Queensland Urban Utilities

C1011-045-OUU037

WP100 – Charlwood Rd, Aratula Surawski Drive – Water Pump Station

Operation and Maintenance Manual

Lend Lease

Version: Draft
As at 26 July 2012

Uncontrolled when printed

Lend Lease

Lend Lease

SECTION 1

WP100 – Aratula Water Pump Station

Functional Description

- 3S0016-DS-02-C WP100 Aratula Functional Specification

WP100 Aratula Pump Station

Control System Functional Specification

Client

Queensland Urban Utilities

Document No

3S0016-DS-02-D WP100 ARATULA FUNCTIONAL SPECIFICATION

REVISION D

CORPORATE OFFICE

39 Suscatand St, Rocklea

QLD 4106

Tel: +61 7 5436 9500

Fax: +61 7 5438 8030

www.lendlease.com

Lend Lease Infrastructure Services Pty Ltd

Control Sheet

Prepared By:	**Kartik Shah**	**Date:**	**28/01/2014**
Checked By:	**John Dalziel**	**Date:**	**28/01/2014**

Distribution List

Copy	**Recipient or Location**
1	Maaran Mutharasa (QUU)
2	Gerard Anderson (QUU)
3	Praveen Gaddam (QUU)
4	Joseph Tam (QUU)
5	Paul Matthews (Alliance Automation)
6	Richard Behan-Howell (Lend Lease)
7	Dharmawan Susanto (Lend Lease)

Revision List

Rev	**Date**	**Comment**	**Operative**
A	14/08/2012	Issued for review	Paul Matthews
B	15/08/2012	Issued to client	Paul Matthews
C	06/05/2013	Revised (added pump Permissives in remote manual mode)	Dharmawan S.
D	28/01/2014	As Built	Kartik Shah
E			

Abbreviations and Definitions

Abbreviation	Definition
ACMA	Australian Communications and Media Authority
ADSL	Asymmetric Digital Subscriber Line
CMI	Control Microsystems
CMF	Central Monitoring Facility
CPU	Central Processing Unit
DOL	Direct On-Line
EP Rating	Environmental Priority Rating
FAT	Factory Acceptance Testing
GST	Goods and Service Tax
HLZ	High Level Zone
HMI	Human Machine Interface
IO	Inputs and Outputs
ISaGRAF	ICS Triplex ISaGRAF is an IEC-61131-3 compliant software development application
ITP	Inspection and Test Plan
KFII	King Fisher Series II Protocol
km	Kilometre
LAN	Local Area Network
LCD	Liquid Crystal Display
OS	Operating System
PAT	Performance Acceptance Testing
PCS	Process Control System
PDD	Project Definition Document
PLC	Programmable Logic Controller
RF	Radio Frequency
RSSI	Received Signal Strength Indication
RTU	Remote Telemetry Unit
SAT	Site Acceptance Testing
SCADA	Supervisory Control and Data Acquisition

Document Control

Prepared For:	Queensland Urban Utilities
Project Name:	WP102 Aratula
Lend Lease Job Code:	3S0016
Document Type:	CONTROL SYSTEM FUNCTIONAL SPECIFICATION
File Name:	3S0016-DS-02-D WP100 Aratula Functional Specification.docx
Revision:	D
Status:	As Built
Release Date:	28/01/2014
Prepared By:	Kartik Shah
	Control Systems Engineer
Reviewed By:	John Dalziel
	Senior Electrical Designer/Drafter

CONTENTS

1. INTRODUCTION

The purpose of this documentation is to detail the functional operation of a standard water pump station. The pump stations use standard DOL/SS starters to maintain the level in a Reservoir. WP100 Aratula is connected to Elpro/Beaudesert infrastructure.

1.1 WP100 Aratula Station Overview

The Aratula site has two RTU’s – a Kingfisher Series II and an Elpro TLX400 Wireless relay (replacing existing TLC unit).

The Kingfisher will have the site controlling code and the Elpro will be used as an intermediary to pass site control and data between the Kingfisher and SCADA via Modbus data. The start and stop signals/fault signals will be replicated/passed through the TLX400.

The pumping station will use Danfoss MCD500 Soft Starters for pump operations.

2 CONTROL SYSTEM FUNCTIONAL REQUIREMENTS

2.1 Analogue Inputs

All analogue inputs will be tested for validity. If the input is determined valid it will be scaled to produce a value in Engineering Units, (EGU). If an input is invalid, i.e. < 2mA, an alarm will be raised and it will not be scaled. This is as per existing sites

Note: Suction Pressure, Delivery Pressure and Delivery Flow signals are filtered in the RTU.

2.2 Digital Inputs

Standard Kingfisher digital inputs will be used. De-bouncing will be provided in code where necessary.

2.3 Pressure Control/Monitoring

The site is fitted with 2 pressure transmitters, a common suction header meter (Pressure1), and a discharge header meter (Pressure 2). Pressure is not used for control in this system, just for monitoring.

2.4 Flow Control Monitoring

The pumping station is fitted with a flow meter located on the common delivery main outside the pump station.

2.5 Next Pump to Start Selection (Duty)

Under normal operating conditions the duty is cycled each time a pump stops to share load on the pumps equally.

2.6 Pumping Station Modes of Operation

The Water Pumping Stations will have two modes of operation as a system:

- Local Mode
- Remote Mode

A two position Pumping Station Control selector switch on the Pumping Station Switchboard provides the ability to select either Local, or Remote control modes for the Pumping Station. This is monitored and displayed at SCADA.

2.6.1 LOCAL MODE

Local Mode enables operation of the pumps from only within the Pumping Station. In local Mode, the RTU has no control of the pumps. As long as the site has power and the emergency stops are not engaged, the pump can be started and stopped from the panel Start/Stop controls.

Once in Local Mode, the Operations Control Room cannot control any item of equipment and will only monitor the status of the Pumping Station.

2.6.2 REMOTE MODE

Remote mode is the usual mode of operation for the Pumping Station and enables automatic or manual operation modes via the RTU. Two Remote Control States can be used to operate the Pumping Station as follows:

- Remote Manual Control
- Remote Automatic Control.

The Remote Manual/Automatic control modes are operator selectable from the screen displays at the Operations Control Room.

Once in Remote Mode, the Pumping Station Switchboard mounted controls for Local Mode control will be inoperative and the Operations Control Room will continue to monitor the status of the Pumping Station and will also have the ability to control appropriate items of equipment.

2.6.3 Remote Manual Control

The pump start/stop commands are manually directed from the Operations Control Room via the telemetry system and the pump or pumps will run independent of the reservoir call to fill signal.

This mode will take precedence to Remote Automatic mode whenever selected. The pumps can be individually operated from Start/Stop controls on the SCADA.

A pump will be considered AVAILABLE for Remote Manual Mode Control if:

- Pump remote mode selected AND
- Pump not Fault

A pump will be STOPPED in Remote Manual Mode if:

- Operations request stop OR
- Pump remote mode not selected OR
- Pump Fault
- Emergency Stop Pushbutton Activates

If the pump has been requested to start in Remote Manual and any of the above conditions occur, the pump will stop.

2.6.4 Remote Automatic Control

The Start command is set by the Reservoir Low Setpoint Level, while the Stop command is set by the Reservoir High Setpoint Level.

Both the Low and High Setpoint Levels are set via the operator at the Operation Control Room at the controlling reservoir site. This will be the normal operating mode for the Pumping Station.

The request to run signal is sent through the Elpro telemetry network from the Reservoir to the Pump station.

A pump will be considered available to start in auto if:

- In Remote Control (RTU control selected on panel) AND
- Automatic Mode selected on SCADA AND
- Mains power healthy input is TRUE AND
- It is the duty Pump

Duty selection is also made according to the above conditions i.e. if one or more of the above conditions is not healthy the system will try to set the other pump as duty and vice versa.

A pump will be STOPPED in auto if:

- Stop Command from SCADA OR
- Pump Remote Control mode not selected OR
- Automatic mode deselected on SCADA OR
- Mains power fails
- Emergency Stop Pushbutton Activates

If the pump has been requested to start in Automatic and any of the above conditions occur, the pump will stop. If it is a pump fault and not a normal stop the system will try to run the backup pump.

2.7 RTU Communications

As previously mentioned only a subset of the information detailed here will be available on the WP100 Aratula system as this will be via a TLX400 Elpro RTU and not directly to the installed Kingfisher.

3 ALARMS

The following alarms are also generated by the site.

3.1 Analogue Inputs

All analogue inputs have a loop failure test. If the loop current falls below 2 mA, a loop fault bit is set (transmitter fault). These events are logged by the RTU.

3.2 General Site Alarms

3.2.1 WATER IN PIT

Float switch to detect that the pit sump has filled with water.

3.2.2 MAINS POWER FAULT

The RTU monitors the site AC power via a digital input. If the mains power fails, an alarm is generated.

3.2.3 RTU BATTERY FLAT ALARM

The RTU has internal monitoring points for several power supply parameters. The battery voltage is monitored and if it falls below 12.7 volts an alarm is generated. This point has a delay (20 minutes) to prevent spurious alarms as well as hysteresis (the voltage must rise above 12.8v to reset).

3.2.4 SWITCHBOARD DOOR ALARM

The switchboard doors and site buildings can be fitted with entry/tamper switches. If activated, an alarm will be generated. The alarm will stay active whilst the entry/tamper switches are open.

3.3 Dosing Panel Alarms

The following alarms are generated by the Dosing Panel.

- Dosing Panel General Fault
- Dosing Panel Power Loss
- Dosing Panel Tamper

4 WP100 ARATULA – ELPRO SPECIFIC SIGNALS

As the Aratula site communicates from the local Kingfisher to Elpro (through a Modbus link) then back to SCADA via radio, only a subset of the available alarms and signals are communicated.
This section details the signals that are to be communicated to the Elpro SCADA via this interface.

4.1 Pump Signals

- Pump 1 Running
- Pump 1 Fault
- Pump 1 Local/Remote
- Pump 2 Running
- Pump 2 Fault
- Pump 2 Local/Remote
- Pump 1 Run (Output)
- Pump 2 Run (Output)

4.2 Dosing Panel Signals

- Dosing Panel General Fault
- Dosing Panel Power Loss
- Dosing Panel Tamper
- Dosing Panel Comms Fail
- Chemical Tank Level
- Free Chlorine
- Total Chlorine

4.3 General Signals

- Water In Pit

Lend Lease

SECTION 2

WP100 – Aratula Water Pump Station

Control System FAT

- 3S0016-TS-04-C-Control System FAT - WP100 Aratula

Lend Lease

QUU Kingfisher/SCADA

Control System FAT – Aratula Reservoir Pump Station

Client

Queensland Urban Utilities

Document No

3S0016-TS-04-C-CONTROL SYSTEM FAT - WP100 ARATULA RESERVOIR.DOCX

REVISION B

Site ID and Name	**WP100 Aratula Reservoir Pump Station**
Test Date	24/05/2013
Lend Lease Operative	DHARMAWAN SUSANTO

CORPORATE OFFICE
39 Suscatand St, Rocklea
QLD 4106
Tel: +61 7 3717 7217
Fax: +61 7 3908 3883

www.lendlease.com

Lend Lease Infrastructure Services Pty Ltd

Lend Lease

Control Sheet

Prepared By:	**Duong Pham**	**Date:**	**18/03/2013**
Checked By:	**Richard Behan-Howell**	**Date:**	**08/02/2013**
Authorised For Issue By:	**Richard Behan-Howell**	**Date:**	**08/02/2013**

Distribution List

Copy	Recipient or Location
1	Faheem Saleh (QUU)
2	Richard Behan-Howell (Lend Lease)
3	Duong Pham (Lend Lease)
4	Dharmawan Susanto (Lend Lease)
5	John Nel (QUU)
6	Maaran Mutharasa (QUU)
7	Rob Butcher (QUU)

Revision List

Rev	Date	Comment	Approved
A	08/02/2012	Issued for Client Review	RBH
B	18/03/2013	Revised as per Geoff Timms comments	
C	23/05/2013	Revised by DS as per FAT findings	
D			
E			

Abbreviations and Definitions

Abbreviation	Definition
ACMA	Australian Communications and Media Authority
ADSL	Asymmetric Digital Subscriber Line
CAL	Client Access Licence
CAT	Commissioning Acceptance Testing
CMI	Control Microsystems
CMF	Central Monitoring Facility
CPU	Central Processing Unit
CSV	Comma Separated Variable File
DMR	Digital Microwave Radio
DMZ	Demilitarized Zone
DOL	Direct On-Line
EP Rating	Environmental Priority Rating
ES	Engineering Station
FAT	Factory Acceptance Testing
GST	Goods and Service Tax
GUI	Graphical User Interface
HLZ	High Level Zone
HMI	Human Machine Interface
I&C	Instrumentation & Controls
IO	Inputs and Outputs
LL	Lend Lease Infrastructure Services
IS	Information Systems
ISaGRAF	ICS Triplex ISaGRAF is an IEC-61131-3 compliant software development application
ITP	Inspection and Test Plan

KFII	King Fisher Series II Protocol
km	Kilometre
KVM	Keyboard Video Mouse (Switch)
LAN	Local Area Network
LCD	Liquid Crystal Display
MTU	Master Telemetry Unit
OS	Operating System
PAT	Performance Acceptance Testing
PCS	Process Control System
PDD	Project Definition Document
PDF	Portable Document Format
PLC	Programmable Logic Controller
QA	Quality Assured
RF	Radio Frequency
RSSI	Received Signal Strength Indication
RTU	Remote Telemetry Unit
SAT	Site Acceptance Testing
SCADA	Supervisory Control and Data Acquisition
SOW	Scope of Works
SWR	Standing Wave Ratio
TIA	Totally Integrated Automation
UHF	Ultra High Frequency
W	Watt

Document Control

Prepared For:	Queensland Urban Utilities
Project Name:	SPS Level Redundancy
Lend Lease Job Code:	17202
Document Type:	CONTROL SYSTEM FAT
File Name:	3S0016-TS-04-C-Control System FAT - WP100 Aratula Reservoir.docx
Revision:	C
Status:	Issued
Release Date:	23 May 2013
Prepared By:	Duong Pham and Dharmawan Susanto
	Senior Control Systems Engineers
Reviewed By:	Richard Behan-Howell
	Engineering Section Lead
Lend Lease Approval By:	Richard Behan-Howell
	Engineering Section Lead

Table of Contents

1. Overview

The following document details and records the functional testing of WP100 Aratula Reservoir Pump Station switchboard. This switchboard is based from existing Water Type 14, with an extra "Water in Sump" input which shall be alarmed in SCADA. As such, complete functional testing shall not be performed. Note that this site is not monitored on the CitectSCADA – Kingfisher Telemetry System, but on the Elpro Telemetry System.

2. Methodology

As the testing will occur in a 'factory' location, the site equipment will be replicated using switches and current sources for inputs. Outputs will be confirmed via software.

The RTU shall be connected to an Elpro TLX 400 where the modbus map shall be tested as part of the FAT.

3. Kingfisher RTU

3.1. Power up board

Task	Complete
Check that the RTU powers up OK	OK ☑
Check all boards mounted in backplane	OK ☑
Confirm communication between the Elpro TLX 400 and Aratula RTU.	OK ☐

3.2. Battery

Task	Completed
Connect DC supply to RTU	OK ☑
Check that the battery is connected and charging (i.e.12VDC across the terminals) Elpro RTU Modbus AIN3 reflects Battery Voltage	✓ OK ☐

4. IO Testing

4.1. Modules

4.1.1. Module 1 – DI5

Task	Completed	
Toggle digital input 1 – Mains Power Healthy – Elpro Modbus DIN016	√	Off: OK ☐
	√	On: OK ☐
Toggle digital input 2 – Switchboard Door Alarm – Internal Register reflects both states	√	Off: OK ☐
	√	On: OK ☐
Toggle digital input 3 – Pump No.1 Running – Elpro Modbus DIN001	√	Off: OK ☐
	√	On: OK ☐
Toggle digital input 4 – Pump No.1 Healthy – Elpro Modbus DIN003	√	Off: OK ☐
	√	On: OK ☐
Toggle digital input 5 – Pump No.1 remote Mode Selected – Elpro Modbus DIN002	√	Off: OK ☐
	√	On: OK ☐
Toggle digital input 6 – Pump No.2 Running – Elpro Modbus DIN005	√	Off: OK ☐
	√	On: OK ☐
Toggle digital input 7 – Pump No.2 Healthy – Elpro Modbus DIN007	√	Off: OK ☐
	√	On: OK ☐
Toggle digital input 8 – Pump No.2 remote Mode Selected – Elpro Modbus DIN006	√	Off: OK ☐
	√	On: OK ☐
Toggle digital input 9 – Water in Sump – Elpro Modbus DIN004	√	Off: OK ☐
	√	On: OK ☐
Spare		
Spare		
Spare		
Spare		
Spare		
Spare		
Spare		

4.1.2. Module 2 – IO3

Task	Completed
Inject current into AI2 – flow meter – Elpro RTU Modbus AIN001	√ 4 – 20mA Correct Value In RTU: OK ☐
Inject current into AI2 – Suction Pressure – RTU Internal Register reflects value	√ 4 – 20mA Correct Value In RTU: OK ☐
Inject current into AI3 – Discharge Pressure – RTU Internal Register reflects value	√ 4 – 20mA Correct Value In RTU: OK ☐
Spare	
Analogue output – Spare	
Digital Input 1 – Flow meter pulse - Elpro RTU Modbus PUL001	√ Total Flow Increments: OK ☐
Digital inputs 2 -4 Spare	
Digital outputs 1 & 2 tested during pump runs	
Digital outputs 3 & 4 spare	

4.1.3. Module 3 – IO3

Task	Completed
Analog Input 1 – Chemical Tank Level – Elpro RTU Modbus AIN002	√ Off: OK ☐
	√ On: OK ☐
Analog Input 2 – Free Chlorine – Elpro RTU Modbus AIN004	√ Off: OK ☐
	√ On: OK ☐
Analog Input 3 – Total Chlorine- – Elpro RTU Modbus AIN005	√ Off: OK ☐
	√ On: OK ☐
Analog Input 4 - Spare	
Analog Output 1 - Spare	
Digital Input 1 – Dosing Panel General Fault – Elpro RTU Modbus DIN013	√ Off: OK ☐
	√ On: OK ☐
Digital Input 2 – Dosing Panel Power Loss – Elpro RTU Modbus DIN014	√ Off: OK ☐
	√ On: OK ☐
Digital Input 3 – Dosing System Tamper – Elpro RTU Modbus DIN017	√ Off: OK ☐
	√ On: OK ☐
Digital Input 4 – Dosing Panel Comms Fail – Elpro RTU Modbus DIN018	√ Off: OK ☐
	√ On: OK ☐

5. Functional Tests

5.1. Pumping Station Modes of Operation

As per section 2.7 in the Functional Specification, this sections tests the modes of operation.

Task – Local Mode	**Completed**
Select Local mode	OK ☑
Ensure pump available to run, operate the pump via the panel start stop buttons	OK ☑
Toggle pump starts in the Elpro RTU modbus (DOT001 & DOT002), pumps don't operate	√ OK ☐

Task – Remote Mode	**Completed**
Select Remote mode	OK ☑
Ensure pump available to run, operate the pump via the panel start stop buttons, pumps don't operate	OK ☑
Toggle pump starts in the Elpro RTU modbus (DOT001 & DOT002), pumps operate	√ OK ☐
Try Local start stop buttons – pumps don't operate	OK ☑

Task – Remote Automatic Control	**Completed**
Ensure pumps are available and in Auto	OK ☑
Set Inlet Pressure > Low SP (for 60 seconds), set DOT001, pump 1 starts. (See Section 2.3 in Functional Spec.)	N/A OK ☐
Set Pump 1 switch to Local. Pump stops. Reset DOT001 and Pump 1 switch to remote	√ OK ☐
set DOT002, pump 2 starts	√ OK ☐
Set Pump 2 switch to Local. Pump stops. Reset DOT002 and Pump 2 switch to remote	√ OK ☐
Set DOT001, Pump 1 runs.	√ OK ☐
Trigger Pump 1 fault input. Pump stops. Reset fault input, and reset DOT001.	√ OK ☐
Set DOT002, Pump 2 runs.	√ OK ☐
Trigger Pump 2 fault input. Pump stops. Reset fault input, and reset DOT002.	√ OK ☐
Set DOT001, Pump 1 Starts. Set DOT002, Pump 2 remains stopped.	√ OK ☐

Kingfisher/SCADA SPS - CONTROL SYSTEM FAT

Trigger Pump 1 fault input. Pump stops. Reset fault input, and reset DOT001.	√	OK ☐
Set DOT002, Pump 2 Starts. Set DOT001, Pump 1 remains stopped.	√	OK ☐
Trigger Pump 2 fault input. Pump stops. Reset fault input, and reset DOT002.	√	OK ☐
Set DOT001, Pump 1 Starts.	√	OK ☐
Set Inlet Pressure Low for 30 seconds, pump 1 stops. (See Section 2.3 in Functional Spec.). Reset DOT001.	N/A	OK ☐
Set DOT002, Pump 2 Starts.	√	OK ☐
Set Inlet Pressure Low for 30 seconds, pump 2 stops. (See Section 2.3 in Functional Spec.).Reset DOT002.	N/A	OK ☐
Set Inlet Pressure > Low SP (for 60 seconds), set DOT001, Pump 1 Starts.	N/A	OK ☐
Remove mains supply. Pump stops.		OK ☑

5.2. SIGN OFF/NOTES

5.2.1. RECORD OF SETUP/WITNESS

Lend Lease Operative	Signature	Date
DHARMAWAN SUSANTO		24 MAY 2013

QUU	Signature	Date
FAHEEM SALEH		24/5/2013
ROB BUTCHER		24/5/2013.

5.2.2. NOTES

(1) The mode Selector switch need to be labeled as LOC - OFF - REM instead of MAN - OFF - AUTO

(2) 415 V OR 240V warning sign shall be displayed on all 415 V or 240V section of the front of the panel.

(3) Additional reset required as Auto Reset would not operate on Emergency stop instatement.

(4) VERIFICATION OF MODBUS TO BE CONFIRMED ON ELPRO. DURING S.A.T.

(5) CONFIRMATION REQUIRED RE- PRESSURE OPERATION AT PUMPS.

SECTION 3

WP100 – Aratula Water Pump Station

Control System SAT

- 3S0016-TS-06-B-Control System SAT - WP100 Aratula

Lend Lease

QUU Kingfisher/SCADA

Control System SAT – Aratula Reservoir Pump Station

Client

Queensland Urban Utilities

Document No

3S0016-TS-06-B-CONTROL SYSTEM SAT - WP100 ARATULA RESERVOIR.DOCX
REVISION B

Site ID and Name	**WP100 Aratula Reservoir Pump Station**
Test Date	24 / 9 /2013
Lend Lease Operative	Kaltek Shah / Tim Bowman

CORPORATE OFFICE
39 Suscatand St, Rocklea
QLD 4106
Tel: +61 7 3717 7217
Fax: +61 7 3908 3883

www.lendlease.com

Lend Lease Infrastructure Services Pty Ltd

Lend Lease

Control Sheet

Prepared By:	**Duong Pham**	**Date:**	**26/06/2013**
Checked By:	**Richard Behan-Howell**	**Date:**	**/ /2013**
Authorised For Issue By:	**Richard Behan-Howell**	**Date:**	**/ /2013**

Distribution List

Copy	Recipient or Location
1	Faheem Saleh (QUU)
2	Richard Behan-Howell (Lend Lease)
3	Duong Pham (Lend Lease)
4	Dharmawan Susanto (Lend Lease)
5	John Nel (QUU)
6	Maaran Mutharasa (QUU)
7	Rob Butcher (QUU)

Revision List

Rev	Date	Comment	Approved
A	26/06/2012	Issued for client	RBH

Abbreviations and Definitions

Abbreviation	Definition
ACMA	Australian Communications and Media Authority
ADSL	Asymmetric Digital Subscriber Line
CAL	Client Access Licence
CAT	Commissioning Acceptance Testing
CMI	Control Microsystems
CMF	Central Monitoring Facility
CPU	Central Processing Unit
CSV	Comma Separated Variable File
DMR	Digital Microwave Radio
DMZ	Demilitarized Zone
DOL	Direct On-Line
EP Rating	Environmental Priority Rating
ES	Engineering Station
FAT	Factory Acceptance Testing
GST	Goods and Service Tax
GUI	Graphical User Interface
HLZ	High Level Zone
HMI	Human Machine Interface
I&C	Instrumentation & Controls
IO	Inputs and Outputs
LL	Lend Lease Infrastructure Services
IS	Information Systems
ISaGRAF	ICS Triplex ISaGRAF is an IEC-61131-3 compliant software development application
ITP	Inspection and Test Plan
KFII	King Fisher Series II Protocol
km	Kilometre

KVM	Keyboard Video Mouse (Switch)
LAN	Local Area Network
LCD	Liquid Crystal Display
MTU	Master Telemetry Unit
OS	Operating System
PAT	Performance Acceptance Testing
PCS	Process Control System
PDD	Project Definition Document
PDF	Portable Document Format
PLC	Programmable Logic Controller
QA	Quality Assured
RF	Radio Frequency
RSSI	Received Signal Strength Indication
RTU	Remote Telemetry Unit
SAT	Site Acceptance Testing
SCADA	Supervisory Control and Data Acquisition
SOW	Scope of Works
SWR	Standing Wave Ratio
TIA	Totally Integrated Automation
UHF	Ultra High Frequency
W	Watt

Document Control

Prepared For:	Queensland Urban Utilities
Project Name:	SPS Level Redundancy
Lend Lease Job Code:	17202
Document Type:	CONTROL SYSTEM SAT
File Name:	3S0016-TS-06-A-Control System SAT - WP100 Aratula Reservoir.docx
Revision:	A
Status:	Issued
Release Date:	26 June 2013
Prepared By:	Dharmawan Susanto
	Senior Control Systems Engineer
Reviewed By:	Richard Behan-Howell
	Engineering Section Lead
Lend Lease Approval By:	Richard Behan-Howell Engineering Section Lead

Table of Contents

1. OVERVIEW

The following document details and records the functional testing of WP100 Aratula Reservoir Pump Station switchboard. This switchboard is based from existing Water Type 14, with an extra "Water in Sump" input which shall be alarmed in SCADA. As such, complete functional testing shall not be performed. Note that this site is not monitored on the CitectSCADA – Kingfisher Telemetry System, but on the Elpro Telemetry System.

2. METHODOLOGY

As the testing will occur in a 'factory' location, the site equipment will be replicated using switches and current sources for inputs. Outputs will be confirmed via software.

The RTU shall be connected to an Elpro TLX 400 where the modbus map shall be tested as part of the SAT.

3. KINGFISHER RTU

3.1. POWER UP BOARD

Task	Complete
Check that the RTU powers up OK	OK ☑
Check all boards mounted in backplane	OK ☑
Confirm communication between the Elpro TLX 400 and Aratula RTU.	OK ☑
Confirm communication between the Elpro TLX 400 and base station at Boonah	OK ☑

3.2. BATTERY

Task	Completed
Connect DC supply to RTU	OK ☑
Check that the battery is connected and charging (i.e.12VDC across the terminals) Elpro RTU Modbus AIN~~6~~ 5 reflects Battery Voltage	OK ☑
Battery Low Alarm(#R124.3) - When < 12.7V, Battery Flat alarm is raised[NOT #DI13.3=NOT #R124.3 =Battery Low] Surawski Dr Battery Low - appears on ELPRO SCADA	OK ☑

4. IO TESTING

4.1. MODULES

4.1.1. MODULE 1 – DI5

Task	Completed
Toggle digital input 1 – Mains Power Healthy – Elpro Modbus DIN016	Off: OK ☑ On: OK ☑
Toggle digital input 2 – Switchboard Door Alarm – Internal Register reflects both states	Off: OK ☑ On: OK ☑
Toggle digital input 3 – Pump No.1 Running – Elpro Modbus DIN001	Off: OK ☑ On: OK ☑
Toggle digital input 4 – Pump No.1 Healthy – Elpro Modbus DIN003	Off: OK ☑ On: OK ☑
Toggle digital input 5 – Pump No.1 remote Mode Selected – Elpro Modbus DIN002	Off: OK ☑ On: OK ☑
Toggle digital input 6 – Pump No.2 Running – Elpro Modbus DIN005	Off: OK ☑ On: OK ☑
Toggle digital input 7 – Pump No.2 Healthy – Elpro Modbus DIN007	Off: OK ☑ On: OK ☑
Toggle digital input 8 – Pump No.2 remote Mode Selected – Elpro Modbus DIN006	Off: OK ☑ On: OK ☑
Toggle digital input 9 – Water in Sump – Elpro Modbus DIN004	Off: OK ☑ On: OK ☑
Spare	
Spare	
Spare	
Spare	
Spare	
Spare	
Spare	

4.1.2. Module 2 – IO3

Task	Completed
Inject current into AI2(at device end) – flow meter – Elpro RTU Modbus AIN001	4 – 20mA Correct Value In RTU: OK ☑
Instrument not installed but checked by injecting 4-20mA	0-60lt/s
Inject current into AI2 (at device end)– Suction Pressure – RTU Internal Register reflects value	4 – 20mA Correct Value In RTU: OK ☑
Instrument installed checked by injecting 4-20mA	Pressure displayed on RedLion in Sw Brd ~~0-20bar~~/0-2000Kpa: OK ☑
Inject current into AI3 (at device end)– Discharge Pressure – RTU Internal Register reflects value	4 – 20mA Correct Value In RTU: OK ☑
Instrument installed checked by injecting 4-20mA	Pressure displayed on RedLion in Sw Brd ~~0-20bar~~/0-2000Kpa: OK ☑
Spare	
Analogue output – Spare	
Digital Input 1 – Flow meter pulse - Elpro RTU Modbus PUL001	Total Flow Increments: OK ☑
Digital inputs 2 -4 Spare	
Digital outputs 1 & 2 tested during pump runs	Yes
Digital outputs 3 & 4 spare	

4.1.3. Module 3 – IO3

Task	Completed
Analog Input 1 – Chemical Tank Level – Elpro RTU Modbus AIN002	4-20mA Correct Level Displayed: OK ☑
	0-100%
Analog Input 2 – Free Chlorine – Elpro RTU Modbus AIN004	4-20mA Correct Level Displayed: OK ☑
	0-5ppm
Analog Input 3 – Total Chlorine- – Elpro RTU Modbus AIN005	4-20mA Correct Level Displayed: OK ☑
	0-5ppm
Analog Input 4 - Spare	
Analog Output 1 - Spare	
Digital Input 1 – Dosing Panel General Fault – Elpro RTU Modbus DIN013	Off: OK ☑
	On: OK ☑
Digital Input 2 – Dosing Panel Power Loss – Elpro RTU Modbus DIN014	Off: OK ☑
	On: OK ☑
Digital Input 3 – Dosing System Tamper – Elpro RTU Modbus DIN017	Off: OK ☑
	On: OK ☑
Digital Input 4 – Dosing Panel Comms Fail – Elpro RTU Modbus DIN018	Dont have feature Off: OK ☑
NOTE: This feature not presently equipped in C-Tech unit at this stage – ~~Bridge at relay to test~~	on C-Tech but Tested On: OK ☑ by bridge the ~~[illegible]~~ @ terminals

5. Functional Tests

5.1. Pumping Station Modes of Operation

Task – Local Mode	**Completed**
Select Local mode	OK ☑
Ensure pump available to run, operate the pump via the panel start stop buttons	OK ☑
Toggle pump starts in the Elpro RTU modbus (DOT001 & DOT002), pumps don't operate	OK ☑

Task – Remote Mode	**Completed**
Select Remote mode	OK ☑
Ensure pump available to run, operate the pump via the panel start stop buttons, pumps don't operate	OK ☑
Toggle pump starts in the Elpro RTU modbus (DOT001 & DOT002), pumps operate	OK ☑
Try Local start stop buttons – pumps don't operate	OK ☑

Task – Remote Control Operation	**Action**	**Completed**
Set DOT001, Pump 1 runs	Set Pump 1 switch to Local. Pump stops. Reset DOT001 and Pump 1 switch to remote	OK ☑
Set DOT001, Pump 1 runs	Trigger Pump 1 fault input. Pump stops. Reset fault input, and reset DOT001.	OK ☑
Set DOT001, Pump 1 runs	Set DOT001, Pump 1 Starts. Set DOT002, Pump 2 remains stopped.	OK ☑
Set DOT001, Pump 1 runs	Trigger Pump 1 fault input. Pump stops. Reset fault input, and reset DOT001.	OK ☑
Set DOT001, Pump 1 runs	Remove mains supply. Pump stops.	OK ☑
Set DOT002, Pump 2 runs	Set Pump 2 switch to Local. Pump stops. Reset DOT002 and Pump 2 switch to remote	OK ☑
Set DOT002, Pump 2 runs	Trigger Pump 2 fault input. Pump stops. Reset fault input, and reset DOT002.	OK ☑
Set DOT002, Pump 2 runs	Set DOT002, Pump 2 Starts. Set DOT002, Pump 2 remains stopped.	OK ☑
Set DOT002, Pump 2 runs	Trigger Pump 2 fault input. Pump stops. Reset fault input, and reset DOT002.	OK ☑
Set DOT002, Pump 2 runs	Remove mains supply. Pump stops.	OK ☑

5.2. SIGN OFF/NOTES

5.2.1. RECORD OF SETUP/WITNESS

Lend Lease Operative	Signature	Date
Kartik Shah	[signature]	25/9/2013
Tim Bowman	[signature]	25/9/13.

QUU	Signature	Date
F. SALEH	[signature]	25/9/2013

5.2.2. NOTES

=> Flowmeter is not installed on site but checked the values by injecting 4-20 mA and displayed on SCADA

=> Free/Residual Chlorine tested by injecting 4-20 mA and displayed on SCADA but on C-tech panel it display 0.6 ppm and displayed 0 ppm on SCADA. Output measured & displayed 4 mA only.

=> CONFIRMED Suction & DISCHARGE pressures on switchboard with gauge pressures on site.

