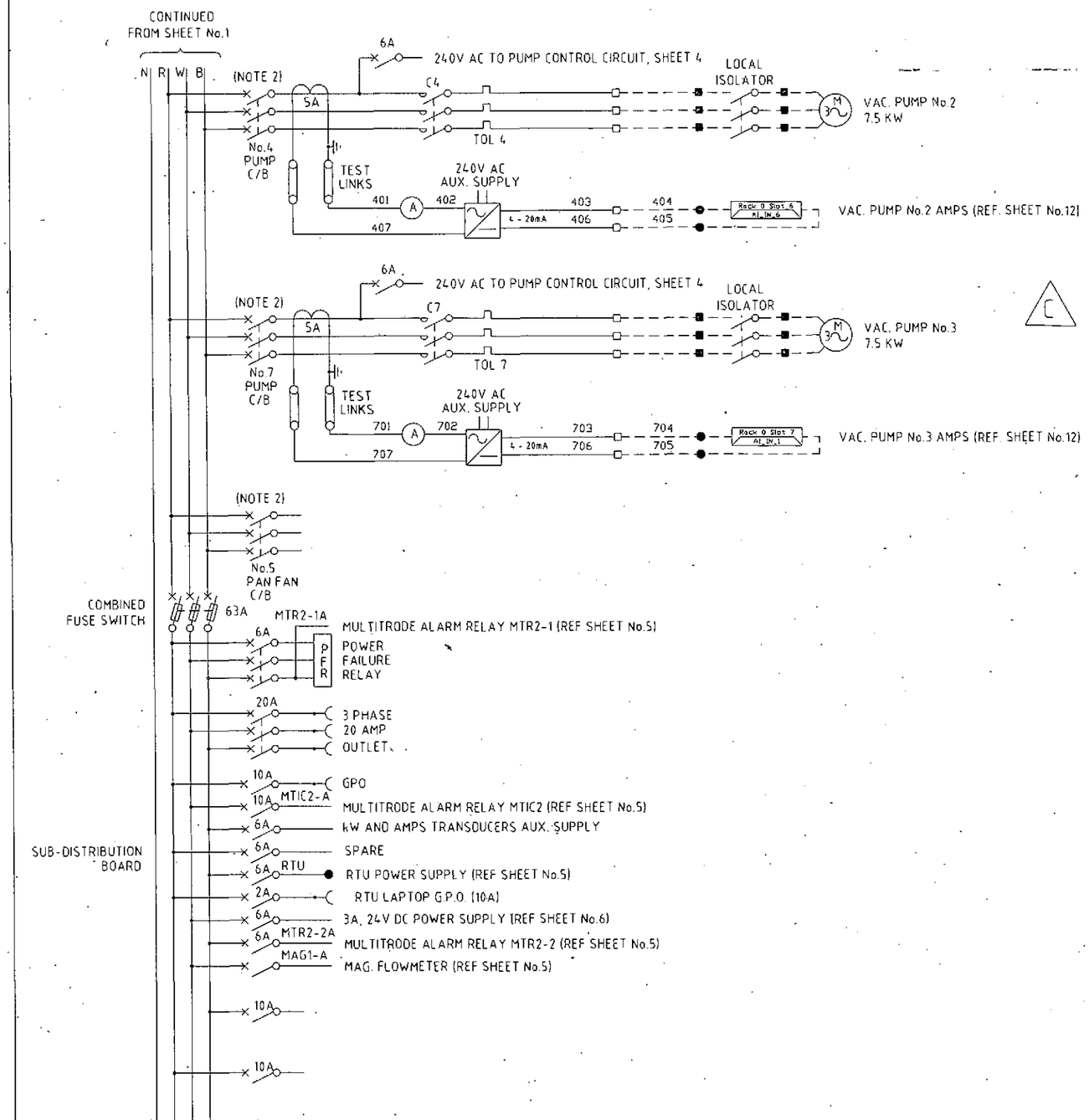
TITLE

SWITCHBOARD SP270
ELECTRICAL SCHEMATIC
& THREE LINE DIAGRAM 1/5

SCALE: N.T.S.	No. 1 OF 14 SHEETS	A3

DRAWING No. 486/7/25-AA1C0051E

AMEND. C



NOTES:

1. SWITCHBOARD NEUTRAL & EARTH BARS TO BE POSITIONED ADJACENT TO EACH OTHER IN CLOSE PROXIMITY TO THE MAIN INCOMING SWITCH.

2. CIRCUIT BREAKERS RATINGS TO SUIT LOAD & ENSURE TYPE 2 COORDINATION WITH CONTACTORS & OVERLOADS TO IEC 947-4-1.

4. TEMPERATURE RELAY ALM1 SETTING MUST BE GREATER THAN ALM2 TEMPERATURE SETTING.

LEGEND:

- RELAY OR CONTACTOR COIL
- FIELD DEVICE
- R.T.U.
- SWITCHBOARD TERMINAL
- RTU DIGITAL INPUT
- RTU DIGITAL OUTPUT
- RTU ANALOG INPUT

NOTES

No	DATE	AMENDMENT	INITIALS	
D	17.11.09	ISSUED FOR CONSTRUCTION	DPM	AW
C	11.09.09	ISSUED FOR CONSTRUCTION	DPM	AW
B	27.05.09	VAC PUMP #3 UPGRADE (& DRG No. WAS STUPIDLY)	DPM	AW
A	13.12.00	R1 & SOL. VALVE ADDED	DPM	
E	02.01.10	AS BUILT	EP	

AMENDMENT & ISSUE REGISTER

MANAGER DATE:	DIRECTOR OF PLANNING & DESIGN DATE:

DIRECTOR OF CONSTRUCTION DATE:		DIRECTOR OF M & E SERVICES DATE:	DIRECTOR OF SEW. OPERATIONS/W.S. DISTRIBUTION DATE:
DESIGN	R.L.	21.11.94	ENGINEER IN CHARGE
DRAWN	R.L.	7.8.95	SUPERVISING ENGINEER
CHECKED			CADD FILE No. 725C052E.dwg
SURVEYOR			FIELD BOOK
SURVEY JOB No.			A.H.DATUM

REFERENCES

BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY & SEWERAGE
PLANNING & DESIGN BRANCH
Brisbane City

PROJECT

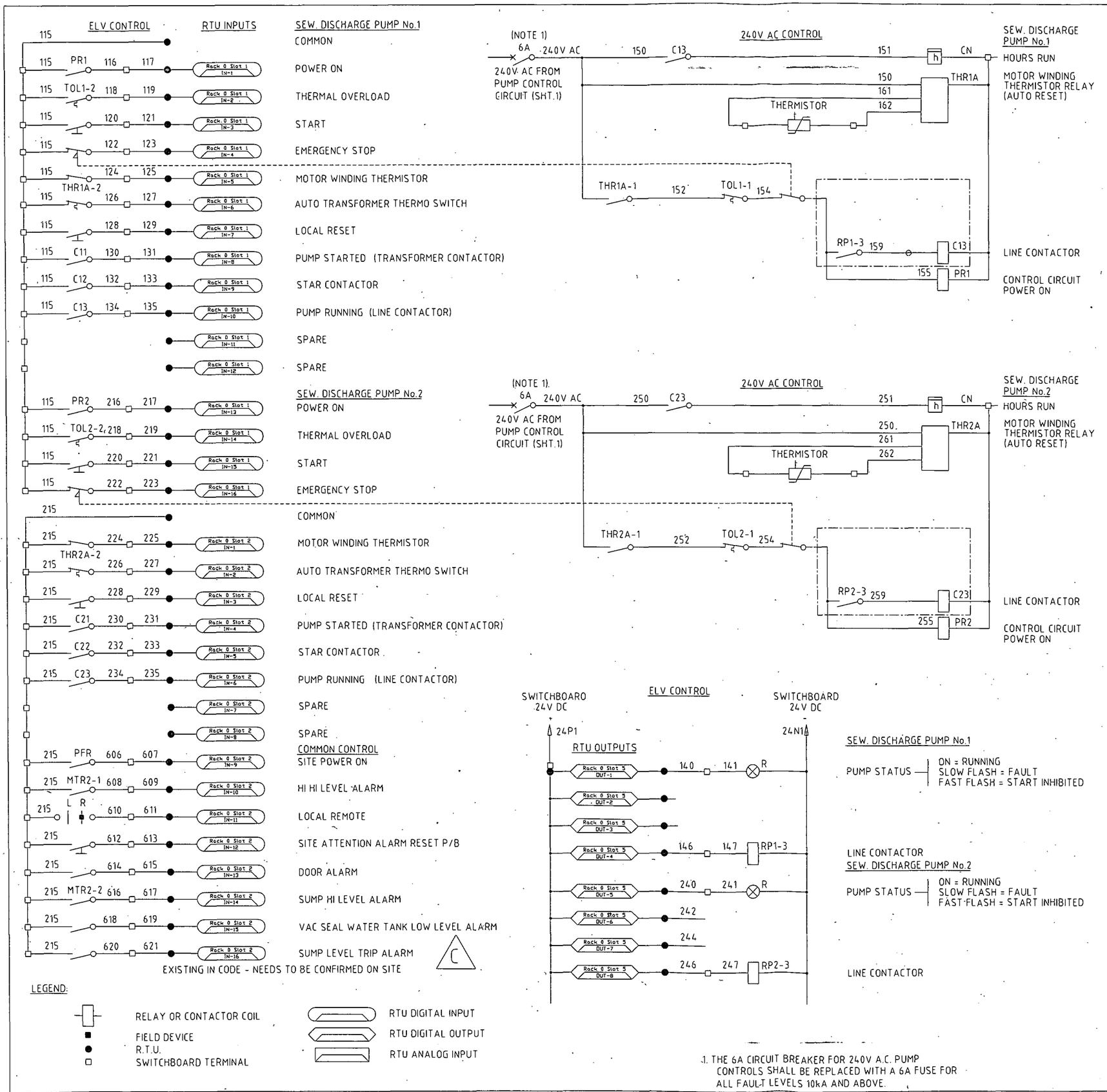
LYTTON Rd HEMMANT SP270
SEWAGE VACUUM PUMP STATION.

TITLE

SP270 - SWITCHBOARD
ELECTRICAL SCHEMATIC
& THREE LINE DIAGRAM 2/2

SCALE: N.T.S.	No. 1 OF 14 SHEETS	A3

DRAWING No.	AMEND.
486/5/7-AA1C0052E	E



NOTES

No	DATE	AMENDMENT	INITIALS	
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B	27.05.09	VAC PUMP #3 UPGRADE	DPM	AW
1	10/9/96	WAE	GB	DS
D	02.01.10	AS BUILT	EP	

AMENDMENT & ISSUE REGISTER

MANAGER DATE:		DIRECTOR OF PLANNING & DESIGN DATE:	
DIRECTOR OF CONSTRUCTION DATE:	DIRECTOR OF M & E SERVICES DATE:	DIRECTOR OF SEW. OPERATIONS/W.S. DISTRIBUTION DATE:	
DESIGN	R.L.	21.11.94	ENGINEER IN CHARGE
DRAWN	R.L.	7.8.95	SUPERVISING ENGINEER
CHECKED			CADD FILE No. 725C053D.dwg
SURVEYOR			FIELD BOOK
SURVEY JOB No.			A.H.DATUM

REFERENCES

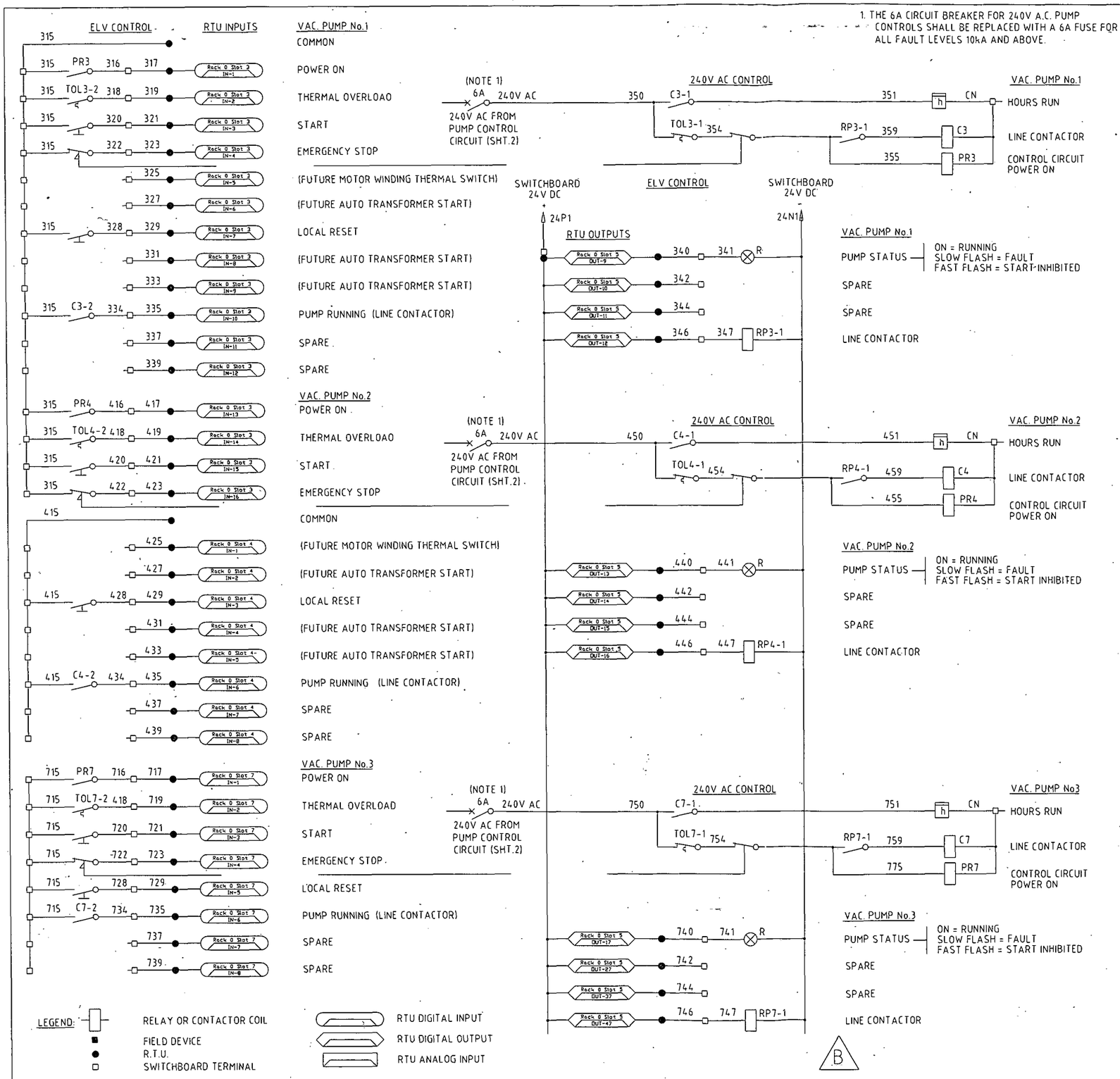
BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY & SEWERAGE
PLANNING & DESIGN BRANCH
Brisbane City

PROJECT
STANDARD SEWAGE VACUUM PUMP STATION

TITLE
SWITCHBOARD SP270
ELECTRICAL SCHEMATIC
& THREE LINE DIAGRAM 3/5

SCALE: N.T.S.	No. 3 OF 14 SHEETS	A3

DRAWING No. 486/7/25-AA1C0053E
AMEND. D



NOTES				
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B	11.09.09	ISSUED FOR CONSTRUCTION	DPM	AW
A	27.05.09	VAC PUMP #3 UPGRADE	DPM	AW
0	28.8.95	ISSUED FOR CONSTRUCTION	R.L.	
No	DATE	AMENDMENT	INITIALS	

AMENDMENT & ISSUE REGISTER

MANAGER DATE:	DIRECTOR OF PLANNING & DESIGN DATE:

DIRECTOR OF CONSTRUCTION DATE:	DIRECTOR OF M & E SERVICES DATE:	DIRECTOR OF SEW. OPERATIONS/W.S. DISTRIBUTION DATE:

DESIGN	R.L.	21.11.94	ENGINEER IN CHARGE
DRAWN	R.L.	8.8.95	SUPERVISING ENGINEER
CHECKED			CADD FILE No. 725C054C.DWG
SURVEYOR			FIELD BOOK
SURVEY JOB No.			A.H.DATUM

REFERENCES

BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY & SEWERAGE
PLANNING & DESIGN BRANCH
Brisbane City

PROJECT
STANDARD SEWAGE VACUUM PUMP STATION.

TITLE
SWITCHBOARD SP270
ELECTRICAL SCHEMATIC
& THREE LINE DIAGRAM 4/5

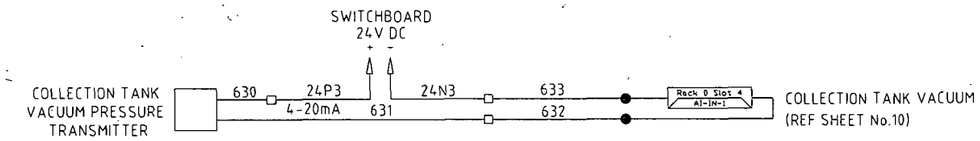
SCALE: N.T.S.	No. 4 OF 14 SHEETS	A3

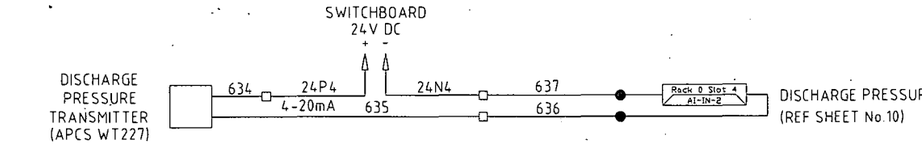
DRAWING No. 486/7/25-AA1C0054E

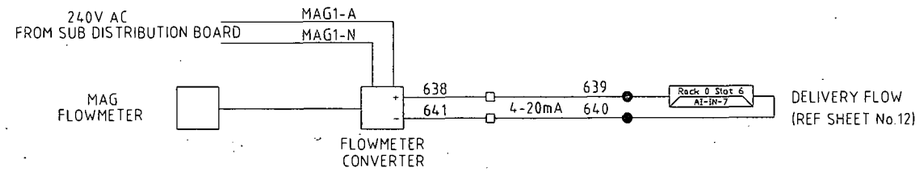
AMEND. C

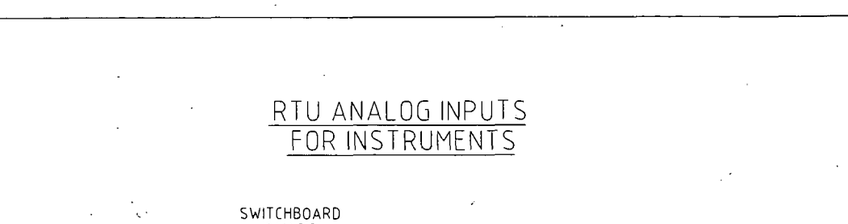
G:\194 WATER SUPP\268 Drafting\6248 Plans\Electrical\2. SEWERAGE\NETWORKS\SP270 Lytton Rd #3\VacPump#3Upgrade\Construction\725C054C.DWG Last Saved by 062870 on Tuesday, 5 January 2010 4:07:24 PM