(Note: FLOW METER & PRV ARE MERGE IN WATER. BUT THAT IS OUT OF SCOPE OF THIS PROJECT. [signatures])

Lend Lease

SECTION 4

WP100 – Aratula Water Pump Station

Kingfisher IO List

- 3S0016-DS-04-A WP100 Aratula Reservoir Water Pump Station
- Aratula ELPRO - Kingfisher Modbus Map

S106 - Aratula PS (WP100)

3S0016-DS-04-A WP100 Aratula Reservoir Water Pump Station.xls

Location	Charlwood Road Aratula - UBD Ref: -

Non Standard I/O	
For Review	

RTU Backplane	BA-4	Kingfisher
RTU Slot 1(#13)		Kingfisher

RTU Slot 2(#14)	DI-5 - 16xDI						SCADA Raw scaling		SCADA Eng scaling				
SCADA Tag Name	**IO Description**	**RTU Address**	**Input No**	**RTU Terminal**	**IO Type**	**RTU Map**	**Scaling min**	**Scaling max**	**Scaling min**	**Scaling max**	**Units**	**Alarm Logic in SCADA**	**Device manf/model**
S106_MainsPwr	S106: Mains Power Healthy	#DI14.1	1	1	Digital +ve	#R193.1	n/a	n/a	n/a	n/a	n/a	not S106_MainsPwrEA	
S106_Tamper	S106: Tamper Alarm	#DI14.2	2	2	Digital +ve	#R193.2	n/a	n/a	n/a	n/a	n/a	S106_TamperEA	
S106_PMP0001Run	S106: Pump1 Running	#DI14.3	3	3	Digital +ve	#R193.3	n/a	n/a	n/a	n/a	n/a	n/a	
S106_PMP0001Flt	S106: Pump1 Fault	#DI14.4	4	4	Digital +ve	#R193.4	n/a	n/a	n/a	n/a	n/a	S106_PMP0001FltEA	
S106_PMP0001Rem	S106: Pump1 Remote	#DI14.5	5	5	Digital +ve	#R193.5	n/a	n/a	n/a	n/a	n/a	NOT S106_PMP0001RemEA	
S106_PMP0002Run	S106: Pump2 Running	#DI14.6	6	6	Digital +ve	#R193.6	n/a	n/a	n/a	n/a	n/a	n/a	
S106_PMP0002Flt	S106: Pump2 Fault	#DI14.7	7	7	Digital +ve	#R193.7	n/a	n/a	n/a	n/a	n/a	S106_PMP0002FltEA	
S106_PMP0002Rem	S106: Pump2 Remote	#DI14.8	8	8	Digital +ve	#R193.8	n/a	n/a	n/a	n/a	n/a	NOT S106_PMP0002RemEA	
S106_SMP0001Hi	S106:Water in Sump	#DI14.9	9	11	Digital +ve	#R193.9	n/a	n/a	n/a	n/a	n/a	S106_SMP0001HiEA	
S106_SpareDI10	S106: Spare DI10	#DI14.10	10	12	Digital +ve	#R193.10	n/a	n/a	n/a	n/a	n/a	n/a	
S106_SpareDI11	S106: Spare DI11	#DI14.11	11	13	Digital +ve	#R193.11	n/a	n/a	n/a	n/a	n/a	n/a	
S106_SpareDI12	S106: Spare DI12	#DI14.12	12	14	Digital +ve	#R193.12	n/a	n/a	n/a	n/a	n/a	n/a	
S106_SpareDI13	S106: Spare DI13	#DI14.13	13	15	Digital +ve	#R193.13	n/a	n/a	n/a	n/a	n/a	n/a	
S106_SpareDI14	S106: Spare DI14	#DI14.14	14	16	Digital +ve	#R193.14	n/a	n/a	n/a	n/a	n/a	n/a	
S106_SpareDI15	S106: Spare DI15	#DI14.15	15	17	Digital +ve	#R193.15	n/a	n/a	n/a	n/a	n/a	n/a	
S106_SpareDI16	S106: Spare DI16	#DI14.16	16	18	Digital +ve	#R193.16	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	Not used	12V	n/a	9 & 19	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	Not used	0V	n/a	10 & 20	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

RTU Slot 3(#15)	IO-3 - 4xAI 1xAO 4xDI 4xDO						SCADA Raw scaling		SCADA Eng scaling				
SCADA Tag Name	**IO Description**	**RTU Address**	**Input No**	**RTU Terminal**	**IO Type**	**RTU Map**	**Scaling min**	**Scaling max**	**Scaling min**	**Scaling max**	**Units**	**Alarm Logic in SCADA**	**Device manf/model**
S106_FIT0001	S106:Flow Rate	#AI15.2	n/a	1	AI 0-20mA	#R129	6552	32760	0	60	l/s	n/a	
S106_PIT0001	S106:Suction Pressure	#AI15.3	n/a	2	AI 0-20mA	#R130	6552	32760	0	2000	Kpa	n/a	
S106_PIT0002	S106:Discharge Pressure	#AI15.4	n/a	3	AI 0-20mA	#R131	6552	32760	0	2000	Kpa	n/a	
S106_SpareAI04	S106: Spare AI04	#AI15.5	n/a	4	AI 0-20mA	#R132	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	Not used	#AO15.6	n/a	7+ve / 8-ve	AO 0-20mA	#R80	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	S106:Flow Pulse	#DI15.1	n/a	10	DI +ve	#R194.1	n/a	n/a	n/a	n/a	n/a	n/a	
S106_SpareDI18	S106: Spare DI18	#DI15.2	n/a	11	DI +ve	#R194.2	n/a	n/a	n/a	n/a	n/a	n/a	
S106_SpareDI19	S106: Spare DI19	#DI15.3	n/a	12	DI +ve	#R194.3	n/a	n/a	n/a	n/a	n/a	n/a	
S106_SpareDI20	S106: Spare DI20	#DI15.4	n/a	13	DI +ve	#R194.4	n/a	n/a	n/a	n/a	n/a	n/a	
n/a	DI common	n/a	n/a	14	DI common	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	S106:Pump1 Run	#DO15.9	n/a	15	DO +ve	#R202.1	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	S106:Pump2 Run	#DO15.10	n/a	16	DO +ve	#R202.2	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	Not used	#DO15.11	n/a	17	DO +ve	#R202.3	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	Not used	#DO15.12	n/a	18	DO +ve	#R202.4	n/a	n/a	n/a	n/a	n/a	n/a	
n/a	DO common	n/a	n/a	19	DO common	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
n/a	Optional DC	n/a	n/a	20	Optional DC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

WP100 CHARLWOOD RD, ARATULA - WATER PUMPING STATION

DETAILS FOR MAPPING KINGFISHER CONTROLLER TO ELPRO TLX400 RTU AND EXISTING ELPRO SCADA

EXISTING ELPRO / SCADA INFORMATION	EXISTING ELPRO TAG NAME	I/O TYPE	ELPRO I/O REF	ACTION REQUIRED	REVISED ELPRO / SCADA INFORMATION	ASSOCIATED KINGFISHER PHYSICAL I/O POINT		COMMENTS
Digital Inputs								
Surawski Dr Pump 1 Running	SDR_PMP_001_RUN	DIGITAL	DIN001	UNCHANGED	Surawski Dr Pump 1 Running	SLOT 14	DI 3	
Surawski Dr Pump 1 Auto Mode Input	SDR_PMP_001_AMI	DIGITAL	DIN002	UNCHANGED	Surawski Dr Pump 1 Remote Mode Selected	SLOT 14	DI 5	
Surawski Dr Pump 1 Fault	SDR_PMP_001_FLT	DIGITAL	DIN003	UNCHANGED	Surawski Dr Pump 1 Fault	SLOT 14	DI 4	
Surawski Dr Duty Select Pump 1 & 2	SDR_DIG_004_DIN	DIGITAL	DIN004	RE-ALLOCATE	Surawski Dr Water in Pump Pit Alarm	SLOT 14	DI 9	
Surawski Dr Pump 2 Running	SDR_PMP_002_RUN	DIGITAL	DIN005	UNCHANGED	Surawski Dr Pump 2 Running	SLOT 14	DI 6	
Surawski Dr Pump 2 Auto Mode Input	SDR_PMP_002_AMI	DIGITAL	DIN006	UNCHANGED	Surawski Dr Pump 2 Remote Mode Selected	SLOT 14	DI 8	
Surawski Dr Pump 2 Fault	SDR_PMP_002_FLT	DIGITAL	DIN007	UNCHANGED	Surawski Dr Pump 2 Fault	SLOT 14	DI 7	
Surawski Dr Purdons Pump 2 Start (At redundant SEQ WTP)	SDR_DIG_008_DIN	DIGITAL	DIN008	RE-ALLOCATE	Surawski Dr Chemical Station General Fault	SLOT 16	DI 1	
Surawski Dr WTP Fault (At redundant SEQ WTP)	SDR_DIG_009_DIN	DIGITAL	DIN009	RE-ALLOCATE	Surawski Dr Chemical Station General Power Loss	SLOT 16	DI 2	
Surawski Dr WTP High Level Alarm (At redundant SEQ WTP)	SDR_DIG_010_DIN	DIGITAL	DIN010	RE-ALLOCATE	Surawski Dr Chemical Station Intruder Alarm	SLOT 16	DI 3	
Surawski Dr Balance Tank Low Alarm (At redundant SEQ WTP)	SDR_DIG_011_DIN	DIGITAL	DIN011	RE-ALLOCATE	Surawski Dr Chemical Station Comms Failure	SLOT 16	DI 4	Presently no practical means of obtaining this signal from the C-Tech panel.
Surawski Dr Fail to Flow Alarm (At redundant SEQ WTP)	SDR_DIG_012_DIN	DIGITAL	DIN012	RE-ALLOCATE	Surawski Dr Switchboard Intruder Alarm	SLOT 14	DI 2	
Surawski Dr Battery Low	SDR_RMT_001_BLW	DIGITAL	DIN015	UNCHANGED	Surawski Dr Battery Low	INTERNAL	N/A	Signal originally came from physical input on Elpro EP-101. Value now from KF internal.
Surawski Dr Mains Fail	SDR_RMT_001_MFL	DIGITAL	DIN016	UNCHANGED	Surawski Dr Mains Fail	SLOT 14	DI 1	
Kingfisher Commands to Run Pumps								
Surawski Dr Pump 1 Remote Manual Start Command	SDR_PMP_001_OST	DIGITAL	DOT001	SEE COMMENT	Surawski Dr Pump Start Command			
Surawski Dr Pump 2 Remote Manual Start Command	SDR_PMP_002_OST	DIGITAL	DOT002	NO LONGER REQUIRED				
Surawski Dr Pump 1 Remote Manual Mode		DIGITAL	DOT003					
Surawski Dr Pump 2 Remote Manual Mode		DIGITAL	DOT004					
Surawski Dr Pump 1 Remote Auto Command		DIGITAL	DOT005					
Surawski Dr Pump 2 Remote Auto Command		DIGITAL	DOT006					
Analogue Inputs								
Surawski Dr Magmeter Flowrate (0-60L/s)	SDR_FLW_001_FLW	INT	AIN001	UNCHANGED	Surawski Dr Magmeter Flowrate	SLOT 15	AI 2	
Surawski Dr Batt. Volts (0-20V)	SDR_RMT_001_BVT	INT	AIN005	UNCHANGED	Surawski Dr Batt. Volts	INTERNAL	N/A	Signal originally came from physical input on Elpro EP-101. Value now from KF internal.
Surawski Dr Magmeter Total Flow ABS	SDR_FLW_001_ABS	LONG	PUL001		Surawski Dr Magmeter Total Flow ABS	SLOT 15	DI 1	
	???		AIN002	NEW INPUT	Surawski Dr Chemical Station Hypo Tank Level	SLOT 16	AI 2	
	???		AIN003	NEW INPUT	Surawski Dr Chemical Station Residual Chlorine	SLOT 16	AI 3	
	???		AIN004	NEW INPUT	Surawski Dr Chemical Station Total Chlorine	SLOT 16	AI 4	No Total Chlorine Analyzer presently installed at this site. Provide input for future.

RTU Slot 4(#16)	IO-3 - 4xAI 1xAO 4xDI 4xDO						SCADA Raw scaling		SCADA Eng scaling				
SCADA Tag Name	IO Description	RTU Address	Input No	RTU Terminal	IO Type	RTU Map	Scaling min	Scaling max	Scaling min	Scaling max	Units	Alarm Logic in SCADA	Device manf/model
S106_LIT0001	S106:Chemical Tank Level	#AI16.2	n/a	1	AI 0-20mA	#R133	6552	32760	0	100	%	n/a	
S106_FAC0001	S106:Free Chlorine	#AI16.3	n/a	2	AI 0-20mA	#R134	6552	32760	0	5	ppm	n/a	
S106_TAC0001	S106:Total Chlorine	#AI16.4	n/a	3	AI 0-20mA	#R135	6552	32760	0	5	ppm	n/a	
S106_SpareAI04	S106: Spare AI04	#AI16.5	n/a	4	AI 0-20mA	#R136	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	Not used	#AO16.6	n/a	7+ve / 8-ve	AO 0-20mA	#R80	n/a	n/a	n/a	n/a	n/a	n/a	
S106_DosFault	S106:Dosing Panel General Fault	#DI16.1	n/a	10	DI +ve	#R195.1	n/a	n/a	n/a	n/a	n/a	S106_DosFaultEA	
S106_DosMainsPwr	S106:Dosing Panel Power Loss	#DI16.2	n/a	11	DI +ve	#R195.2	n/a	n/a	n/a	n/a	n/a	not S106_DosMainsPwrEA	
S106_DosTamper	S106:Dosing System Tamper	#DI16.3	n/a	12	DI +ve	#R195.3	n/a	n/a	n/a	n/a	n/a	S106_DosTamperEA	
S106_DosCommsFail	S106:Dosing Panel Comms Fail	#DI16.4	n/a	13	DI +ve	#R195.4	n/a	n/a	n/a	n/a	n/a	S106_DosCommsFailEA	
n/a	DI common	n/a	n/a	14	DI common	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	Not used	#DO16.9	n/a	15	DO +ve	#R202.5	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	Not used	#DO16.10	n/a	16	DO +ve	#R202.6	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	Not used	#DO16.11	n/a	17	DO +ve	#R202.7	n/a	n/a	n/a	n/a	n/a	n/a	
Not used	Not used	#DO16.12	n/a	18	DO +ve	#R202.8	n/a	n/a	n/a	n/a	n/a	n/a	
n/a	DO common	n/a	n/a	19	DO common	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
n/a	Optional DC	n/a	n/a	20	Optional DC	n/a	n/a	n/a	n/a	n/a	n/a	n/a	

Digital Alarms

							SCADA Raw scaling		SCADA Eng scaling				
Tag Name	Alarm Description	RTU Address	Category	SP Address	SP Raw	SP Scaled	Scaling min	Scaling max	Scaling min	Scaling max	Units	Alarm Logic in SCADA	SP Tag
S106_PMP0001Ctrl	Remote Manual Control	#R201.1	4				n/a	n/a	n/a	n/a	n/a	S106_PMP0001Ctrl	
S106_PMP0002Ctrl	Remote Manual Control	#R201.2	4				n/a	n/a	n/a	n/a	n/a	S106_PMP0002Ctrl	
S106_IOScan	IO Scanning Disabled	#R128.3	1				n/a	n/a	n/a	n/a	n/a	NOT S106_IOScan	
S106_LLen	Ladder Program Disabled	#R128.4	1				n/a	n/a	n/a	n/a	n/a	NOT S106_LLen	

Advanced Alarms

							SCADA Raw scaling		SCADA Eng scaling				
Tag Name	Alarm Description	RTU Address	Category	SP Address	SP Raw	SP Scaled	Scaling min	Scaling max	Scaling min	Scaling max	Units	Alarm Logic in SCADA	SP Tag
S106_Person1	S106: Aratula PS 1st	#R401	6				n/a	n/a	n/a	n/a	n/a	S106_SecurCard1 > 0	
S106_Person2	S106: Aratula 2nd	#R403	6				n/a	n/a	n/a	n/a	n/a	S106_SecurCard2 > 0	
S106_Person3	S106: Aratula 3rd	#R405	6				n/a	n/a	n/a	n/a	n/a	S106_SecurCard3 > 0	
S106_Person4	S106: Aratula 4th	#R407	6				n/a	n/a	n/a	n/a	n/a	S106_SecurCard4 > 0	
S106_Person5	S106: Aratula 5th	#R409	6				n/a	n/a	n/a	n/a	n/a	S106_SecurCard5 > 0	

Time Stamped Alarms

							SCADA Raw scaling		SCADA Eng scaling				
Tag Name	Alarm Description	RTU Address	Category	SP Address	SP Raw	SP Scaled	Scaling min	Scaling max	Scaling min	Scaling max	Units	Alarm Logic in SCADA	SP Tag
S106_CBusFail	Comms Bus Fail	D014	1				n/a	n/a	n/a	n/a	n/a	S106_CBusFailEA	
S106_FIT0001HA	Flow 1 High Alarm	#R153.2	2				n/a	n/a	n/a	n/a	n/a	S106_FIT0001HAEA	
S106_LIT0001LA	Chemical Tank Low Alarm	#R157.1	2				n/a	n/a	n/a	n/a	n/a	S106_LIT0001LAEA	
S106_FAC0001LA	Free Chlorine Low Alarm	#R158.1	1				n/a	n/a	n/a	n/a	n/a	S106_FAC0001LAEA	
S106_FAC0001HA	Free Chlorine High Alarm	#R158.4	1				n/a	n/a	n/a	n/a	n/a	S106_FAC0001HAEA	
S106_TAC0001LA	Total Chlorine Low Alarm	#R159.1	1				n/a	n/a	n/a	n/a	n/a	S106_TAC0001LAEA	
S106_TAC0001HA	Total Chlorine High Alarm	#R159.4	1				n/a	n/a	n/a	n/a	n/a	S106_TAC0001HAEA	
S106_FIT0001LPF	Flow 1 Transmitter Fault	#R153.16	1				n/a	n/a	n/a	n/a	n/a	S106_FIT0001LPFEA	
S106_Grp1AllFlt	All Pumps In Fault	#R212.6	3				n/a	n/a	n/a	n/a	n/a	S106_Grp1AllFltEA	
S106_Grp1AllFTS	All Pumps Failed to Start	#R212.5	3				n/a	n/a	n/a	n/a	n/a	S106_Grp1AllFTSEA	
S106_Grp1AllNR	All Pumps Not Ready	#R212.4	3				n/a	n/a	n/a	n/a	n/a	S106_Grp1AllNREA	
S106_HWAlarm	RTU Module Hardware Alarm	#R125.1	1				n/a	n/a	n/a	n/a	n/a	S106_HWAlarmEA	
S106_HWFltC1	Hardware Fault Card 1	#R126.1	1				n/a	n/a	n/a	n/a	n/a	S106_HWFltC1EA	
S106_HWFltC2	Hardware Fault Card 2	#R126.2	1				n/a	n/a	n/a	n/a	n/a	S106_HWFltC2EA	
S106_HWFltC3	Hardware Fault Card 3	#R126.3	1				n/a	n/a	n/a	n/a	n/a	S106_HWFltC3EA	
S106_HWFltC4	Hardware Fault Card 4	#R126.4	1				n/a	n/a	n/a	n/a	n/a	S106_HWFltC4EA	
S106_LOSAlarm	RTU Battery not Charging Alarm	#R125.2	1				n/a	n/a	n/a	n/a	n/a	S106_LOSAlarmEA	
S106_MainsPwr	Mains Power Fault	#R193.1	2				n/a	n/a	n/a	n/a	n/a	not S106_MainsPwrEA	
S106_PIT0001LPF	Pressure 1 Transmitter Fault	#R154.16	1				n/a	n/a	n/a	n/a	n/a	S106_PIT0001LPFEA	
S106_PIT0002LPF	Pressure 2 Transmitter Fault	#R155.16	1				n/a	n/a	n/a	n/a	n/a	S106_PIT0002LPFEA	
S106_PMP0001Flt	Pump 1 Fault	#R193.4	2				n/a	n/a	n/a	n/a	n/a	S106_PMP0001FltEA	
S106_PMP0001FltXE	Pump 1 Fault XS Events Alarm	#R206.2	3				n/a	n/a	n/a	n/a	n/a	S106_PMP0001FltXEEA	
S106_PMP0001FltXH	Pump 1 Fault XS Hours Alarm	#R209.2	3				n/a	n/a	n/a	n/a	n/a	S106_PMP0001FltXHEA	
S106_PMP0001FTS	Pump 1 Fail To Start	#R212.1	2				n/a	n/a	n/a	n/a	n/a	S106_PMP0001FTSEA	
S106_PMP0001Rem	Pump 1 In Local Control	#R193.5	2				n/a	n/a	n/a	n/a	n/a	NOT S106_PMP0001RemEA	
S106_PMP0001RunXE	Pump 1 Run XS Events Alarm	#R206.1	3				n/a	n/a	n/a	n/a	n/a	S106_PMP0001RunXEEA	
S106_PMP0001RunXH	Pump 1 Run XS Hours Alarm	#R209.1	3				n/a	n/a	n/a	n/a	n/a	S106_PMP0001RunXHEA	
S106_PMP0002Flt	Pump 2 Fault	#R193.7	2				n/a	n/a	n/a	n/a	n/a	S106_PMP0002FltEA	
S106_PMP0002FltXE	Pump 2 Fault XS Events Alarm	#R206.4	3				n/a	n/a	n/a	n/a	n/a	S106_PMP0002FltXEEA	
S106_PMP0002FltXH	Pump 2 Fault XS Hours Alarm	#R209.4	3				n/a	n/a	n/a	n/a	n/a	S106_PMP0002FltXHEA	
S106_PMP0002FTS	Pump 2 Fail To Start	#R212.2	2				n/a	n/a	n/a	n/a	n/a	S106_PMP0002FTSEA	
S106_PMP0002Rem	Pump 2 In Local Control	#R193.8	2				n/a	n/a	n/a	n/a	n/a	NOT S106_PMP0002RemEA	
S106_SMP0001HI	Water in Sump	#R193.9	2				n/a	n/a	n/a	n/a	n/a	S106_SMP0001HIEA	
S106_PMP0002RunXE	Pump 2 Run XS Events Alarm	#R206.3	3				n/a	n/a	n/a	n/a	n/a	S106_PMP0002RunXEEA	
S106_PMP0002RunXH	Pump 2 Run XS Hours Alarm	#R209.3	3				n/a	n/a	n/a	n/a	n/a	S106_PMP0002RunXHEA	
S106_RTCFail	Real Time Clock Fail	#R125.12	1				n/a	n/a	n/a	n/a	n/a	S106_RTCFailEA	
S106_SupplyOK	RTU Battery Flat Alarm <12.7V	#R124.3	1				n/a	n/a	n/a	n/a	n/a	not S106_SupplyOKEA	
S106_Tamper	Tamper Alarm	#R193.2	2				n/a	n/a	n/a	n/a	n/a	S106_TamperEA	
S106_WDTFail	Watchdog Timer Fail	#R125.13	1				n/a	n/a	n/a	n/a	n/a	S106_WDTFailEA	
S106_DosFault	S106:Dosing Panel General Fault	#R195.1	1				n/a	n/a	n/a	n/a	n/a	S106_DosFaultEA	
S106_DosMainsPwr	S106:Dosing Panel Power Loss	#R195.2	1				n/a	n/a	n/a	n/a	n/a	not S106_DosMainsPwrEA	
S106_DosTamper	S106:Dosing System Tamper	#R195.3	1				n/a	n/a	n/a	n/a	n/a	S106_DosTamperEA	
S106_DosCommsFail	S106:Dosing Panel Comms Fail	#R195.4	1				n/a	n/a	n/a	n/a	n/a	S106_DosCommsFailEA	

SCADA to local RTU Various Setpoints

					SCADA Raw scaling		SCADA Eng scaling		
Tag Name	Setpoint Description	SP Address	SP Raw	SP Scaled	Scaling min	Scaling max	Scaling min	Scaling max	Units
S106_ASP1	Not used	#R961	n/a	n/a	n/a	n/a	n/a	n/a	l/s
S106_ASP2	S106: Flow 1 High SP	#R962	6553		6553	32760	0	100	l/s
S106_ASP3	S106: Chemical Tanks Low SP	#R963	n/a	n/a	6553	32760	0	100	%
S106_ASP4	S106: Free Chlorine Low SP	#R964	n/a	n/a	6553	32760	0	?	mg/L
S106_ASP5	S106: Free Chlorine High SP	#R965	n/a	n/a	6553	32760	0	?	mg/L
S106_ASP6	S106: Total Chlorine Low SP	#R966	n/a	n/a	6553	32760	0	?	mg/L
S106_ASP7	S106: Total Chlorine High SP	#R967	n/a	n/a	6553	32760	0	?	mg/L

SCADA to local RTU Event Setpoints

					SCADA Raw scaling		SCADA Eng scaling		
Tag Name	Setpoint Description	SP Address	SP Raw	SP Scaled	Scaling min	Scaling max	Scaling min	Scaling max	Units
S106_ESP[0]	Pump 1 Excess Starts / Hr	#R993	0		0	32767	0	32767	n/a
S106_ESP[1]	Not used	#R994	0		0	32767	0	32767	n/a
S106_ESP[2]	Pump 2 Excess Starts / Hr	#R995	0		0	32767	0	32767	n/a
S106_ESP[3]	Not used	#R996	0		0	32767	0	32767	n/a
S106_ESP[4]	Not used	#R997	0		0	32767	0	32767	n/a
S106_ESP[5]	Not used	#R998	0		0	32767	0	32767	n/a
S106_ESP[6]	Not used	#R999	0		0	32767	0	32767	n/a
S106_ESP[7]	Not used	#R1000	0		0	32767	0	32767	n/a
S106_ESP[8]	Not used	#R1001	0		0	32767	0	32767	n/a
S106_ESP[9]	Not used	#R1002	0		0	32767	0	32767	n/a
S106_ESP[10]	Not used	#R1003	0		0	32767	0	32767	n/a
S106_ESP[11]	Not used	#R1004	0		0	32767	0	32767	n/a
S106_ESP[12]	Not used	#R1005	0		0	32767	0	32767	n/a
S106_ESP[13]	Not used	#R1006	0		0	32767	0	32767	n/a
S106_ESP[14]	Not used	#R1007	0		0	32767	0	32767	n/a
S106_ESP[15]	Not used	#R1008	0		0	32767	0	32767	n/a

ADA to local RTU Hour Run Setpoints

					SCADA Raw scaling		SCADA Eng scaling		
Tag Name	Setpoint Description	SP Address	SP Raw	SP Scaled	Scaling min	Scaling max	Scaling min	Scaling max	Units
S106_HSP[0]	Pump 1 Excess Run Hours	#R1009	0		0	6000	0	100	Hr
S106_HSP[1]	Pump 1 Fault	#R1010	0		0	6000	0	100	Hr
S106_HSP[2]	Pump 2 Run	#R1011	0		0	6000	0	100	Hr
S106_HSP[3]	Pump 2 Fault	#R1012	0		0	6000	0	100	Hr
S106_HSP[4]	Not used	#R1013	0		0	6000	0	100	Hr
S106_HSP[5]	Not used	#R1014	0		0	6000	0	100	Hr
S106_HSP[6]	Not used	#R1015	0		0	6000	0	100	Hr
S106_HSP[7]	Not used	#R1016	0		0	6000	0	100	Hr
S106_HSP[8]	Not used	#R1017	0		0	6000	0	100	Hr
S106_HSP[9]	Not used	#R1018	0		0	6000	0	100	Hr
S106_HSP[10]	Not used	#R1019	0		0	6000	0	100	Hr
S106_HSP[11]	Not used	#R1020	0		0	6000	0	100	Hr
S106_HSP[12]	Not used	#R1021	0		0	6000	0	100	Hr
S106_HSP[13]	Not used	#R1022	0		0	6000	0	100	Hr
S106_HSP[14]	Not used	#R1023	0		0	6000	0	100	Hr
S106_HSP[15]	Not used	#R1024	0		0	6000	0	100	Hr

	Menu Item	Setting
4.1 Site Config	TLC Emulation Mode	TLX Native Mode
	Redundancy Options	No Redundancy
	Address of Pre-processor	?
	Address of Pager RTU	255 (Disabled)
	Address of Control RTU	255 (Disabled)
	SMF Option	n
	Address of Local RTU	255 (Disabled)
	Input Debounce Time	Not Required - default
	Comms Fail Timeout	?
	Frame type	?
	Default sensitivity	Not Required - default
	Analogue inputs to square root	Not Required - default
	Analogue inputs to filter	Not Required - default
	Routing	?
	Store and Forward Configuration	Not Required - default
4.2 Configure Radio	Tx/Rx Frequency	?
	Tx Power	?
	Baud Rate	?
	Radio Tones	?
	Lead-in	?
4.3 Configure Local Control		Not Required - default
4.4 Load Configuration From File		Not Required - default
4.5 Save Configuration To File		Not Required - default
4.6 Service Menu		Not Required - default
4.7 Pager/Modem Options		Not Required - default
4.8 Logging Options		Not Required - default
4.9 Serial Ports Configuration	Set HOST Port Baudrate	Not Required - default
	Set HOST Port Data Format	Not Required - default
	Set EXPANSION Port Baudrate	38400
	Set EXPANSION Port Data Format	8bits,odd parity,1stop
	Configure HOST for modem	Not Required - default
	Configure HOST for pager	Not Required - default
4.1 Modbus Configuration		
	Auto Detect 115S Configuration	Not Required
	Manually Configure 115S Modules	Not Required - default
	Set Modbus Slave Address	0 (Master) TBA
	Set Delay Between Polls (mSec)	100
	Add Master Poll Commands	TBA
	Edit an existing command	Not Required
	Delete the final command	Not Required
4.11 Factory Defaults		Not Required
4.12 Reset		Not Required
4.13 Exit		Not Required

Lend Lease

SECTION 5

WP100 – Aratula Water Pump Station

Electrical Design & Drawings and

Pump Pit Civil Drawings

Lend Lease

Section 5.01 Electrical Design

- 3S0016-DR-002-A Design Report

Lend Lease

Queensland Urban Utilities
WP100 Charlwood Road
Aratula Water Pump Station
Switchboard Replacement

Design Report
(Power System Analysis and Protection Coordination)

3S0016-DR-002-A

RPEQ Certification

Revision	Date	Author	Electrical Design Reviewer
A	15/05/2014	John Dalziel – Licence 104697	Derrick Sutcliffe – RPEQ No. 07782
			D.P. Sutcliffe

Document Revision Details

Prepared For:	Queensland Urban Utilities
Site Name:	WP100
Area Name:	Aratula
Document Type:	Design Report
File Name:	3S0016-DR-002-A - Design Report.Docx
Revision Version:	A
Release Date:	15/05/2014
Revision Status:	As Constructed Final
Job Number	3S0016
Author:	John Dalziel
	Senior Electrical Designer
Reviewed By:	Derrick Sutcliffe
	Electrical Engineer RPEQ
Approved By:	Sean O'Callaghan
	Job Owner

Document Revision History

Revision	Date	Reason
P1	10/09/2013	Preliminary Design
A	15/05/2014	As Constructed Final for RPEQ Certification

TABLE OF CONTENTS

1 INTRODUCTION

Queensland Urban Utilities has commissioned Lend Lease Services to Design and Construct a replacement switchboard for the WP100 Charlwood Road, Aratula Water Pump Station in the Scenic Rim area.

The purpose of this document is to analyse the equipment selected for the installation to ensure design compliance with the requirements of AS3000:2007 and AS3008.1.1:2009 with particular regard to:-

- Prospective Short Circuit Current
- Prospective Earth Fault Current
- Cable Current Carrying Capacity
- Circuit Voltage Drop
- Prospective Touch Voltage Limits and Disconnection Times
- Rating and Co-ordination of Protective Devices

2 METHODOLOGY

The analysis is carried out with the aid of two software packages.

2.1 Powerpac Pro version 6.2.0.245

Powerpac is a powerful electrical cable sizing software package designed specifically for the Australian and New Zealand markets. The version used for this analysis performs calculations based on the current revisions of AS3000:2007 and AS3008.1.1:2009.

Prospective short circuit current, circuit load currents, cable sizes, cable lengths, cable installation method and protective device settings are entered into the input fields of the user interface and the software analyses the scenario and prints the calculated solution or results.

The software calculates and/or verifies the following:-

- The current carrying capacity of each cable is suitable for the stated load under stated installation conditions in accordance with AS3000:2007 Clause 3.4 using the relevant tables of AS3008.1.1:2009
- The voltage drop for each circuit cable is within the allowable limits of AS3000:2007 Clause 3.6.2
- The let through energy of each circuit protective device will not give rise to excessive cable temperatures during short circuit conditions in accordance with AS3008.1.1:2009 Clause 5.5
- The earth fault loop impedance of each circuit is low enough to ensure automatic disconnection of the supply within the times specified in AS3000:2007 Clause 5.7.2 under earth fault conditions.

If any input data or calculated result fails to comply with the requirements of the standards, the software displays a yellow warning triangle and highlights the error in red text. The absence of any warning is deemed to indicate full compliance.

2.2 Temcurve version 6.0.3.2

Temcurve is a proprietary software package designed specifically for analysing and comparing Terasaki circuit breaker time/current characteristic curves. The same circuit breaker settings used in the Powerpac analysis are entered into Temcurve and the curves are plotted on a common scale.

The curves are visually compared to ensure compliance with the discrimination requirements of AS3000:2007 Clause 2.5.7.1

3 TECHNICAL NOTES

3.1 Prospective Short Circuit Current

The prospective short circuit current at the point of installation of the switchboard was determined by measurement with a Fluke 1653B installation tester to be 0.93kA.

The switchboard main circuit breaker and pump circuit breakers are chosen from the Terasaki T2 economy MCCB range, and the miniature circuit breakers used on final sub circuits are from the DINT6 range. All these devices have breaking capacities of 6kA or greater. Accordingly the switchboard has been assigned a conservative short circuit rating of 6kA.

A Powerpac software analysis has been performed at both 0.93kA and 6kA to ensure compliance.

3.2 Maximum Demand

The maximum demand of the installation is calculated by Powerpac Pro in accordance with AS3000:2007 Table C2 for non-domestic installations. The pumps operate in a duty/standby arrangement so only one pump will ever operate at a time. This duty has been taken into consideration in the maximum demand input data.

4 CONCLUSION

4.1 Cable Sizing

Powerpac Pro software did not display any warnings during either the 0.93kA or 6kA analysis. All of the installation cables are therefore deemed to be fully compliant with the various clauses of the Australian Standards mentioned in paragraph 2.1.

The full Powerpac printout for each short circuit rating is incorporated in this report.

4.2 Protection Coordination

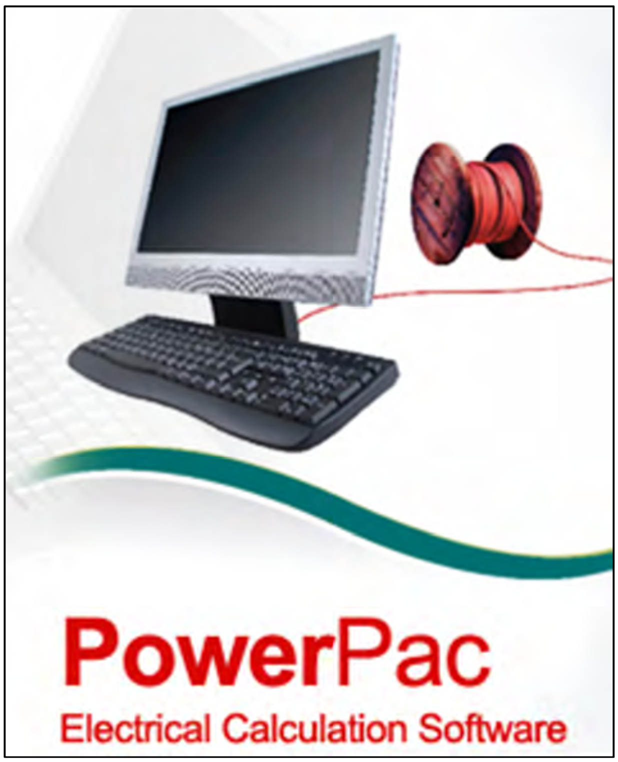
Examination of the time-current curves of the Main MCCB vs the Pump MCCB shows clear discrimination throughout the thermal and magnetic parts of the two curves. The protective devices therefore discriminate in accordance with AS3000:2007 Clause 2.5.7.1

Comparison of the time current curves of the Main MCCB vs the largest final sub circuit MCB (16A) shows clear discrimination throughout the thermal and magnetic parts of the two curves. The protective devices therefore discriminate in accordance with AS3000:2007 Clause 2.5.7.1 All sub circuits protected by MCB's of less than 16A rating will automatically comply.

The full TemCurve printout is incorporated in this report.

5 SOFTWARE REPORTS

5.1 Powerpac Pro Report Printout (0.93kA study)



Powerpac Pro

Project Supply Summary

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	4 Apr 2014
Job Description	WP100 New Switchboard		

Project Input Data

Supply description	Supply
Voltage	415 V / 3 Ø
Maximum volt drop	5.00 %
Prospective short circuit current	0.93 kA
Impedance of supply	0.258 ohms

Maximum Demand Calculation

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	4 Apr 2014
Job Description	WP100 New Switchboard		

Load Description WP100 MSB

Installation type	Factories
Supply details	415 V / 3 Ø
Calculated maximum demand	45.50 A
Phase 1 load	39.50 A
Phase 2 load	39.50 A
Phase 3 load	45.50 A

Inputs

Group	Qty	Description	Phase 1	Phase 2	Phase 3
D	1	Pump 1 or Pump 2	34.50	34.50	34.50
K	1	C-Tech Dosing Panel			
K	1	Panel Accessories	5.00	5.00	5.00

Result

Group	Qty	Description	Phase 1	Phase 2	Phase 3
D	1	Pump 1 or Pump 2	34.50	34.50	34.50
K	1	C-Tech Dosing Panel			6.00
K	1	Panel Accessories	5.00	5.00	5.00

Cable Schedule

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	4 Apr 2014
Job Description	WP100 New Switchboard		

Cable No.	Active	Neutral	Earth	Insulation	Configuration	Length	Load	Volt drop	Source	Destination
P01	1 set/s of 25 mm²	1 x 25 mm²	N/A	V-90 Thermoplastic cable	3 x 1 core flat	12.00m	45.50A	0.77V / 0.19%	Supply	WP100 MSB
P101	1 x 10 mm²	1 x 10 mm²	1 x 4 mm²	V-90 Thermoplastic cable	1 x 3 core circular	6.00m	34.50A	0.63V / 0.15%	WP100 MSB	Pump 1
P201	1 x 10 mm²	1 x 10 mm²	1 x 4 mm²	V-90 Thermoplastic cable	1 x 3 core circular	6.00m	34.50A	0.63V / 0.15%	WP100 MSB	Pump 2
P02	1 x 2.5 mm²	1 x 2.5 mm²	1 x 2.5 mm²	V-90 Thermoplastic cable	1 x 2 core circular	11.00m	6.00A	0.92V / 0.38%	WP100 MSB	C-Tech Dosing Panel
Panel Wiring	1 set/s of 2.5 mm²	1 x 2.5 mm²	1 x 2.5 mm²	V-90 Thermoplastic cable	2 x 1 core	2.00m	5.00A	0.14V / 0.06%	WP100 MSB	Panel Accessories

Cable Size Calculation

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	4 Apr 2014
Job Description	WP100 New Switchboard		
Load Description	WP100 MSB		

Inputs

Run Length	12.00 m	Voltage	415 V / 3 Ø
Conductor	Copper	Max Volt Drop	3.00 %
Load	45.50 A	Allowed Expansion	0.00 %
Efficiency	100 %	Power Factor	1.00
Cable Reference	P01	Device Fault Limit	N/A kA
Protective Device	Custom Circuit Breaker	Protection Rating	63.0 A
Cable	3 x 1 core flat V-90 Thermoplastic cable Enclosed in single layer of conduit in air		
Calculated to	AS3000:2007 & AS3008.1.1:2009		

Additional derating factor	1.00
Ambient Temperature	40.0 ° C
Number of other circuits in group	0
Parallel sets of cables in the same pipe	No

Solution			
Active	1 set/s of 25 mm²		
Neutral	1 x 25 mm²		
Earth	N/A		
Load On Cable	45.50 A	Operating Temperature	51.04 degrees
Capacity	81.00 A	Spare Capacity	35.50 A
Phase Resistance	0.0098 ohms	Phase Reactance	0.0015 ohms
Earth Resistance	0.0098 ohms	Earth Reactance	0.0015 ohms
Volt Drop on Cable	0.77 V / 0.19 %	Total Volt Drop	0.77 V / 0.19 %
Cable Fault Loop Imp.	0.0214 ohms	Total Fault Loop Imp.	0.2675 ohms
Max Fault Loop Imp.	0.2495 ohms		
Fault kA at Source	0.93 kA	Fault kA at Destination	0.91 kA
Max. Run Length	139.79 m	Touch Potential	9.59 V

Derating Factors		Total Derating	1.00
Cable Configuration	1.00	Ambient Temperature	1.00
Depth of Laying	1.00	Thermal Resistivity	1.00
Other Circuits	1.00	Cable Drum / Reel	1.00

Cable Size Calculation

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	4 Apr 2014
Job Description	WP100 New Switchboard		
Load Description	Pump 1		

Inputs

Run Length	6.00 m	Voltage	415 V / 3 Ø
Conductor	Copper	Max Volt Drop	3.00 %
Load	34.50 A	Allowed Expansion	0.00 %
Efficiency	100 %	Power Factor	0.85
Cable Reference	P101	Device Fault Limit	N/A kA
Protective Device	Custom Circuit Breaker	Protection Rating	40.0 A
Cable	1 x 3 core circular V-90 Thermoplastic cable In underground ducts		
Calculated to	AS3000:2007 & AS3008.1.1:2009		

Additional derating factor	1.00
Ambient Temperature	25.0° C
Depth of laying	0.5m
Number of other circuits in enclosure	0
Number of other enclosures in group	0
Parallel sets of cables in the same pipe	No
Spacing between enclosures	0.3
Thermal Resistivity	1.2° C.m/W

Solution			
Active	1 x 10 mm²		
Neutral	1 x 10 mm²		
Earth	1 x 4 mm²		
Load On Cable	34.50 A	Operating Temperature	44.67 degrees
Capacity	55.00 A	Spare Capacity	20.50 A
Phase Resistance	0.0121 ohms	Phase Reactance	0.0005 ohms
Earth Resistance	0.0304 ohms	Earth Reactance	0.0006 ohms
Volt Drop on Cable	0.63 V / 0.15 %	Total Volt Drop	1.40 V / 0.34 %
Cable Fault Loop Imp.	0.0471 ohms	Total Fault Loop Imp.	0.2891 ohms
Max Fault Loop Imp.	0.5312 ohms		
Fault kA at Source	0.91 kA	Fault kA at Destination	0.90 kA
Max. Run Length	67.73 m	Touch Potential	36.72 V

Derating Factors		Total Derating	1.00
Cable Configuration	1.00	Ambient Temperature	1.00
Depth of Laying	1.00	Thermal Resistivity	1.00
Other Circuits	1.00	Cable Drum / Reel	1.00

Cable Size Calculation

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	4 Apr 2014
Job Description	WP100 New Switchboard		
Load Description	Pump 2		

Inputs

Run Length	6.00 m	Voltage	415 V / 3 Ø
Conductor	Copper	Max Volt Drop	3.00 %
Load	34.50 A	Allowed Expansion	0.00 %
Efficiency	100 %	Power Factor	0.85
Cable Reference	P201	Device Fault Limit	N/A kA
Protective Device	Custom Circuit Breaker	Protection Rating	40.0 A
Cable	1 x 3 core circular V-90 Thermoplastic cable In underground ducts		
Calculated to	AS3000:2007 & AS3008.1.1:2009		

Additional derating factor	1.00
Ambient Temperature	25.0° C
Depth of laying	0.5m
Number of other circuits in enclosure	0
Number of other enclosures in group	0
Parallel sets of cables in the same pipe	No
Spacing between enclosures	0.3
Thermal Resistivity	1.2° C.m/W

Solution			
Active	1 x 10 mm²		
Neutral	1 x 10 mm²		
Earth	1 x 4 mm²		
Load On Cable	34.50 A	Operating Temperature	44.67 degrees
Capacity	55.00 A	Spare Capacity	20.50 A
Phase Resistance	0.0121 ohms	Phase Reactance	0.0005 ohms
Earth Resistance	0.0304 ohms	Earth Reactance	0.0006 ohms
Volt Drop on Cable	0.63 V / 0.15 %	Total Volt Drop	1.40 V / 0.34 %
Cable Fault Loop Imp.	0.0471 ohms	Total Fault Loop Imp.	0.2891 ohms
Max Fault Loop Imp.	0.5312 ohms		
Fault kA at Source	0.91 kA	Fault kA at Destination	0.90 kA
Max. Run Length	67.73 m	Touch Potential	36.72 V
Derating Factors		Total Derating	1.00
Cable Configuration	1.00	Ambient Temperature	1.00
Depth of Laying	1.00	Thermal Resistivity	1.00
Other Circuits	1.00	Cable Drum / Reel	1.00

Cable Size Calculation

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	4 Apr 2014
Job Description	WP100 New Switchboard		
Load Description	C-Tech Dosing Panel		

Inputs

Run Length	11.00 m	Voltage	240 V / 1 Ø
Conductor	Copper	Max Volt Drop	3.00 %
Load	6.00 A	Allowed Expansion	0.00 %
Efficiency	100 %	Power Factor	0.85
Cable Reference	P02	Device Fault Limit	N/A kA
Protective Device	C Curve Circuit Breaker	Protection Rating	16.0 A
Cable	1 x 2 core circular V-90 Thermoplastic cable Enclosed in single layer of conduit in air		
Calculated to	AS3000:2007 & AS3008.1.1:2009		

Additional derating factor	1.00
Ambient Temperature	40.0° C
Number of other circuits in group	0
Parallel sets of cables in the same pipe	No

Solution			
Active	1 x 2.5 mm²		
Neutral	1 x 2.5 mm²		
Earth	1 x 2.5 mm²		
Load On Cable	6.00 A	Operating Temperature	42.38 degrees
Capacity	23.00 A	Spare Capacity	17.00 A
Phase Resistance	0.0895 ohms	Phase Reactance	0.0011 ohms
Earth Resistance	0.0895 ohms	Earth Reactance	0.0011 ohms
Volt Drop on Cable	0.92 V / 0.38 %	Total Volt Drop	1.37 V / 0.57 %
Cable Fault Loop Imp.	0.1982 ohms	Total Fault Loop Imp.	0.3886 ohms
Max Fault Loop Imp.	1.7292 ohms		
Fault kA at Source	0.90 kA	Fault kA at Destination	0.62 kA
Max. Run Length	85.90 m	Touch Potential	67.67 V

Derating Factors		Total Derating	1.00
Cable Configuration	1.00	Ambient Temperature	1.00
Depth of Laying	1.00	Thermal Resistivity	1.00
Other Circuits	1.00	Cable Drum / Reel	1.00

Cable Size Calculation

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	4 Apr 2014
Job Description	WP100 New Switchboard		
Load Description	Panel Accessories		

Inputs

Run Length	2.00 m	Voltage	240 V / 1 Ø
Conductor	Copper	Max Volt Drop	3.00 %
Load	5.00 A	Allowed Expansion	0.00 %
Efficiency	100 %	Power Factor	0.85
Cable Reference	Panel Wiring	Device Fault Limit	N/A kA
Protective Device	C Curve Circuit Breaker	Protection Rating	16.0 A
Cable	2 x 1 core V-90 Thermoplastic cable Bunched in air		
Calculated to	AS3000:2007 & AS3008.1.1:2009		

Additional derating factor	1.00
Ambient Temperature	40.0 ° C
Number of other circuits in group	0
Parallel sets of cables in the same pipe	No

Solution			
Active	1 set/s of 2.5 mm²		
Neutral	1 x 2.5 mm²		
Earth	1 x 2.5 mm²		
Load On Cable	5.00 A	Operating Temperature	41.04 degrees
Capacity	29.00 A	Spare Capacity	24.00 A
Phase Resistance	0.0163 ohms	Phase Reactance	0.0003 ohms
Earth Resistance	0.0163 ohms	Earth Reactance	0.0003 ohms
Volt Drop on Cable	0.14 V / 0.06 %	Total Volt Drop	0.59 V / 0.24 %
Cable Fault Loop Imp.	0.0360 ohms	Total Fault Loop Imp.	0.2832 ohms
Max Fault Loop Imp.	1.7292 ohms		
Fault kA at Source	0.90 kA	Fault kA at Destination	0.85 kA
Max. Run Length	95.95 m	Touch Potential	24.26 V

Derating Factors		Total Derating	1.00
Cable Configuration	1.00	Ambient Temperature	1.00
Depth of Laying	1.00	Thermal Resistivity	1.00
Other Circuits	1.00	Cable Drum / Reel	1.00

Project Notes:

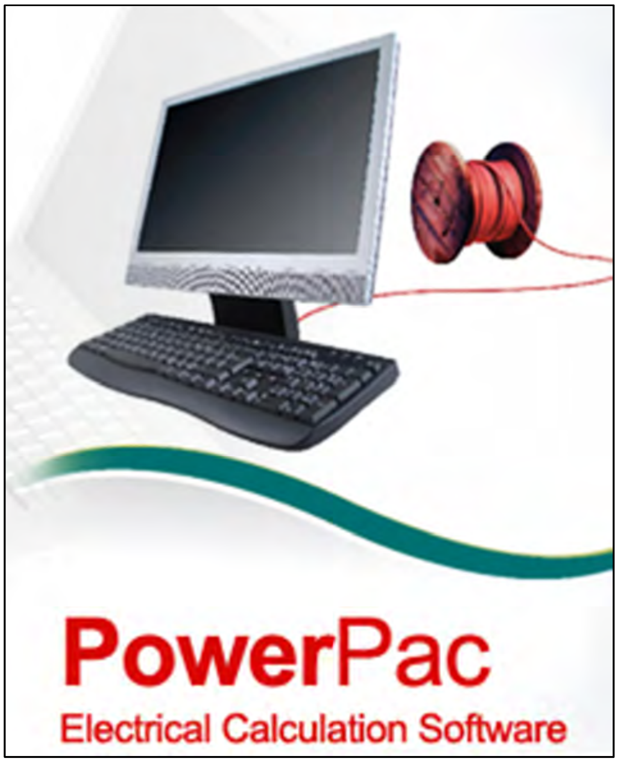
Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	4 Apr 2014
Job Description	WP100 New Switchboard		

Calculation Notes:

1) The WP100 Pump Station comprises two 15kW Water Pump Motors operating in a Duty / Standby arrangement, i.e only one of the pumps can operate at a time. The maximum demand calculation takes this fact into account.

2) Powerpac Pro has not flagged any problems therefore the project calculations are deemed to comply with all the relevant requirements of AS3000:2007 and AS3008.1.1:2009.

5.2 Powerpac Pro Report Printout (6kA study)



Project Supply Summary

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	4 Apr 2014
Job Description	WP100 New Switchboard		

Project Input Data

Supply description	Supply
Voltage	415 V / 3 Ø
Maximum volt drop	5.00 %
Prospective short circuit current	6.00 kA
Impedance of supply	0.040 ohms

Maximum Demand Calculation

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	26 Mar 2014
Job Description	WP100 New Switchboard		

Load Description WP100 MSB

Installation type	Factories
Supply details	415 V / 3 Ø
Calculated maximum demand	45.50 A
Phase 1 load	39.50 A
Phase 2 load	39.50 A
Phase 3 load	45.50 A

Inputs

Group	Qty	Description	Phase 1	Phase 2	Phase 3
D	1	Pump 1 or Pump 2	34.50	34.50	34.50
K	1	C-Tech Dosing Panel			
K	1	Panel Accessories	5.00	5.00	5.00

Result

Group	Qty	Description	Phase 1	Phase 2	Phase 3
D	1	Pump 1 or Pump 2	34.50	34.50	34.50
K	1	C-Tech Dosing Panel			6.00
K	1	Panel Accessories	5.00	5.00	5.00

Cable Schedule

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	26 Mar 2014
Job Description	WP100 New Switchboard		

Cable No.	Active	Neutral	Earth	Insulation	Configuration	Length	Load	Volt drop	Source	Destination
P01	1 set/s of 25 mm^2	1 x 25 mm^2	N/A	V-90 Thermoplastic cable	3 x 1 core flat	12.00m	45.50A	0.77V / 0.19%	Supply	WP100 MSB
P101	1 x 10 mm^2	1 x 10 mm^2	1 x 4 mm^2	V-90 Thermoplastic cable	1 x 3 core circular	6.00m	34.50A	0.63V / 0.15%	WP100 MSB	Pump 1
P201	1 x 10 mm^2	1 x 10 mm^2	1 x 4 mm^2	V-90 Thermoplastic cable	1 x 3 core circular	6.00m	34.50A	0.63V / 0.15%	WP100 MSB	Pump 2
P02	1 x 2.5 mm^2	1 x 2.5 mm^2	1 x 2.5 mm^2	V-90 Thermoplastic cable	1 x 2 core circular	11.00m	6.00A	0.92V / 0.38%	WP100 MSB	C-Tech Dosing Panel
Panel Wiring	1 set/s of 2.5 mm^2	1 x 2.5 mm^2	1 x 2.5 mm^2	V-90 Thermoplastic cable	2 x 1 core	2.00m	5.00A	0.14V / 0.06%	WP100 MSB	Panel Accessories

Cable Size Calculation

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	26 Mar 2014
Job Description	WP100 New Switchboard		
Load Description	WP100 MSB		

Inputs

Run Length	12.00 m	Voltage	415 V / 3 Ø
Conductor	Copper	Max Volt Drop	3.00 %
Load	45.50 A	Allowed Expansion	0.00 %
Efficiency	100 %	Power Factor	1.00
Cable Reference	P01	Device Fault Limit	N/A kA
Protective Device	Custom Circuit Breaker	Protection Rating	63.0 A
Cable	3 x 1 core flat V-90 Thermoplastic cable Enclosed in single layer of conduit in air		
Calculated to	AS3000:2007 & AS3008.1.1:2009		

Additional derating factor	1.00
Ambient Temperature	40.0 ° C
Number of other circuits in group	0
Parallel sets of cables in the same pipe	No

Solution			
Active	1 set/s of 25 mm²		
Neutral	1 x 25 mm²		
Earth	N/A		
Load On Cable	45.50 A	Operating Temperature	51.04 degrees
Capacity	81.00 A	Spare Capacity	35.50 A
Phase Resistance	0.0098 ohms	Phase Reactance	0.0015 ohms
Earth Resistance	0.0098 ohms	Earth Reactance	0.0015 ohms
Volt Drop on Cable	0.77 V / 0.19 %	Total Volt Drop	0.77 V / 0.19 %
Cable Fault Loop Imp.	0.0214 ohms	Total Fault Loop Imp.	0.0528 ohms
Max Fault Loop Imp.	0.4672 ohms		
Fault kA at Source	6.00 kA	Fault kA at Destination	5.26 kA
Max. Run Length	193.52 m	Touch Potential	48.63 V

Derating Factors		Total Derating	1.00
Cable Configuration	1.00	Ambient Temperature	1.00
Depth of Laying	1.00	Thermal Resistivity	1.00
Other Circuits	1.00	Cable Drum / Reel	1.00

Cable Size Calculation

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	26 Mar 2014
Job Description	WP100 New Switchboard		
Load Description	Pump 1		

Inputs

Run Length	6.00 m	Voltage	415 V / 3 Ø
Conductor	Copper	Max Volt Drop	3.00 %
Load	34.50 A	Allowed Expansion	0.00 %
Efficiency	100 %	Power Factor	0.85
Cable Reference	P101	Device Fault Limit	N/A kA
Protective Device	Custom Circuit Breaker	Protection Rating	40.0 A
Cable	1 x 3 core circular V-90 Thermoplastic cable In underground ducts		
Calculated to	AS3000:2007 & AS3008.1.1:2009		

Additional derating factor	1.00
Ambient Temperature	25.0° C
Depth of laying	0.5m
Number of other circuits in enclosure	0
Number of other enclosures in group	0
Parallel sets of cables in the same pipe	No
Spacing between enclosures	0.3
Thermal Resistivity	1.2° C.m/W

Solution			
Active	1 x 10 mm²		
Neutral	1 x 10 mm²		
Earth	1 x 4 mm²		
Load On Cable	34.50 A	Operating Temperature	44.67 degrees
Capacity	55.00 A	Spare Capacity	20.50 A
Phase Resistance	0.0121 ohms	Phase Reactance	0.0005 ohms
Earth Resistance	0.0304 ohms	Earth Reactance	0.0006 ohms
Volt Drop on Cable	0.63 V / 0.15 %	Total Volt Drop	1.40 V / 0.34 %
Cable Fault Loop Imp.	0.0471 ohms	Total Fault Loop Imp.	0.0906 ohms
Max Fault Loop Imp.	0.7459 ohms		
Fault kA at Source	5.26 kA	Fault kA at Destination	4.45 kA
Max. Run Length	95.11 m	Touch Potential	117.15 V

Derating Factors		Total Derating	1.00
Cable Configuration	1.00	Ambient Temperature	1.00
Depth of Laying	1.00	Thermal Resistivity	1.00
Other Circuits	1.00	Cable Drum / Reel	1.00

Cable Size Calculation

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	26 Mar 2014
Job Description	WP100 New Switchboard		
Load Description	Pump 2		

Inputs

Run Length	6.00 m	Voltage	415 V / 3 Ø
Conductor	Copper	Max Volt Drop	3.00 %
Load	34.50 A	Allowed Expansion	0.00 %
Efficiency	100 %	Power Factor	0.85
Cable Reference	P201	Device Fault Limit	N/A kA
Protective Device	Custom Circuit Breaker	Protection Rating	40.0 A
Cable	1 x 3 core circular V-90 Thermoplastic cable In underground ducts		
Calculated to	AS3000:2007 & AS3008.1.1:2009		

Additional derating factor	1.00
Ambient Temperature	25.0 ° C
Depth of laying	0.5m
Number of other circuits in enclosure	0
Number of other enclosures in group	0
Parallel sets of cables in the same pipe	No
Spacing between enclosures	0.3
Thermal Resistivity	1.2 ° C.m/W

Solution			
Active	1 x 10 mm²		
Neutral	1 x 10 mm²		
Earth	1 x 4 mm²		
Load On Cable	34.50 A	Operating Temperature	44.67 degrees
Capacity	55.00 A	Spare Capacity	20.50 A
Phase Resistance	0.0121 ohms	Phase Reactance	0.0005 ohms
Earth Resistance	0.0304 ohms	Earth Reactance	0.0006 ohms
Volt Drop on Cable	0.63 V / 0.15 %	Total Volt Drop	1.40 V / 0.34 %
Cable Fault Loop Imp.	0.0471 ohms	Total Fault Loop Imp.	0.0906 ohms
Max Fault Loop Imp.	0.7459 ohms		
Fault kA at Source	5.26 kA	Fault kA at Destination	4.45 kA
Max. Run Length	95.11 m	Touch Potential	117.15 V

Derating Factors		Total Derating	1.00
Cable Configuration	1.00	Ambient Temperature	1.00
Depth of Laying	1.00	Thermal Resistivity	1.00
Other Circuits	1.00	Cable Drum / Reel	1.00

Cable Size Calculation

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	26 Mar 2014
Job Description	WP100 New Switchboard		
Load Description	C-Tech Dosing Panel		

Inputs

Run Length	11.00 m	Voltage	240 V / 1 Ø
Conductor	Copper	Max Volt Drop	3.00 %
Load	6.00 A	Allowed Expansion	0.00 %
Efficiency	100 %	Power Factor	0.85
Cable Reference	P02	Device Fault Limit	N/A kA
Protective Device	C Curve Circuit Breaker	Protection Rating	16.0 A
Cable	1 x 2 core circular V-90 Thermoplastic cable Enclosed in single layer of conduit in air		
Calculated to	AS3000:2007 & AS3008.1.1:2009		

Additional derating factor	1.00
Ambient Temperature	40.0° C
Number of other circuits in group	0
Parallel sets of cables in the same pipe	No

Solution			
Active	1 x 2.5 mm²		
Neutral	1 x 2.5 mm²		
Earth	1 x 2.5 mm²		
Load On Cable	6.00 A	Operating Temperature	42.38 degrees
Capacity	23.00 A	Spare Capacity	17.00 A
Phase Resistance	0.0895 ohms	Phase Reactance	0.0011 ohms
Earth Resistance	0.0895 ohms	Earth Reactance	0.0011 ohms
Volt Drop on Cable	0.92 V / 0.38 %	Total Volt Drop	1.37 V / 0.57 %
Cable Fault Loop Imp.	0.1982 ohms	Total Fault Loop Imp.	0.2354 ohms
Max Fault Loop Imp.	1.9439 ohms		
Fault kA at Source	4.54 kA	Fault kA at Destination	1.02 kA
Max. Run Length	85.90 m	Touch Potential	111.70 V

Derating Factors		Total Derating	1.00
Cable Configuration	1.00	Ambient Temperature	1.00
Depth of Laying	1.00	Thermal Resistivity	1.00
Other Circuits	1.00	Cable Drum / Reel	1.00

Cable Size Calculation

Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	26 Mar 2014
Job Description	WP100 New Switchboard		
Load Description	Panel Accessories		

Inputs

Run Length	2.00 m	Voltage	240 V / 1 Ø
Conductor	Copper	Max Volt Drop	3.00 %
Load	5.00 A	Allowed Expansion	0.00 %
Efficiency	100 %	Power Factor	0.85
Cable Reference	Panel Wiring	Device Fault Limit	N/A kA
Protective Device	C Curve Circuit Breaker	Protection Rating	16.0 A
Cable	2 x 1 core V-90 Thermoplastic cable Bunched in air		
Calculated to	AS3000:2007 & AS3008.1.1:2009		

Additional derating factor	1.00
Ambient Temperature	40.0 ° C
Number of other circuits in group	0
Parallel sets of cables in the same pipe	No

Solution			
Active	1 set/s of 2.5 mm²		
Neutral	1 x 2.5 mm²		
Earth	1 x 2.5 mm²		
Load On Cable	5.00 A	Operating Temperature	41.04 degrees
Capacity	29.00 A	Spare Capacity	24.00 A
Phase Resistance	0.0163 ohms	Phase Reactance	0.0003 ohms
Earth Resistance	0.0163 ohms	Earth Reactance	0.0003 ohms
Volt Drop on Cable	0.14 V / 0.06 %	Total Volt Drop	0.59 V / 0.24 %
Cable Fault Loop Imp.	0.0360 ohms	Total Fault Loop Imp.	0.0808 ohms
Max Fault Loop Imp.	1.9439 ohms		
Fault kA at Source	4.54 kA	Fault kA at Destination	2.97 kA
Max. Run Length	102.77 m	Touch Potential	85.09 V
Derating Factors		Total Derating	1.00
Cable Configuration	1.00	Ambient Temperature	1.00
Depth of Laying	1.00	Thermal Resistivity	1.00
Other Circuits	1.00	Cable Drum / Reel	1.00

Project Notes:

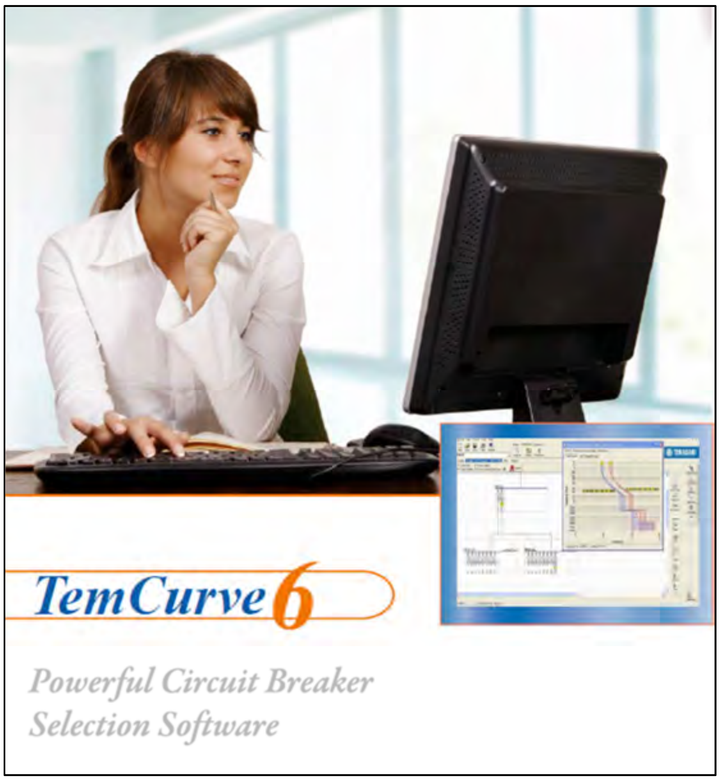
Job Number	3S0016	Company Name	Lend Lease Services
Job Name	Aratula New Switchboard	ABN	87 081 540 847
Author	John Dalziel	License Number	66516
User Name	John Dalziel		
Client	Queensland Urban Utilities	Date Printed	26 Mar 2014
Job Description	WP100 New Switchboard		

Calculation Notes:

1) The WP100 Pump Station comprises two 15kW Water Pump Motors operating in a Duty / Standby arrangement, i.e only one of the pumps can operate at a time. The maximum demand calculation takes this fact into account.

2) Powerpac Pro has not flagged any problems therefore the project calculations are deemed to comply with all the relevant requirements of AS3000:2007 and AS3008.1.1:2009.

5.3 Temcurve Report Printout



TERASAKI

Selectivity Analysis Program

Ph No. : Mobile No. : Fax No. : Email :

Project : WP100 Aratula New Switchboard

File : WP100 Aratula

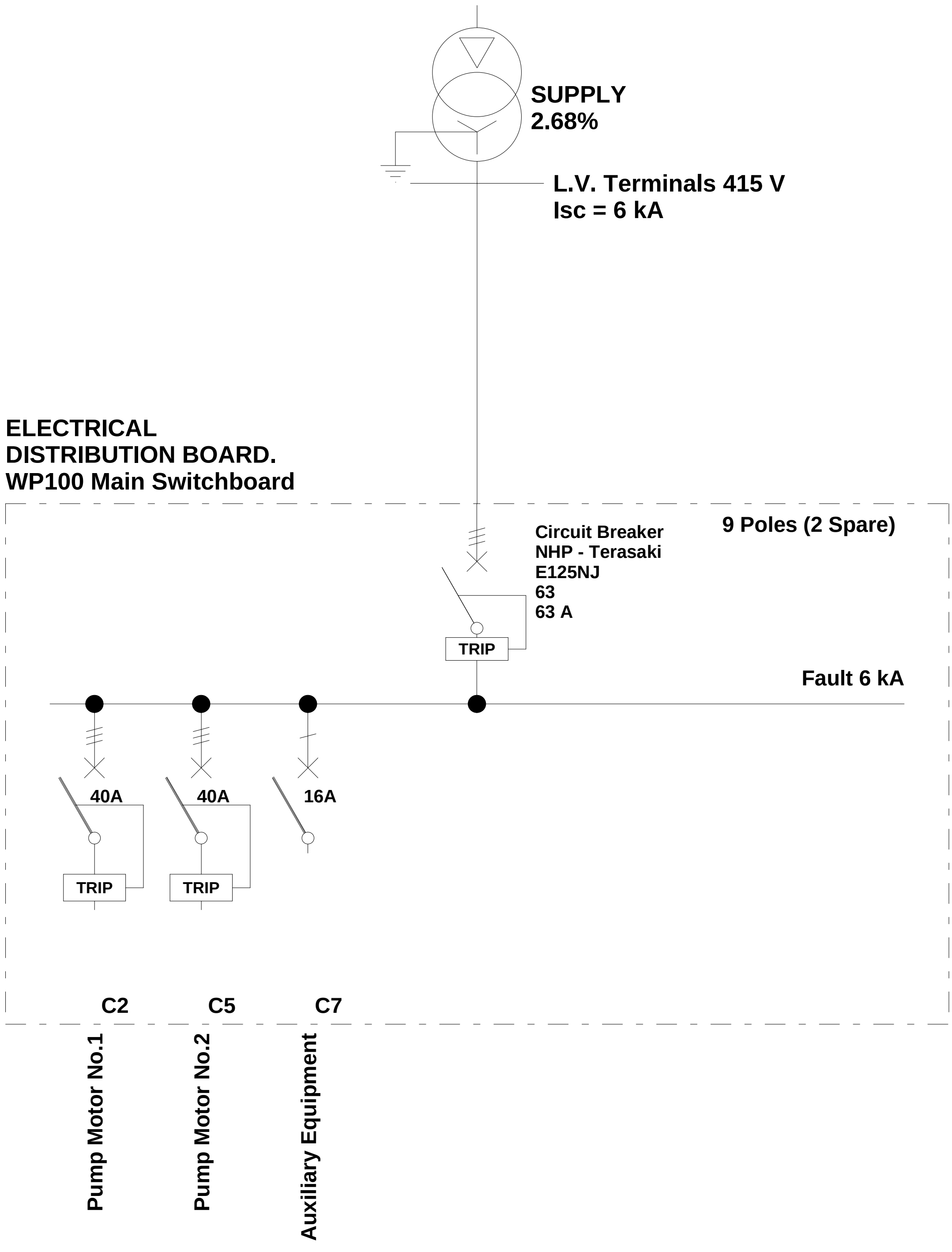
Printed : 06 Apr 2014 10:31 pm

Designed By : J. Dalziel

SUPPLY

Switch Board: **WP100 Main Switchboard** (3ø)

Single Line Diagram



TERASAKI

Selectivity Analysis Program

Ph No. : Mobile No. : Fax No. : Email :

Project : WP100 Aratula New Switchboard

File : WP100 Aratula

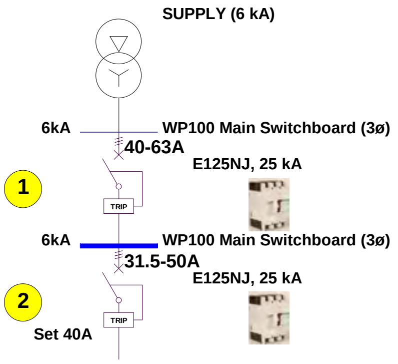
Printed : 06 Apr 2014 10:31 pm

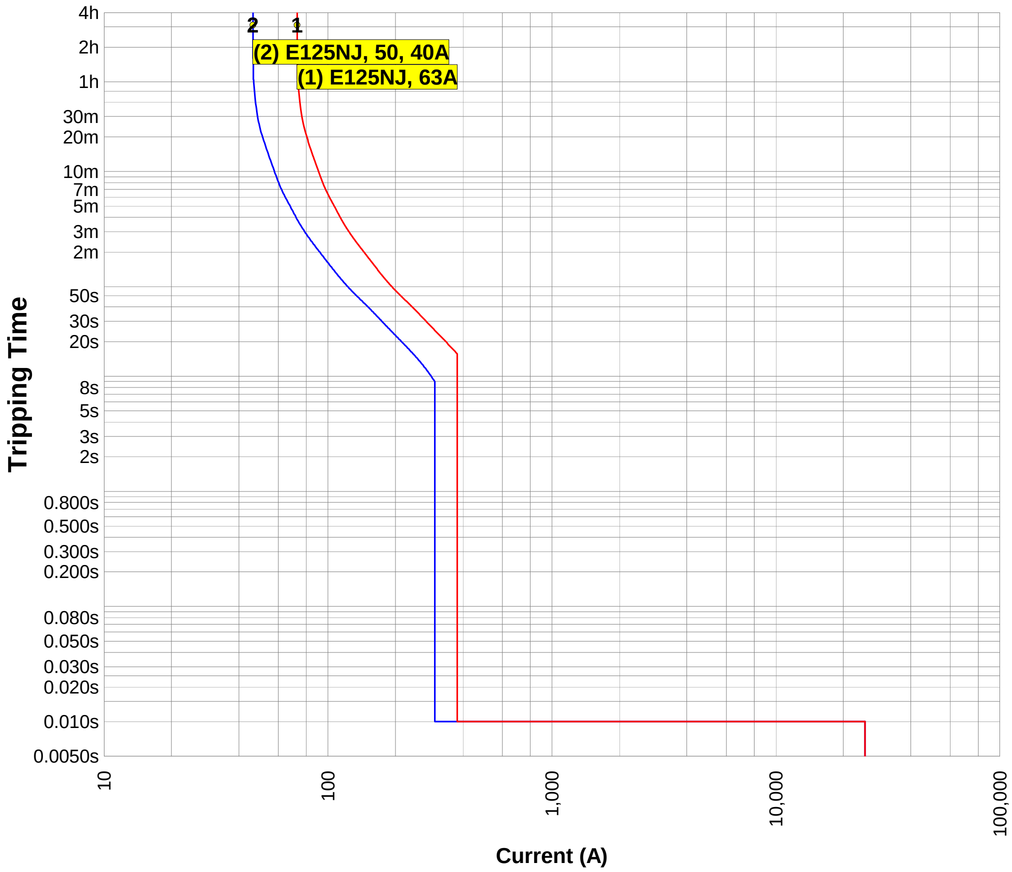
Designed By : J. Dalziel

SUPPLY

Circuit: **WP100 Main Switchboard - C2** (3ø)

TIME/CURRENT CURVE





TERASAKI

Selectivity Analysis Program

Ph No. : Mobile No. : Fax No. : Email :

Project : WP100 Aratula New Switchboard

File : WP100 Aratula

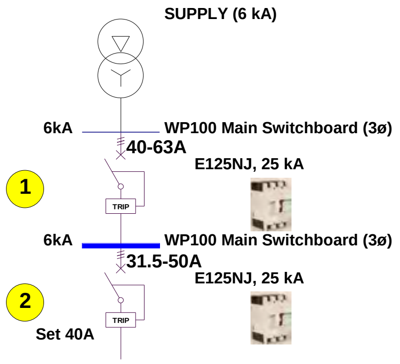
Printed : 06 Apr 2014 10:31 pm

Designed By : J. Dalziel

SUPPLY

Circuit: **WP100 Main Switchboard - C2** (3ø)

TIME/CURRENT CURVE



Ir	Im
1	6
63 A	378 A

Ir	Im
0.8	6
40 A	300 A

TERASAKI

Selectivity Analysis Program

Ph No. : Mobile No. : Fax No. : Email :

Project : WP100 Aratula New Switchboard

File : WP100 Aratula

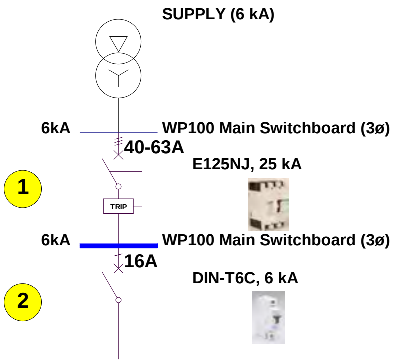
Printed : 06 Apr 2014 10:31 pm

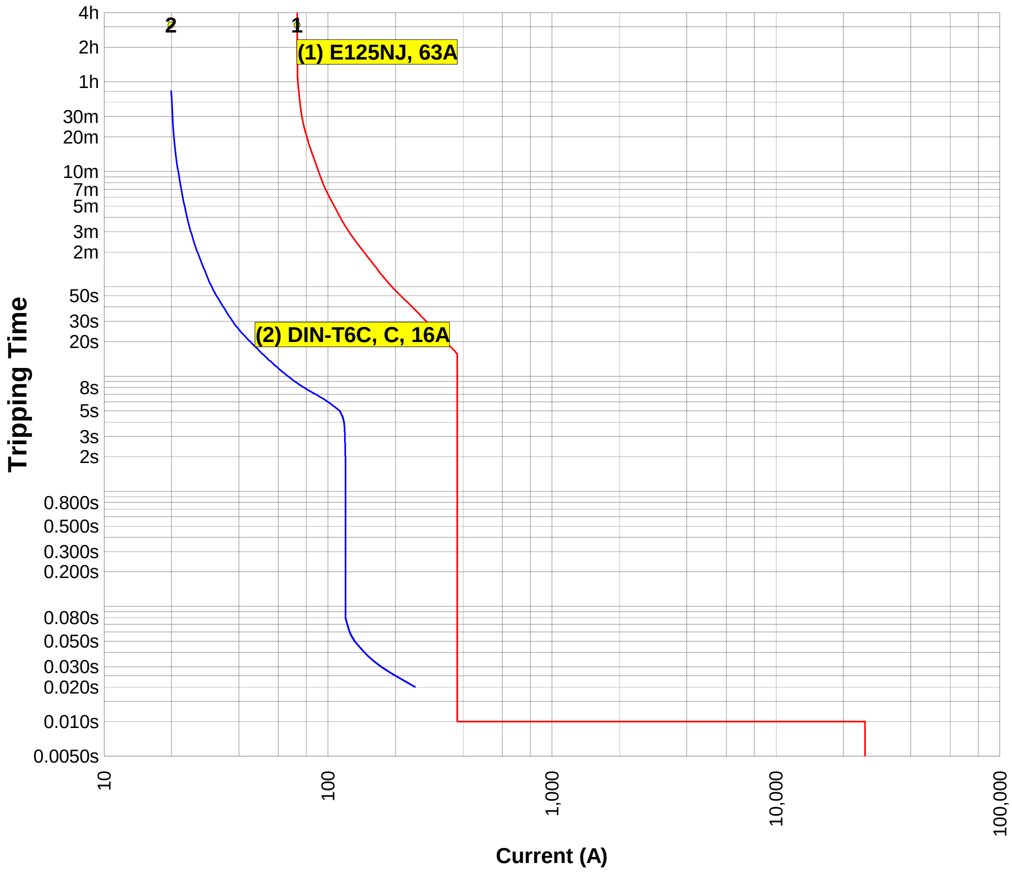
Designed By : J. Dalziel

SUPPLY

Circuit: **WP100 Main Switchboard - C7** (1ø)

TIME/CURRENT CURVE





TERASAKI

Selectivity Analysis Program

Ph No. : Mobile No. : Fax No. : Email :

Project : WP100 Aratula New Switchboard

File : WP100 Aratula

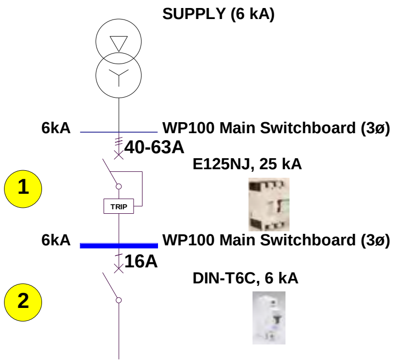
Printed : 06 Apr 2014 10:31 pm

Designed By : J. Dalziel

SUPPLY

Circuit: **WP100 Main Switchboard - C7** (1ø)

TIME/CURRENT CURVE



Ir	Im
1	6
63 A	378 A

No Adjustable Settings

Section 5.02 Electrical Drawings

- Please see separate A3 Folder for hard copy
- AutoCAD soft copy on disc
- PDF soft copy on disc

QUEENSLAND UrbanUtilities

WP100 - CHARLWOOD RD, ARATULA
WATER PUMP STATION

SITE COVER SHEET

ELECTRICAL DRAWING INDEX		
DRAWING NUMBER	REV.	DRAWING TITLE
486/4/7-0013-000	A	MAIN SWITCHBOARD SITE COVER SHEET & DRAWING INDEX
486/4/7-0013-001	A	MAIN SWITCHBOARD SINGLE LINE DIAGRAM
486/4/7-0013-002	A	MAIN SWITCHBOARD POWER DISTRIBUTION SCHEMATIC DIAGRAM
486/4/7-0013-003	A	MAIN SWITCHBOARD PUMPS 1 & 2 POWER AND CONTROL SCHEMATIC DIAGRAM
486/4/7-0013-004	A	MAIN SWITCHBOARD 24V DC AUXILIARY CIRCUITS SCHEMATIC DIAGRAM
486/4/7-0013-005	A	MAIN SWITCHBOARD RTU BACKPLANE AND SLOT 1 CPU SCHEMATIC DIAGRAM
486/4/7-0013-006	A	MAIN SWITCHBOARD RTU SLOT 2 SCHEMATIC DIAGRAM
486/4/7-0013-007	A	MAIN SWITCHBOARD RTU SLOT 3 SCHEMATIC DIAGRAM
486/4/7-0013-008	A	MAIN SWITCHBOARD RTU SLOT 4 SCHEMATIC DIAGRAM
486/4/7-0013-009	A	MAIN SWITCHBOARD SHEET RESERVED FOR FLOWMETER SCHEMATIC DIAGRAM
486/4/7-0013-010	A	MAIN SWITCHBOARD TERMINATION DIAGRAM VSD TERMINALS
486/4/7-0013-011	A	MAIN SWITCHBOARD TERMINATION DIAGRAM RTU SLOT 2 TERMINALS
486/4/7-0013-012	A	MAIN SWITCHBOARD TERMINATION DIAGRAM RTU SLOT 3 TERMINALS
486/4/7-0013-013	A	MAIN SWITCHBOARD TERMINATION DIAGRAM RTU SLOT 4 TERMINALS
486/4/7-0013-014	A	MAIN SWITCHBOARD CONSTRUCTION NOTES
486/4/7-0013-015	A	MAIN SWITCHBOARD EXTERNAL GENERAL ARRANGEMENT
486/4/7-0013-016	A	MAIN SWITCHBOARD PLAN, ELEVATIONS & SECTIONS
486/4/7-0013-017	A	MAIN SWITCHBOARD EQUIPMENT LAYOUT
486/4/7-0013-018	A	MAIN SWITCHBOARD CABLE SCHEDULE
486/4/7-0013-019	A	MAIN SWITCHBOARD LABEL DETAILS
486/4/7-0013-020	A	MAIN SWITCHBOARD PARTS LIST
486/4/7-0013-021	A	SITE EQUIPMENT LAYOUT

CIVIL DRAWING INDEX		
DRAWING NUMBER	REV.	DRAWING TITLE
486/4/7-0013-022	A	WATER PUMPING STATION ACCESS COVER LIDS ACCESS COVER ASSEMBLY
486/4/7-0013-023	A	WATER PUMPING STATION ACCESS COVER LIDS ACCESS COVER LID DETAILS
486/4/7-0013-024	A	WATER PUMPING STATION ACCESS COVER LIDS ACCESS COVER FRAME DETAILS
486/4/7-0013-025	A	WATER PUMPING STATION ACCESS COVER LIDS ACCESS COVER DETAILS

AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD
DRAFTING CHECK	JC-S
CAD FILE	48647-0013-000
B.C.C. FILE No.	-