RTU ANALOG INPUTS FOR INSTRUMENTS

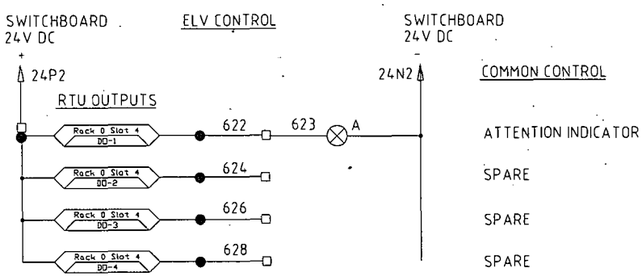


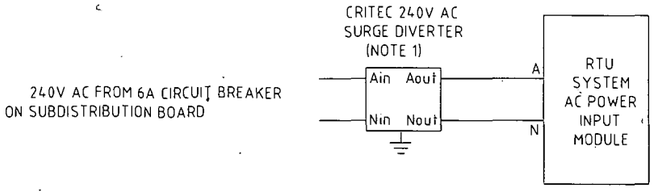


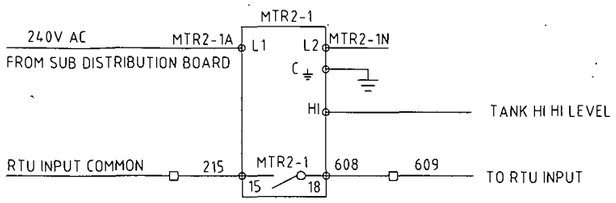




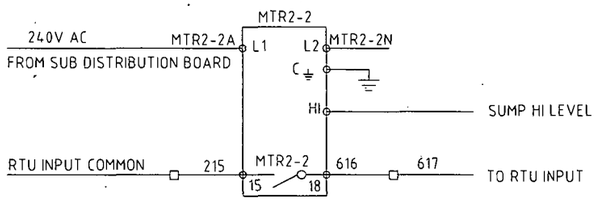
MTIC2 = TANK LIQUID LEVELS



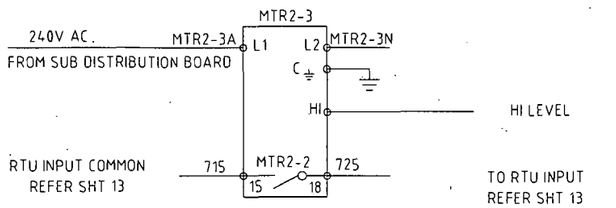




MTR2-1 = TANK HI HI LEVEL ALARM



MTR2-2 = SUMP HI LEVEL ALARM



MTR2-3 = 3kl VAC TANK HI LEVEL ALARM

C

REFERENCE DRAWINGS

1 FOR SWITCHBOARD ELECTRICAL SCHEMATICS AND THREE LINE DIAGRAM REFER DRAWINGS No.486/7/25-AA1C0051E TO 62E, SHEETS 1 TO 12 INCLUSIVE.

LEGEND:

- RELAY OR CONTACTOR COIL
- FIELD DEVICE
- R.T.U.
- SWITCHBOARD TERMINAL
- RTU DIGITAL INPUT
- RTU DIGITAL OUTPUT
- RTU ANALOG INPUT

NOTES

No	DATE	AMENDMENT	INITIALS	
D	02.01.10	AS BUILT	EP	
C	17.11.09	ISSUED FOR CONSTRUCTION	DPM	AW
B	11.09.09	ISSUED FOR CONSTRUCTION	DPM	AW
A	27.05.09	VAC PUMP #3 UPGRADE	DPM	AW
0	28.8.95	ISSUED FOR CONSTRUCTION	R.L.	

AMENDMENT & ISSUE REGISTER

MANAGER DATE:	DIRECTOR OF PLANNING & DESIGN DATE:

DIRECTOR OF CONSTRUCTION DATE:	DIRECTOR OF M & E SERVICES DATE:		DIRECTOR OF SEW. OPERATIONS/W.S. DISTRIBUTION DATE:
DESIGN	R.L.	21.11.94	ENGINEER IN CHARGE
DRAWN	R.L.	8.8.95	SUPERVISING ENGINEER
CHECKED			CADD FILE No. 725C055D.dwg
SURVEYOR			FIELD BOOK
SURVEY JOB No.			A.H.DATUM

REFERENCES

BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY & SEWERAGE
PLANNING & DESIGN BRANCH
Brisbane City

PROJECT
STANDARD SEWAGE VACUUM PUMP STATION.

TITLE
SWITCHBOARD SP270
ELECTRICAL SCHEMATIC
& THREE LINE DIAGRAM 5/5

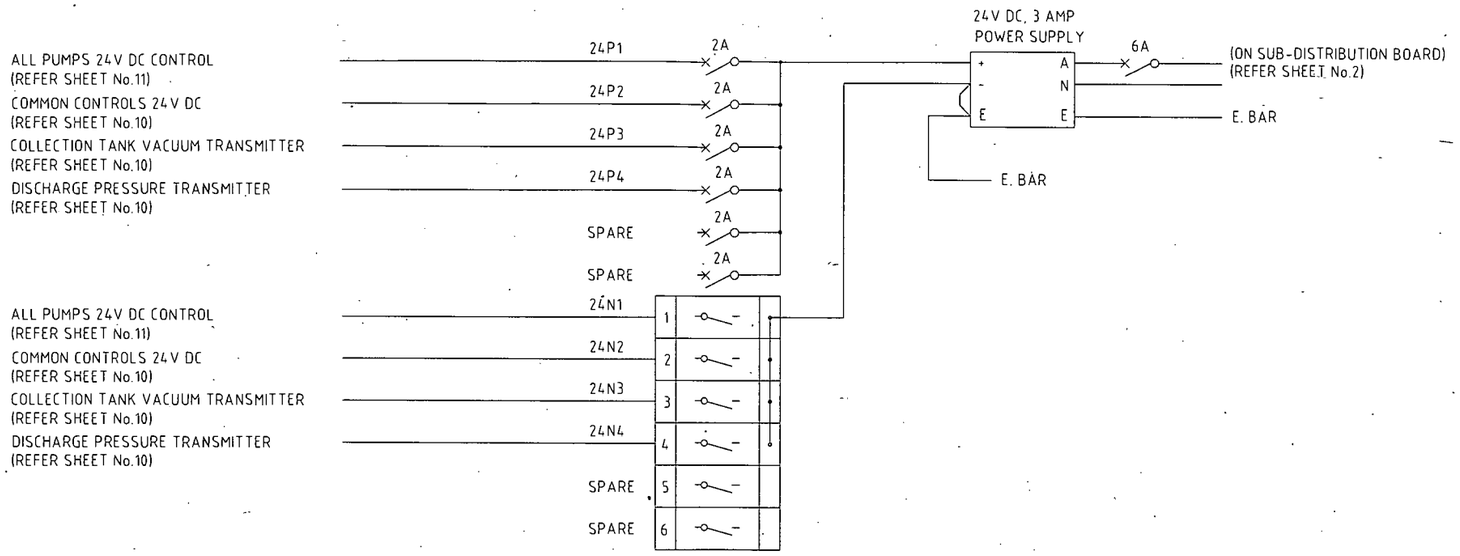
SCALE: N.T.S.	No. 5 OF 14 SHEETS	A3

DRAWING No.	AMEND.
486/7/25-AA1C0055E	D

SWITCHBOARD

24V DC DISTRIBUTION TERMINAL STRIP

SWITCHBOARD



REFERENCE DRAWINGS

1 FOR SWITCHBOARD ELECTRICAL SCHEMATICS AND THREE LINE DIAGRAM REFER DRAWINGS No.486/7/25-AA1C0051E TO 62E, SHEETS 1 TO 12 INCLUSIVE.

No	DATE	AMENDMENT	BY
C	02.01.10	AS BUILT	EP
B	11.09.09	ISSUED FOR CONSTRUCTION	AW
A	27.05.09	VAC PUMP #3 UPGRADE	DPM
0	29.8.95	ISSUED FOR CONSTRUCTION	R.L.