J. DALZIEL	-	12/12
DESIGN	R.P.E.Q. No.	DATE
D. DAYMOND	5505	12/12
DESIGN CHECK	R.P.E.Q. No.	DATE

-	-
PRINCIPAL DESIGN MANAGER	DATE
-	-
CLIENT DELEGATE	DATE

QUEENSLAND UrbanUtilities
A DIVISION OF THE BRISBANE CITY COUNCIL

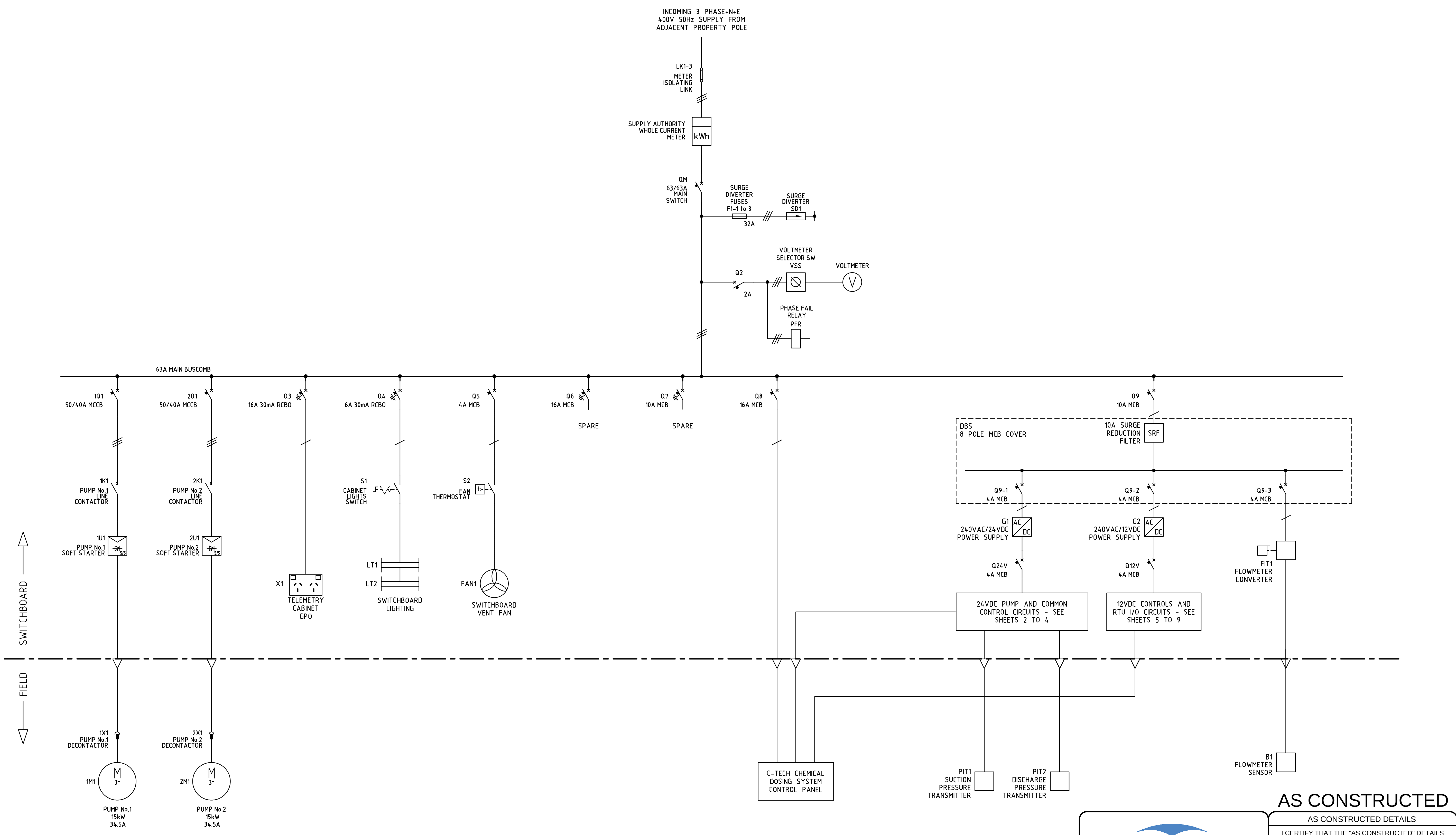
SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

TITLE
MAIN SWITCHBOARD
SITE COVER SHEET
& DRAWING INDEX
-

SHEET No. 00

Queensland Urban Utilities DRAWING No. 486/4/7-0013-000 AMEND. A

G:\Water\Jobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-000.dwg Last Saved by John.Dalziel on Thursday, 22 May 2014 2:52:07 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS	
I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.	
SIGNED:	DATE:
NAME of SIGNATORY: JOHN DALZIEL	
RPEQ No. or LICENCE: 104697	
COMPANY NAME: LEND LEASE SERVICES	
START DATE: DEC 2012	FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE
CAD FILE	48647-0013-001	D. DAYMOND	5505	12/12
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE

-	-
PRINCIPAL DESIGN MANAGER	DATE
-	-
CLIENT DELEGATE	DATE

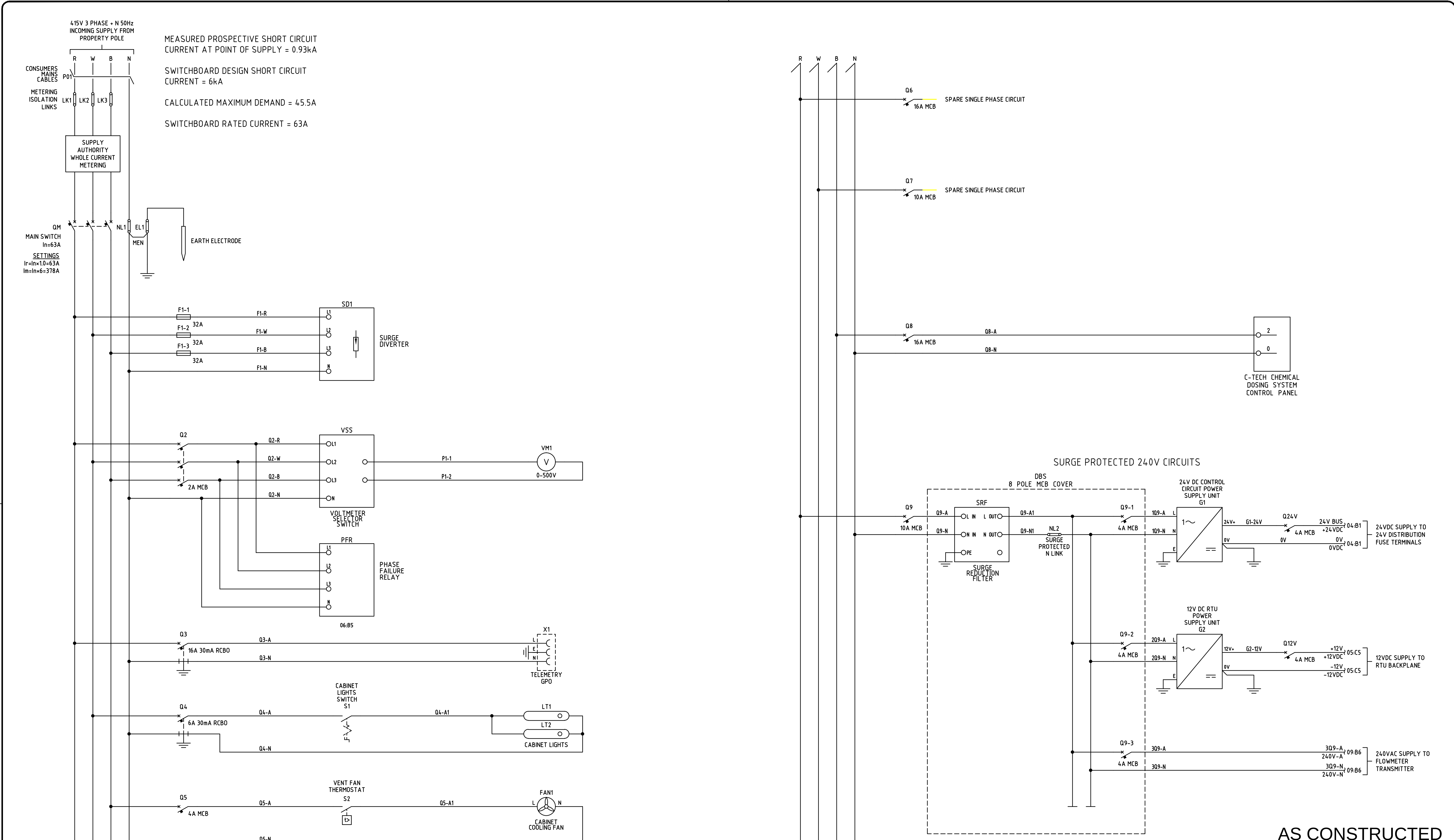
QUEENSLAND UrbanUtilities
A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

TITLE
MAIN SWITCHBOARD
SINGLE LINE DIAGRAM
-

SHEET No. 01
Queensland Urban Utilities DRAWING No. 486/4/7-0013-001
AMEND. A

G:\Water\Jobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-001.dwg Last Saved by John.Dalziel on Thursday, 22 May 2014 2:52:27 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:
NAME of SIGNATORY: JOHN DALZIEL
RPEQ No. or LICENCE: 104697
COMPANY NAME: LEND LEASE SERVICES
START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847
Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12	-
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE	PRINCIPAL DESIGN MANAGER DATE
CAD FILE	48647-0013-002	D. DAYMOND	5505	12/12	-
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE	CLIENT DELEGATE DATE

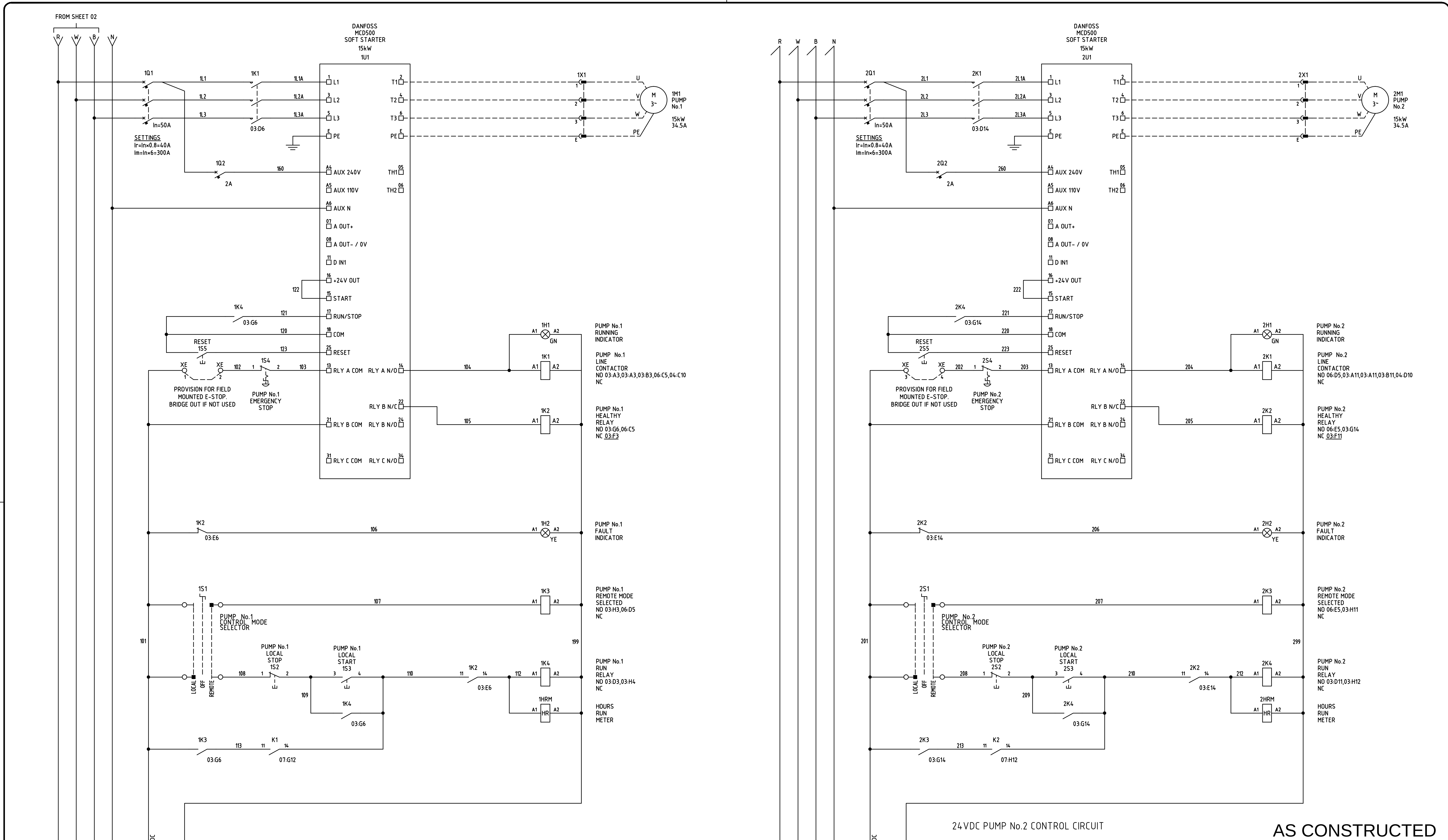
QUEENSLAND UrbanUtilities A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION

TITLE
MAIN SWITCHBOARD
POWER DISTRIBUTION
SCHEMATIC DIAGRAM

SHEET No. 02
Queensland Urban Utilities DRAWING No. 486/4/7-0013-002 AMEND. A

G:\Water\Jobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-002.dwg Last Saved by John.Dalziel on Thursday, 22 May 2014 2:52:46 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS	
I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.	
SIGNED:	DATE:
NAME of SIGNATORY: JOHN DALZIEL	
RPEQ No. or LICENCE: 104697	
COMPANY NAME: LEND LEASE SERVICES	
START DATE: DEC 2012	FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE
CAD FILE	48647-0013-003	D. DAYMOND	5505	12/12
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE

-	-
PRINCIPAL DESIGN MANAGER	DATE
-	-
CLIENT DELEGATE	DATE

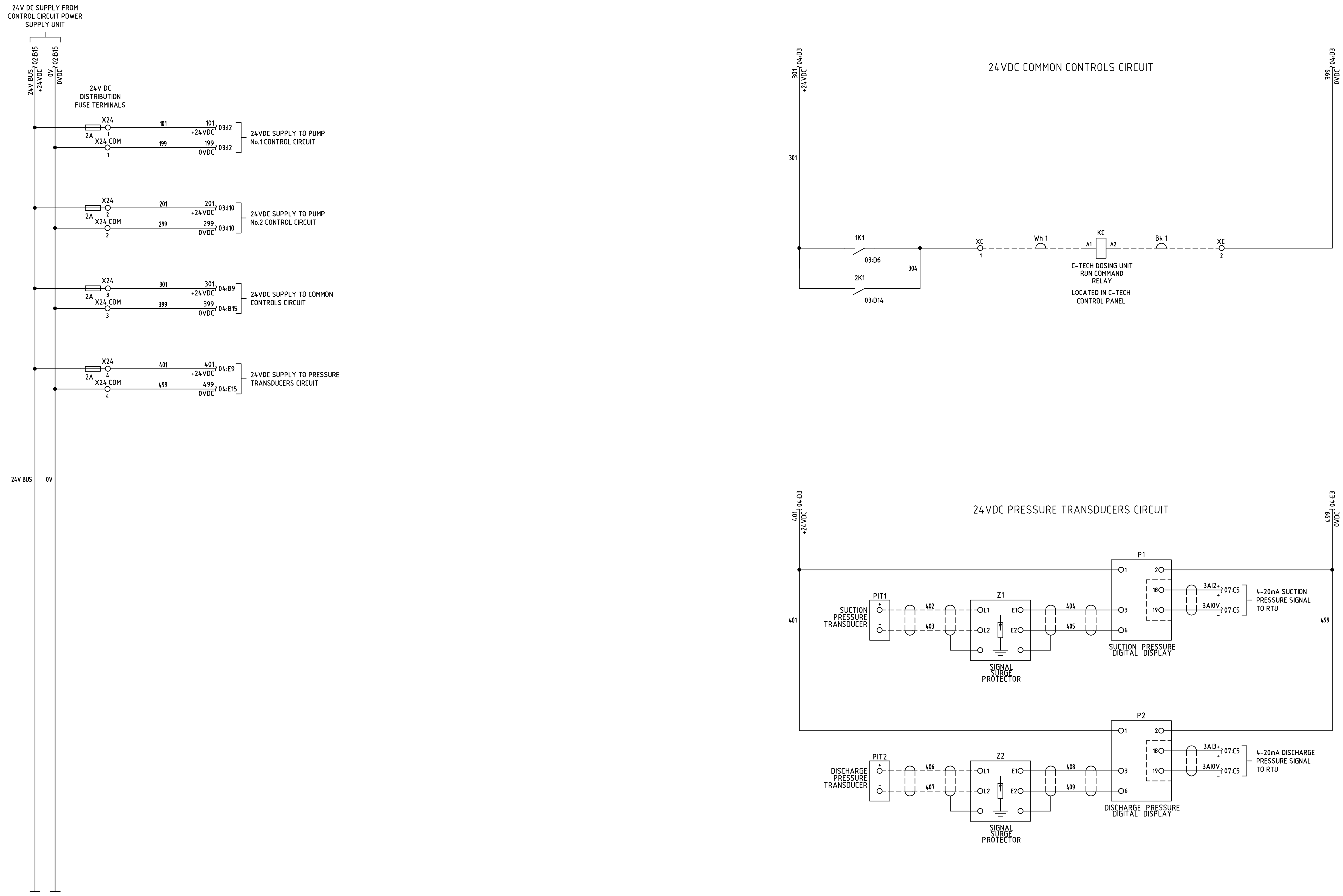
QUEENSLAND UrbanUtilities
A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION

TITLE
MAIN SWITCHBOARD
PUMPS 1 & 2 POWER AND CONTROL
SCHEMATIC DIAGRAM
-

SHEET No. 03
Queensland Urban Utilities DRAWING No. 486/4/7-0013-003
AMEND. A

G:\Water\Jobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-003.dwg Last Saved by John.Dalziel on Thursday, 22 May 2014 2:53:18 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12	-
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE	PRINCIPAL DESIGN MANAGER — DATE
CAD FILE	48647-0013-004	D. DAYMOND	5505	12/12	-
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE	CLIENT DELEGATE — DATE

QUEENSLAND UrbanUtilities — A DIVISION OF THE BRISBANE CITY COUNCIL

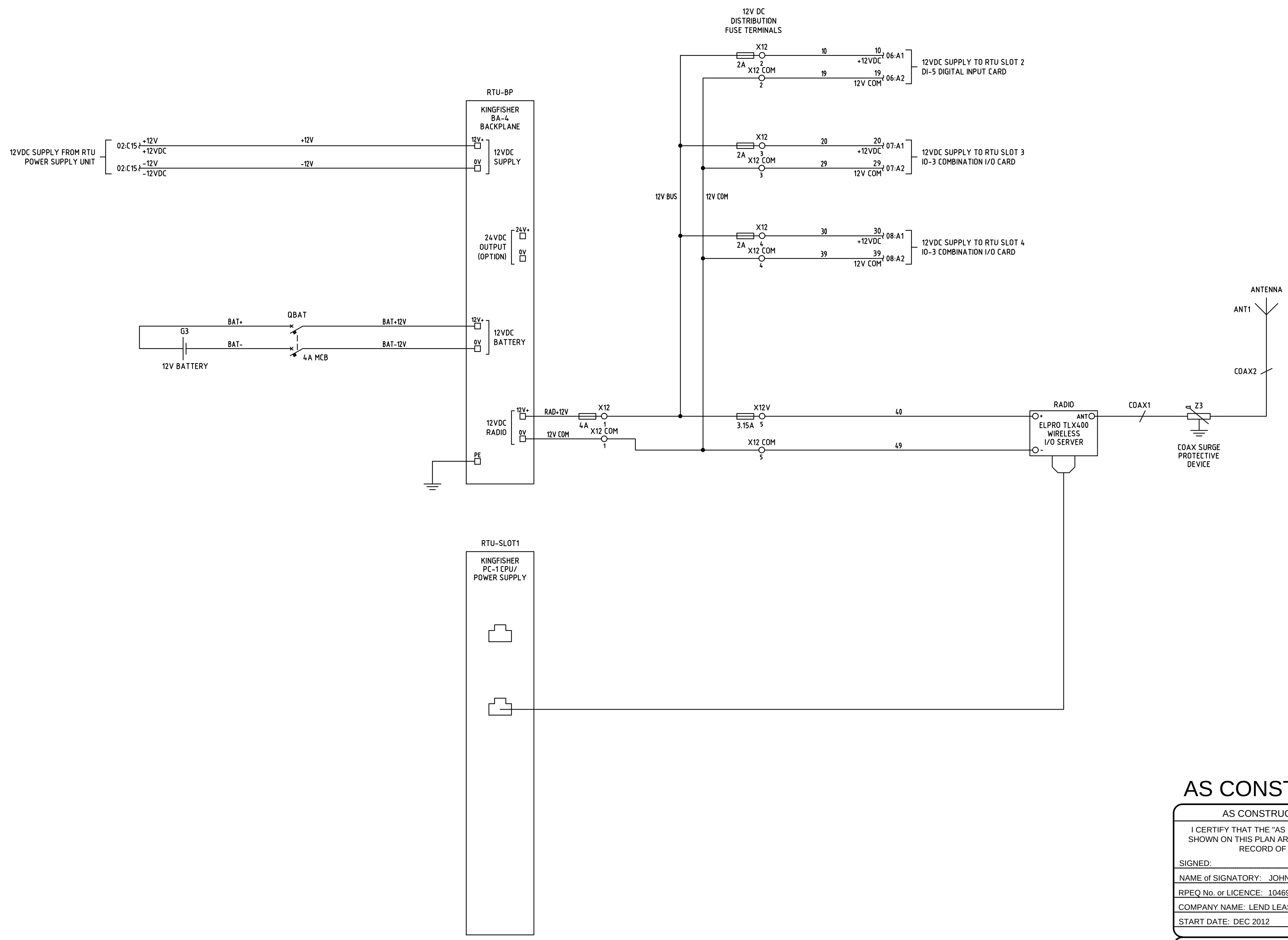
SITE: WP100 CHARLWOOD RD, ARATULA WATER PUMP STATION

TITLE: MAIN SWITCHBOARD 24V DC AUXILIARY CIRCUITS SCHEMATIC DIAGRAM

SHEET No. 04

Queensland Urban Utilities DRAWING No. 486/4/7-0013-004 AMEND. A

G:\Water\Jobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-004.dwg Last Saved by John.Dalziel on Thursday, 22 May 2014 2:53:24 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12	-
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE	PRINCIPAL DESIGN MANAGER DATE
CAD FILE	48647-0013-005	D. DAYMOND	5505	12/12	-
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE	CLIENT DELEGATE DATE

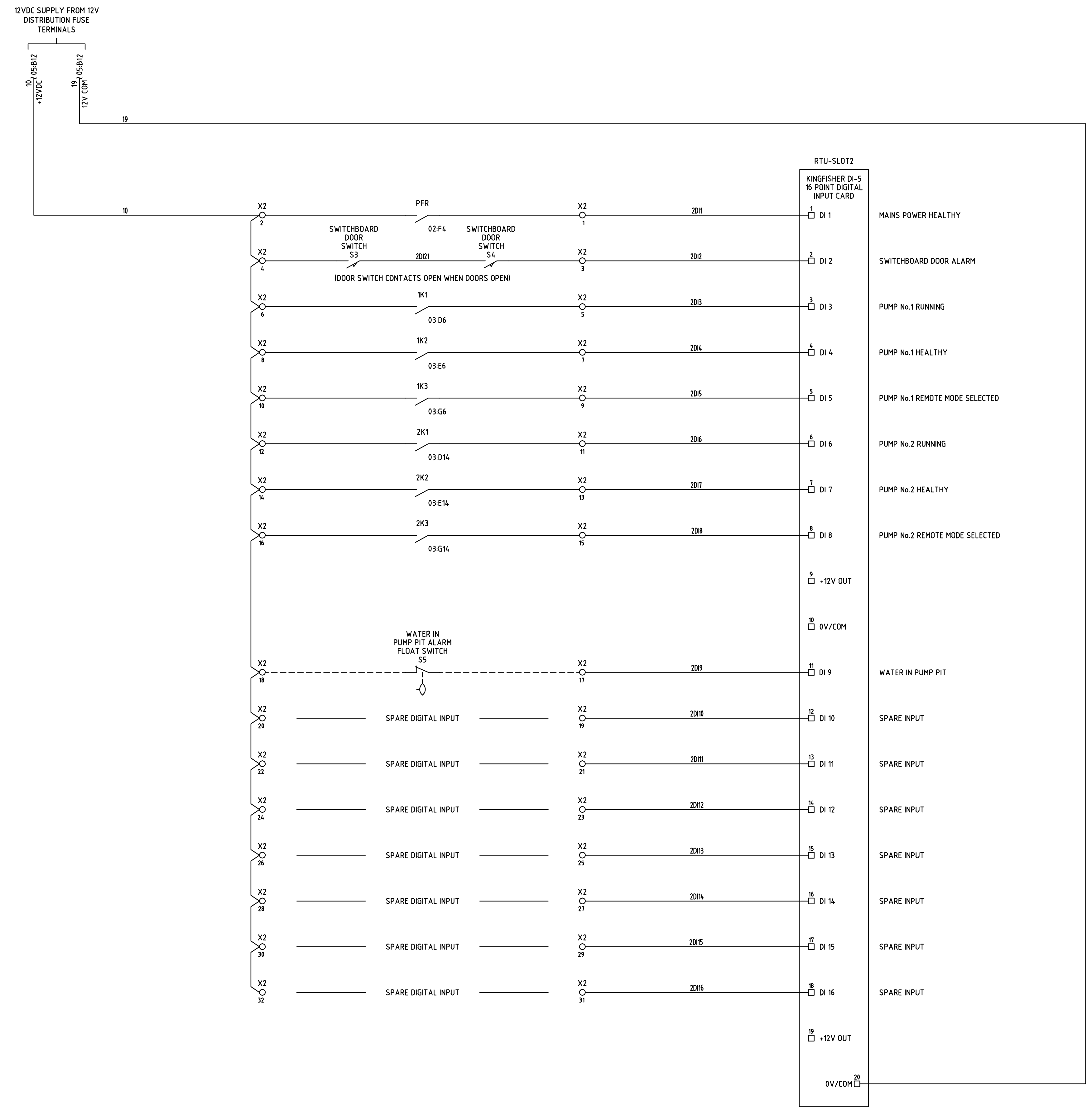
QUEENSLAND UrbanUtilities
A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION

TITLE
MAIN SWITCHBOARD
RTU BACKPLANE AND SLOT 1 CPU
SCHEMATIC DIAGRAM

SHEET No. 05
Queensland Urban Utilities DRAWING No. 486/4/7-0013-005
AMEND. A

G:\WaterJobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-005.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:10:10 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS	
I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.	
SIGNED:	DATE:
NAME of SIGNATORY: JOHN DALZIEL	
RPEQ No. or LICENCE: 104697	
COMPANY NAME: LEND LEASE SERVICES	
START DATE: DEC 2012	FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12	
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE	
CAD FILE	48647-0013-006	D. DAYMOND	5505	12/12	
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE	

-	-
PRINCIPAL DESIGN MANAGER	DATE
-	-
CLIENT DELEGATE	DATE

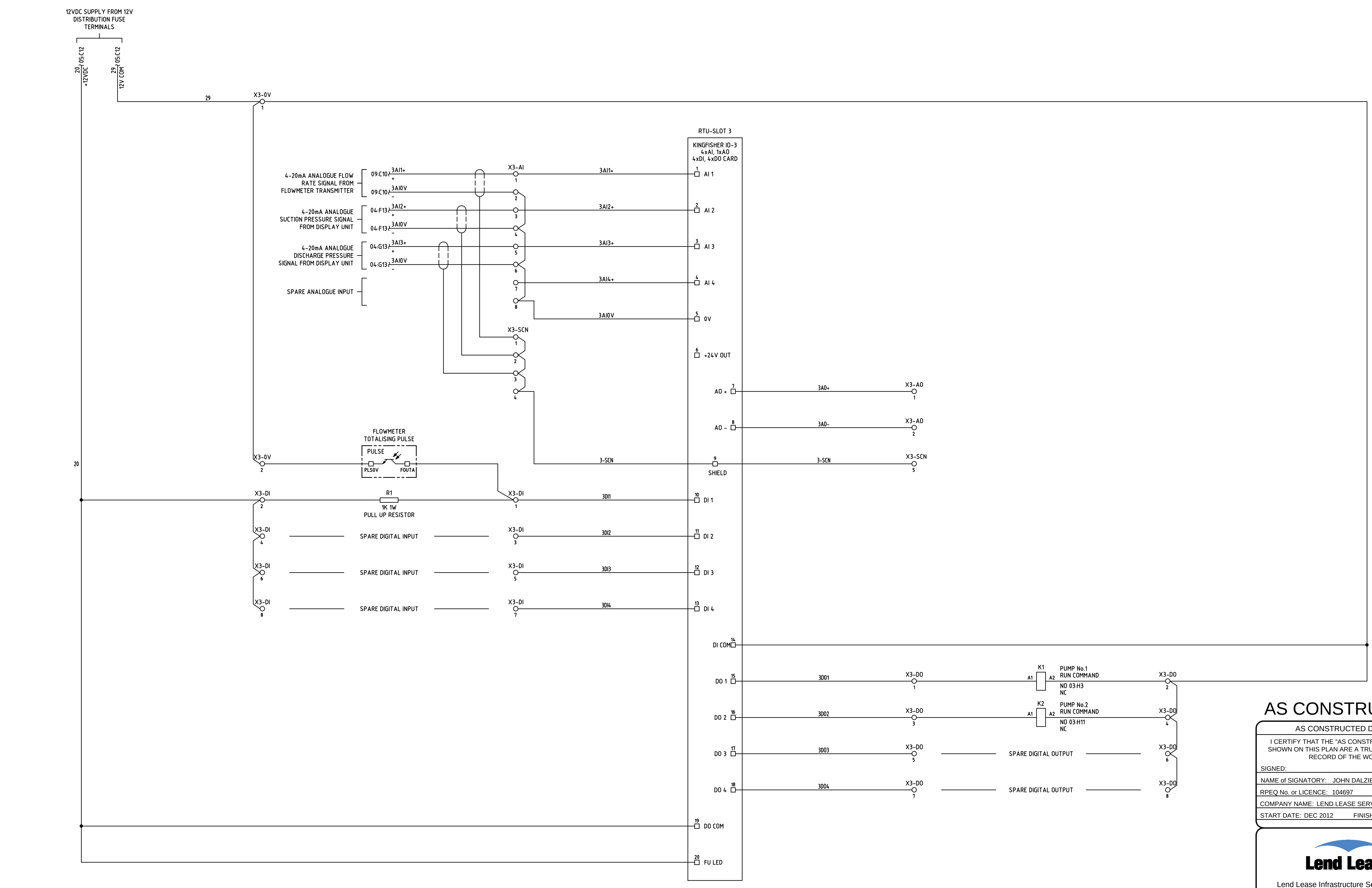
QUEENSLAND UrbanUtilities — A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

TITLE
MAIN SWITCHBOARD
RTU SLOT 2
SCHEMATIC DIAGRAM
-

SHEET No. 06
Queensland Urban Utilities DRAWING No. 486/4/7-0013-006
AMEND. A

G:\WaterJobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-006.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:10:01 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE
CAD FILE	48647-0013-007	D. DAYMOND	5505	12/12
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE

-	-
PRINCIPAL DESIGN MANAGER	DATE
-	-
CLIENT DELEGATE	DATE

QUEENSLAND UrbanUtilities — A DIVISION OF THE BRISBANE CITY COUNCIL

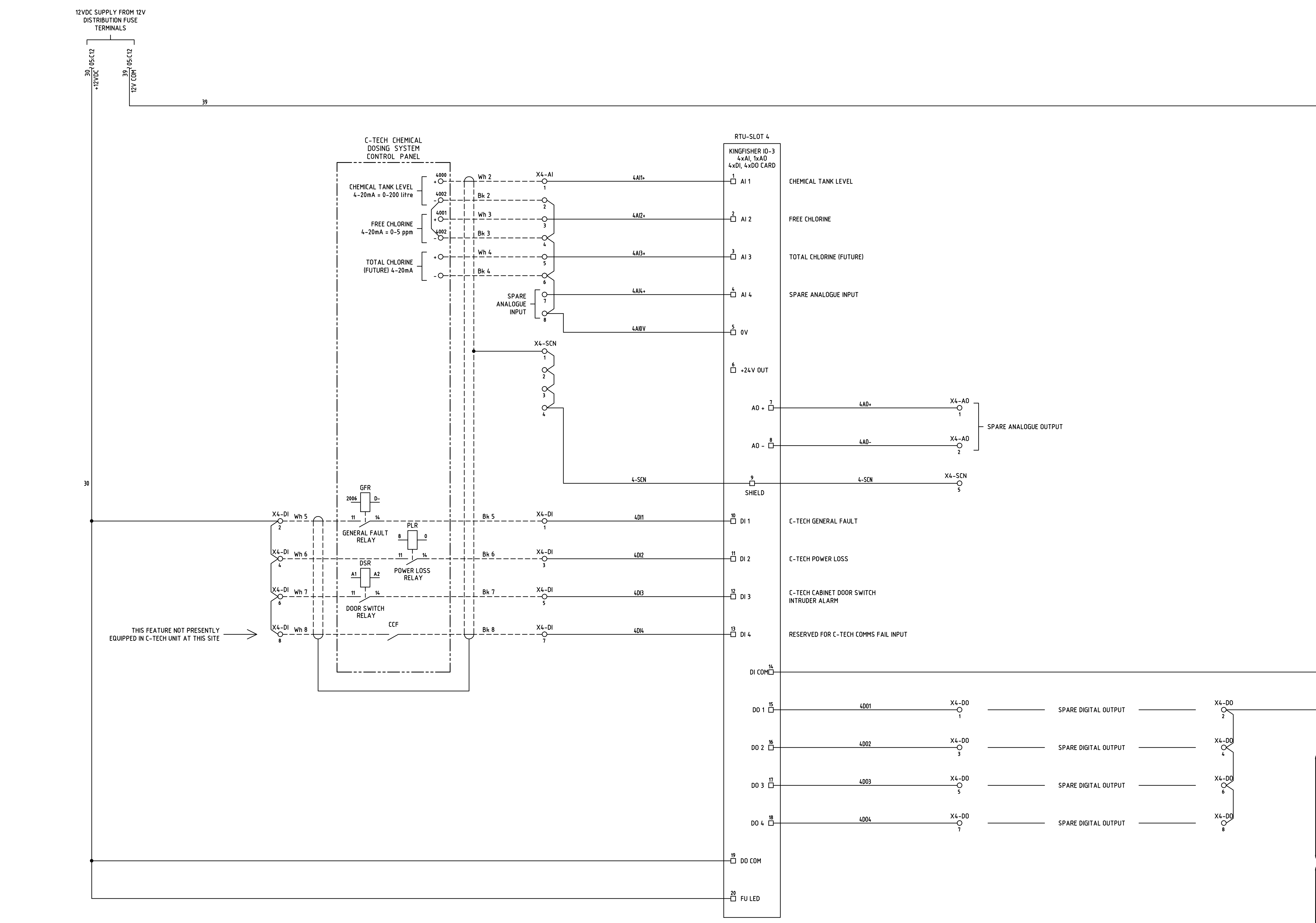
SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

TITLE
MAIN SWITCHBOARD
RTU SLOT 3
SCHEMATIC DIAGRAM
-

SHEET No. 07

Queensland Urban Utilities DRAWING No. 486/4/7-0013-007 AMEND. A

G:\WaterJobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-007.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:09:53 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE
CAD FILE	48647-0013-008	D. DAYMOND	5505	12/12
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE

PRINCIPAL DESIGN MANAGER — DATE
CLIENT DELEGATE — DATE

QUEENSLAND UrbanUtilities — A DIVISION OF THE BRISBANE CITY COUNCIL

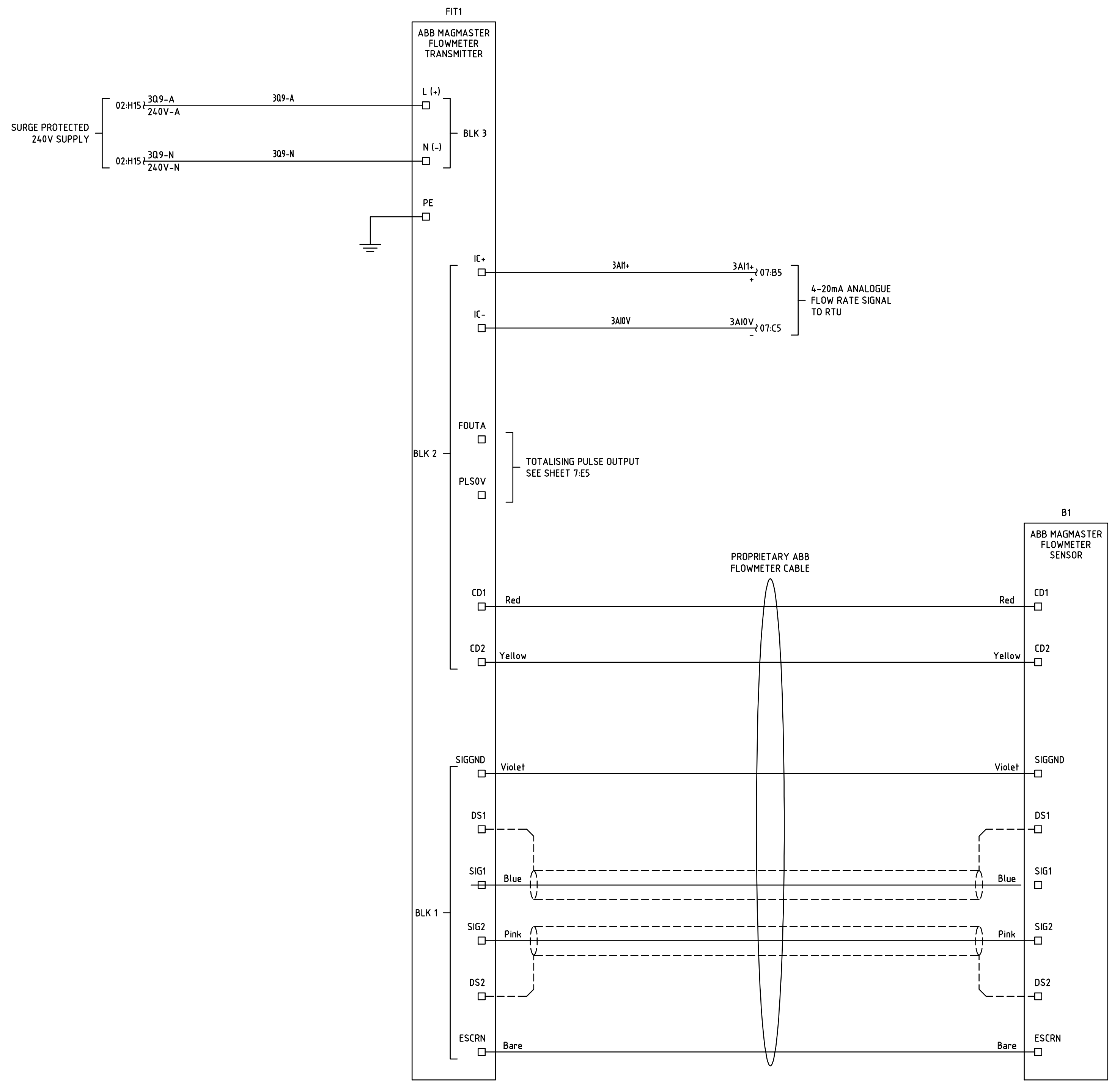
SITE: WP100 CHARLWOOD RD, ARATULA WATER PUMP STATION