CADD FILE No. 725C056-

MANAGER	DIRECTOR OF PLANNING & DESIGN	
DATE:	DATE:	
DIRECTOR OF CONSTRUCTION	DIRECTOR OF M & E SERVICES	DIRECTOR OF SEW. OPERATIONS/W.S. DISTRIBUTION.
DATE:	DATE:	DATE:

DESIGN	R.L.	21.11.94
DRAWN	R.L.	8.8.95
CHECKED		
ENGINEER IN CHARGE		
SUPERVISING ENGINEER		

PROJECT
STANDARD SEWAGE VACUUM PUMP STATION

TITLE SP270 - SWITCHBOARD TERMINATION DIAGRAM 24V DC DISTRIBUTION

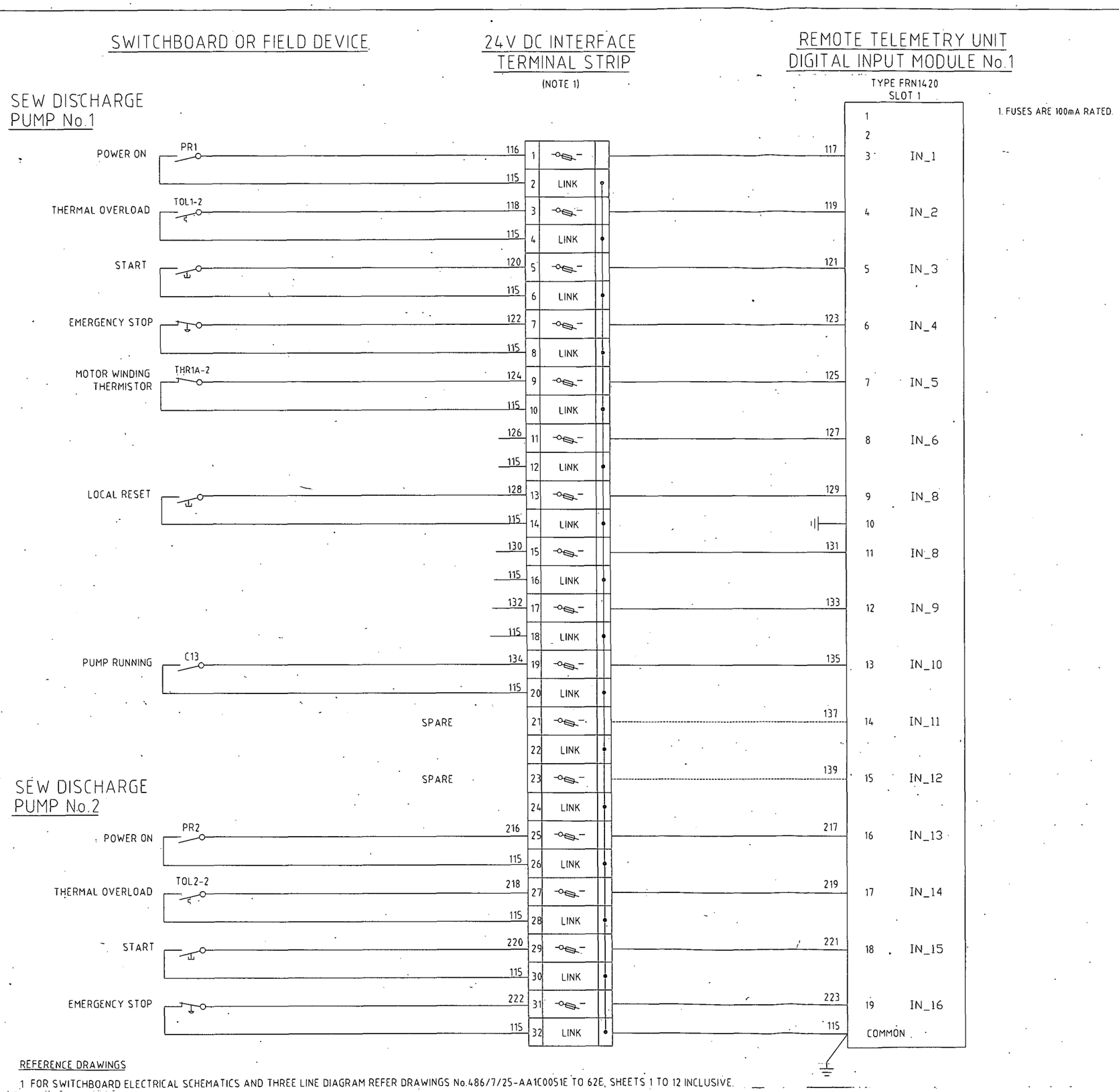
A.H.DATUM

BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY AND SEWERAGE
PLANNING & DESIGN BRANCH
Brisbane City

SCALE: N.T.S. | No. 6 OF 14 SHEETS

DRAWING No. 725C056C.DWG
486/7/25-AA1C0056E

AMEND. C



REFERENCE DRAWINGS

1 FOR SWITCHBOARD ELECTRICAL SCHEMATICS AND THREE LINE DIAGRAM REFER DRAWINGS No.486/7/25-AA1C0051E TO 62E, SHEETS 1 TO 12 INCLUSIVE.

NOTES				
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C	11.09.09	ISSUED FOR CONSTRUCTION	DPM	AW
B	27.05.09	VAC PUMP #3 UPGRADE	DPM	AW
1	10/9/96	WAE	GB	DS
0	29.8.95	ISSUED FOR CONSTRUCTION	R.L.	
No	DATE	AMENDMENT	INITIALS	

AMENDMENT & ISSUE REGISTER

MANAGER DATE:	DIRECTOR OF PLANNING & DESIGN DATE:

DIRECTOR OF CONSTRUCTION DATE:	DIRECTOR OF M & E SERVICES DATE:	DIRECTOR OF SEW. OPERATIONS/W.S. DISTRIBUTION DATE:

DESIGN	R.L.	21.11.94	ENGINEER IN CHARGE
DRAWN	R.L.	8.8.95	SUPERVISING ENGINEER
CHECKED			CADD FILE No. 725C057D.DWG
SURVEYOR			FIELD BOOK
SURVEY JOB No.			A.H.DATUM

REFERENCES

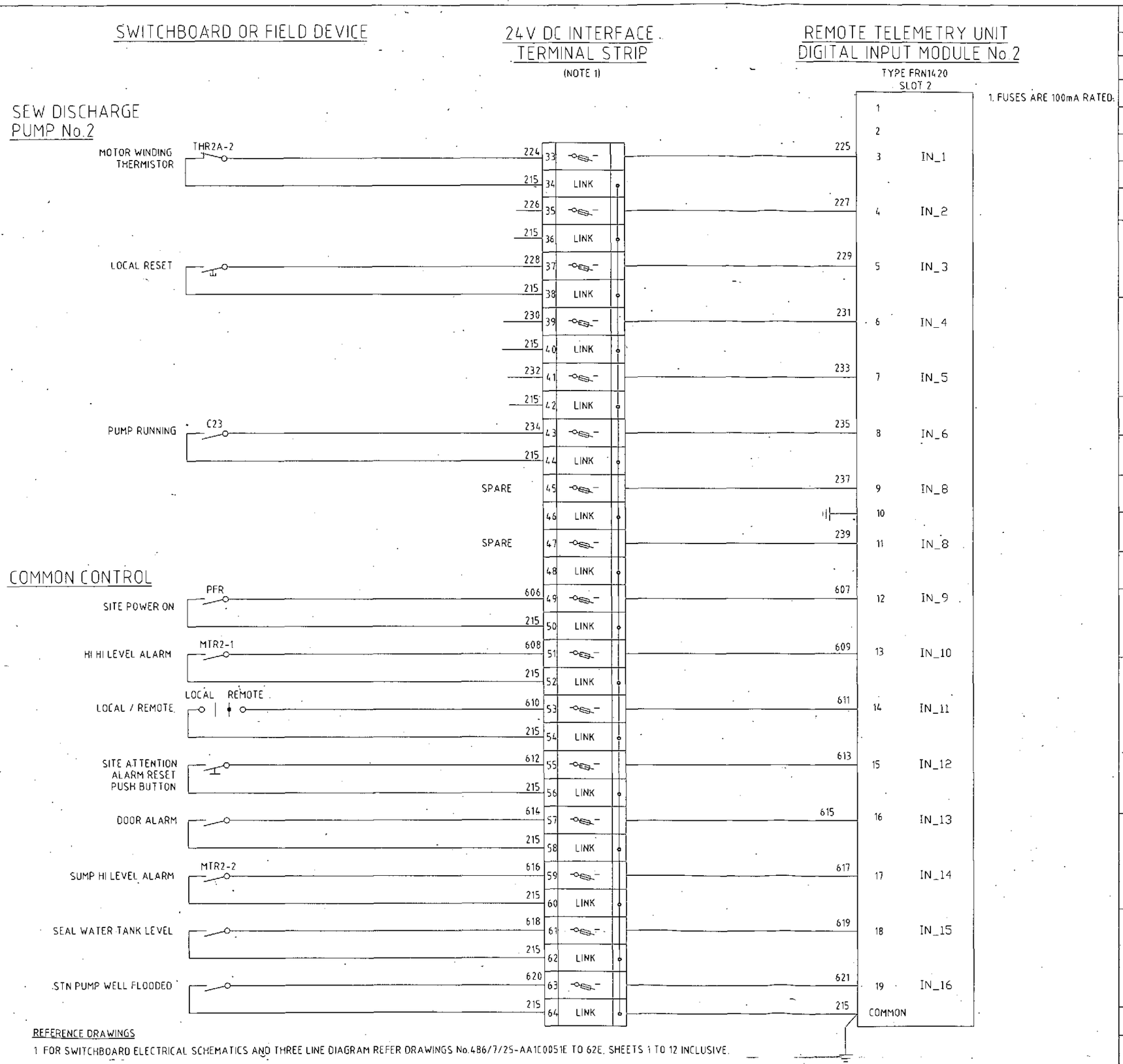
BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY & SEWERAGE
PLANNING & DESIGN BRANCH
Brisbane City

PROJECT
STANDARD SEWAGE VACUUM PUMP STATION

TITLE
SWITCHBOARD TERMINATION DIAGRAM - SLOT 1 DIGITAL INPUTS

SCALE: N.T.S.	No. 7 OF 14 SHEETS	A3

DRAWING No.	AMEND.
486/7/25-AA1C0057E	D



REFERENCE DRAWINGS

1 FOR SWITCHBOARD ELECTRICAL SCHEMATICS AND THREE LINE DIAGRAM REFER DRAWINGS No.486/7/25-AA1C0051E TO 62E. SHEETS 1 TO 12 INCLUSIVE.

NOTES				
D	02.01.10	AS BUILT	EP	
C	11.09.09	ISSUED FOR CONSTRUCTION	DPM	AW
B	27.05.09	VAC PUMP #3 UPGRADE	DPM	AW
1	10/9/96	WAE	GB	DS
0	29.8.95	ISSUED FOR CONSTRUCTION	R.L.	
No	DATE	AMENDMENT	INITIALS	

AMENDMENT & ISSUE REGISTER.

MANAGER DATE:	DIRECTOR OF PLANNING & DESIGN DATE:

DIRECTOR OF CONSTRUCTION DATE:	DIRECTOR OF M & E SERVICES DATE:	DIRECTOR OF SEW. OPERATIONS/W.S. DISTRIBUTION DATE:

DESIGN	R.L.	21.11.94	ENGINEER IN CHARGE
DRAWN	R.L.	8.8.95	SUPERVISING ENGINEER
CHECKED			CADD FILE No. 725C058D.dwg
SURVEYOR			FIELD BOOK
SURVEY JOB No.			A.H.DATUM

REFERENCES

BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY & SEWERAGE
PLANNING & DESIGN BRANCH
Brisbane City

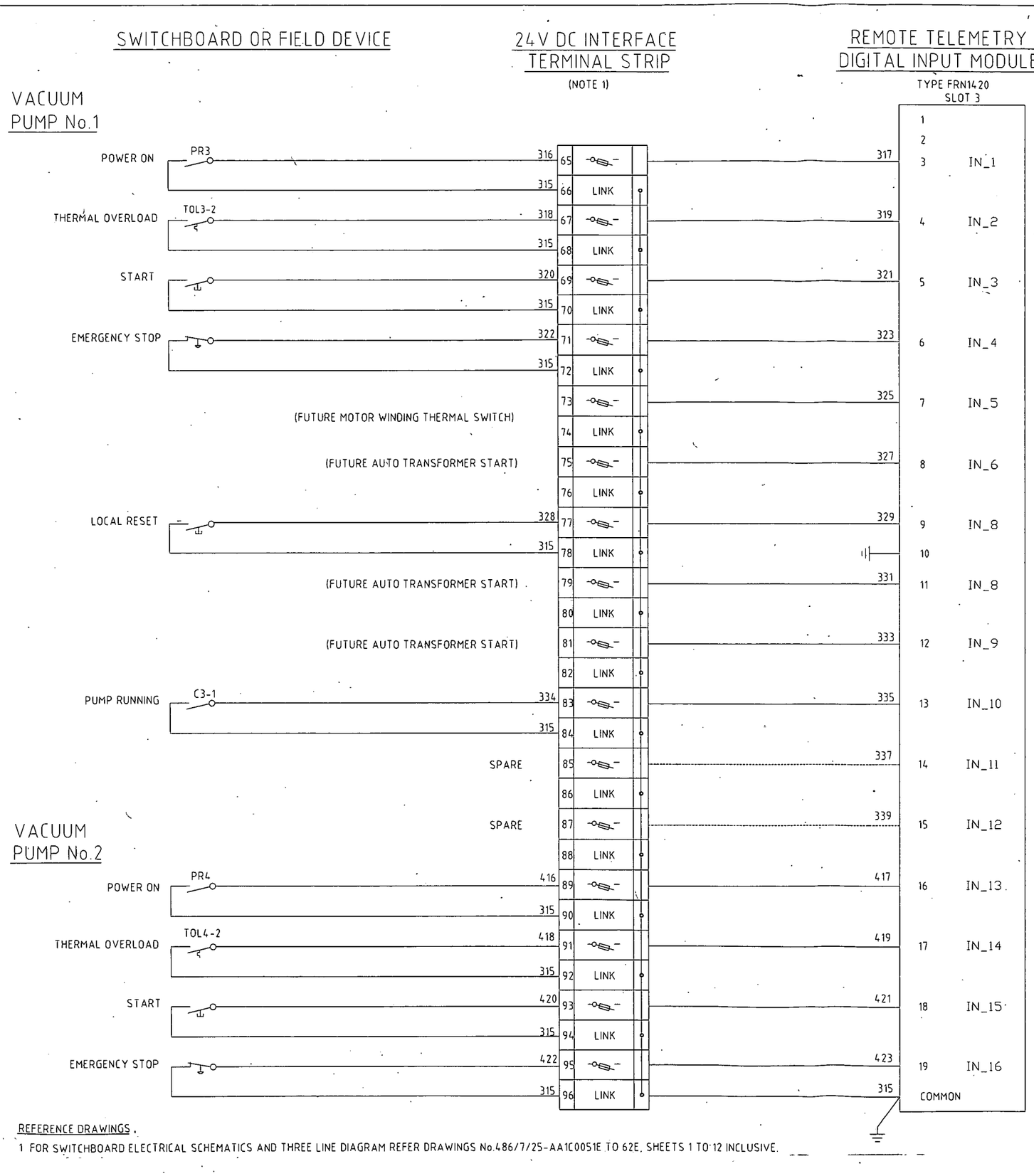
PROJECT
STANDARD SEWAGE VACUUM PUMP STATION.

TITLE
SP270 - SWITCHBOARD TERMINATION DIAGRAM - SLOT 2 DIGITAL INPUTS

SCALE: N.T.S.	No. 8 OF 14 SHEETS	A3

DRAWING No. 486/7/25-AA1C0058E

AMEND. D



REFERENCE DRAWINGS.

1 FOR SWITCHBOARD ELECTRICAL SCHEMATICS AND THREE LINE DIAGRAM REFER DRAWINGS No.486/7/25-AA1C0051E TO 62E, SHEETS 1 TO 12 INCLUSIVE.

NOTES

1. FUSES ARE 100mA RATED.

No	DATE	AMENDMENT	INITIALS	
C	02.01.10	AS BUILT	EP	
B	11.09.09	ISSUED FOR CONSTRUCTION	DPM	AW
A	27.05.09	VAC PUMP #3 UPGRADE	DPM	AW
0	29.8.95	ISSUED FOR CONSTRUCTION	R.L.	

AMENDMENT & ISSUE REGISTER.

MANAGER DATE:	DIRECTOR OF PLANNING & DESIGN DATE:
DIRECTOR OF CONSTRUCTION DATE:	DIRECTOR OF M & E SERVICES DATE:
DIRECTOR OF SEW. OPERATIONS/W.S. DISTRIBUTION DATE:	

DESIGN	R.L.	21.11.94	ENGINEER IN CHARGE
DRAWN	R.L.	8.8.95	SUPERVISING ENGINEER
CHECKED			CADD FILE No. 725C059C.dwg
SURVEYOR			FIELD BOOK
SURVEY JOB No.			A.H.DATUM

REFERENCES

BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY & SEWERAGE
PLANNING & DESIGN BRANCH
Brisbane City