TITLE: MAIN SWITCHBOARD RTU SLOT 4 SCHEMATIC DIAGRAM

SHEET No. 08

Queensland Urban Utilities DRAWING No. 486/4/7-0013-008 AMEND. A

G:\Water\Jobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-008.dwg Last Saved by John.Dalziel on Wednesday, 12 February 2014 3:40:16 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS
I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.
SIGNED: DATE:
NAME of SIGNATORY: JOHN DALZIEL
RPEQ No. or LICENCE: 104697
COMPANY NAME: LEND LEASE SERVICES
START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE
CAD FILE	48647-0013-009	D. DAYMOND	5505	12/12
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE

-	-
PRINCIPAL DESIGN MANAGER	DATE
-	-
CLIENT DELEGATE	DATE

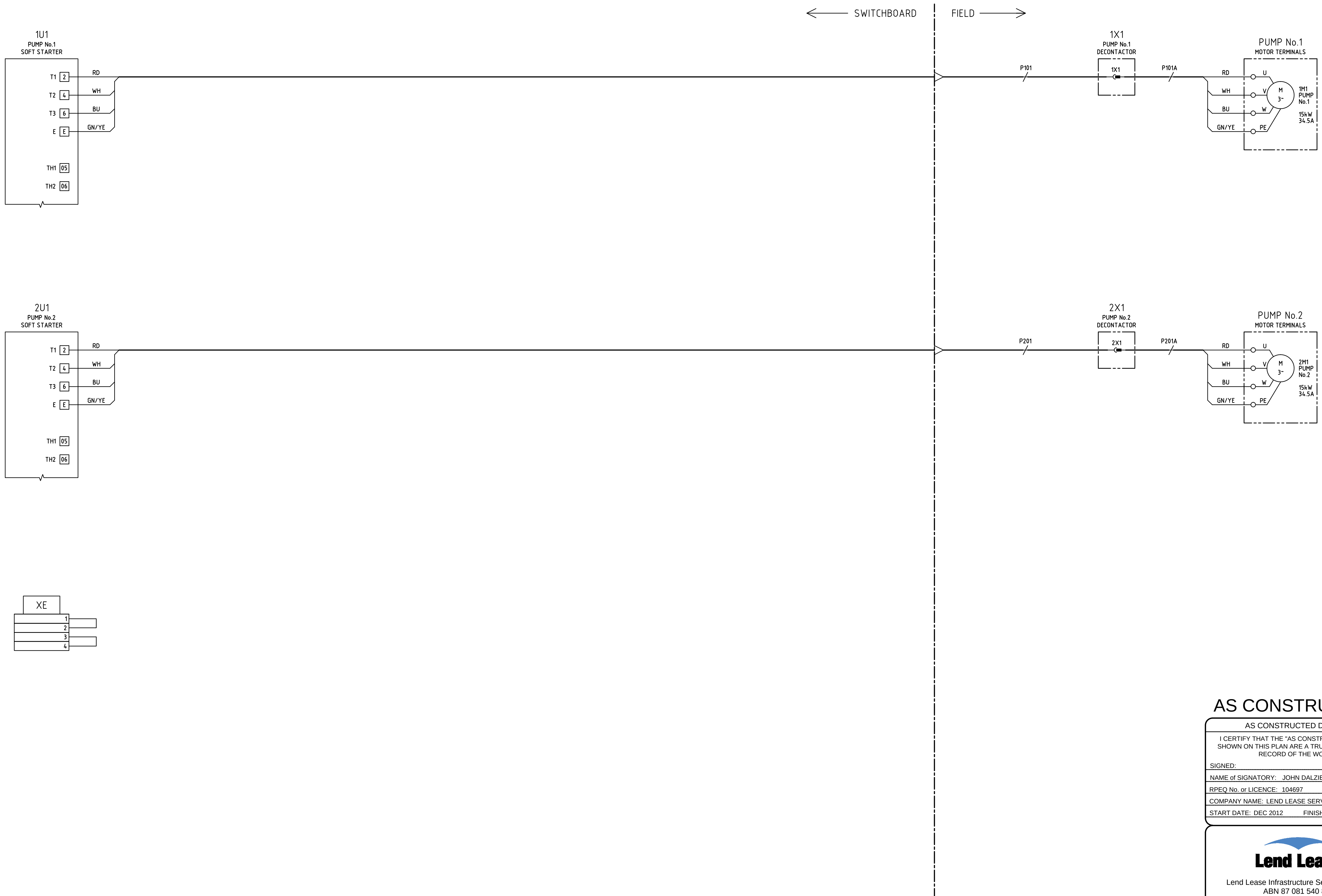
QUEENSLAND UrbanUtilities
A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

TITLE
MAIN SWITCHBOARD
SHEET RESERVED FOR FLOWMETER
SCHEMATIC DIAGRAM
-

SHEET No. 09
Queensland Urban Utilities DRAWING No. 486/4/7-0013-009
AMEND. A

G:\WaterJobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-009.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:09:27 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12	-
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE	PRINCIPAL DESIGN MANAGER DATE
CAD FILE	48647-0013-010	D. DAYMOND	5505	12/12	-
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE	CLIENT DELEGATE DATE

QUEENSLAND UrbanUtilities
A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

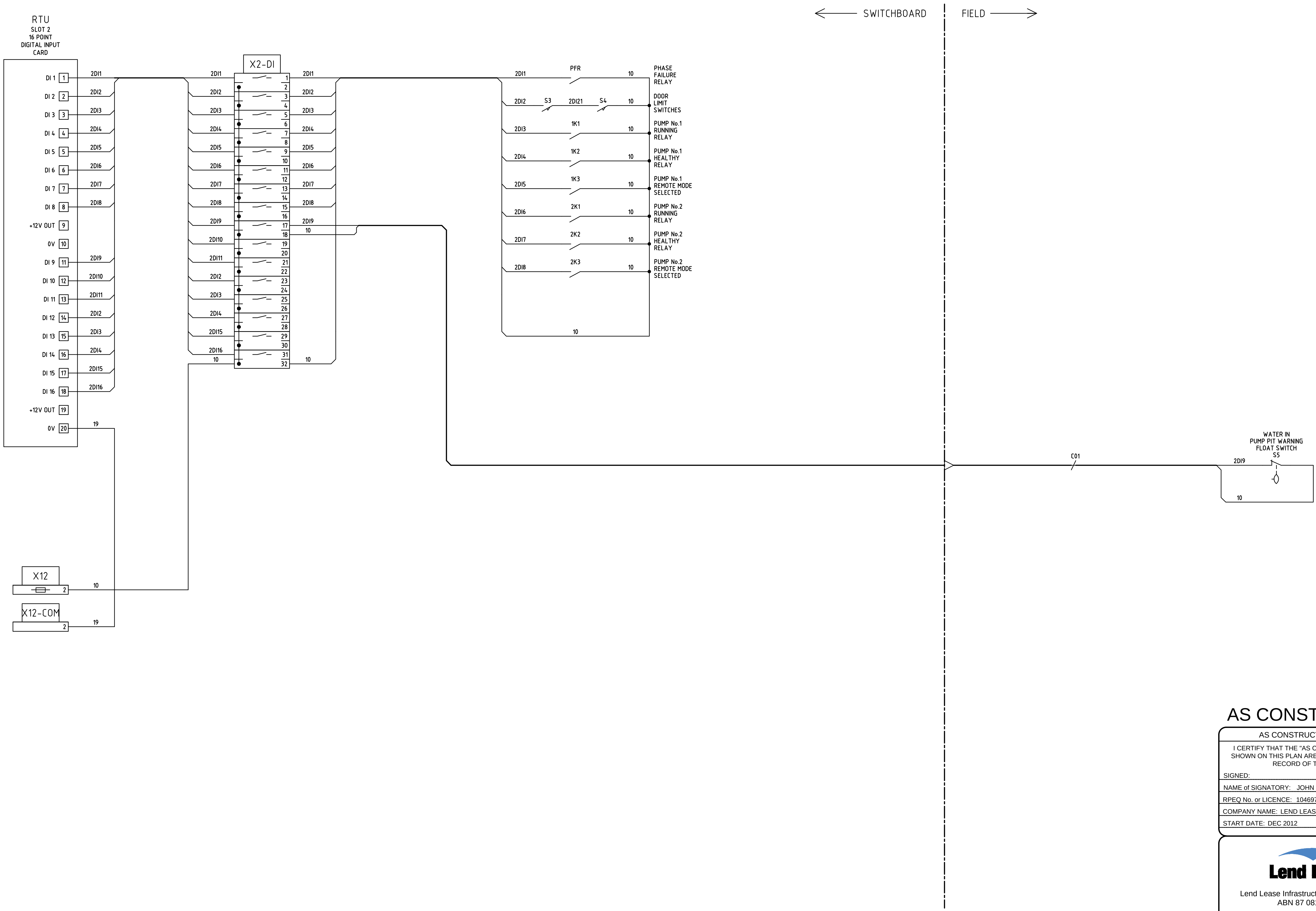
TITLE
MAIN SWITCHBOARD
TERMINATION DIAGRAM
VSD TERMINALS
-

SHEET No. 10

Queensland Urban Utilities DRAWING No. 486/4/7-0013-010

AMEND. A

G:\Water\Jobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-010.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:09:07 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12	
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE	
CAD FILE	48647-0013-011	D. DAYMOND	5505	12/12	
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE	

PRINCIPAL DESIGN MANAGER DATE

CLIENT DELEGATE DATE

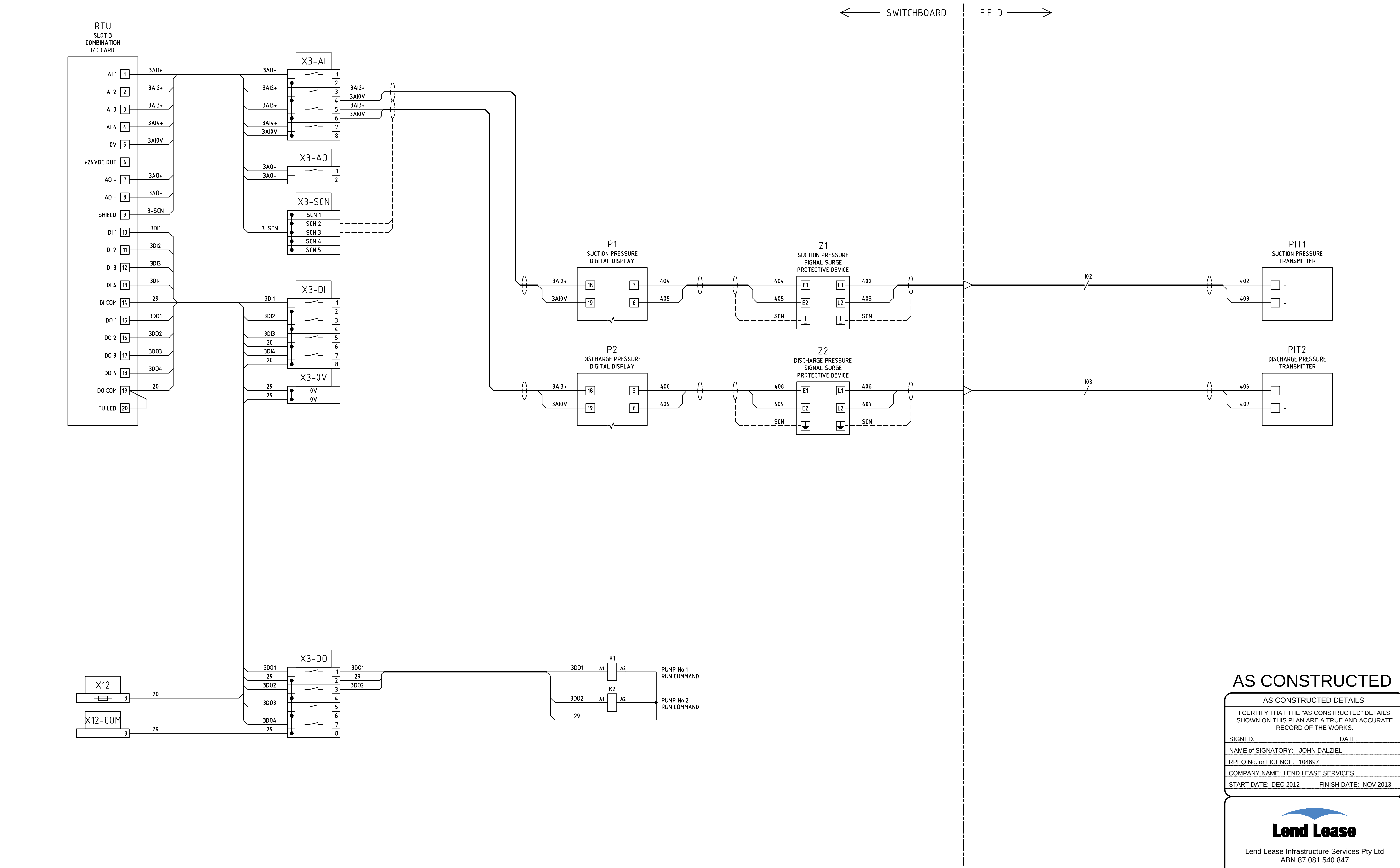
QUEENSLAND UrbanUtilities
A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION

TITLE
MAIN SWITCHBOARD
TERMINATION DIAGRAM
RTU SLOT 2 TERMINALS

SHEET No. 11
Queensland Urban Utilities DRAWING No. 486/4/7-0013-011
AMEND. A

G:\Water\Jobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-011.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:08:49 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12	-
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE	PRINCIPAL DESIGN MANAGER DATE
CAD FILE	48647-0013-012	D. DAYMOND	5505	12/12	-
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE	CLIENT DELEGATE DATE

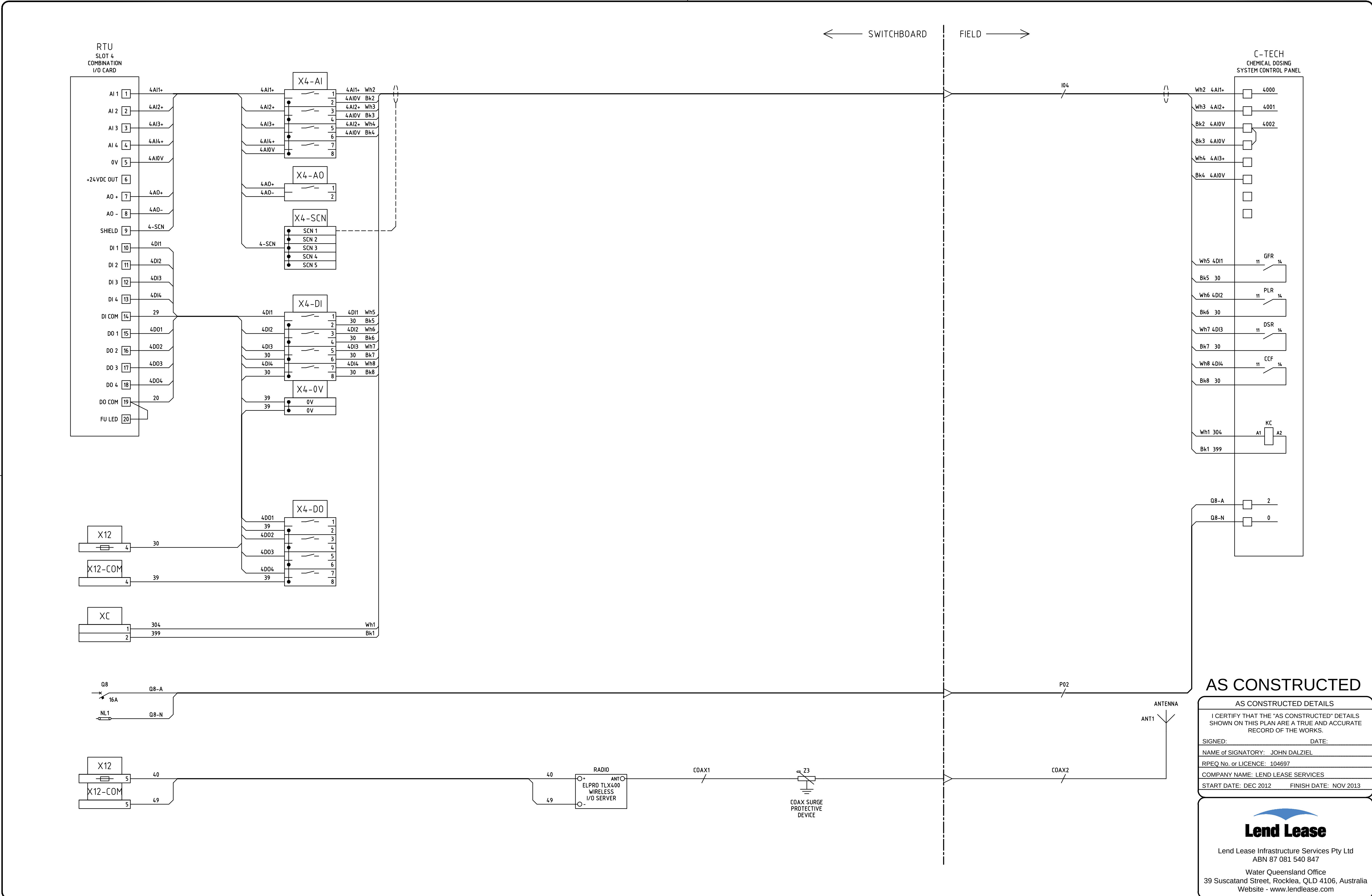
QUEENSLAND UrbanUtilities
A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

TITLE
MAIN SWITCHBOARD
TERMINATION DIAGRAM
RTU SLOT 3 TERMINALS
-

SHEET No. 12
Queensland Urban Utilities DRAWING No. 486/4/7-0013-012
AMEND. A

G:\Water\Jobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-012.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:08:26 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12	
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE	PRINCIPAL DESIGN MANAGER — DATE
CAD FILE	48647-0013-013	D. DAYMOND	5505	12/12	-
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE	CLIENT DELEGATE — DATE

QUEENSLAND UrbanUtilities — A DIVISION OF THE BRISBANE CITY COUNCIL

SITE: WP100 CHARLWOOD RD, ARATULA WATER PUMP STATION

TITLE: MAIN SWITCHBOARD TERMINATION DIAGRAM RTU SLOT 4 TERMINALS

SHEET No. 13

Queensland Urban Utilities DRAWING No. 486/4/7-0013-013 AMEND. A

G:\WaterJobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-013.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:13:25 PM

CONSTRUCTION - EXTERNAL SWITCHBOARD

Cubicle construction 3mm marine grade aluminium.
Equipment panels to be 3mm marine grade aluminium.
Meter Panel is double-hinged 6mm laminated phoenelic resin fitted with Supply Authority sealing facility.
Lifting via 38mm holes in plinth.
Plinth construction 160x63 channel 6061 T6 grade aluminium.
Fully welded on fascia of cubicle and stiffened to prevent warping and form a rigid enclosure.
External doors and covers fitted with Dore Electrics ES60-051 seal.
All Fixings shall be 316 grade stainless steel.
M6 earth buttons fixed to the interior of all doors and hinged escutcheons and on adjacent cubicle interior surfaces.
Earth all doors/escutcheons with 4mm² flexible earth wire.
Fit door switch brackets to each door opening on hinge side.
Door dropstay arms to be S/Steel and of sufficient strength to prevent being deformed when subjected to reasonable loads. Minimum 3mm S/Steel.
Gland plates manufactured from 3mm aluminium, unless otherwise shown.
Inspection/Access plates manufactured from 3mm aluminium.
Gland/Inspect/Access plate openings fitted with M6x1.0 flat head closed end rivet nuts.
Cable glands to be fitted with compression side installed within cubicle.
Gland/Inspection/Access plates to be fitted with seals attached to cubicle.
Gland/Inspection/Access plate fixings at 150mm with hex head bolts.
Gland/Inspection/Access plates are NOT to be split.
Inspection/Access plates are NOT to be earthed.
Hinges (external) lift-off type. Stainless steel with star washers fitted under all hinge screws.
Hinged escutcheons fixed with 1/4 turn coin lock with a square insert.
All equipment to be removable via front access.
All escutcheons to open a minimum of 90°
Forced ventilation via fan and grille.
Fit laptop tray to rear of door 2.
Fit drawing pocket and log book pocket to rear of door 3.

LOCK - DOOR 1

CLOSETRADE - Stainless steel Padlockable Swing Handle.
ENERGEX padlock, S/Steel Shackle, 45mm brass pin tumbler.
ENERGEX Key No. 24242 (Supply 1 key)

LOCKS - DOORS 2 & 3

CLOSETRADE - Stainless steel Lockable Swing Handle. (Keyed 92268)
CLOSETRADE - 3 point lock rod set with rollers.

OPERATING PARAMETERS

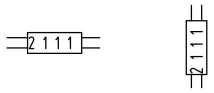
Standard	AS 3439.1
Current & Frequency	AC 50Hz
Rated Operational Voltage Ue	415 VAC
Rated Insulation Voltage Ui	0.6/1kV
Rated Auxiliary Voltage	240 VAC / 24 VDC / 12VDC
Short Circuit Current Isc	6 kA
Duration of Isc	0.2 sec
Degree of Protection	IP56 Weather Resistant
Internal Degree of Protection	IP20B to AS60529:2004
Service Conditions	Outdoors
Mass	Not exceeding 500kg
Forms of Separation	Form 1
Earthing System	MEN
MEN Link	Required

PAINTING

Paint Type	Polyester Powdercoat to 50 micron thickness.
Preparation	Grind smooth all welds, descale and degrease.
Exterior/Doors Colour	Mist Green
Interior Colour	Mist Green
Equipment Panel Colour	Bright White
Escutcheon Colour	Bright White
Plinth Colour	Mist Green

WIRING

All wiring to be PVC V90 HT 0.6/1Kv Grade with tinned conductor.
Control and instrumentation wiring has flexible copper conductors, and is colour coded as detailed below, each individual wire shall be numbered each end, and terminated by the use of appropriate pre-insulated crimp lugs or pins.
Separate lugs or pins shall be used for each conductor. A proprietary double pin lug may be used to terminate two conductors.
Use proprietary bridging links when required to common up terminals.
Not more than two wires shall be connected to any terminal.
Power wiring to be minimum 2.5mm² stranded copper conductors, phase colour coded as detailed below.
Control wiring to be minimum 1.0mm² flexible copper conductors, colour coded as detailed below.
Low level control signals to be minimum 0.5mm² flexible copper conductors, colour coded as detailed below.
4-20mA analog signals (internal & external) wired in shielded pair minimum size 0.5mm², and earthed at one end only. (Switchboard end for external signals)
All 240VAC terminals shall be shouded and labelled - ' Danger 240VAC'
Earth cables minimum 2.5mm² flexible.
Doors and hinged escutcheons bonded with 4mm² flexible earth wire.
Switchboard to have dedicated earthing cable bonding directly to main earth bar.
Wire numbering will be equal to Brady marking system.
Wire numbers are readable left to right, bottom to top as shown.



COLOUR CODE

Phase wiring (A, B &C)	Red, White, Blue	2.5mm² (min)
Potential Metering (240/415 VAC)	Red, White, Blue, Black	1.5mm²
Current Metering (Secondary)	Red, White, Blue, Grey	2.5mm²
240 VAC Control Active	Red	1.0mm²
240 VAC Neutral	Black	1.0mm²
Extra Low VDC Positive supplies	Orange	1.0mm²
Extra Low VDC Negative supplies	Violet	1.0mm²
General Extra Low VDC Wiring	Grey	1.0mm²
RTU & PLC Wiring	Grey	0.5mm²
Electrode Wiring	Pink	1.0mm²
Intrinsically safe wiring	Light Blue	1.5mm²
Earth	Green/Yellow	2.5mm² (min)
Door & Escutcheon Earth Bonds	Green/Yellow	4.0 mm²

LABELS

Internal labels - W/B engraved Gravoply.
Warning labels - R/W engraved Gravoply.
E/Stop labels - Y/B engraved Gravoply.
First letter = Background colour, Second letter = Lettering colour.

Main switch label	MAIN SWITCH 400A	10mm 4mm	Material ABS PLASTIC Colour B/W
Pump CB labels	PUMP No1 250A	6mm 4mm	Material ABS PLASTIC Colour W/B
Compartment labels	PUMP No1	10mm	Material Stainless Steel
E/Stop labels	LOCK-OFF STOP	4mm	Material ABS PLASTIC Colour Y/B
Warning labels	DANGER 415V ISOLATE ELSE WHERE	7mm 5mm	Material ABS PLASTIC Colour R/W

Internal labels secured by M3 316 grade stainless steel screws and double sided adhesive tape.
Labels obstructed by switchboard wiring are relocated to adjacent duct lid and secured by M3 nylon screws. Lid to be secured by a single cable tie at one corner.
External labels 1.2 mm thick 316 grade s/steel secured by M3 316 s/steel screws.
All internal and external labels are to have bevelled edges.
Label on the Internal side of the escutcheon for all equipment mounted on escutcheon. Affix labels with double sided tape only.

AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:
NAME of SIGNATORY: JOHN DALZIEL
RPEQ No. or LICENCE: 104697
COMPANY NAME: LEND LEASE SERVICES
START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE
CAD FILE	48647-0013-014	D. DAYMOND	5505	12/12
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE

-	-
PRINCIPAL DESIGN MANAGER	DATE
-	-
CLIENT DELEGATE	DATE

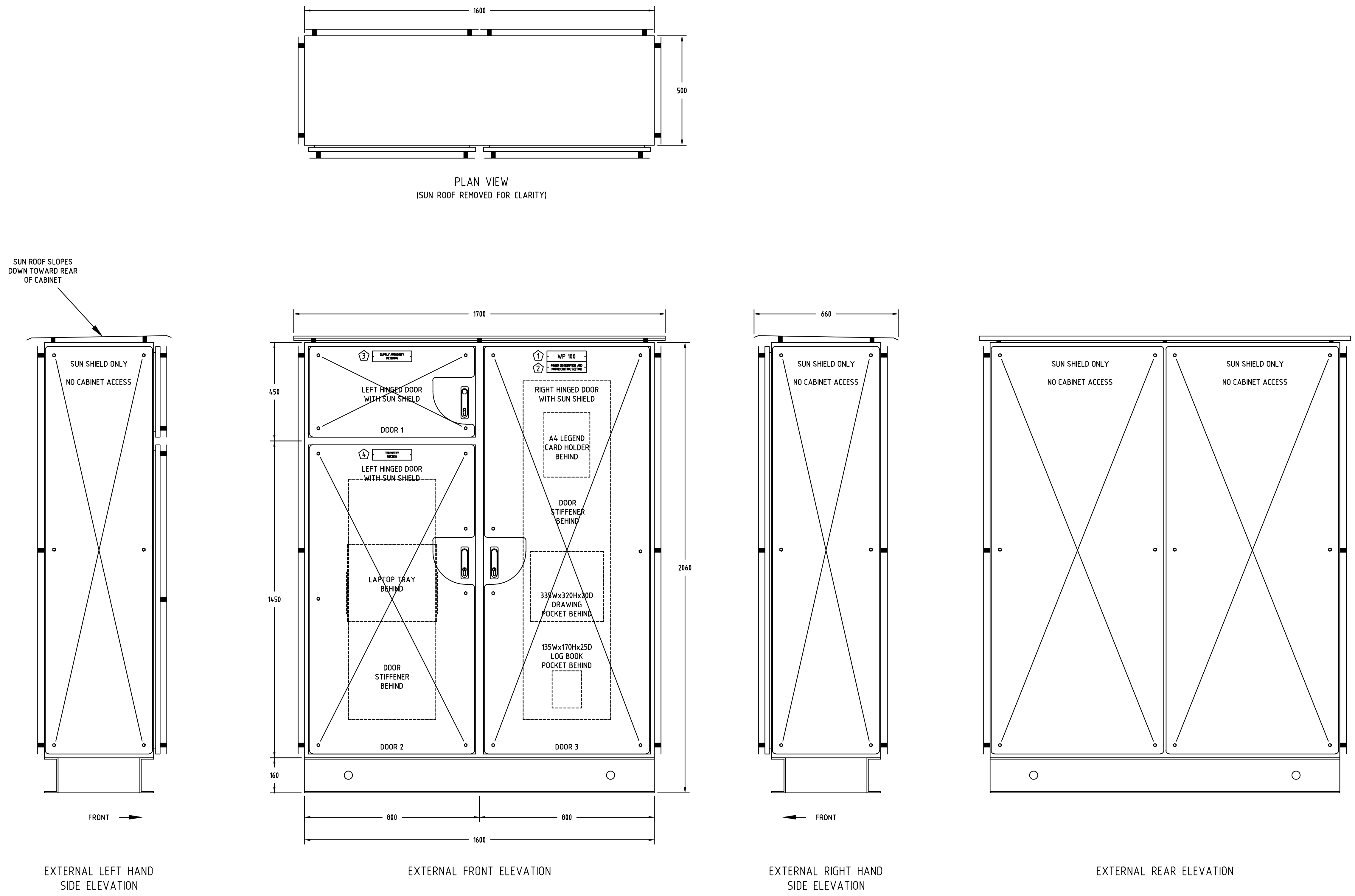
QUEENSLAND UrbanUtilities
A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

TITLE
MAIN SWITCHBOARD
CONSTRUCTION NOTES
-

SHEET No. 14
Queensland Urban Utilities DRAWING No. 486/4/7-0013-014
AMEND. A

G:\WaterJobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-014.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:07:51 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	- 12/12
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No. DATE
CAD FILE	48647-0013-015	D. DAYMOND	5505 12/12
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No. DATE

PRINCIPAL DESIGN MANAGER DATE

CLIENT DELEGATE DATE

QUEENSLAND Urban Utilities
A DIVISION OF THE BRISBANE CITY COUNCIL

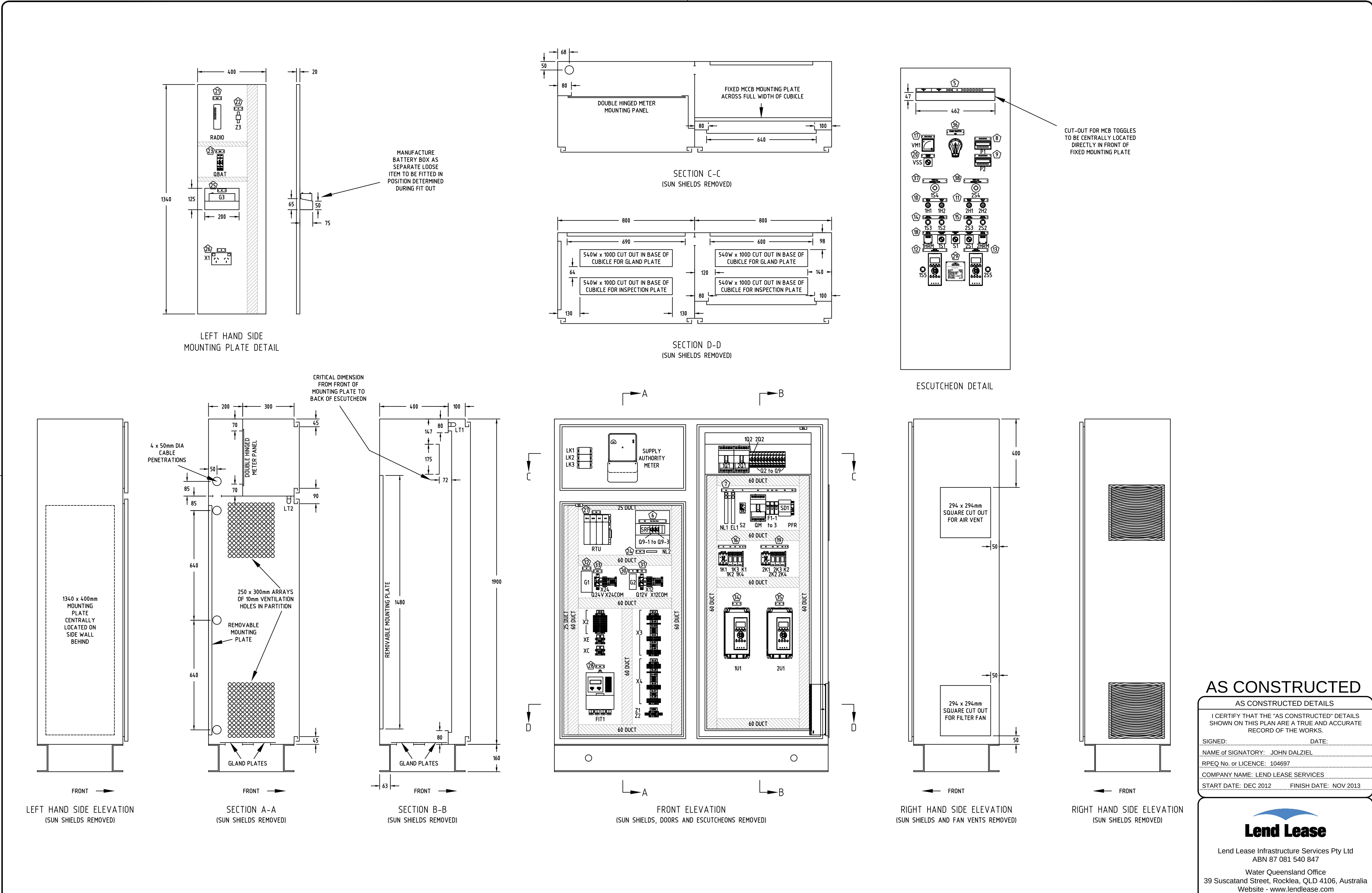
SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION

TITLE
MAIN SWITCHBOARD
EXTERNAL GENERAL ARRANGEMENT

SHEET No. 15

Queensland Urban Utilities DRAWING No. 486/4/7-0013-015 AMEND. A

G:\WaterJobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-015.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:07:36 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE
CAD FILE	48647-0013-016	D. DAYMOND	5505	12/12
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE

PRINCIPAL DESIGN MANAGER DATE

CLIENT DELEGATE DATE

QUEENSLAND UrbanUtilities — A DIVISION OF THE BRISBANE CITY COUNCIL

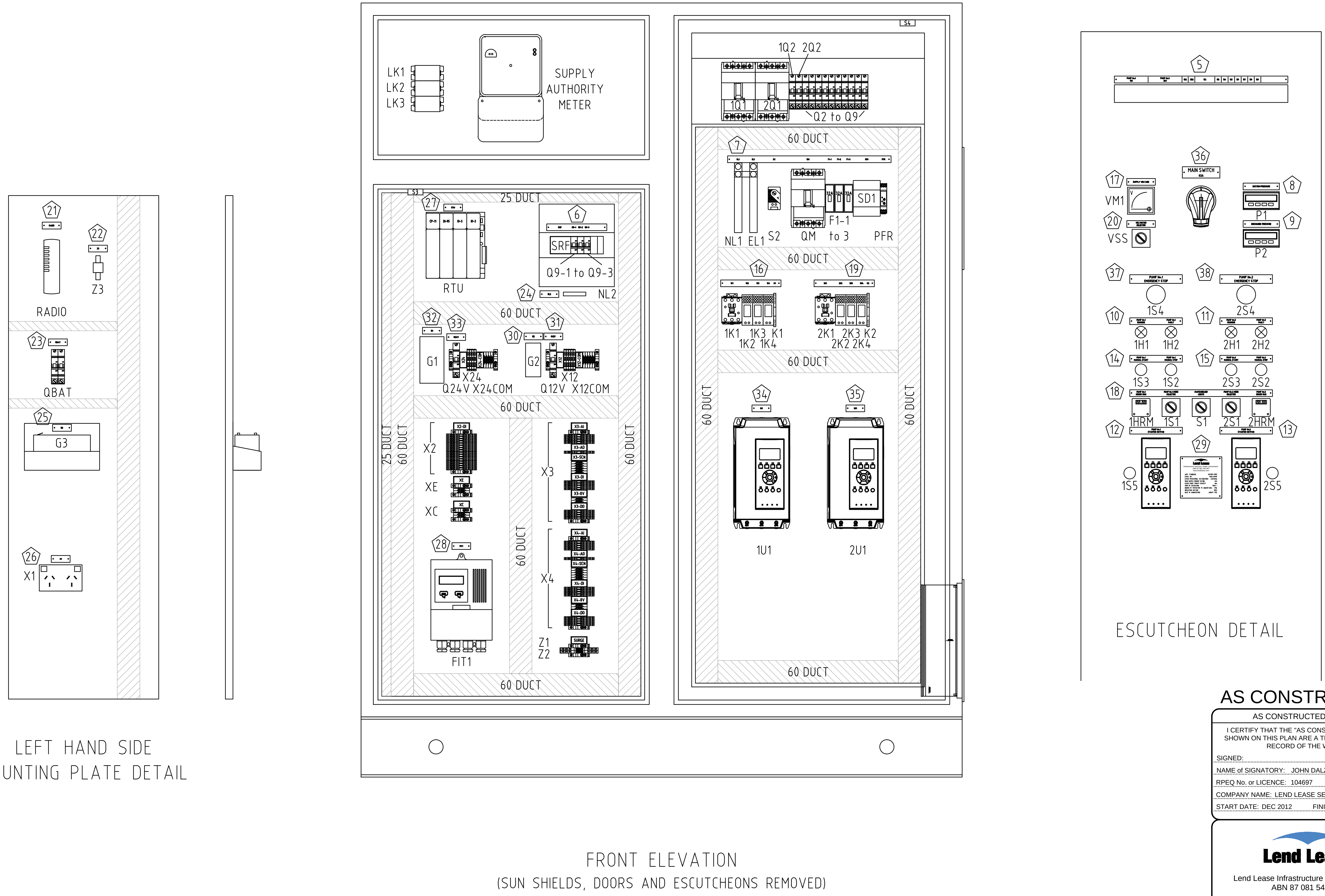
SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION

TITLE
MAIN SWITCHBOARD
PLAN, ELEVATIONS & SECTIONS

SHEET No. 16

Queensland Urban Utilities DRAWING No. 486/4/7-0013-016 AMEND. A

G:\WaterJobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-016.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:07:19 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	J. DALZIEL	-	12/12	
DRAFTING CHECK	JC-S	DESIGN	R.P.E.Q. No.	DATE	PRINCIPAL DESIGN MANAGER DATE
CAD FILE	48647-0013-017	D. DAYMOND	5505	12/12	
B.C.C. FILE No.	-	DESIGN CHECK	R.P.E.Q. No.	DATE	CLIENT DELEGATE DATE

QUEENSLAND UrbanUtilities — A DIVISION OF THE BRISBANE CITY COUNCIL

SITE: WP100 CHARLWOOD RD, ARATULA WATER PUMP STATION

TITLE: MAIN SWITCHBOARD EQUIPMENT LAYOUT

SHEET No. 17

Queensland Urban Utilities DRAWING No. 486/4/7-0013-017 AMEND. A

G:\WaterJobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-017.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:13:00 PM