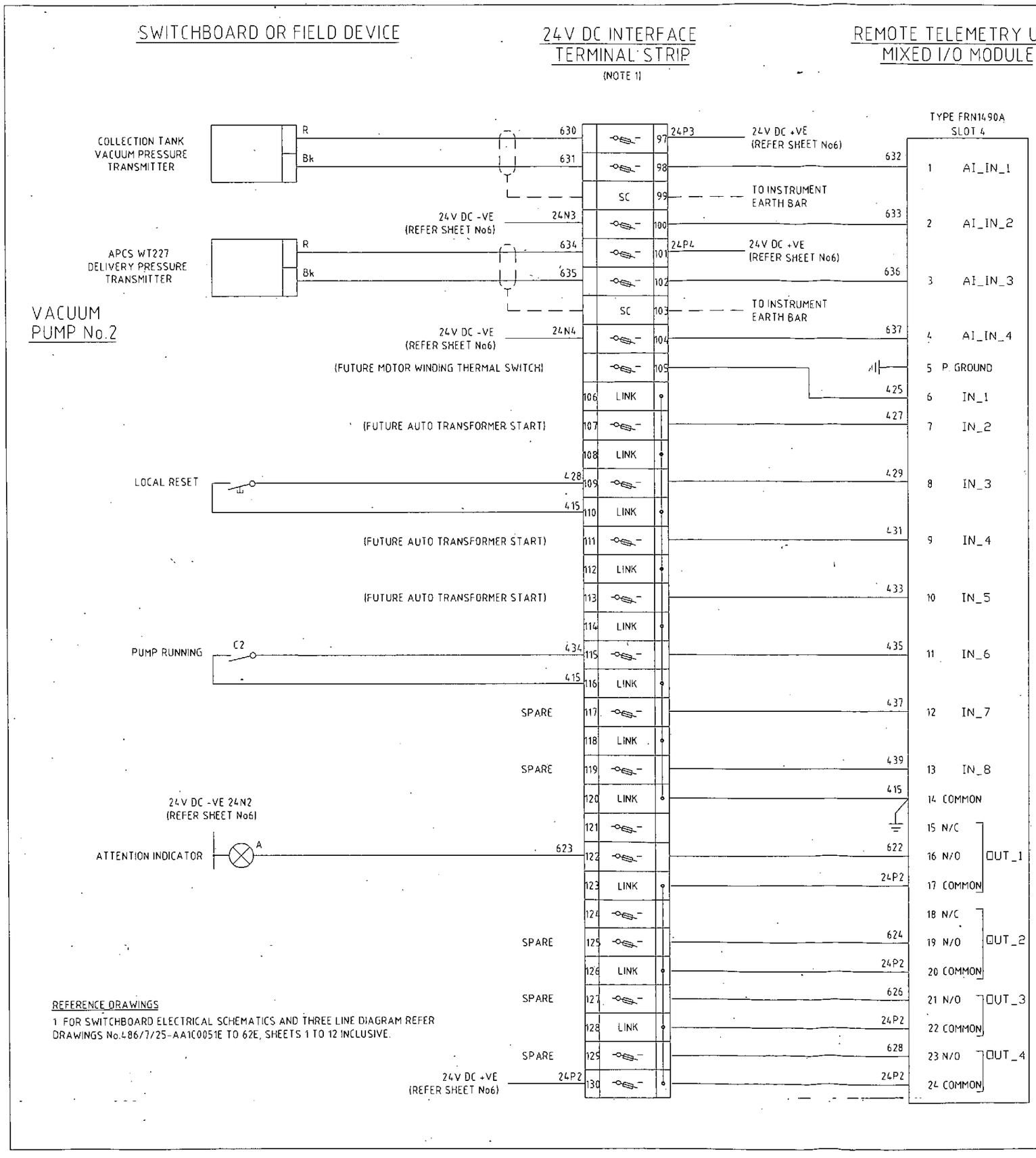
PROJECT
STANDARD SEWAGE VACUUM PUMP STATION.

TITLE
SP270 - SWITCHBOARD TERMINATION DIAGRAM - SLOT 3 DIGITAL INPUTS.

SCALE: N.T.S.	No. 9 OF 14 SHEETS	A3

DRAWING No. 486/7/25-AA1C0059E

AMEND. C



NOTES

1. FUSES ARE 100mA RATED.

No	DATE	AMENDMENT	INITIALS	
C	02.01.10	AS BUILT	EP	
B	11.09.09	ISSUED FOR CONSTRUCTION	DPM	AW
A	27.05.09	VAC PUMP #3 UPGRADE	DPM	AW
0	29.8.95	ISSUED FOR CONSTRUCTION	R.L.	

AMENDMENT & ISSUE REGISTER

MANAGER DATE:		DIRECTOR OF PLANNING & DESIGN DATE:	
DIRECTOR OF CONSTRUCTION DATE:	DIRECTOR OF M & E SERVICES DATE:	DIRECTOR OF SEW. OPERATIONS/W.S. DISTRIBUTION DATE:	
DESIGN	R.L.	21.11.94	ENGINEER IN CHARGE
DRAWN	R.L.	8.8.95	SUPERVISING ENGINEER
CHECKED			CADD FILE No. 725C060C.dwg
SURVEYOR			FIELD BOOK
SURVEY JOB No.			A.H.DATUM

REFERENCES

BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY & SEWERAGE
PLANNING & DESIGN BRANCH
Brisbane City

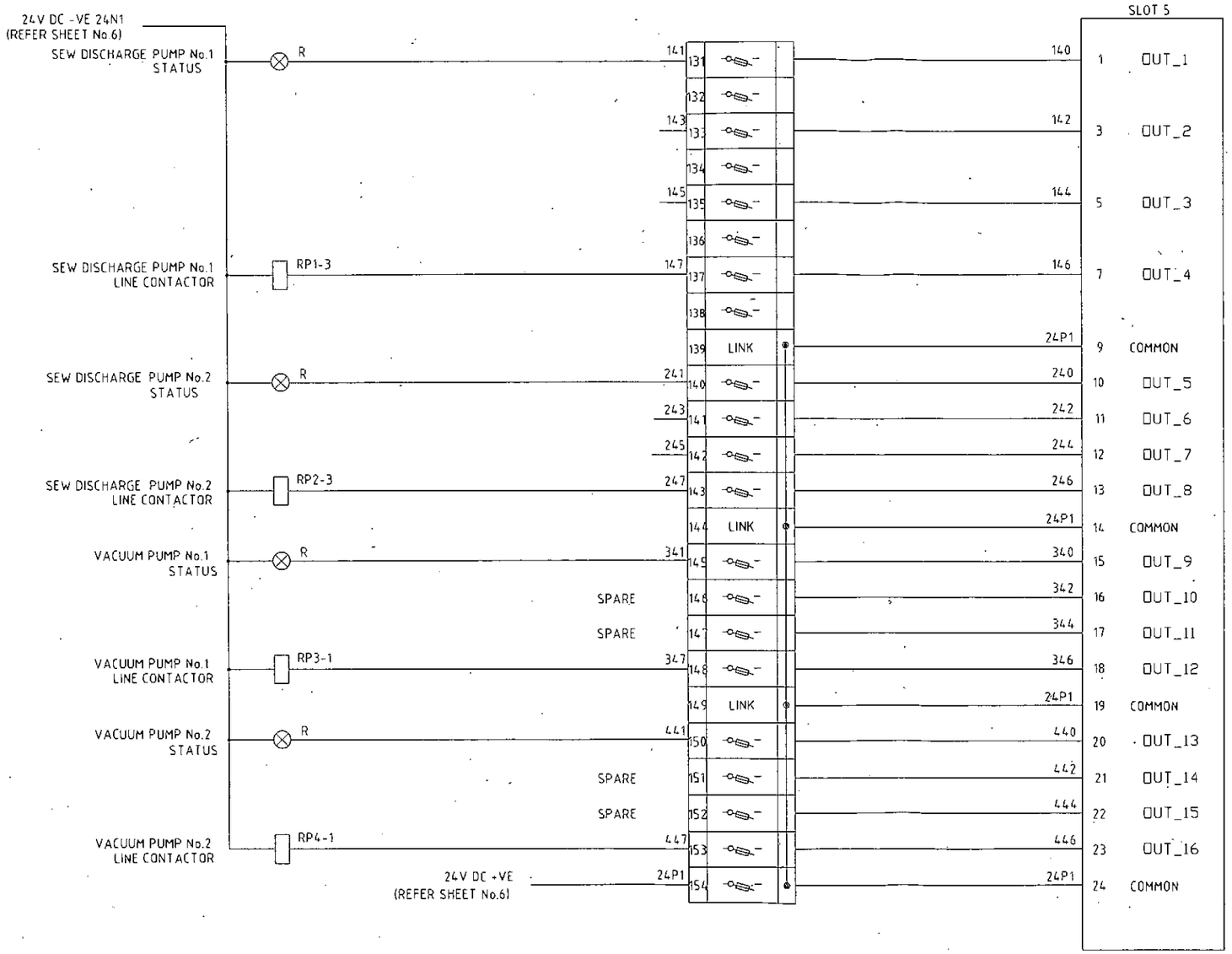
PROJECT
STANDARD SEWAGE VACUUM PUMP STATION.

TITLE
SP270 - SWITCHBOARD TERMINATION DIAGRAM - SLOT 4 DIGITAL INPUTS

SCALE: N.T.S.	No. 10 OF 14 SHEETS	A3

DRAWING No. 486/7/25-AA1C0060E

AMEND. C



REFERENCE DRAWINGS

1 FOR SWITCHBOARD ELECTRICAL SCHEMATICS AND THREE LINE DIAGRAM REFER DRAWINGS No.486/7/25-AA1C0051E TO 62E, SHEETS 1 TO 12 INCLUSIVE.

NOTES

No	DATE	AMENDMENT	INITIALS	
D	02.01.10	AS BUILT	EP	
C	11.09.09	ISSUED FOR CONSTRUCTION	DPM	AW
B	27.05.09	VAC PUMP #3 UPGRADE	DPM	AW
1	10/9/96	WAE	GB	DS
0	29.8.95	ISSUED FOR CONSTRUCTION	R.L.	