ELECTRICAL CABLE SCHEDULE

CABLE No.	STATUS	SIZE	CORES	TYPE	LENGTH	FROM	TO	FUNCTION	NOTE
P01	EXISTING	25mm²	4 x 1C	SDI	12m	PROPERTY POLE	SWITCHBOARD METER DISCONNECT LINKS	CONSUMERS MAINS	
P02	NEW	2.5mm²	2C+E	V90 PVC/PVC CIRCULAR	11m	SWITCHBOARD MCB DISTRIBUTION	C–TECH CHEMICAL DOSING CONTROL PANEL	C–TECH POWER SUPPLY	
P101	EXISTING	10mm²	3C+E	V90 PVC/PVC CIRCULAR	6m	PUMP No.1 SOFT STARTER POWER TERMINALS	PUMP No.1 DECONTACTOR SOCKET	PUMP No.1 MOTOR POWER	
P101A	NEW	10mm²	3C+E	FLEXOLEX EPR/CPE FLEXIBLE	2.5m	PUMP No.1 DECONTACTOR PLUG	PUMP No.1 MOTOR TERMINAL BOX	PUMP No.1 MOTOR POWER	
P201	EXISTING	10mm²	3C+E	V90 PVC/PVC CIRCULAR	6m	PUMP No.2 SOFT STARTER POWER TERMINALS	PUMP No.2 DECONTACTOR SOCKET	PUMP No.2 MOTOR POWER	
P201A	NEW	10mm²	3C+E	FLEXOLEX EPR/CPE FLEXIBLE	1.5m	PUMP No.2 DECONTACTOR PLUG	PUMP No.2 MOTOR TERMINAL BOX	PUMP No.2 MOTOR POWER	
C01	NEW	1.5mm²	3C	V90 PVC/PVC FLEXIBLE	4m	SWITCHBOARD RTU CABINET TERMINALS	PUMP PIT FLOAT SWITCH	WATER IN PUMP PIT ALARM	
I01	EXISTING	CUSTOM	MULTI	FLOWMETER SENSOR CABLE	20m	FLOWMETER TRANSMITTER	FLOWMETER SENSOR	FLOW SENSING	
I02	NEW	0.5mm²	1 PAIR	INSTROLEX OVERALL SCREENED	4m	SWITCHBOARD SURGE DEVICE Z1	SUCTION PRESSURE TRANSMITTER	SUCTION PRESSURE SIGNAL	
I03	NEW	0.5mm²	1 PAIR	INSTROLEX OVERALL SCREENED	8m	SWITCHBOARD SURGE DEVICE Z2	DISCHARGE PRESSURE TRANSMITTER	DISCHARGE PRESSURE SIGNAL	
I04	NEW	0.5mm²	10 PAIR	INSTROLEX OVERALL SCREENED	9m	SWITCHBOARD RTU CABINET TERMINALS	C–TECH CHEMICAL DOSING CONTROL PANEL	DOSING I/O SIGNALS	
COAX1	NEW	–	1	CNT–400 50 OHM COAXIAL	1m	TELEMETRY RADIO / WIRELESS I/O SERVER	COAX SURGE PROTECTOR	DATA TRANSMISSION	
COAX2	EXISTING	–	1	CNT–400 50 OHM COAXIAL	10m	COAX SURGE PROTECTOR	YAGI TELEMETRY ANTENNA	DATA TRANSMISSION	

AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED JHD | DRAFTING CHECK JC-S | CAD FILE 48647-0013-018 | B.C.C. FILE No. -

J. DALZIEL - 12/12 | DESIGN R.P.E.Q. No. DATE | D. DAYMOND 5505 12/12 | DESIGN CHECK R.P.E.Q. No. DATE

PRINCIPAL DESIGN MANAGER DATE | CLIENT DELEGATE DATE

QUEENSLAND UrbanUtilities — A DIVISION OF THE BRISBANE CITY COUNCIL

SITE: WP100 CHARLWOOD RD, ARATULA WATER PUMP STATION

TITLE: MAIN SWITCHBOARD CABLE SCHEDULE

SHEET No. 18

Queensland Urban Utilities DRAWING No. 486/4/7-0013-018 AMEND. A

G:\Water\Jobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-018.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:06:31 PM

1 STAINLESS STEEL 20mm BLACK FILL

WP 100

2 STAINLESS STEEL 10mm BLACK FILL

POWER DISTRIBUTION AND
MOTOR CONTROL SECTION

3 STAINLESS STEEL 10mm BLACK FILL

SUPPLY AUTHORITY
METERING

4 STAINLESS STEEL 10mm BLACK FILL

TELEMETRY
SECTION

5 TRAFFOLYTE 4mm W/B

PUMP No.1 1Q1 | PUMP No.2 2Q1 | 1Q2 | 2Q2 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9

6 TRAFFOLYTE 4mm W/B

SRF Q9-1 Q9-2 Q9-3

7 TRAFFOLYTE 4mm W/B

NL1 EL1 S2 QM F1-1 F1-2 F1-3 SD1 PFR

8 TRAFFOLYTE 4mm W/B

SUCTION PRESSURE

9 TRAFFOLYTE 4mm W/B

DISCHARGE PRESSURE

10 TRAFFOLYTE 4mm W/B

PUMP No.1 RUNNING | PUMP No.1 FAULT

11 TRAFFOLYTE 4mm W/B

PUMP No.2 RUNNING | PUMP No.2 FAULT

12 TRAFFOLYTE 4mm W/B

PUMP No.1 STARTER KEYPAD

13 TRAFFOLYTE 4mm W/B

PUMP No.2 STARTER KEYPAD

14 TRAFFOLYTE 4mm W/B

PUMP No.1 MANUAL START | PUMP No.1 MANUAL STOP

15 TRAFFOLYTE 4mm W/B

PUMP No.2 MANUAL START | PUMP No.2 MANUAL STOP

16 TRAFFOLYTE 4mm W/B

1K1 1K2 1K3 1K4 K1

17 TRAFFOLYTE 4mm W/B

SUPPLY VOLTAGE

18 TRAFFOLYTE 4mm W/B

PUMP No.1 HOURS RUN | PUMP No.1 MODE SELECTOR | SWITCHBOARD LIGHTS | PUMP No.2 MODE SELECTOR | PUMP No.2 HOURS RUN

19 TRAFFOLYTE 4mm W/B

2K1 2K2 2K3 2K4 K2

20 TRAFFOLYTE 4mm W/B

VOLTMETER SELECTOR

21 TRAFFOLYTE 4mm W/B — RADIO

22 TRAFFOLYTE 4mm W/B — Z3

23 TRAFFOLYTE 4mm W/B — QBAT

24 TRAFFOLYTE 4mm W/B — NL2

25 TRAFFOLYTE 4mm W/B — G3

26 TRAFFOLYTE 4mm W/B — X1

27 TRAFFOLYTE 4mm W/B — RTU

28 TRAFFOLYTE 4mm W/B — FIT1

30 TRAFFOLYTE 4mm W/B — G2

31 TRAFFOLYTE 4mm W/B — Q12V

32 TRAFFOLYTE 4mm W/B — G1

33 TRAFFOLYTE 4mm W/B — Q24V

34 TRAFFOLYTE 4mm W/B — 1U1

35 TRAFFOLYTE 4mm W/B — 2U1

29 TRAFFOLYTE 3.5mm W/B

Lend Lease
Infrastructure Services | Water Queensland
ABN 87 081 540 847
www.lendlease.com

AUST. STANDARD	AS3439.1-2002
SERIAL NO.	17552-WP100
RATED OPERATIONAL VOLTAGE/FREQ	415V/50Hz
MAIN SWITCH CURRENT RATING	63A
RATED SHORT CIRCUIT CAPACITY	6kA
FORM OF SEPARATION	FORM 1
DEGREE OF PROTECTION TO AS60529-2004	IP56
INSULATION VOLTAGE	600V
DATE OF MANUFACTURE	AUGUST 2012

37 TRAFFOLYTE 6mm Y/B

PUMP No.1
EMERGENCY STOP

38 TRAFFOLYTE 4mmY/B

PUMP No.2
EMERGENCY STOP

36 TRAFFOLYTE 10mm + 6mm B/W

MAIN SWITCH
63A

AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease
Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847
Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No.	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD
DRAFTING CHECK	JC-S
CAD FILE	48647-0013-019
B.C.C. FILE No.	-

	R.P.E.Q. No.	DATE
J. DALZIEL	-	12/12
DESIGN	R.P.E.Q. No.	DATE
D. DAYMOND	5505	12/12
DESIGN CHECK	R.P.E.Q. No.	DATE

-	-
PRINCIPAL DESIGN MANAGER	DATE
-	-
CLIENT DELEGATE	DATE

QUEENSLAND UrbanUtilities
A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION

TITLE
MAIN SWITCHBOARD
LABEL DETAILS

SHEET No. 19
Queensland Urban Utilities DRAWING No. 486/4/7-0013-019
AMEND. A

© 2010 THIS DRAWING OR PART THEREOF IS PROTECTED BY THE LAWS OF COPYRIGHT AND MAY NOT BE COPIED OR REPRODUCED WITHOUT THE EXPRESS PERMISSION OF QUEENSLAND URBAN UTILITIES

G:\WaterJobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-019.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:06:18 PM

ITEM DESIGNATION	QTY	DESCRIPTION	PART NUMBER	SUPPLIER
1H1	1	PILOT LIGHT GREEN 24VAC/DC	D7P-P3-PN3G	NHP
1H2	1	PILOT LIGHT YELLOW 24VAC/DC	D7P-P5-PN3Y	NHP
1HRM	1	HOUR RUN METER 24VDC	RQ480-10-80VDC	NHP
1K1	1	CONTACTOR 3 POLE 24VDC + AUX	CA7-43C-00-24VDC + CS7-PV-40	NHP
1K2	1	RELAY 4 POLE C/O 24VDC + BASE	55.34.0074.24VDC + 94.04	NHP
1K3	1	RELAY 4 POLE C/O 24VDC + BASE	55.34.0074.24VDC + 94.04	NHP
1K4	1	RELAY 4 POLE C/O 24VDC + BASE	55.34.0074.24VDC + 94.04	NHP
1Q1	1	MCCB 3 POLE 50A + SHIELDS	E125NJ350 +T2CF123SSNBA	NHP
1Q2	1	MCB 1 POLE 2A C CURVE 6kA	DTCB6102C	NHP
1S1	1	CHANGEOVER SWITCH WITH CENTRE OFF 1 POLE	CA10-A210-620-FT2	KRAUS & NAIMER
1S2	1	PUSHBUTTON RED 1N/C	D7P-F4-PX01	NHP
1S3	1	PUSHBUTTON GREEN 1N/O	D7P-F3-PX10	NHP
1S4	1	PUSHBUTTON E-STOP 1N/C + LEGEND	D7P-MT44-PX01S	NHP
1S5	1	PUSHBUTTON BLUE RESET 1N/O	D7P-F607-PX10	NHP
1U1	1	SOFT STARTER 18.5kW + LCP + PANEL KIT	175G5526 + 175G0096 + 130B1117	DANFOSS
1X1P	1	DECONTACTOR PLUG 50A 415V	3138013 + 313A013	MARECHAL
1X1S	1	DECONTACTOR SOCKET 50A 415V	3134013 + 51CA058	MARECHAL
2H1	1	PILOT LIGHT GREEN 24V	D7P-P3-PN3G	NHP
2H2	1	PILOT LIGHT YELLOW 24V	D7P-P5-PN3Y	NHP
2HRM	1	HOUR RUN METER 24VDC	RQ480-10-80VDC	NHP
2K1	1	CONTACTOR 3 POLE 24VDC + AUX	CA7-43C-00-24VDC +CS7-PV-40	NHP
2K2	1	RELAY 4 POLE C/O 24VDC + BASE	55.34.0074.24VDC + 94.04	NHP
2K3	1	RELAY 4 POLE C/O 24VDC + BASE	55.34.0074.24VDC + 94.04	NHP
2K4	1	RELAY 4 POLE C/O 24VDC + BASE	55.34.0074.24VDC + 94.04	NHP
2Q1	1	MCCB 3 POLE 50A + SHIELDS	E125NJ350 +T2CF123SSNBA	NHP
2Q2	1	MCB 1 POLE 2A C CURVE 6kA	DTCB6102C	NHP
2S1	1	CHANGEOVER SWITCH WITH CENTRE OFF 1 POLE	CA10-A210-620-FT2	KRAUS & NAIMER
2S2	1	PUSHBUTTON RED 1N/C	D7P-F4-PX01	NHP
2S3	1	PUSHBUTTON GREEN 1N/O	D7P-F3-PX10	NHP
2S4	1	PUSHBUTTON E-STOP 1N/C + LEGEND	D7P-MT44-PX01S	NHP
1S5	1	PUSHBUTTON BLUE RESET 1N/O	D7P-F607-PX10	NHP
2U1	1	SOFT STARTER 18.5kW + LCP + PANEL KIT	175G5526 + 175G0096 + 130B1117	DANFOSS
2X1P	1	DECONTACTOR PLUG 50A 415V	3138013 + 313A013	MARECHAL
2X1S	1	DECONTACTOR SOCKET 50A 415V	3134013 + 51CA058	MARECHAL
ANT1	1	6 ELEMENT YAGI TELEMETRY ANTENNA	YB6-61	RF INDUSTRIES
B1	1	ABB FLOWMETER SENSOR	MAGMASTER	EXISTING
DBS	1	8 POLE MCB COVER	DAL8	DORE ELECTRICS
EL1	1	EARTH LINK 165A 18 WAY	165E18	DORE ELECTRICS
F1-1	1	FUSE HOLDER 32A + 32A FUSE	NV32FW + NNS32	NHP
F1-2	1	FUSE HOLDER 32A + 32A FUSE	NV32FW + NNS32	NHP
F1-3	1	FUSE HOLDER 32A + 32A FUSE	NV32FW + NNS32	NHP
FAN1	1	VENT FAN 230V 615m2/h AIR IN	GKV30A1220	NHP
FIT1	1	ABB FLOWMETER TRANSMITTER	MAGMASTER	EXISTING
G1	1	POWER SUPPLY UNIT 240VAC/24VDC 120W	PBDRN120S24-A	POWERBOX
G2	1	POWER SUPPLY UNIT 240VAC/12VDC 60W	PBDRN60S12-A	POWERBOX
G3	1	BATTERY 7200mAh	LC-R127R2P1	PANASONIC
K1	1	RELAY INTERFACE MODULE 12VDC	38.51.12VDC	NHP
K2	1	RELAY INTERFACE MODULE 12VDC	38.51.12VDC	NHP
KC	1	RELAY INTERFACE MODULE 24VDC	1275100000	WEIDMULLER
LK1	1	METER DISCONNECT LINK	AU410NCS	DORE ELECTRICS
LK2	1	METER DISCONNECT LINK	AU410NCS	DORE ELECTRICS
LK3	1	METER DISCONNECT LINK	AU410NCS	DORE ELECTRICS
LT1	1	MINI FLUORESCENT BATTEN 13W 240V	BB0113	THORN LIGHTING
LT2	1	MINI FLUORESCENT BATTEN 13W 240V	BB0113	THORN LIGHTING
NL1	1	NEUTRAL LINK 165A 18 WAY	165E18 + E/NFEET	DORE ELECTRICS
NL2	1	NEUTRAL LINK ENCLOSED 100A 5 WAY	100A5C	DORE ELECTRICS
P1	1	UNIVERSAL PROCESS INDICATOR 24VDC	PAX2A + PAXCDL EXP. CARD	CONTROL LOGIC
P2	1	UNIVERSAL PROCESS INDICATOR 24VDC	PAX2A + PAXCDL EXP. CARD	CONTROL LOGIC
PFR	1	PHASE SEQUENCE / FAIL RELAY 400VAC	DPB-01-C-M48	NHP

ITEM DESIGNATION	QTY	DESCRIPTION	PART NUMBER	SUPPLIER
Q12V	1	MCB 1 POLE 4A C CURVE 6kA	DTCB6104C	NHP
Q2	1	MCB 3 POLE 2A C CURVE 6kA	DTCB6302C	NHP
Q24V	1	MCB 1 POLE 4A C CURVE 6kA	DTCB6104C	NHP
Q3	1	RCBO 1 POLE 16A C CURVE 30mA	DSRCBS1630C	NHP
Q4	1	RCBO 1 POLE 6A C CURVE 30mA	DSRCBS0630C	NHP
Q5	1	MCB 1 POLE 4A C CURVE 6kA	DTCB6104C	NHP
Q6	1	RCBO 1 POLE 16A C CURVE 30mA	DSRCBS1630C	NHP
Q7	1	RCBO 1 POLE 10A C CURVE 30mA	DSRCBS1030C	NHP
Q8	1	MCB 1 POLE 16A C CURVE 6kA	DTCB6116C	NHP
Q9	1	MCB 1 POLE 10A C CURVE 6kA	DTCB6110C	NHP
Q9-1	1	MCB 1 POLE 4A C CURVE 6kA	DTCB6104C	NHP
Q9-2	1	MCB 1 POLE 4A C CURVE 6kA	DTCB6104C	NHP
Q9-3	1	MCB 1 POLE 4A C CURVE 6kA	DTCB6104C	NHP
QBAT	1	MCB 2 POLE 4A C CURVE 6kA	DTCB6204C	NHP
QM	1	MCCB 3 POLE 63A + HANDLE + SHIELDS	E125NJ363 + T2HS12R5GM +T2CF123SSNBA	NHP
R1	1	RESISTOR 1KOHM 1 WATT	707-8669	RS COMPONENTS
RADIO	1	TELEMETRY WIRELESS I/O SERVER	TLX-400	ELPRO (FREE ISSUED)
RTU-BP	1	KINGFISHER BA-4 RTU BACKPLANE	BA-4	CSE-SEMAPHORE
RTU-SLOT1	1	KINGFISHER CPU / POWER SUPPLY MODULE	PC-1-0S1	CSE-SEMAPHORE
RTU-SLOT2	1	KINGFISHER 16 POINT DIGITAL INPUT MODULE	DI-5-1	CSE-SEMAPHORE
RTU-SLOT3	1	KINGFISHER COMBINATION I/O MODULE	IO-3-1	CSE-SEMAPHORE
RTU-SLOT4	1	KINGFISHER COMBINATION I/O MODULE	IO-3-1	CSE-SEMAPHORE
S1	1	OFF/ON SWITCH 1 POLE	CA10-A290-621-FT2	KRAUS & NAIMER
S2	1	FAN THERMOSTAT	KTS01141	NHP
S3	1	LIMIT SWITCH	DS3-UL	RS COMPONENTS
S4	1	LIMIT SWITCH	DS3-UL	RS COMPONENTS
S5	1	FLOAT SWITCH	K10M	KELCO (IIT SOLUTIONS)
SD1	1	SURGE DIVERTER 3 PHASE 100kA	SDD3-100-275	POWERCOM SOLUTIONS
SRF	1	SURGE FILTER 1 PHASE 10A 13kA	SFD1-10-13-275	POWERCOM SOLUTIONS
VENT1	1	VENT GRILLE 325mm	GKF30	NHP
VM1	1	VOLTMETER 72mm 0-500V	RQ72EVAC500V	NHP
VSS	1	VOLTMETER SELECTOR SWITCH	CA10-A007/AU2122-FT2	KRAUS & NAIMER
X1	1	DOUBLE SOCKET OUTLET + MOUNT	C2025WE + 449A	CLIPSAL
X12 COM:1-5	5	TERMINAL THROUGH 2.5mm	UK2.5N (3003347)	PHOENIX CONTACT
X12:1-5	5	TERMINAL FUSED	UT4-HESI (3046032)	PHOENIX CONTACT
X2:1-32	16	TERMINAL 2 LEVEL DISCONNECT/THROUGH 2.5mm	UKK5-MTK-P/P (2800004)	PHOENIX CONTACT
X24 COM:1-4	4	TERMINAL THROUGH 2.5mm	UK2.5N (3003347)	PHOENIX CONTACT
X24:1-4	4	TERMINAL FUSED	UT4-HESI (3046032)	PHOENIX CONTACT
X3-0V:1-2	2	TERMINAL THROUGH 2.5mm	UK2.5N (3003347)	PHOENIX CONTACT
X3-AI:1-8	4	TERMINAL 2 LEVEL DISCONNECT/THROUGH 2.5mm	UKK5-MTK-P/P (2800004)	PHOENIX CONTACT
X3-AO:1-2	1	TERMINAL 2 LEVEL DISCONNECT/THROUGH 2.5mm	UKK5-MTK-P/P (2800004)	PHOENIX CONTACT
X3-D1:1-8	4	TERMINAL 2 LEVEL DISCONNECT/THROUGH 2.5mm	UKK5-MTK-P/P (2800004)	PHOENIX CONTACT
X3-DO:1-8	4	TERMINAL 2 LEVEL DISCONNECT/THROUGH 2.5mm	UKK5-MTK-P/P (2800004)	PHOENIX CONTACT
X3-SCN:1-5	5	TERMINAL THROUGH 2.5mm	UK2.5N (3003347)	PHOENIX CONTACT
X4-AI:1-8	4	TERMINAL 2 LEVEL DISCONNECT/THROUGH 2.5mm	UKK5-MTK-P/P (2800004)	PHOENIX CONTACT
X4-AO:1-2	1	TERMINAL 2 LEVEL DISCONNECT/THROUGH 2.5mm	UKK5-MTK-P/P (2800004)	PHOENIX CONTACT
X4-D1:1-8	4	TERMINAL 2 LEVEL DISCONNECT/THROUGH 2.5mm	UKK5-MTK-P/P (2800004)	PHOENIX CONTACT
X4-DO:1-8	4	TERMINAL 2 LEVEL DISCONNECT/THROUGH 2.5mm	UKK5-MTK-P/P (2800004)	PHOENIX CONTACT
X4-SCN:1-5	5	TERMINAL THROUGH 2.5mm	UK2.5N (3003347)	PHOENIX CONTACT
XC:1-2	2	TERMINAL THROUGH 2.5mm	UK2.5N (3003347)	PHOENIX CONTACT
XE:1-4	4	TERMINAL THROUGH 2.5mm	UK2.5N (3003347)	PHOENIX CONTACT
Z1	1	SIGNAL LINE SURGE PROTECTOR 10kA	SL36-G	POWERCOM SOLUTIONS
Z2	1	SIGNAL LINE SURGE PROTECTOR 10kA	SL36-G	POWERCOM SOLUTIONS
Z3	1	COAXIAL LINE SURGE PROTECTOR	IS-50NX-C1	RF INDUSTRIES

AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD	
DRAFTING CHECK	JC-S	
CAD FILE	48647-0013-020	
B.C.C. FILE No.	-	

J. DALZIEL	-	12/12
DESIGN	R.P.E.Q. No.	DATE
D. DAYMOND	5505	12/12
DESIGN CHECK	R.P.E.Q. No.	DATE

-	-
PRINCIPAL DESIGN MANAGER	DATE
-	-
CLIENT DELEGATE	DATE

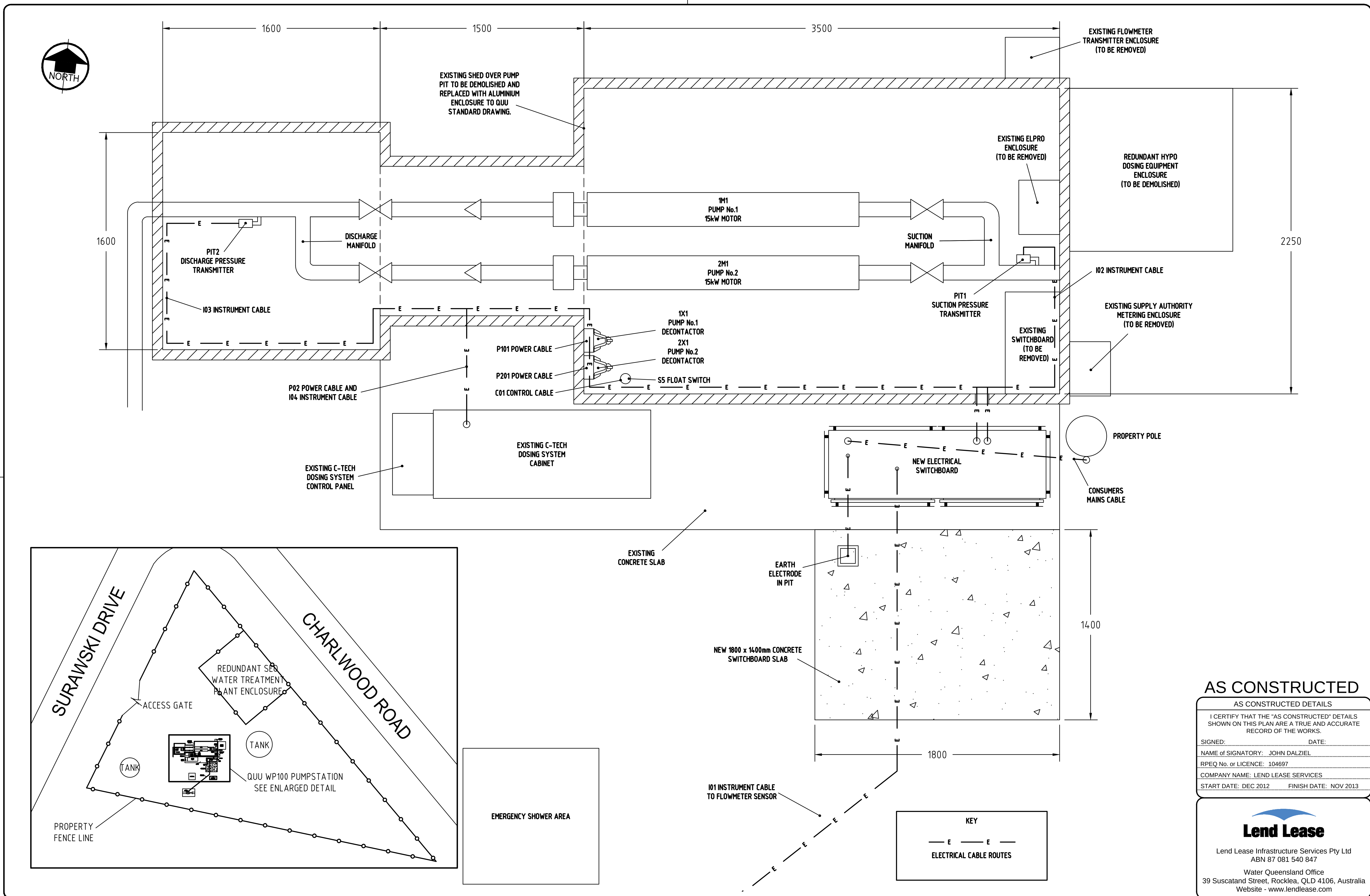
QUEENSLAND UrbanUtilities
A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

TITLE
MAIN SWITCHBOARD
PARTS LIST
-

SHEET No. 20
Queensland Urban Utilities DRAWING No. 486/4/7-0013-020
AMEND. A

G:\WaterJobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-020.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:06:03 PM



AS CONSTRUCTED

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE:

NAME of SIGNATORY: JOHN DALZIEL

RPEQ No. or LICENCE: 104697

COMPANY NAME: LEND LEASE SERVICES

START DATE: DEC 2012 FINISH DATE: NOV 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

No	DATE	AMENDMENT	DRN.	APD.
A	09/13	AS CONSTRUCTED	J.H.D.	S.O'C
O	12/12	ISSUED FOR CONSTRUCTION	J.H.D.	-

DRAFTED	JHD
DRAFTING CHECK	JC-S
CAD FILE	48647-0013-021
B.C.C. FILE No.	-

J. DALZIEL	-	12/12
DESIGN	R.P.E.Q. No.	DATE
D. DAYMOND	5505	12/12
DESIGN CHECK	R.P.E.Q. No.	DATE

-	-
PRINCIPAL DESIGN MANAGER	DATE
-	-
CLIENT DELEGATE	DATE

QUEENSLAND UrbanUtilities
A DIVISION OF THE BRISBANE CITY COUNCIL

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

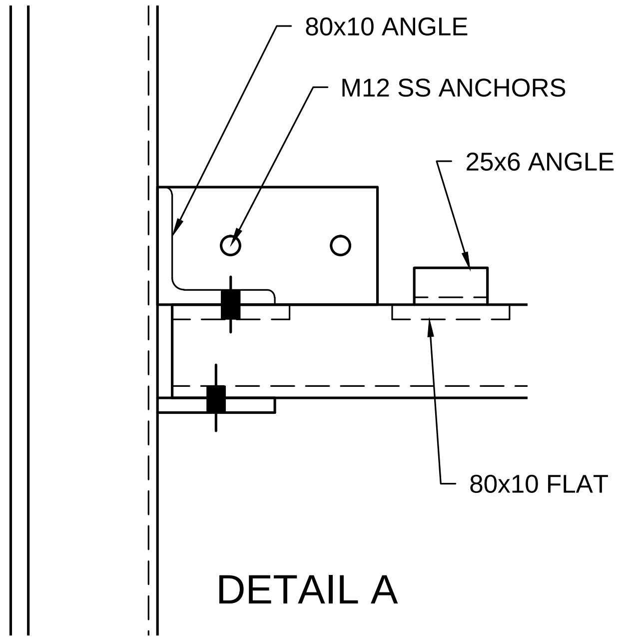
TITLE
SITE EQUIPMENT LAYOUT
-

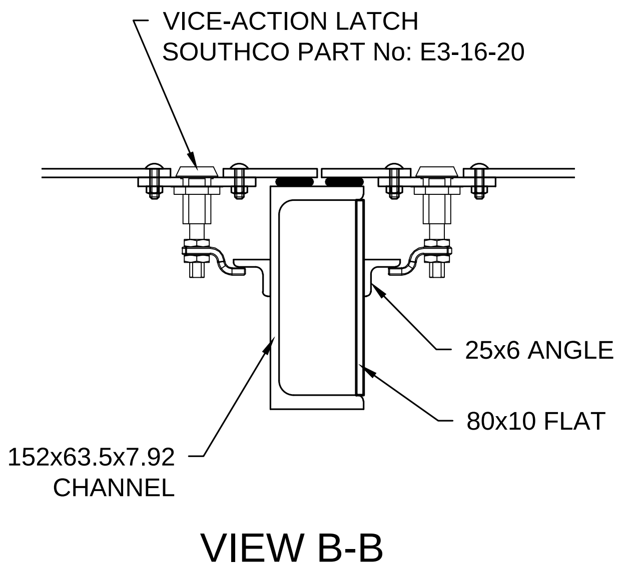
SHEET No. 21
Queensland Urban Utilities DRAWING No. 486/4/7-0013-021
AMEND. A

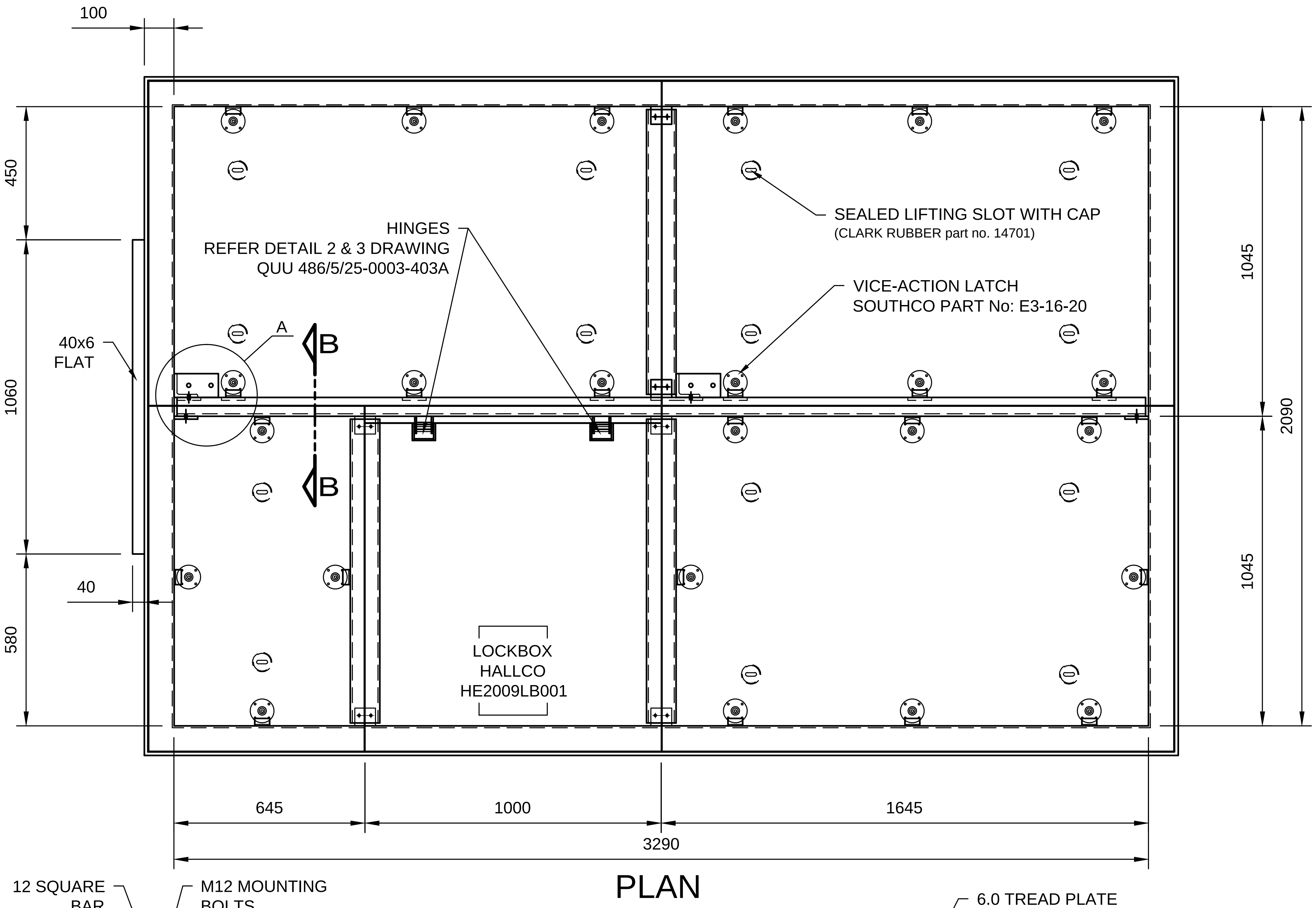
G:\WaterJobs\J2012\17500+\17552 - 3S0016 QUU West 3 x Switchboard Replacements\B. Controlled Documents\01. Document Register\WP100 Pump Station\Electrical Drawings\48647-0013-021.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 2:05:37 PM

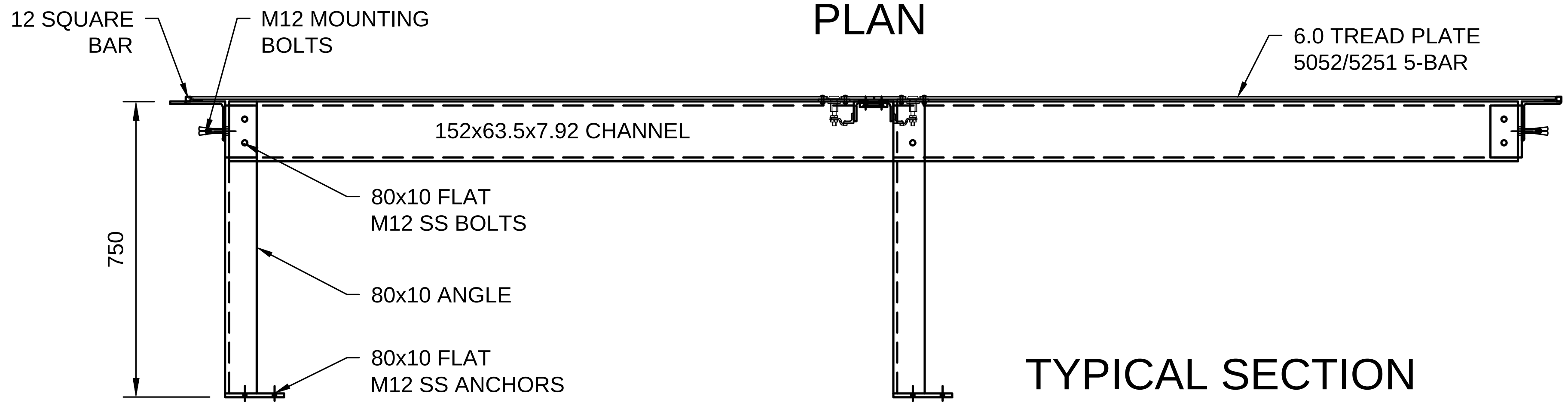
Section 5.03 Civil Drawings

- Please see separate A1 Folder for hard copy
- AutoCAD soft copy on disc
- PDF soft copy on disc









FABRICATION NOTES:

1. ALL COMPONENTS UNLESS NOTED OTHERWISE ARE FABRICATED FROM GRADE 6061-T6 ALUMINIUM
2. ALL NUTS, BOLTS, WASHERS TO BE GRADE 316 STAINLESS STEEL.
3. ALL WELDING TO BE WELD QUALITY 'B' IN ACCORDANCE WITH AS 1665.
4. WELDS TO BE 6mm FILLET USING FILLER ALLOY 4043.
5. EMBEDDED SURFACES TO HAVE TWO COATS OF BITUMEN BASED PAINT.
6. WELDS OMITTED FROM DRAWING FOR CLARITY.
7. DISSIMMILAR METALS TO BE SEPARATED BY 'DURALAC' JOINTING COMPOUND AND/ORNYLON BUSHES/WASHERS.
8. MATERIAL SIZE MAY BE DEPENDANT ON PRODUCT OR PRODUCT AVAILABILITY.

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE: 11/12/2013
NAME of SIGNATORY: SCOTT BRIMELOW
RPEQ No. or LICENCE: RPEQ 4942
COMPANY NAME: HALLCO ENGINEERING
START DATE: NOV 2013 FINISH DATE: DEC 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

AS CONSTRUCTED

No.	DATE	AMENDMENT	DRN.	APD.
A	12/13	AS CONSTRUCTED	KMR	BH
O	10/13	ISSUED FOR CONSTRUCTION	KMR	BH

DRAFTED	KMR
DRAFTING CHECK	
CAD FILE	486/4/7-0013-022 to 025
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 -

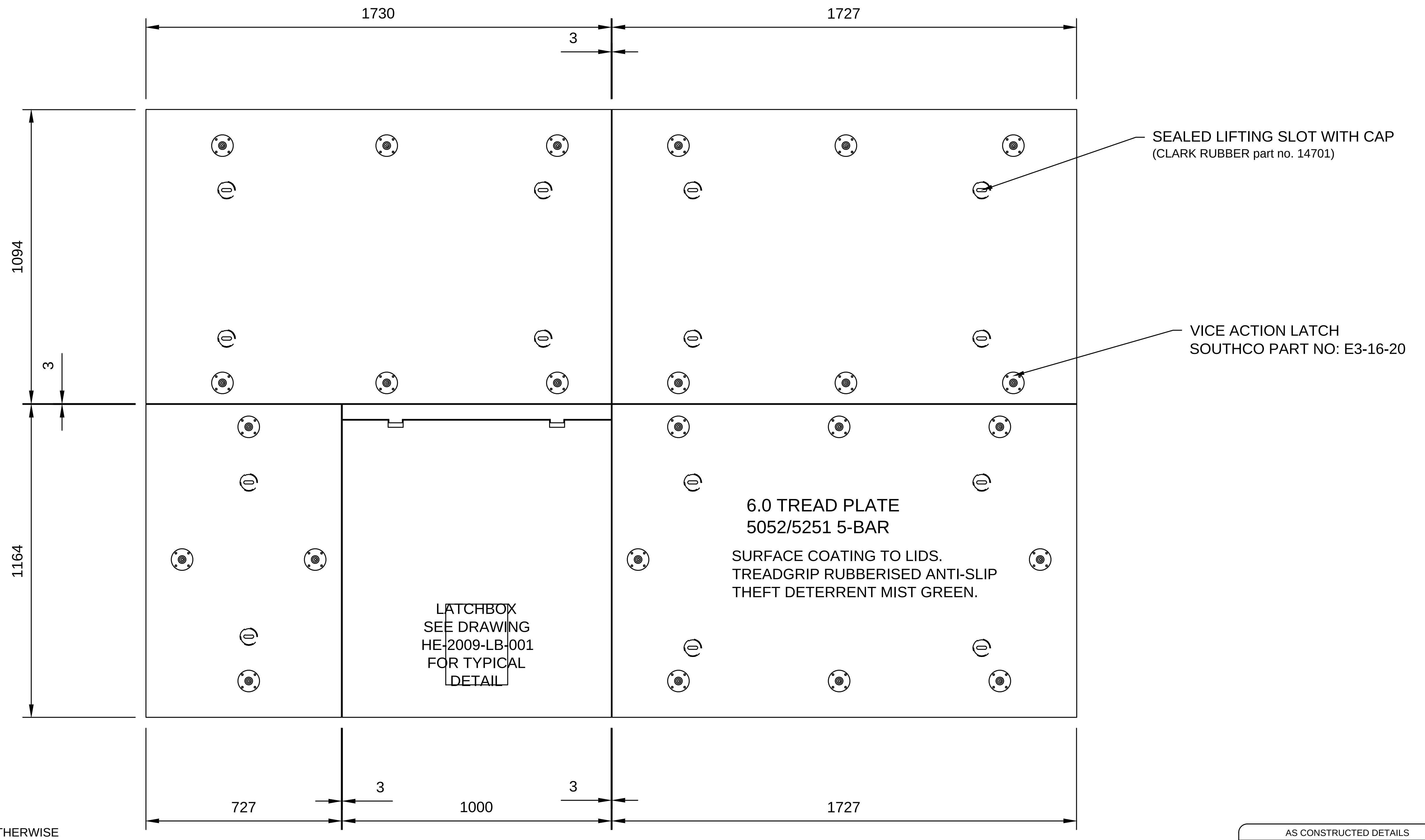
HALLCO ENGINEERING
PUMP STATION, CONCRETE CONSTRUCTION, STEEL AND ALUMINIUM FABRICATION.
55 WILLIAM STREET, CALOUNDRA
PH: 07 5491 6811 FAX: 5491 9818
www.hallcoengineering.com.au

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

TITLE
WATER PUMPING STATION
ACCESS COVER LIDS
ACCESS COVER ASSEMBLY
-

SHEET No. 022
Queensland Urban Utilities DRAWING No. 486/4/7-0013-022
AMEND. A

C:\Data\John Dalziel\Local Drawings\WP100 Pump Station\Civil Drawings\486-4-7-0013-022 to 025.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 1:24:02 PM



FABRICATION NOTES:

1. ALL COMPONENTS UNLESS NOTED OTHERWISE ARE FABRICATED FROM GRADE 6061-T6 ALUMINIUM
2. ALL NUTS, BOLTS, WASHERS TO BE GRADE 316 STAINLESS STEEL.
3. ALL WELDING TO BE WELD QUALITY 'B' IN ACCORDANCE WITH AS 1665.
4. WELDS TO BE 6mm FILLET USING FILLER ALLOY 4043.
5. EMBEDDED SURFACES TO HAVE TWO COATS OF BITUMEN BASED PAINT.
6. WELDS OMITTED FROM DRAWING FOR CLARITY.
7. DISSIMMILAR METALS TO BE SEPARATED BY 'DURALAC' JOINTING COMPOUND AND/ORNYLON BUSHES/WASHERS.
8. MATERIAL SIZE MAY BE DEPENDANT ON PRODUCT OR PRODUCT AVAILABILITY.

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE: 11/12/2013
NAME of SIGNATORY: SCOTT BRIMELOW
RPEQ No. or LICENCE: RPEQ 4942
COMPANY NAME: HALLCO ENGINEERING
START DATE: NOV 2013 FINISH DATE: DEC 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

AS CONSTRUCTED

No.	DATE	AMENDMENT	DRN.	APD.
A	12/13	AS CONSTRUCTED	KMR	BH
O	10/13	ISSUED FOR CONSTRUCTION	KMR	BH

DRAFTED	KMR
DRAFTING CHECK	
CAD FILE	486/4/7-0013-022 to 025
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 -

HALLCO ENGINEERING
PUMP STATION, CONCRETE CONSTRUCTION, STEEL AND ALUMINIUM FABRICATION.
55 WILLIAM STREET, CALOUNDRA
PH: 07 5491 6811 FAX: 5491 9818
www.hallcoengineering.com.au

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

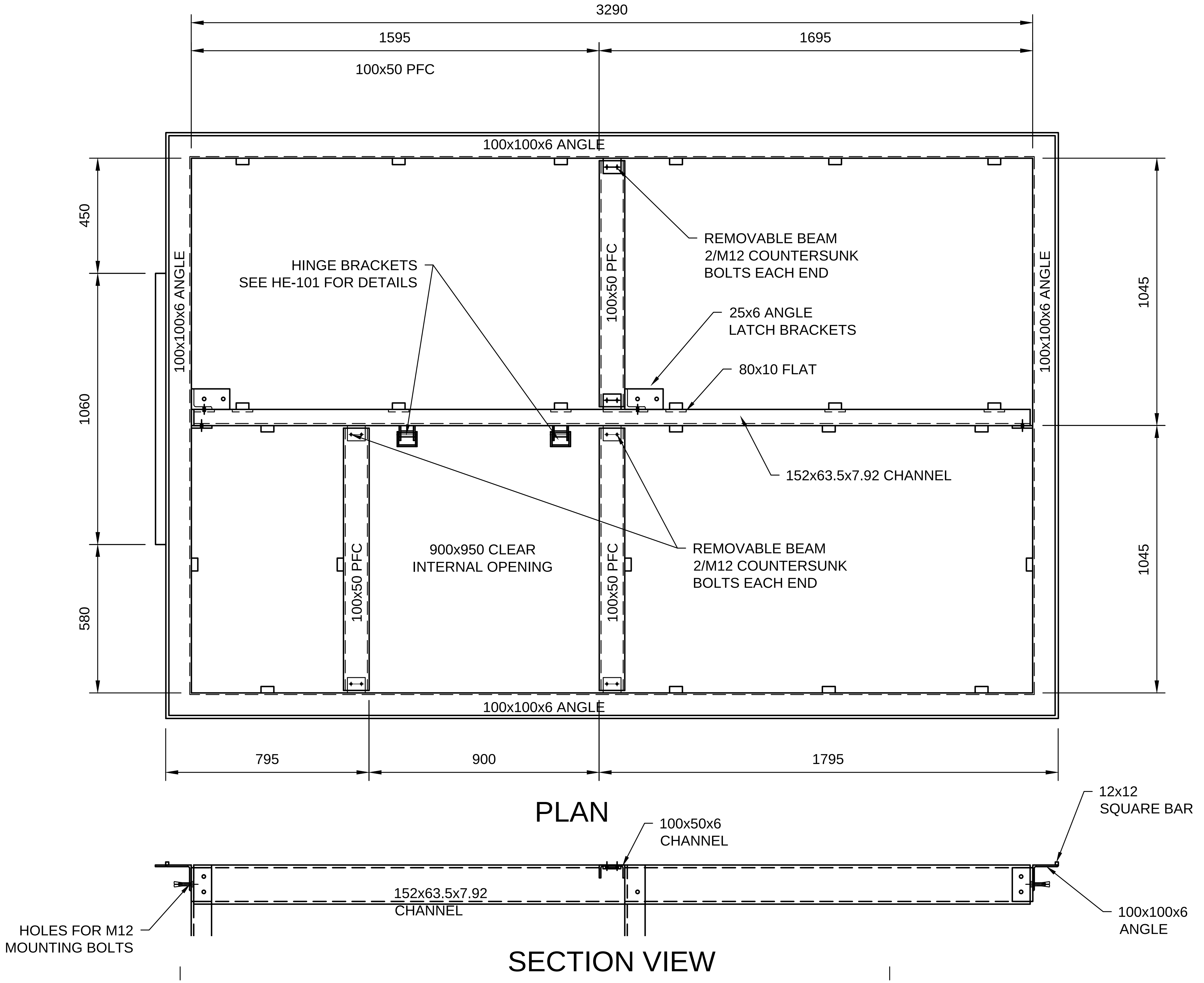
TITLE
WATER PUMPING STATION
ACCESS COVER LIDS
ACCESS COVER LID DETAILS
-

SHEET No. 023
Queensland Urban Utilities DRAWING No. 486/4/7-0013-023
AMEND. A

C:\Data\John Dalziel\Local Drawings\WP100 Pump Station\Civil Drawings\486-4-7-0013-022 to 025.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 1:24:02 PM

FABRICATION NOTES:

1. ALL COMPONENTS UNLESS NOTED OTHERWISE ARE FABRICATED FROM GRADE 6061-T6 ALUMINIUM
2. ALL NUTS, BOLTS, WASHERS TO BE GRADE 316 STAINLESS STEEL.
3. ALL WELDING TO BE WELD QUALITY 'B' IN ACCORDANCE WITH AS 1665.
4. WELDS TO BE 6mm FILLET USING FILLER ALLOY 4043.
5. EMBEDDED SURFACES TO HAVE TWO COATS OF BITUMEN BASED PAINT.
6. WELDS OMITTED FROM DRAWING FOR CLARITY.
7. DISSIMMILAR METALS TO BE SEPARATED BY 'DURALAC' JOINTING COMPOUND AND/ORNYLON BUSHES/WASHERS.
8. MATERIAL SIZE MAY BE DEPENDANT ON PRODUCT OR PRODUCT AVAILABILITY.



PLAN

SECTION VIEW

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE: 11/12/2013
NAME of SIGNATORY: SCOTT BRIMELOW
RPEQ No. or LICENCE: RPEQ 4942
COMPANY NAME: HALLCO ENGINEERING
START DATE: NOV 2013 FINISH DATE: DEC 2013

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847

Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

AS CONSTRUCTED

No	DATE	AMENDMENT	DRN.	APD.
A	12/13	AS CONSTRUCTED	KMR	BH
O	10/13	ISSUED FOR CONSTRUCTION	KMR	BH

DRAFTED	KMR
DRAFTING CHECK	
CAD FILE	486/4/7-0013-022 to 025
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 -

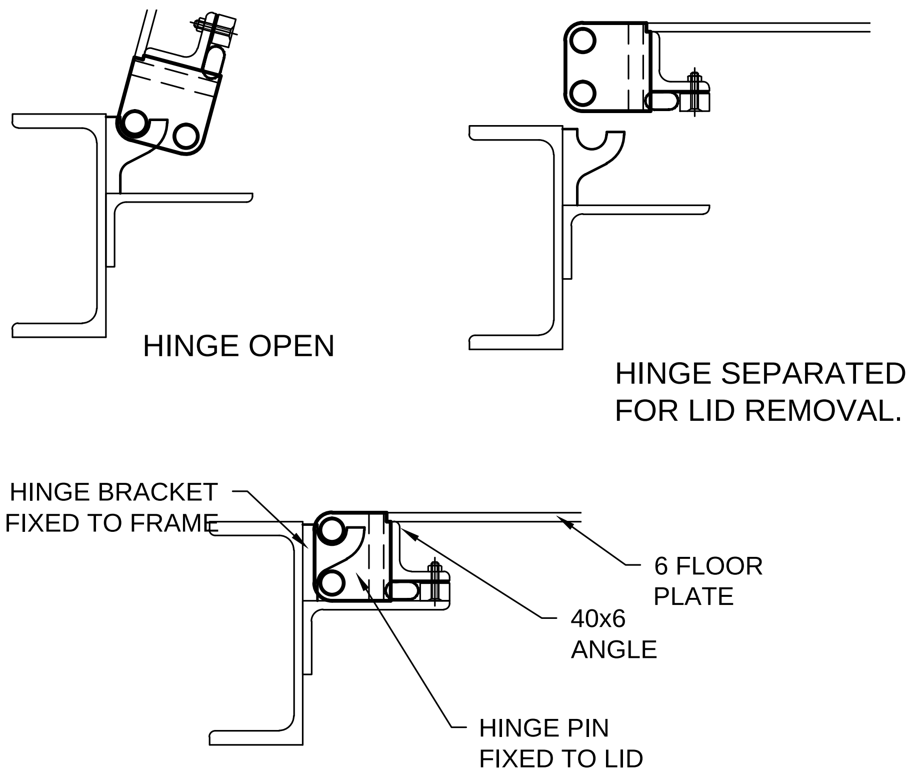
HALLCO ENGINEERING
PUMP STATION, CONCRETE CONSTRUCTION, STEEL AND ALUMINIUM FABRICATION.
55 WILLIAM STREET, CALOUNDRA
PH: 07 5491 6811 FAX: 5491 9818
www.hallcoengineering.com.au

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

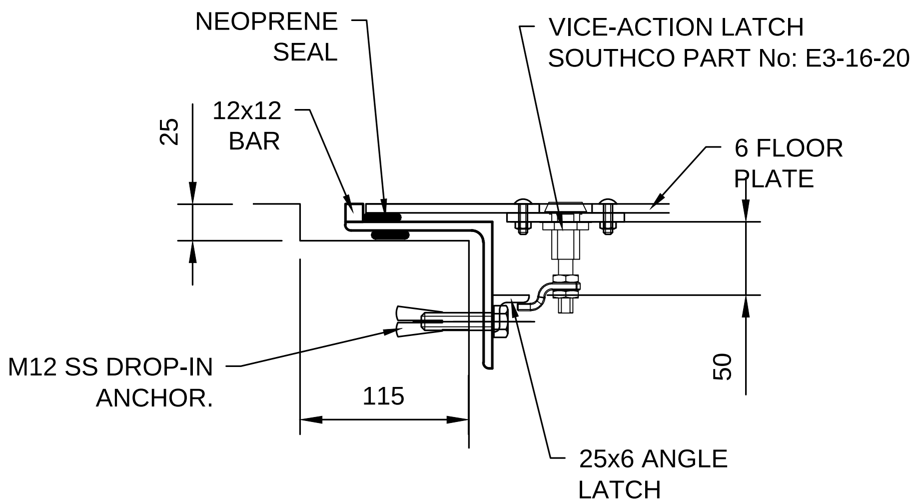
TITLE
WATER PUMPING STATION
ACCESS COVER LIDS
ACCESS COVER FRAME DETAILS
-

SHEET No. 024
Queensland Urban Utilities DRAWING No. 486/4/7-0013-024
AMEND. A

C:\Data\John Dalziel\Local Drawings\WP100 Pump Station\Civil Drawings\486-4-7-0013-022 to 025.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 1:24:02 PM



HINGE ASSEMBLY



TYPICAL DETAIL

FABRICATION NOTES:

1. ALL COMPONENTS UNLESS NOTED OTHERWISE ARE FABRICATED FROM GRADE 6061-T6 ALUMINIUM
2. ALL NUTS, BOLTS, WASHERS TO BE GRADE 316 STAINLESS STEEL.
3. ALL WELDING TO BE WELD QUALITY 'B' IN ACCORDANCE WITH AS 1665.
4. WELDS TO BE 6mm FILLET USING FILLER ALLOY 4043.
5. EMBEDDED SURFACES TO HAVE TWO COATS OF BITUMEN BASED PAINT.
6. WELDS OMITTED FROM DRAWING FOR CLARITY.
7. DISSIMMILAR METALS TO BE SEPARATED BY 'DURALAC' JOINTING COMPOUND AND/ORNYLON BUSHES/WASHERS.
8. MATERIAL SIZE MAY BE DEPENDANT ON PRODUCT OR PRODUCT AVAILABILITY.

AS CONSTRUCTED DETAILS

I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.

SIGNED: DATE: 11/12/2013
NAME of SIGNATORY: SCOTT BRIMELOW
RPEQ No. or LICENCE: RPEQ 4942
COMPANY NAME: HALLCO ENGINEERING
START DATE: NOV 2013 FINISH DATE: DEC 2013

Lend Lease

Lend Lease Infrastructure Services Pty Ltd
ABN 87 081 540 847
Water Queensland Office
39 Suscatand Street, Rocklea, QLD 4106, Australia
Website - www.lendlease.com

AS CONSTRUCTED

No	DATE	AMENDMENT	DRN.	APD.
A	12/13	AS CONSTRUCTED	KMR	BH
O	10/13	ISSUED FOR CONSTRUCTION	KMR	BH

DRAFTED	KMR
DRAFTING CHECK	
CAD FILE	486/4/7-0013-022 to 025
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

HALLCO ENGINEERING
PUMP STATION, CONCRETE CONSTRUCTION, STEEL AND ALUMINIUM FABRICATION.
55 WILLIAM STREET, CALOUNDRA
PH: 07 5491 6811 FAX: 5491 9818
www.hallcoengineering.com.au

SITE
WP100
CHARLWOOD RD, ARATULA
WATER PUMP STATION
-

TITLE
WATER PUMPING STATION
ACCESS COVER LIDS
ACCESS COVER DETAILS
-

SHEET No. 025
Queensland Urban Utilities DRAWING No. 486/4/7-0013-025
AMEND. A

C:\Data\John Dalziel\Local Drawings\WP100 Pump Station\Civil Drawings\486-4-7-0013-022 to 025.dwg Last Saved by John.Dalziel on Friday, 13 December 2013 1:24:02 PM

Lend Lease

SECTION 6

WP100 – Aratula Water Pump Station

Electrical Test Documents

- Aratula Site ITP
- Certificate of Test
- Switchboard ITP

800 -Test Inspection
QW-ITP-881 - CABLE INSTALLATION CHECK SHEET - CONTROL

Job No	3S0016	**Contract / PO Number**	QUU037
Job Name	3 x Switchboard Replacement - Aratula Water Pump Station		
ITP Description			
Component	Control cables	**Item / Tag Number / Panel No**	
Drawing Reference		**Client Document Number**	
Drawing Reference			
Cable Schedule			
Technical Ref			

*** Do not energise equipment during this stage of checks. All equipment is to be correctly tagged and isolated. ***
Do not begin any testing until the surrounding area is safe to work and appropriate Job Safety Analysis' or equivalent have been consulted.

Cable checks: Each of the below tests are to be completed on the cables included in this test sheet.	
A	Cable glands appropriate size, with shrouds and lock nuts tight.
B	Cable installed correctly, supported and protected from damage.
C	Cable numbers fitted and correct as per cable schedule.
D	All terminations completed and tested as per the termination drawing.
E	Cable schedule and termination drawing updated when required.

Note:	
	Resistance test each earth conductor to earth (Maximum reading of 0.5Ω allowed).
	DO NOT INSULATION RESISTANCE TEST THE CONTROL CABLES!!

	Cable Check passes? (✓)					Ω Value?	Completed?	
Cable Number	**A**	**B**	**C**	**D**	**E**	**Earth Continuity**	**Yes (✓)**	**No (✓)**
I01								
I02	✓	✓	✓	✓	✓		✓	
I03	✓	✓	✓	✓	✓		✓	
I101	–	–	–	–	–			
I101A	–	–	–	–	–			
I201	–	–	–	–	–			
I201A								
COAX1	✓	✓	✓	✓	✓	–	✓	
COAX2	✓	✓	✓	✓	✓	–	✓	

Tests have been carried out in accordance with AS/NZS 3000:2007 and AS/NZS 3012

Authorised Person Comments & Notes:

Tested By: (Authorised Person)		**Witnessed By:** (Client if applicable)	
(Name)		(Name)	
(Sign)		(Sign)	
Date	/ /	Date	/ /

NOTE: Ensure relevant items or comments are recorded on the Hit List (SF-500)

Version 3

Page 1 of 1
Uncontrolled when Printed

800 - Test Inspection
QW-ITP-848 - FIELD DEVICE INSPECTION

Job No	3S0016	**Contract / PO Number**	QUU037
Job Name	3 x Switchboard Replacement - Aratula Water Pump Station		
ITP Description	Discharge Pressure Transducer		
Component	Discharge Pressure Transducer	**Item / Tag Number / Panel No**	P1T2
Drawing Reference		**Client Document Number**	
Drawing Reference			
Technical Ref			
Technical Ref			

ITEM	DESCRIPTION	COMMENT	ACCEPT
1.1	Check that device is correct type.		✓
1.2	Check that device is undamaged and securely mounted.		✓
1.3	Check device is labeled correctly.		
1.4	Check device operates correctly.		✓
1.5	Check device is installed in correct location.		✓
1.6	Check that device signal to control system is correct.		✓

Testing Officer Comments & Notes:

Tested By: (Authorised Person)	**Witnessed By:** (Client if applicable)
(Name) Dan Rensmussen	(Name)
(Sign)	(Sign)
Date 24/9/13	Date / /

NOTE: Ensure relevant items or comments are recorded on the Hit List (SF-500)

Version 1

QW-ITP-848 - Field Device Inspection Form

800 - Test Inspection
QW-ITP-848 - FIELD DEVICE INSPECTION

Job No	3S0016	**Contract / PO Number**	QUU037
Job Name	3 x Switchboard Replacement - Aratula Water Pump Station		
ITP Description	Suction Pressure Transducer		
Component	Suction Pressure Transducer	**Item / Tag Number / Panel No**	P1T1
Drawing Reference		**Client Document Number**	
Drawing Reference			
Technical Ref			
Technical Ref			

ITEM	DESCRIPTION	COMMENT	ACCEPT
1.1	Check that device is correct type.		✓
1.2	Check that device is undamaged and securely mounted.		✓
1.3	Check device is labeled correctly.		
1.4	Check device operates correctly.		✓
1.5	Check device is installed in correct location.		✓
1.6	Check that device signal to control system is correct.		✓

Testing Officer Comments & Notes:

Tested By: (Authorised Person)		**Witnessed By:** (Client if applicable)	
(Name)	Dan Rasmussen	(Name)	
(Sign)	[signature]	(Sign)	
Date	24 / 9 / 13	Date	/ /

NOTE: Ensure relevant items or comments are recorded on the Hit List (SF-500)

Version 1

QW-ITP-848 - Field Device Inspection Form

800 - Test Inspection
QW-ITP-882 - CABLE INSTALLATION CHECK SHEET - POWER

Job No	3S0016	**Contract / PO Number**	QUU037
Job Name	3 x Switchboard Replacement - Aratula Water Pump Station		
ITP Description			
Component	Power cables	**Item / Tag Number / Panel No**	
Drawing Reference		**Client Document Number**	
Drawing Reference			
Cable Schedule			
Technical Ref			

*** Do not energise equipment during this stage of checks. All equipment is to be correctly tagged and isolated. ***
Do not begin any testing until the surrounding area is safe to work and appropriate Job Safety Analysis' or equivalent have been consulted.

Cable checks: Each of the below tests are to be completed on the cables included in this test sheet.	
A	Cable glands appropriate size, with shrouds and lock nuts tight.
B	Cable installed correctly, supported and protected from damage.
C	Cable numbers fitted and correct as per cable schedule.
D	All terminations completed and tested as per the termination drawing.
E	Cable schedule and termination drawing updated when required.

Note:	Insulation Resistance test the cables Core - Core and Core - Earth at 500V (Minimum reading of only 25MΩ allowed).
	Resistance test each earth conductor to earth (Maximum reading of 0.5Ω allowed).

	Cable Check passes? (✓)					Insulation Resistance Reading Recorded? (MΩ)							Ω Value?	Complete?	
Cable Number	**A**	**B**	**C**	**D**	**E**	**R-B**	**R-W**	**B-W**	**R-E**	**W-E**	**B-E**	**Neutral**	**Earth Continuity**	**Yes (✓)**	**No (✓)**
PO1	✓	✓	✓	✓	✓										
P101															
P101A	✓	✓	✓	✓	✓				>1MΩ	>1MΩ	>1MΩ	-	.05	✓	
P201	✓	✓	✓	✓	✓	>1MΩ	>1MΩ	>1MΩ	>1MΩ	>1MΩ	>1MΩ	-	.05	✓	
P201A	✓	✓	✓	✓	✓				>1MΩ	>1MΩ	>1MΩ	-	.05	✓	
PO2	✓	✓	✓	✓	✓				>200MΩ	-	-	>200MΩ	.05	✓	

Insulation Tester — Equipment No 5191436
Multimeter — Equipment No 14390585

Authorised Person Comments & Notes:

PO1 Done by Energex

Tested By: (Authorised Person)		**Witnessed By: (Client if applicable)**	
(Name)	DAN RASMUSSEN.	**(Name)**	
(Sign)	[signature]	**(Sign)**	
Date	24 / 9 / 13	**Date**	/ /

NOTE: Ensure relevant items or comments are recorded on the Hit List (SF-500)

Version 4

Page 1 of 1
Uncontrolled when Printed

QW-ITP-3055 - Electric Motor Precommissioning Test

3000 - Electrical Management

Lend Lease

Job No	3S0016	**Contract / PO Number**	QUU037
Job Name	3 x Switchboard Replacement - Aratula Water Pump Station		
ITP Description	Pump 2		
Component	Pump 2	**Item / Tag Number / Panel No**	2M1 Pump
Drawing Reference	486/4/7-0013-003.	**Client Document Number**	
Drawing Reference			
Technical Ref		**Applicable Standards**	
Technical Ref			

Motor Description: GRUNDFOS BM46-10-N (Sleeve Type).

Check/Record Nameplate Details:

Manufacturer	GRUNDFOS	Frequency	50
Voltage	400	RPM	—
kW Rating	15	Insulation	—
Full Load Current	34.5	Classification (IP Rating)	58
Power Factor	—	Frame Size	—

Installation Checks:

Check No.	Description	Accept?
1	Inspect motor for mechanical damage.	✓
2	Check motor for mechanical alignment.	—
3	Overall appearance of motor and associated equipment satisfactory.	✓
4	Motor anchor bolts complete and tight.	—
5	Check motor for fluid leaks/levels.	—
6	Check motor earthing correct as per design.	✓
7	Check motor for free rotation.	—
8	Check bearing lubrication.	—
9	Check motor fan assembly(ies).	—
10	Inspect motor termination box.	—
11	Inspect motor cable terminations.	—
12	Verify motor cable phasing correct as per design.	—
13	Inspect motor RTD connections.	—
14	Verify correct measurement of temperature by motor RTD devices.	—
15	Inspect motor RTD termination box.	—
16	Inspect motor heater terminations	—
17	Verify correct operation of motor heater elements.	—

Electrical Tests:

Insulation Resistance:

Test	Voltage (V)	Duration (minutes)	Resistance (Ω)
Φ Windings to (Frame + Earth)	500	0.5	>200 mΩ -
Φ Windings to (Cable Frame + Earth)	500	0.5	>200 mΩ -
Heater to (Frame + Earth + Φ Windings)	—	—	—
Temperature Detector to (Frame + Earth + Φ Windings)	—	—	—

Winding Resistance:

Motor winding vector group: —

Test	Current (A)	Resistance (Ω)
AΦ to BΦ		
BΦ to CΦ		
CΦ to AΦ		

Phase rotation (uncoupled from load) viewed from non-drive-end:

Motor control operation checked from both local and remote.

Motor emergency stop operation checked.

Thermography required?

Testing Officer Comments & Notes:

Existing Installation - pump was rewired to new switchboard

Insulation Tester Equip No. 519436

Tested By: (IPS Authorised Person)	**Witnessed By:** (Client if applicable)
(Name) Tim Bowman	(Name)
(Sign) [signature]	(Sign)
Date 24/9/13	Date / /

NOTE: Ensure relevant items or comments are recorded on the Hit List (SF-1100)

Job No	3S0016	**Contract / PO Number**	QUU037
Job Name	3 x Switchboard Replacement - Aratula Water Pump Station		
ITP Description	Pump 1		
Component	Pump 1	**Item / Tag Number / Panel No**	1M1 Pump
Drawing Reference	486/4/7-0013-003	**Client Document Number**	
Drawing Reference			
Technical Ref		**Applicable Standards**	
Technical Ref			

Motor Description: Grundfos BM46-10-N (Sleeve Type).

Check/Record Nameplate Details:

Manufacturer	Grundfos	Frequency	50
Voltage	400	RPM	—
kW Rating	15	Insulation	—
Full Load Current	34.5	Classification (IP Rating)	58
Power Factor	—	Frame Size	—

Installation Checks:

Check No.	Description	Accept?
1	Inspect motor for mechanical damage.	✓
2	Check motor for mechanical alignment.	—
3	Overall appearance of motor and associated equipment satisfactory.	✓
4	Motor anchor bolts complete and tight.	—
5	Check motor for fluid leaks/levels.	—
6	Check motor earthing correct as per design.	✓
7	Check motor for free rotation.	—
8	Check bearing lubrication.	—
9	Check motor fan assembly(ies).	—
10	Inspect motor termination box.	—
11	Inspect motor cable terminations.	—
12	Verify motor cable phasing correct as per design.	—
13	Inspect motor RTD connections.	—
14	Verify correct measurement of temperature by motor RTD devices.	—
15	Inspect motor RTD termination box.	—
16	Inspect motor heater terminations	—
17	Verify correct operation of motor heater elements.	—

Electrical Tests:

Insulation Resistance:

Test	Voltage (V)	Duration (minutes)	Resistance (Ω)
Φ Windings to (Frame + Earth)	500	0.5	>200M
Φ Windings to (Cable Frame + Earth)	500	0.5	>200M.
Heater to (Frame + Earth + Φ Windings)	—	—	—
Temperature Detector to (Frame + Earth + Φ Windings)	—	—	—

Winding Resistance:

Motor winding vector group: —

Test	Current (A)	Resistance (Ω)
AΦ to BΦ		
BΦ to CΦ		
CΦ to AΦ		

Phase rotation (uncoupled from load) viewed from non-drive-end:

Motor control operation checked from both local and remote.

Motor emergency stop operation checked.

Thermography required?

Testing Officer Comments & Notes:

Existing installation – pump was rewired to new Switchboard.

Insulation Tester Equip No. 5191436

Tested By: (IPS Authorised Person)	**Witnessed By: (Client if applicable)**
(Name) Tim Bowman	(Name)
(Sign) [signature]	(Sign)
Date 24/9/13.	Date / /

NOTE: Ensure relevant items or comments are recorded on the Hit List (SF-1100)

800 - Test Inspection
QW-ITP-894 - LOCAL CONTROL PANEL TEST SHEET

Job No	350016	**Contract / PO Number**	
Job Name	3 x SCENIC RIM SWITCHBOARD	**Client Document Number**	
ITP Description	ARATULA		
Component		**Item / Tag Number / Panel No**	
Drawing Reference			

Section 1	**EQUIPMENT RECORDING (Place a √ / N/A in the blocks)**		
Equipment Item	**Recorded Information**	**CHECKED BY**	
		Electrician	**Engineer/Supervisor**
Record main switching device rating	63 Amps	✓	
Record contactor KW rating	22 KW AC3	✓	
Record Power Cable rating	16 mm²	✓	

Section 2 — PANEL ASSEMBLY CHECKLIST (Place a √ / N/A in the blocks)		
GENERAL	**CHECKED BY**	
	Electrician	**Engineer/Supervisor**
Check Panel is clean and free of loose objects	✓	
Front layout as per drawing	✓	
Paint colour correct and acceptable	✓	
Door escutcheon and cut-outs are correct	✓	
Overall dimensions are correct	✓	
Components in doors mounted straight	✓	
Doors aligned, right angle (no paint or steel damage)	✓	
All doors requiring earth have earth studs fitted and are terminated correctly	✓	
All gaskets intact	✓	
The Switchboard cleaned	✓	
Labels are fitted and correct fittings used	✓	
All components in accordance with parts list	—	
Form of segregation specified	✓	
Degree of protection specified	✓	
Full documentation in drawing pocket		
Name plate on switchboard correct	✓	
Cable ducts not over filled Max 60%	✓	
Check Panel for correct IP Rating	✓	
All wiring supports are suitable on doors and panels	✓	
Doors can open and close with ease	✓	
No movement of mounted equipment	✓	
All Drilled Holes Deburred including Label screw holes	✓	
Rubber blanking grommets are fitted to all unused holes	—	
All mechanical interlocks are working	—	
Correct Gland plate material and size used	✓	
All manually operated components are working	✓	
Door Locks correct and hinges tight	✓	
Shrouding fitted where applicable	✓	
All live terminals are covered to IP2X	✓	
Sufficient space for incoming and outgoing cables	✓	
All cables are secured and it is not rest against live busbars	—	
Clearance and creep age distance specified	—	
Check for loose connections at terminals	✓	
8.8 quality bolts used for all busbar and joints	—	
Pressure washers on both sides of joints and connections	✓	
Torque check of all connections and joints	✓	
Check marks on all connections and joints torque checked	✓	
Flexible wires used for components in doors	✓	
Busbar dimensions and supports as specified	—	
All segregation mounted correctly	—	
Busbar insulation mounted correctly	—	
MEN link installed and indentified	✓	
Phase rotation checked R W B	✓	
Cables and wires laid properly, neat and tidy	✓	
ENERGEX consumables supplied	✓	

Electrician Tim Bowman	Date Comp 4/2/13	Print Name Tim Bowman	Sign Name T Bowman
Engineer / Supervisor	Date Comp	Print Name	Sign Name

TEST EQUIPMENT

- Multimeter Equip. No. ________

Testing Comments & Notes:

Tested By:	**Witnessed By:**
(Name)	**(Name)**
(Sign)	**(Sign)**
Date / /	**Date** / /

Version 1 **QW-ITP-0894 - Local Control Panel Test Sheet.xlsx Form**

800 - Test Inspection
QW-ITP-894 - LOCAL CONTROL PANEL TEST SHEET

Electrical inpsection and test	CHECKED BY	
	Electrician	Engineer/Supervisor
All Wire Numbers are Fitted and correct	✓	
All terminals are numbered		
Door Looms are secured at door and compartment	✓	
All Equipment is correctly earthed	✓	
All Power Cable is Correct Current Rating	✓	
All Power Cable is free of sharp Bends (Minimum Bend Radius is 6 x Dia of cable)	✓	
All Power Cable is Coloured or Marked with a band of heat shrink	✓	
All Power and Control Looms are neat	✓	
All Terminations are Tight	✓	
All control Wiring is correct colour and size	✓	
All Terminal Bridge Links are fitted to terminal strips	✓	
Switchboard complies with specification	✓	
Fault level as specified for busbars and components		
Meter / C.T sections complies with local authorities	✓	
MCCB / ACB Calibrations and settings as specified		
Timer settings etc as specified in diagrams		
All meters tested under variable load		
fuse ratings, contactors , overloads etc as specified	✓	
Colour of wires as specified	✓	
Size of neutral as specified	✓	
Earth Bar connected to metal frame in sections	✓	
Wire numbers, ferrel as per diagram	✓	
Busbar and power continuity test, point to point	✓	
Earth continuity test	✓	
Dialectical test as per attached sheet check 41- 43!!!!TBA		
Full functional test according to FAT		
Overloads and trip circuits checked / test functionally		
Electrical interlocking tested		

Electrician	Date Comp	Print Name	Sign Name
Engineer / Supervisor	Date Comp	Print Name	Sign Name

TEST EQUIPMENT

- Multimeter Equip. No. ____________

Testing Comments & Notes:

Tested By:	**Witnessed By:**
(Name) ____________	**(Name)** ____________
(Sign) ____________	**(Sign)** ____________
Date / /	**Date** / /

NOTE: Ensure relevant items or comments are recorded on the Hit List (SF-500)

Lend Lease's infrastructure services business

IP-TS-3251 - Electrical Test Report

3000 - Electrical

Lend Lease

JOB No:	300016
SITE ADDRESS:	ARATULA
DATE:	12/2/13

AS 3000, 8.3.3 Mandatory Tests: The following tests shall be carried out on low voltage electrical installations:

(a) Continuity of the earthing system (earth resistance to the main earthing conductor, protective earthing conductors and bonding conductors), in accordance with Clause 8.3.5.
(b) Insulation resistance, in accordance with Clause 8.3.6.
(c) Polarity, in accordance with Clause 8.3.7.
(d) Correct circuit connections, in accordance with Clause 8.3.8.
(e) Verification of impendence required for automatic disconnection of supply (earth fault-loop impendence), in accordance with Clause 8.3.9
(f) Operation of RCD's, in accordance with Clause 8.3.10.

REF. PLAN NUMBERS:	DRAWING REF 486/4/7-0013
ACTUAL WORK CARRIED OUT:	

SIGHT / CONFIRM	MEN	YES NO	IF NO, WHY?	
	EARTH STAKE / CONNECTION	YES / NO	IF NO, WHY?	FAT

CIRCUIT	INSULATION RESISTANCE	EARTH CONTINUITY	POLARITY CHECK	*RCD TRIP TIME	ADDITIONAL INFORMATION
QM	>1MΩ.	—	Y		
Q2	>1MΩ.	0.05Ω.	Y		
Q3	>1MΩ.	0.05Ω.	Y		SEE ITP-1208 FOR RCD TEST
Q4	>1MΩ.	0.05Ω.	Y		SEE ITP-1208 FOR RCD TEST
Q5	>1MΩ.	0.05Ω.	Y		
Q6	>1MΩ.	—	Y		SEE ITP-1208 FOR RCD TEST
Q7	>1MΩ	—	Y		SEE ITP-1208 FOR RCD TEST
Q8	>1MΩ.	—	Y		
Q9	>1MΩ.	0.05Ω.	Y		
1Q1	>1MΩ.	0.05Ω.	Y		
1Q2	>1MΩ	—	Y		
2Q1	>1MΩ.	0.05Ω.	Y		
2Q2	>1MΩ.	—	Y		

*Time test required when testing portable RCD's only

I,	I certify that the above tests have been completed and are a true and accurate record.	
Signed	Lic No:	Date:

800 - Test Inspection
QW-ITP-826 - AUXILIARY CIRCUITS

Job No	3S0016	**Contract / PO Number** QUU037	
Job Name	3 X Scenic Rim Switchboards		
ITP Description	WP100 Aratula Switchboard test and Inspection		
Component	Point to Point	**Item / Tag Number / Panel No**	
Drawing Reference	486/4/7-0013-000	**Client Document Number**	
Drawing Reference			
Technical Ref			
Technical Ref			

CIRCUIT TESTS:
Tests to be carried out in respect to clause 8.3.1 AS/NZS 3439.1 - 2002

The total operation, control and indication of the auxiliary circuits is satisfactory as per the following Drawings.

DRAWING No	SHEET No	DRAWING REV		MARKED-UP	DRAWING No	SHEET No	DRAWING REV		MARKED-UP
486/4/7-0013	SH 000	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 001	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 002	Rev	P3	☑			Rev		☐
486/4/7-0013	SH 003	Rev	P3	☑			Rev		☐
486/4/7-0013	SH 004	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 005	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 006	Rev	P3				Rev		☐
486/4/7-0013	SH 007	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 008	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 009	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 010	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 011	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 012	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 013	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 014	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 015	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 016	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 017	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 018	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 019	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 020	Rev	P3	☐			Rev		☐
486/4/7-0013	SH 021	Rev	P3	☐			Rev		☐
		Rev		☐			Rev		☐
		Rev		☐			Rev		☐

TEST EQUIPMENT

- Current Injection Test Set	Equip. No.	
- Multimeter	Equip. No.	10270022
- Current Clamp	Equip. No.	