AMENDMENT & ISSUE REGISTER

MANAGER DATE:		DIRECTOR OF PLANNING & DESIGN DATE:	
DIRECTOR OF CONSTRUCTION DATE:	DIRECTOR OF M & E SERVICES DATE:	DIRECTOR OF SEW. OPERATIONS/W.S. DISTRIBUTION DATE:	
DESIGN	R.L.	21.11.94	ENGINEER IN CHARGE
DRAWN	R.L.	8.8.95	SUPERVISING ENGINEER
CHECKED			CADD FILE No. 725C061D.dwg
SURVEYOR			FIELD BOOK
SURVEY JOB No.			A.H.DATUM

REFERENCES

BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY & SEWERAGE
PLANNING & DESIGN BRANCH
Brisbane City

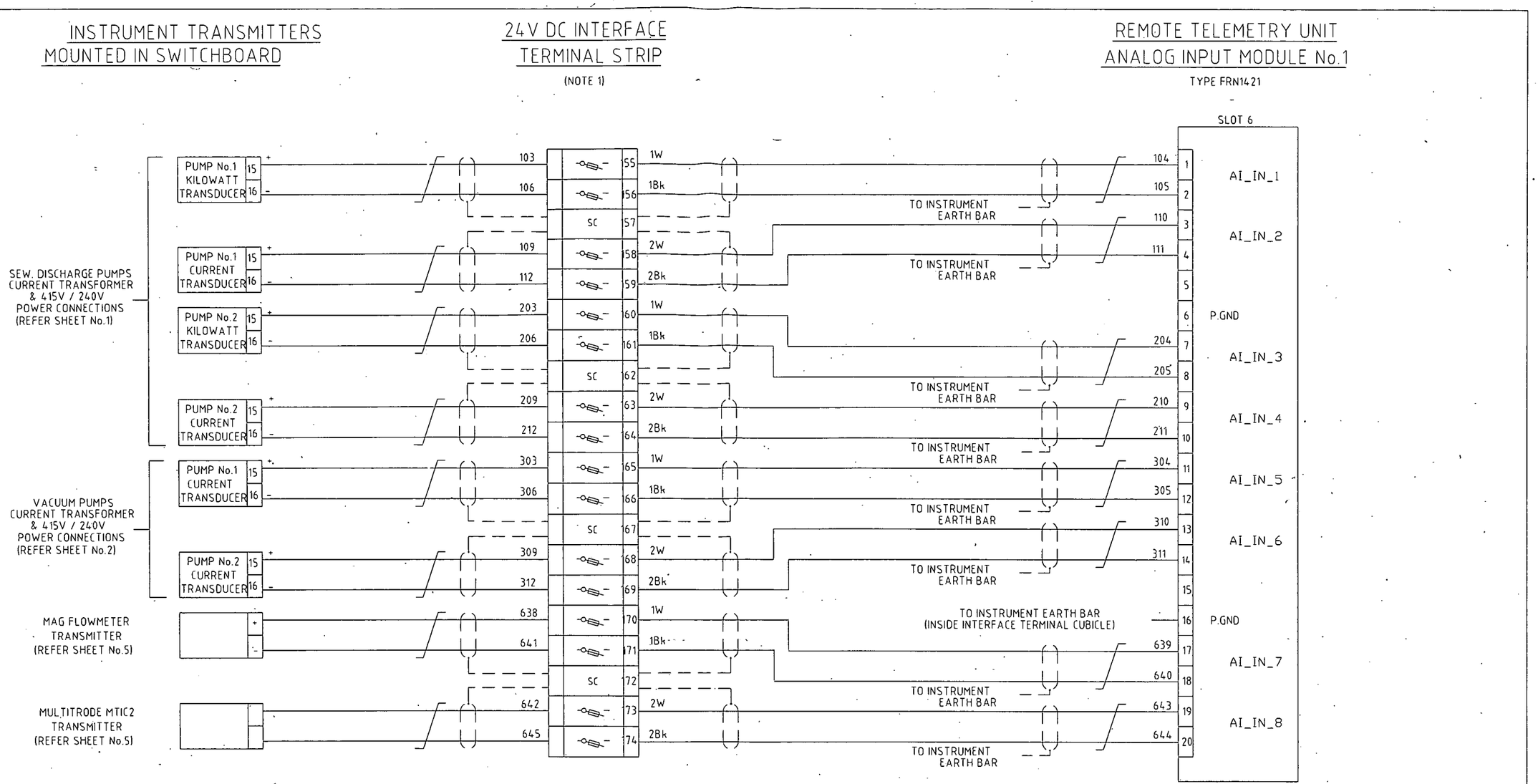
PROJECT
STANDARD SEWAGE VACUUM PUMP STATION

TITLE
SWITCHBOARD
TERMINATION DIAGRAM - SLOT 5
DIGITAL OUTPUTS

SCALE: N.T.S.	No. 11 OF 14 SHEETS	A3

DRAWING No. 486/7/25-AA1C0061E

AMEND. D



NOTES

1. FUSES ARE 100mA RATED.

No	DATE	AMENDMENT	BY
C	02.01.10	AS BUILT	EP
B	11.09.09	ISSUED FOR CONSTRUCTION	AW
A	27.05.09	VAC PUMP #3 UPGRADE	DPM
0	29.8.95	ISSUED FOR CONSTRUCTION	R.L.

CADD FILE No. 725C062-

MANAGER — DATE:

DIRECTOR OF PLANNING & DESIGN — DATE:

DIRECTOR OF CONSTRUCTION — DATE:

DIRECTOR OF M & E SERVICES — DATE:

DIRECTOR OF SEW. OPERATIONS/W.S. DISTRIBUTION — DATE:

DESIGN	R.L.	21.11.94
DRAWN	R.L.	8.8.95
CHECKED		
ENGINEER IN CHARGE		
SUPERVISING ENGINEER		

PROJECT: STANDARD SEWAGE VACUUM P/S.

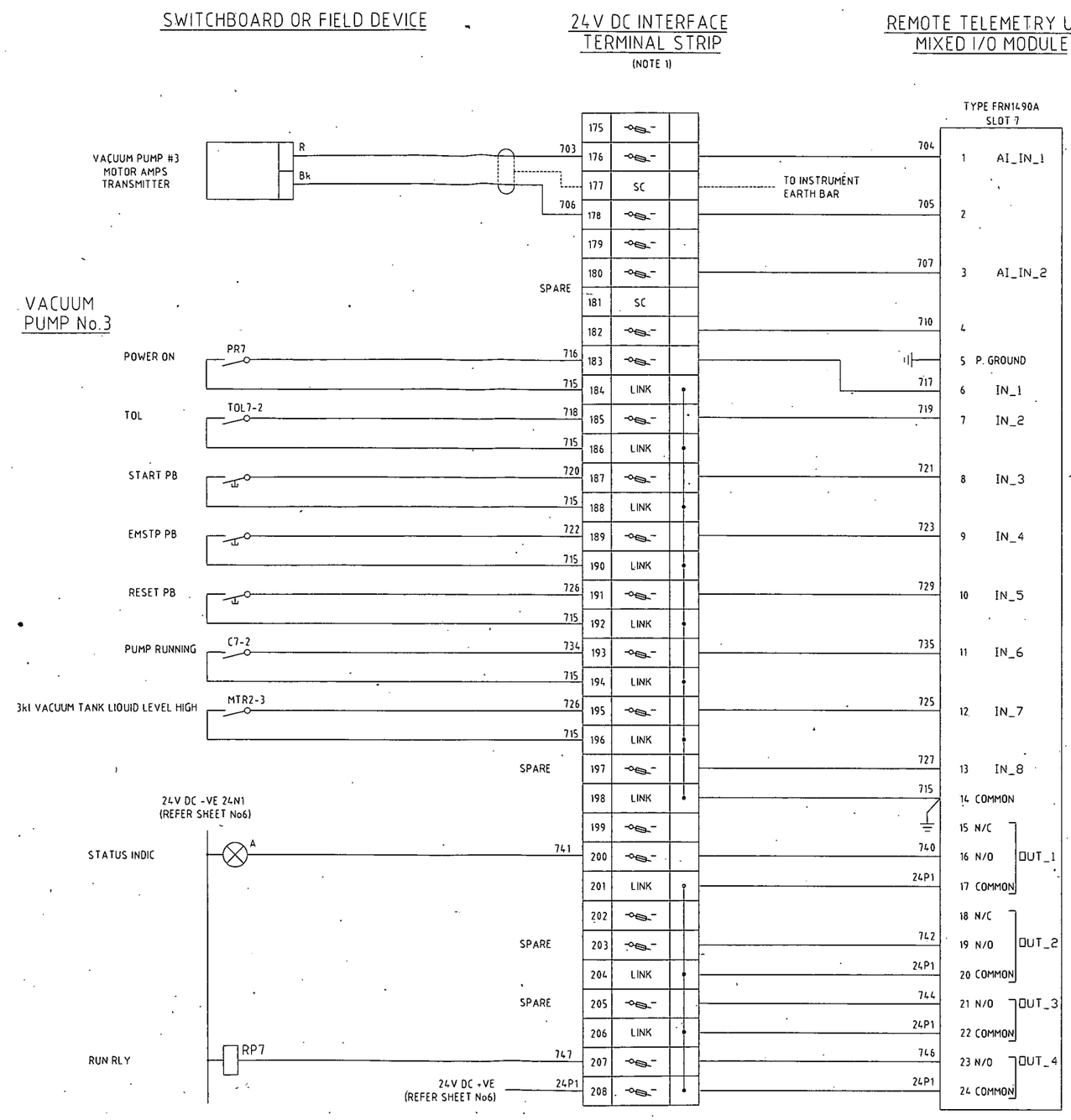
TITLE: SWITCHBOARD TERMINATION DIAGRAM - SLOT6 ANALOG INPUTS

A.H.DATUM

BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY AND SEWERAGE
PLANNING & DESIGN BRANCH
Brisbane City

SCALE: N.T.S. | No. 12 OF 14 SHEETS

DRAWING No. 486/7/25-AA1C0062E | AMEND. C



ELECTRICAL AS BUILT DETAILS

REV COMPANY

CONTRACTOR LICENCE No.

ELECTRICIAN DATE:

AS BUILT

No	DATE	AMENDMENT	DRN.	APD.
C	01.10	AS BUILT	EP	.
B	11.09	ISSUED FOR CONSTRUCTION	DPM	AW
O	27.05.09	ISSUED FOR TENDER	DPM	AW

FUNDING: DESIGN W.O. No. . CONSTRUCTION W.O. No. . FUNDED BY B.C.C. (✓) EXTERNAL ( )

DRAFTED P.MOSTERT 05.09; DRAFTING CHECK P.HAGUE 05.09; CAD FILE 570075006; B.C.C. FILE No. .

DESIGN R.P.E.Q. No. DATE

DESIGN CHECK R.P.E.Q. No. DATE

PRINCIPAL DESIGN MANAGER DATE

CLIENT DELEGATE DATE

BRISBANE WATER

PROJECT: VACUUM SEWAGE PUMP STATION VAC PUMP #3 UPGRADE

TITLE: SP270 SWITCHBOARD TERMINATION DIAGRAM - SLOT 7 DIGITAL I/O & ANALOG INPUTS

SHEET No. 13 of 14

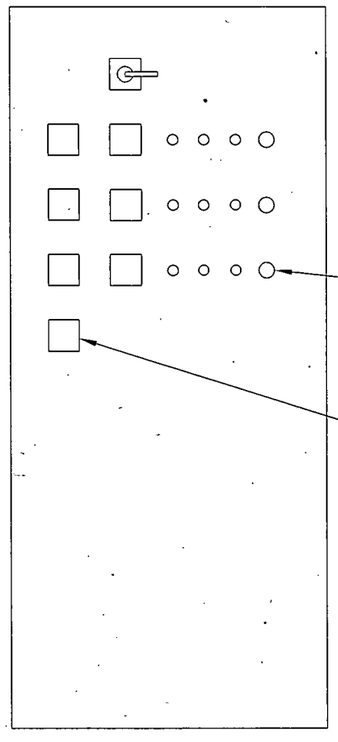
BRISBANE WATER DRAWING No. 486/5/7-0075-006

AMEND. C

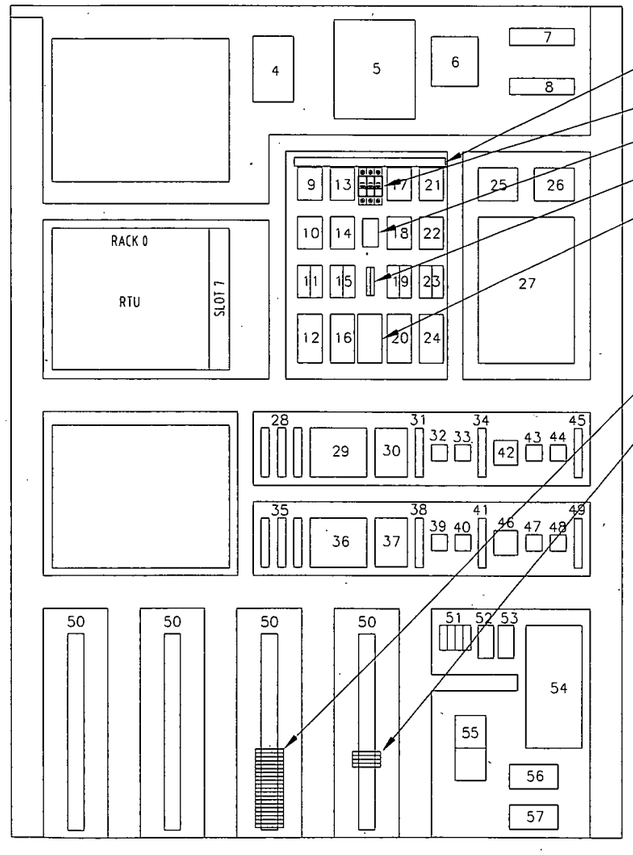
Q:\104 WATER SUPPLY\268 Drafting\6248 Plans\Electrical\2. SEWERAGE\NETWORKS\SP270 Lytton Rd #3\VacPump#3\Upgrade\Construction\570075006C.dwg Last Saved by 082670 on Tuesday, 5 January 2010 4:15:34 PM

PARTS LIST

REF	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	REMARKS
01	1	VAC PMP No.3 CIRCUIT BREAKER 40A	TERASAKI	DTCB10340C	10kA
02	1	18 POLE 3PHASE 120A DIN T BUS.COMB	TERASAKI	KL183	REPLACES EXISTING
03	1	50/5 CT	CROMPTON	781-943T NWL SFD 50/5A (6T)	
04	2	CT TEST LINK	KLIPPON	SAKC10	
05	1	AMMETER 0-5AC SCALED 0/15/90 AMPS	CROMPTON	243-026G	
06	1	TRANSDUCER 0-5A AC / 4-20mA	CROMPTON	253-TALW 0-5A 240VAC 4-20mA	
07	1	CONTROL CCT CIRCUIT BREAKER 6A	TERASAKI	DTCB1016C	
08	1	HOURS RUN METER	CROMPTON	243-155G-RNZH 240V50Hz	
09	1	STATUS INDICATOR LAMP	SPRECHER & SCHUH	DSP-P43 DLO	
10	1	START PB	SPRECHER & SCHUH	DSP-F33 LX 10	
11	1	STOP PB	SPRECHER & SCHUH	DSP-MTS 44-3 LX 01	
12	1	RESET PB	SPRECHER & SCHUH	DSP-F2 LX 10	
13	1	CONTROL CCT POWER ON RLY	IDEC	RH2B-UL-240VAC	
14	1	CONTACTOR RELAY	IDEC	RH2B-UL-240VDC	
15	1	CONTACTOR 3P 7.5kW (240VAC) + 7.5kW TOL	SPRECHER & SCHUH	CA7-16-1024DV AC + CT 7K-17-7.5	+ CS 7-PV-11 1NO,1NC AUX CONTACT BLOCK
16					
18	1	RTU MIXED I/O CARD 24VDC	MOTOROLA	-	FREE ISSUE
19	2	EARTH TERMINAL	KLIPPON	SAKR	
20	11	LINK TERMINAL	KLIPPON	ASK1	
21	21	FUSED TERMINALS C/W 100mA 20X5 FUSES	KLIPPON	ASK1	
22		MULTITRODE	MULTITRODE	MTR-2	
23		MULTITRODE	MULTITRODE	0.21s?	
24					
25					
26					
27					
28					
29					
30					



DOOR LAYOUT



GEAR PANEL LAYOUT

ELECTRICAL AS BUILT DETAILS

REV COMPANY
CONTRACTOR LICENCE No.
ELECTRICIAN DATE:

No	DATE	AMENDMENT	DRN.	APD.
B	09.09	ISSUED FOR CONSTRUCTION	DPM	AW
A	27.05.09	VAC PUMP #3 UPGRADE REVISED	DPM	AW
C	01.10	AS BUILT	EP	.

FUNDING: DESIGN W.O. No. | CONSTRUCTION W.O. No. | FUNDED BY B.C.C. (✓) EXTERNAL ( )

DRAFTED P.MOSTERT 10.08
DRAFTING CHECK P.HAGUE 10.08
CAD FILE 570075007C.dwg
B.C.C. FILE No.

DESIGN R.P.E.Q. No. DATE
DESIGN CHECK R.P.E.Q. No. DATE
PRINCIPAL DESIGN MANAGER DATE
CLIENT DELEGATE DATE

BRISBANE WATER

PROJECT
VACUUM SEWAGE PUMP STATION
VAC PUMP #3 UPGRADE

TITLE
SP270 SWITCHBOARD
SWITCHBOARD LAYOUT

SHEET No. 14 of 14
BRISBANE WATER DRAWING No. 486/5/7-0075-007
AMEND. C

G:\194 WATER SUPPLY\268 Drafting\6348 Plans\Electrical\2. SEWERAGE\NETWORKS\SP270 Lytton Rd #3\VacPump#3Upgrade\Construction\570075007C.dwg Last Saved by 052870 on Wednesday, 6 January 2010 8:52:06 AM