Testing Officer Comments & Notes:

Tested By: (Testing Officer)		**Witnessed By: (Client if applicable)**	
(Name)	Tim Bowman	(Name)	
(Sign)	TBowman	(Sign)	
Date	12/02/13	Date	/ /

NOTE: Ensure relevant items or comments are recorded on the Hit List (SF500)

1200 - Test Inspection
QW-ITP-1208 - RCD TESTING

Job No	3S0016	**Contract / PO Number**	QUU037
Job Name	3 X Scenic Rim Switchboards		
ITP Description	WP100 Aratula Switchboard test and Inspection		
Component	RCD Functional test	**Item / Tag Number / Panel No**	
Drawing Reference		**Client Document Number**	
Drawing Reference			
Technical Ref			
Technical Ref			

Device Designation	Circuit Description	Type I, II, III or IV	Size (A)	Device Rating (mA)	.5 x Rated Trip (mS)	1 x Rated Trip (mS)	5 x Rated Trip (mS)	1 x Rated Trip 180* (mS)	Test Button Operation
Q3	TELEMETRY GPO	II	16	30	>300mS	0-029	0·009	0-018	OK
Q4	CABINETS LIGHTS	II	6	30	>300mS	0·031	0·012	0-021	OK
Q6	SPARE SINGLE PHASE CIRCUIT	II	16	30	>300mS	0·029	0·019	0·019	OK
Q7	SPARE SINGLE PHASE CIRCUIT	II	10	30	>300mS	0·029	0·019	0-029	OK.

Test acceptance criteria:
1. Type II RCD (<30mA) – trip time shall be less than 300 milli-seconds. (as per AS/NZS 3760).
2. Unless otherwise specified, devices shall be function tested only.

TEST EQUIPMENT

- RCD Test Set LLIS Equip. No SER NO. 9970134

Authorised Person Comments & Notes:

Tested By:	**Witnessed By: (Client if applicable)**
(Name) Tim Bowman	**(Name)**
(Sign) TBowman	**(Sign)**
Date 12/02/13	**Date** / /

NOTE: Ensure relevant items or comments are recorded on the Hit List (SF-1100)

Test Inspection
QW-ITP-0900 - Switchboard Routine Tests

Job No	3S0016	**Contract / PO Number**	QUU037
Job Name	3 X Scenic Rim Switchboards		
ITP Description	WP100 Aratula Switchboard test and Inspection		
Component	Switchboard Routinge tests	**Item / Tag Number / Panel No**	
Drawing Reference	486/4/7-0013-000	**Client Document Number**	
Drawing Reference			
Technical Ref			
Technical Ref			

Tests to be carried out in accordance with Clause 8.3.4 AS/NZS 3439.1 - 2002
Insulation voltage of 500 Vdc minimum to be applied with a resistance reading >1 000Ω/V

Test	Insulation Resistance @ 500/100 Vdc
R,W,B –N, E.	>1 MΩ
W,B,E –N, R	>1 MΩ
R,B,E – N, W	>1 MΩ

TEST EQUIPMENT

- Insulation Tester — Lend Lease Equip. No SER NO. 981 2054
- Multimeter — Lend Lease Equip. No SER NO. 1027 0022

CIRCUIT TESTS:

PANEL COMPONENT CHECK (VISUAL)

	Checked
Component, MCB, MCCB's installed with correct current rating and orientation to drawing number	TB
Legend Card fitted and filled out as per drawing	TB

The total operation, control and indication of the auxiliary circuits is satisfactory as per the following Drawings:-

	Pass/Fail
RCD test operation	PASS

	Rev	
	Rev	
	Rev	
	Rev	
	Rev	
	Rev	
	Rev	

Comments & Notes:

Tested By:		**Witnessed By:** (Client if applicable)	
(Name)		(Name)	
(Sign)		(Sign)	
Date	/ /	Date	/ /

Lend Lease

CERTIFICATE OF:
(Please mark relevant check-box)

☒ **TESTING AND COMPLIANCE** (Electrical Installations)
Issued in accordance with s159 of the *Electrical Safety Regulation 2002*

☐ **TESTING AND SAFETY** (Electrical equipment)
Issued in accordance with s15 of the *Electrical Safety Regulation 2002*

* Work performed for:

* Name QUU — Queensland Urban Utilities
Title / Given name/s / Surname

* Address Charlwood Rd, Aratula Surawski Drive
Street

Aratula
Suburb/town / Postcode

* Electrical installation / equipment tested (detailed list of all work done):

Electrical Installation/ Installed equipment.

New Sitchboard (Existing mains) New Earth Stake, Pump staters, RTU, Radio and controls, new pressure sensor.

* Date of test 6 / 10 / 2013 * Electrical contractor licence number 66516

Name on contractor licence Lend Lease Services Pty Ltd.

Electrical contractor phone number 0407 258 279

For **electrical installations**, this certifies that the electrical installation, to the extent it is affected by the electrical work, has been tested to ensure that it is electrically safe and is in accordance with the requirements of the wiring rules and any other standard applying under the *Electrical Safety Regulation 2002* to the electrical installation.

For **electrical equipment**, this certifies that the electrical equipment, to the extent it is affected by the electrical work, is electrically safe.

Name Sean O'Callaghan
Person who performed, or person who is responsible for work

Signature Date 10 / 10 / 2013

* **Indicates a mandatory field**

V2.02-2008

Lend Lease

SECTION 7

WP100 – Aratula Water Pump Station

Switchgear Data Sheets

- Burgess DS-3UL Door Switch
- Danfoss FC202 Variable Speed Drive
- Elpro TLX-400 RTU
- Kelco K-Series Float Switch
- Kingfisher Plus RTU
- Kraus & Naimer Control Switches
- Marechal DS1 Decontactors
- NHP Compact BS88 Fuse Holders
- NHP Cosmotec Fans & Accessories
- NHP Finder 38-Series Relay Interface Modules
- NHP Finder 55-Series Relays
- NHP Gavazzi Phase Failure Relays
- NHP IME Panel Mounting Meters
- NHP S&S Pushbuttons Pilot Lights & Selectors
- NHP S&S Type CA Contactors
- NHP Terasaki Din Safe RCBO's
- NHP Terasaki Din T6 MCB's
- NHP Terasaki E125NJ MCCB's
- Novaris SDD-Series Surge Diverters
- Novaris SFD-Series Surge Filters
- Novaris SL-Series Signal Line Protectors
- Panasonic LC-R127R2P Battery
- Phoenix Type UK Terminals
- Powerbox PBDRN60 & 120 Power Supplies
- Red Lion PAX2A Digital Panel Meter
- RFI Polyphaser IS-50NX-C0 Coax Surge Protector
- RFI Yagi YB9-Series Antenna
- Schneider Trio E-Series Data Radio
- Thorn Bikini Fluorescent Fittings

DS

Momentary Switches

Door

DS

Characteristics	■ Long overtravel door actuation ■ Override facility for maintenance purposes ■ Available with or without a cover
Rating	Up to 250 VAC, 15 A
Dimensions (mm)	48 × 51 × 16
Actuator	Long overtravel horizontal plunger
Approvals	UL, CSA

Preferred Range

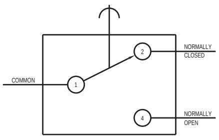
Ordering Reference	Actuating Force (N)	(ozf)	Sealing	Operating pos. (mm)	(in)	Terminal	Circuit	Actuator	Contacts	Electrical rating
DS1UL	13,3	48,0	IP40	14,5	0,580	Screw	CO	Plunger	Silver	Up to 250 VAC, 15 A
DS3UL	13,3	48,0	IP40	14,5	0,580	Screw	CO	Plunger	Silver	Up to 250 VAC, 15 A

DS

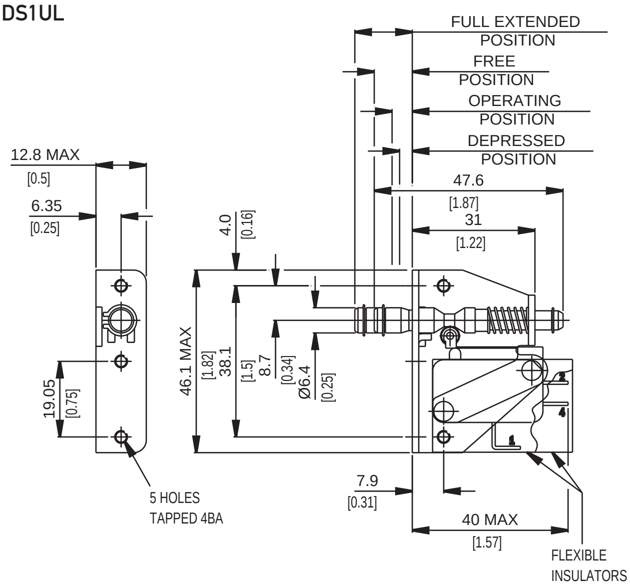
Specifications

Housing	DS3UL only - Flame retardant polycarbonate
Base plate	Mild steel, zinc-plated
Plunger	Stainless steel
Mechanism	Single pole change-over
Contacts	Silver
Terminals	Solder tags - Silver-plated brass - common (1), Brass - normally closed (2), normally open (4)
Temperature range	–10°C to +85°C
Mechanical life	10^6 cycles minimum (impact free actuation)
Type of protection	IP40 (switch)

Circuit diagram



Dimensions DS1UL

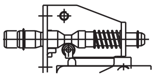


Recommended maximum electrical ratings

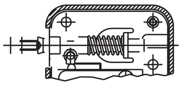
Voltage (max)	Resistive load (A)	Inductive load	Horsepower	Approval
250 VAC	15 (0.75 pf)	-	-	UL 1054/CSA 22.2 No. 55 - 6,000 operations
0 - 15 VDC	10	-	-	General rating - 50,000 operations
15 - 30 VDC	7	-	-	General rating - 50,000 operations

DS

Operating Characteristics

Actuator		Reference	Actuating Force Maximum (N)	(ozf)	Free Position Maximum (mm)	(in)	Operating Position Maximum (mm)	(in)	Fully extended Position Maximum (mm)	(in)	Depressed Position Maximum (mm)	(in)
Spring Plunger		DS1UL	13,3	48,00	10,5	0,41	6	0,23	14,5	0,58	3,2	0,14

Overtravel: Plunger can be depressed flush with housing. The housing should not be used as an end stop.

Spring Plunger		DS3UL	13,3	48,00	10,5	0,41	6	0,23	14,5	0,58	3,2	0,14

Overtravel: Plunger can be depressed flush with housing. The housing should not be used as an end stop.

For the convenience of maintenance engineers who must have full working conditions with the door open, DS units are fitted with a lock-on device which overrides the interlock while working. When the door is open, the plunger can be moved down and out to an extended position which will cause the switches to operate. At the conclusion of the maintenance work, full interlock facilities are restored automatically when the door is closed.

Ordering Reference

Type	DS
Switch variants	1 Open bracket type using one miniature type insert switch 3 As DS1 but fitted with plastic cover
Approvals	UL UL and CSA approved

MAKING MODERN LIVING POSSIBLE

Operating Instructions

VLT® Soft Starter - MCD 500

VLT® THE REAL DRIVE

Contents

1 Safety

1.1 Safety

When reading this manual you will come across different symbols that require special attention. The symbols used are the following:

NOTE

Indicates something to be noted by the reader

CAUTION

Indicates a general warning

WARNING

Indicates a high voltage warning

The examples and diagrams in this manual are included solely for illustrative purposes. The information contained in this manual is subject to change at any time and without prior notice. In no event will responsibility or liability be accepted for direct, indirect or consequential damages resulting from the use or application of this equipment.

NOTE

Before changing any parameter settings, ensure that the current parameter set is saved to an internal file. Refer to *MCD 500 Operating Instructions, MG.17.KX.YY*, for more information.

WARNING

WARNING - ELECTRICAL SHOCK HAZARD
MCD 500 soft starters contain dangerous voltages when connected to mains voltage. Only a competent electrician should carry out the electrical installation. Improper installation of the motor or the soft starter may cause equipment failure, serious injury or death. Follow this manual and local electrical safety codes.
Models MCD5-0360C - MCD5-1600C: The bus bar and heatsink are live while the unit is operating (starting, running or stopping). If the starter is installed without a main contactor, the bus bar and heatsink are live whenever mains voltage is connected (including when the starter is ready or tripped).

WARNING

Disconnect the soft starter from mains voltage before carrying out repair work.
It is the responsibility of the user or person installing the soft starter to provide proper grounding and branch circuit protection according to local electrical safety codes.
Do not connect power factor correction capacitors to the output of MCD 500 soft starters. If static power factor correction is employed, it must be connected to the supply side of the soft starter.
MCD5-0021B - MCD5-0105B: After transportation, mechanical shock or rough handling there is possibility that the bypass contactor may have latched into the on state. To prevent the possibility of the motor starting immediately, on first commissioning or operation after transportation, always ensure that the control supply is applied before the power, so that the contactor state is initialised.

WARNING

Safety of Personnel

The soft starter is not a safety device and does not provide electrical isolation or disconnection from the supply.

- If isolation is required, the soft starter must be installed with a main contactor
- The start and stop functions of the soft starter must not be relied upon for personnel safety. A motor may start or stop unexpectedly if faults occur in the mains supply, the motor connection, or the electronics of the soft starter.

To provide machine or personnel safety, the isolation device must be controlled through an external safety system.

In Auto On mode, the motor can be stopped using digital or bus commands while the soft starter is connected to mains.

CAUTION

These stop functions are not sufficient to avoid unintended start.
A motor that has been stopped may start if faults occur in the electronics of the soft starter, or a temporary fault in the supply mains or the motor connection ceases.

CAUTION

Use the auto-start feature with caution. Read all the notes related to auto-start before operation.

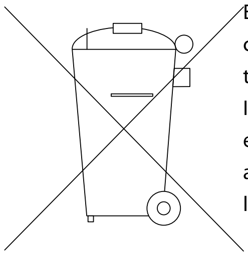
	Equipment containing electrical components may not be disposed of together with domestic waste. It must be collected separately as electrical and electronic waste according to local and currently valid legislation.

Table 1.1

2 Introduction

The MCD 500 is an advanced digital soft start solution for motors from 7 kW to 800 kW. MCD 500 soft starters provide a complete range of motor and system protection features and have been designed for reliable performance in the most demanding installation situations.

2.1.1 Feature List

Models for all connection requirements

- 21 A to 1600 A (in-line connection)
- In-line or inside delta connection
- Internally bypassed up to 215 A
- Mains voltage: 200 - 525 VAC or 380 - 690 VAC
- Control voltage: 24 VAC/VDC, 110 - 120 VAC or 220 - 240 VAC

User-friendly LCP

- Loggings
- Real-time graphs
- SCR conduction bar graph

Tools

- Application setups
- Date and time stamped event log with 99 entries
- 8 most recent trips
- Counters
- Protection simulation
- Output signal simulation

Inputs and Outputs

- Local or remote control input options (3 x fixed 1 x programmable)
- Relay outputs (3 x programmable)
- Analog programmable output
- 24 VDC 200 mA supply output

Start and run modes

- AAC - Adaptive Acceleration Control
- Constant current
- Current ramp
- Kickstart
- Jog
- Emergency run operation

Stop modes

- AAC - Adaptive Acceleration Control
- Timed voltage ramp soft stop
- DC brake
- Soft brake
- Emergency stop

Other features

- Auto start/stop timer
- Second order thermal model
- Battery backup of clock and thermal model
- Optional DeviceNet, Modbus or Profibus communication modules

Comprehensive protection

- Wiring/Connection/Supply
  - Motor connection
  - Phase sequence
  - Power loss
  - Individual phase loss
  - Mains frequency
- Current
  - Excess start time
  - Current imbalance
  - Undercurrent
  - Instantaneous overcurrent
- Thermal
  - Motor thermistor
  - Motor overload
  - Bypass relay overload
  - Heatsink temperature
- Communication
  - Network comms
  - Starter comms
- External
  - Input trip
- Starter
  - Individual shorted SCR
  - Battery/Clock

2.1.2 Type Code

Illustration 2.1

3 Installation

3.1 Mechanical Installation

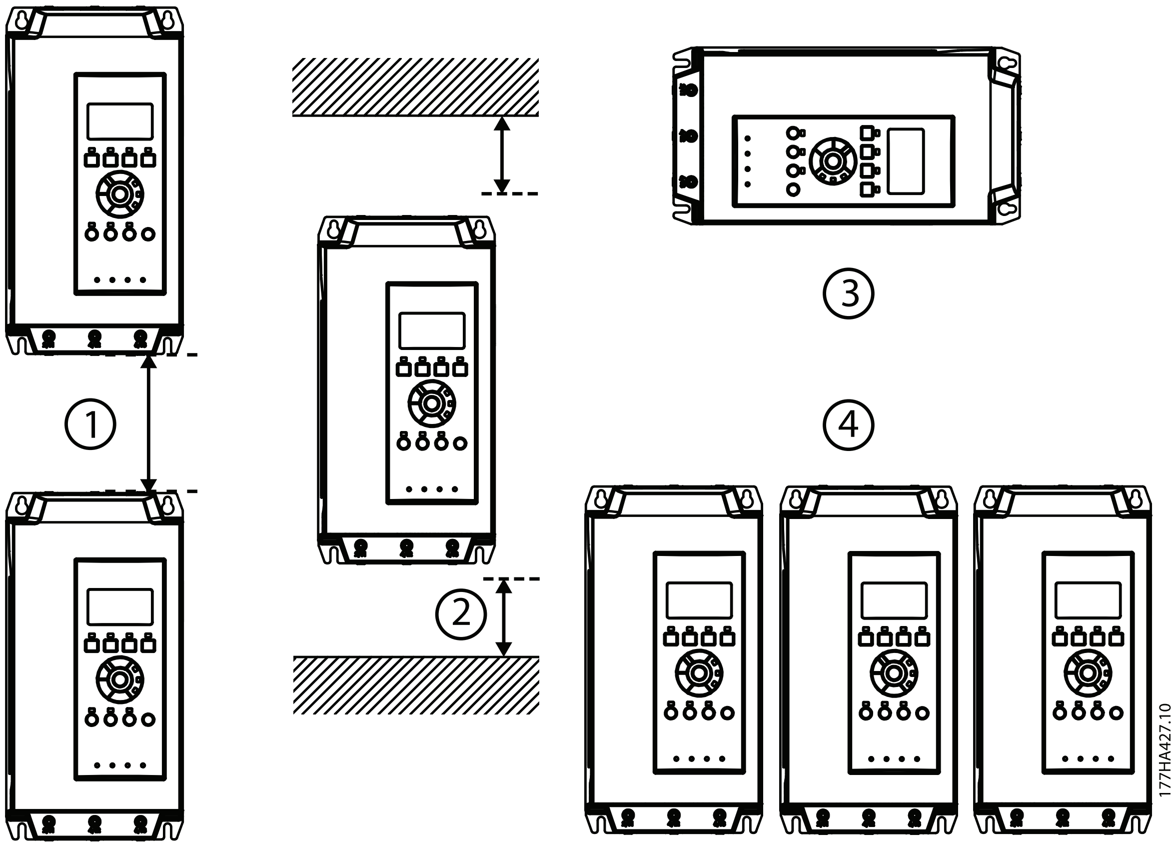


Illustration 3.1

1	MCD5-0021B - MCD5-0245C: Allow 100 mm (3.94 inches) between soft starters. MCD5-0360C - MCD5-1600C: Allow 200 mm (7.88 inches) between soft starters.
2	MCD5-0021B - MCD5-0215B: Allow 50 mm (1.97 inches) between the soft starter and solid surfaces. MCD5-0245C: Allow 100 mm (3.94 inches) between the soft starter and solid surfaces. MCD5-0360C - MCD5-1600C: Allow 200 mm (7.88 inches) between the soft starter and solid surfaces.
3	The soft starter may be mounted on its side. Derate the soft starter's rated current by 15%.
4	Soft starters may be mounted side by side with clearance of 50 mm (1.97 inches) on both sides.

Table 3.1

3

3.2 Dimensions and Weights

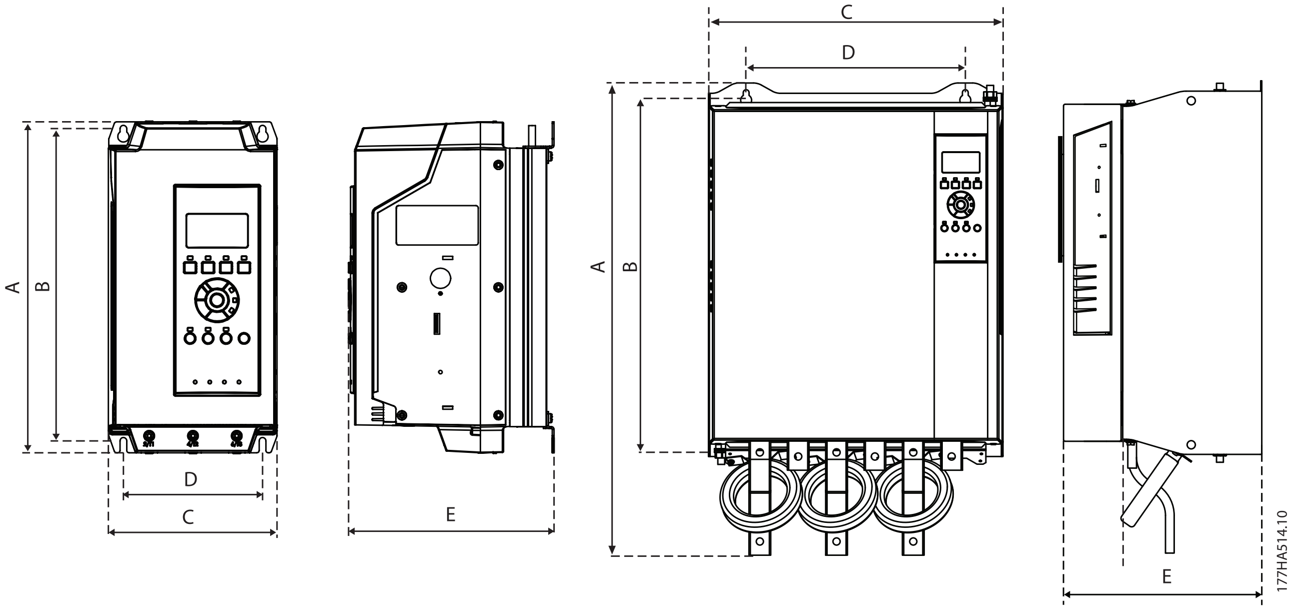


Illustration 3.2

<table>
<tr><th>Model</th><th>A mm
(inches)</th><th>B mm
(inches)</th><th>C mm
(inches)</th><th>D mm
(inches)</th><th>E mm
(inches)</th><th>Weight kg
(lbs)</th></tr>
<tr><td>MCD5-0021B</td><td rowspan="4">295
(11.6)</td><td rowspan="4">278
(10.9)</td><td rowspan="4">150
(5.9)</td><td rowspan="4">124
(4.9)</td><td rowspan="2">183
(7.2)</td><td rowspan="2">4.2
(9.3)</td></tr>
<tr><td>MCD5-0037B
MCD5-0043B
MCD5-0053B</td></tr>
<tr><td>MCD5-0068B</td><td rowspan="2">213
(8.14)</td><td>4.5
(9.9)</td></tr>
<tr><td>MCD5-0084B
MCD5-0089B
MCD5-0105B</td><td>4.9
(10.8)</td></tr>
<tr><td>MCD5-0131B
MCD5-0141B
MCD5-0195B
MCD5-0215B</td><td>438
(17.2)</td><td>380
(15.0)</td><td>275
(10.8)</td><td>248
(9.8)</td><td>250
(9.8)</td><td>14.9
(32.8)</td></tr>
<tr><td>MCD5-0245C</td><td>460
(18.1)</td><td>400
(15.0)</td><td>390
(15.4)</td><td>320
(12.6)</td><td>279
(11.0)</td><td>23.9
(52.7)</td></tr>
<tr><td>MCD5-0360C
MCD5-0380C
MCD5-0428C</td><td rowspan="2">689
(27.1)</td><td rowspan="2">522
(20.5)</td><td rowspan="2">430
(16.9)</td><td rowspan="2">320
(12.6)</td><td rowspan="2">300.2
(11.8)</td><td>35
(77.2)</td></tr>
<tr><td>MCD5-0595C
MCD5-0619C
MCD5-0790C
MCD5-0927C</td><td>45
(99.2)</td></tr>
<tr><td>MCD5-1200C
MCD5-1410C
MCD5-1600C</td><td>856
(33.7)</td><td>727
(28.6)</td><td>585
(23.0)</td><td>500
(19.7)</td><td>364
(14.3)</td><td>120
(264.6)</td></tr>
</table>

Table 3.2

4 Electrical Installation

4.1 Electrical Installation

4.1.1 Control Wiring

The soft starter can be controlled in three ways

- using the buttons on the LCP
- via remote inputs
- via a serial communication link

The MCD 500 will always respond to a local start or stop command (via the [Hand On] and [Off] buttons on the LCP). Pressing the [Auto On] button selects remote control (the MCD 500 will accept commands from the remote inputs). In remote mode, the Auto On LED will be on. In local mode, the Hand On LED will be on if the MCD 500 is starting or running and the Off LED will be on if the MCD 500 is stopped or stopping.

4.1.2 Control Terminals

Control terminations use 2.5 mm² plug-in terminal blocks. Different models require control voltage to different terminals:

CV1 (24 VAC/VDC): A5, A6

CV2 (110 - 120 VAC): A5, A6

CV2 (220 - 240 VAC): A4, A6

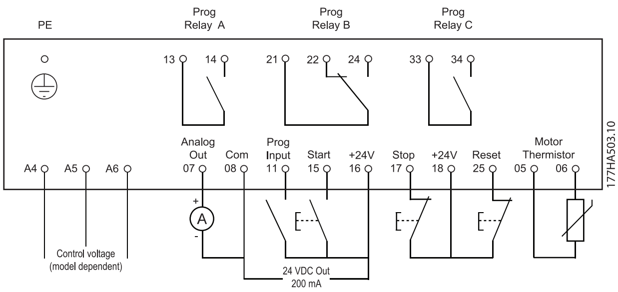


Illustration 4.1

NOTE

Do not short terminals 05, 06 without using a thermistor.

All control terminals and relay terminals comply with SELV (Protective Extra Low Voltage). This protection does not apply to grounded Delta leg above 400 V.

To maintain SELV, all connections made to the control terminals must be PELV (eg. thermistor must be reinforced/ double insulated from motor).

NOTE

SELV offers protection by way of extra low voltage. Protection against electric shock is ensured when the electrical supply is of the SELV type and the installation is made as described in local/national regulations on SELV supplies.

NOTE

Galvanic (ensured) isolation is obtained by fulfilling requirements for higher isolation and by providing the relevant creepages/clearance distances. These requirements are described in the IEC61140 standard.
The components that make up the electrical isolation also comply with the requirements for higher isolation and the relevant test as described in IEC61140.

4.1.3 Remote Inputs

The MCD 500 has three fixed inputs for remote control. These inputs should be controlled by contacts rated for low voltage, low current operation (gold flash or similar).

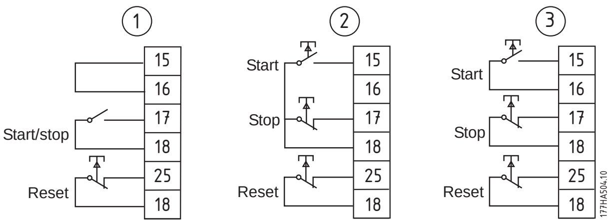


Illustration 4.2

1	Two-wire control
2	Three-wire control
3	Four-wire control

Table 4.1

The reset input can be normally open or normally closed. Use *3-8 Remote Reset Logic* to select the configuration.

⚠CAUTION

Do not apply voltage to the control input terminals. These are active 24 VDC inputs and must be controlled with potential free contacts.
Cables to the control inputs must be segregated from mains voltage and motor cabling

4

4.1.4 Serial Communication

Serial communication is always enabled in local control mode, and can be enabled or disabled in remote control mode (see *3-2 Comms in Remote*).

4.1.5 Earth Terminal

Earth terminals are located at the back of the soft starter.

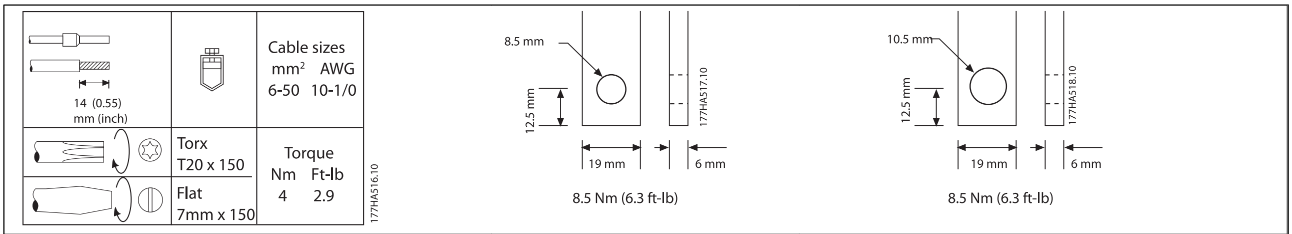
- MCD5-0021B - MCD5-0105B have one terminal, on the input side.
- MCD5-0131B - MCD5-1600C have two terminals, one on the input side and one on the output side.

4.1.6 Power Terminations

Use only copper stranded or solid conductors, rated for 75° C.

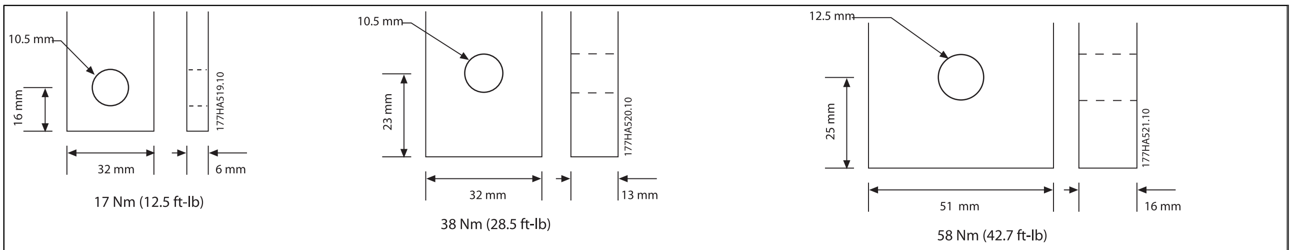
NOTE

Some units are aluminium bus bars. When connecting power terminations, we recommend cleaning the surface contact area thoroughly (using an emery or stainless steel brush) and using an appropriate jointing compound to prevent corrosion.



MCD5-0021B - MCD5-0105B	MCD5-0131B	MCD5-0141B - MCD5-0215B

Table 4.2



MCD5-0245C	MCD5-0360C - MCD50927C	MCD5-1200C - MCD5-1600C

Table 4.3

The bus bars on models MCD5-0360C - MCD5-1600C can be adjusted for top or bottom input and output as required. For step-by-step instructions on adjusting the bus bars, refer to the supplied insert.

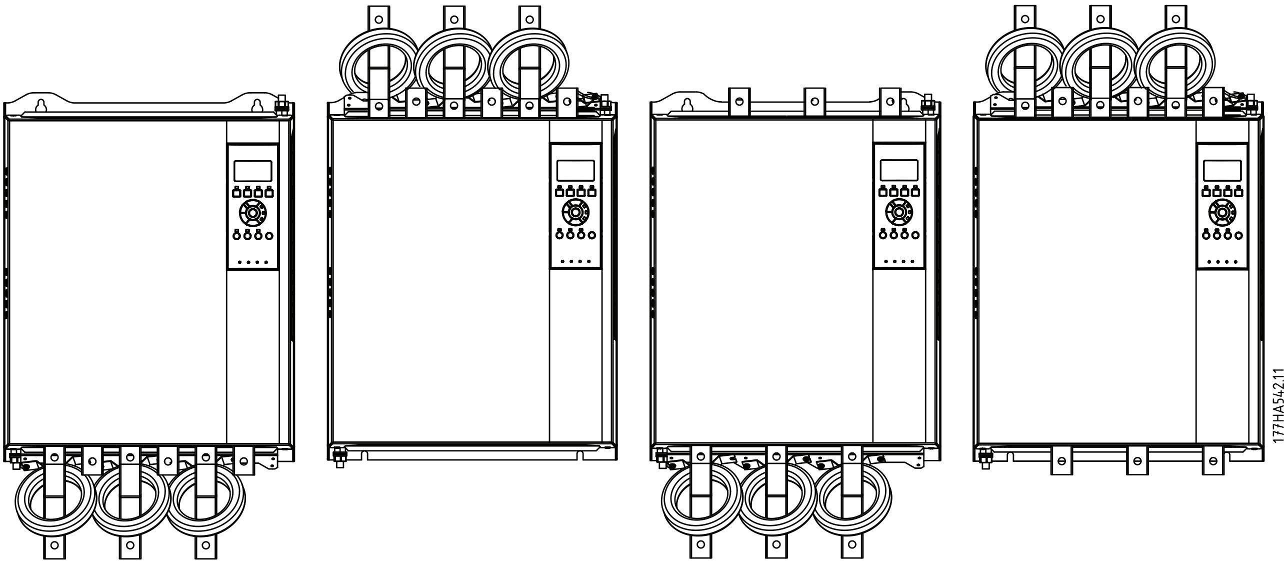


Illustration 4.3

I/O	Input/Output
I	Input
O	Output

Table 4.4

4.2 Motor Connection

MCD 500 soft starters can be connected to the motor in-line or inside delta (also called three-wire and six-wire connection). The MCD 500 will automatically detect the motor connection and perform the necessary calculations internally, so it is only necessary to program the motor full load current (*1-1 Motor FLC*).

NOTE

For personnel safety, the power terminals on models up to MCD5-0105B are protected by snap-off tabs. When using large cables, it may be necessary to break off these tabs. Models which are internally bypassed do not require an external bypass contactor.

4.2.1 Testing the Installation

The MCD 500 can be connected to a small motor for testing. During this test, the soft starter's control input and relay output protection settings can be tested. This test mode is not suitable for testing soft starting or soft stopping performance.

The minimum motor FLC for test purposes is 2% of the soft starter's minimum FLC (see *4.4 Minimum and Maximum Current Settings*).

NOTE

When testing the soft starter with a small motor, set *1-1 Motor FLC* to the minimum allowable value.

4

4.2.2 In-line Installation

4.2.2.1 In-line Installation, Internally Bypassed

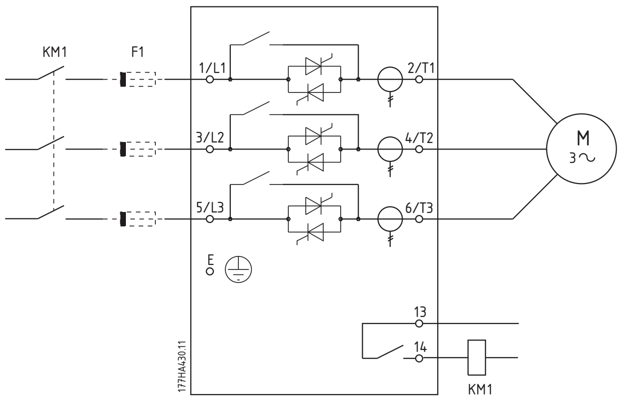


Illustration 4.4

KM1	Main contactor (optional)
F1	Fuses (optional)

Table 4.5

4.2.2.2 In-line Installation, Non-bypassed

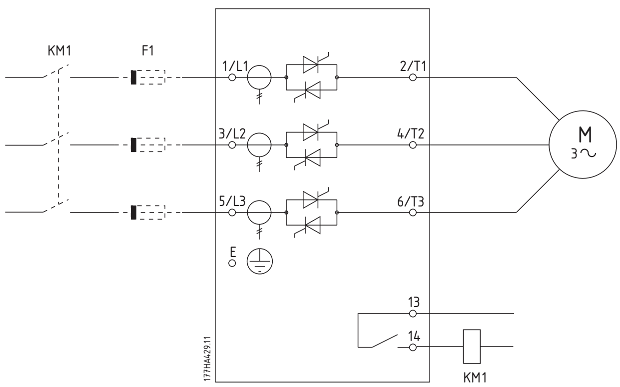


Illustration 4.5

KM1	Main contactor (optional)
F1	Fuses (optional)

Table 4.6

4.2.2.3 In-line Installation, Externally Bypassed

Non-bypassed models have dedicated bypass terminals, which allow the soft starter to continue providing protection and monitoring functions even when bypassed via external contactor. The bypass contactor must be connected to the bypass terminals and controlled by a programmable output configured to Run (see parameters 4.1 thorugh 4.9).

NOTE

The bypass terminals on MCD5-0245C are T1B, T2B, T3B. The bypass terminals on MCD5-0360C ~ MCD5-1600C are L1B, L2B, L3B.

NOTE

The fuses can be installed on the input side if required.

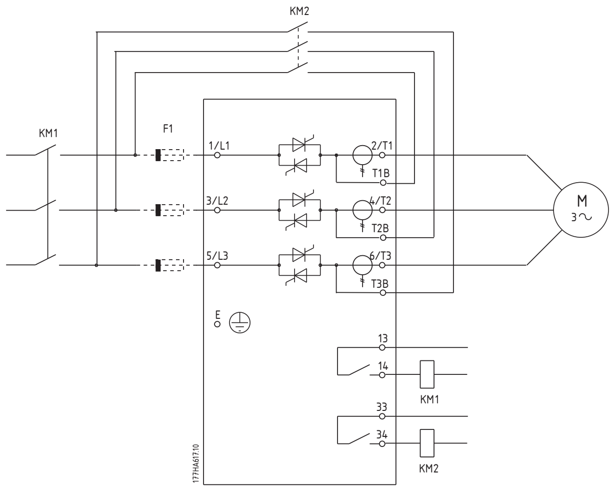


Illustration 4.6 MCD5-0245C

KM1	Main contactor
KM2	Bypass contactor (external)
F1	Semiconductor fuses (optional)

Table 4.7

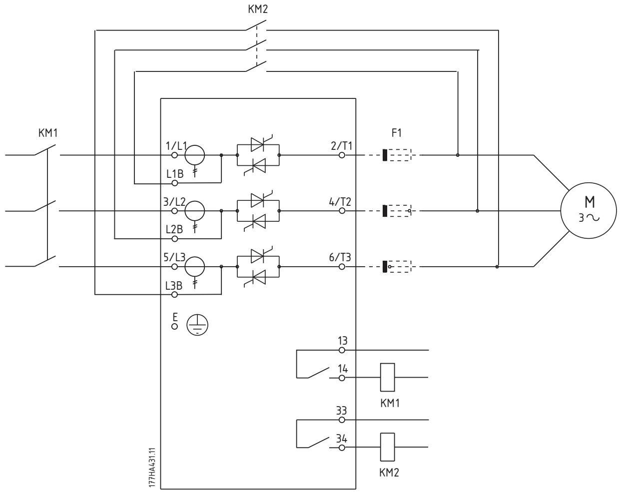


Illustration 4.7 MCD5-0360C ~ MCD5-1600C

KM1	Main contactor
KM2	Bypass contactor (external)
F1	Semiconductor fuses (optional)

Table 4.8

4.2.3 Inside Delta Installation

CAUTION

When connecting the MCD 500 in inside delta configuration, always install a main contactor or shunt trip circuit breaker.

NOTE

When connecting in inside delta, enter the motor full load current (FLC) for *1-1 Motor FLC*. MCD 500 software calculates inside delta currents from this. *15-7 Motor Connection* is set to *Auto detect* as default and can be set to force the soft starter inside delta or in-line.

4.2.3.1 Inside Delta Installation, Internally Bypassed

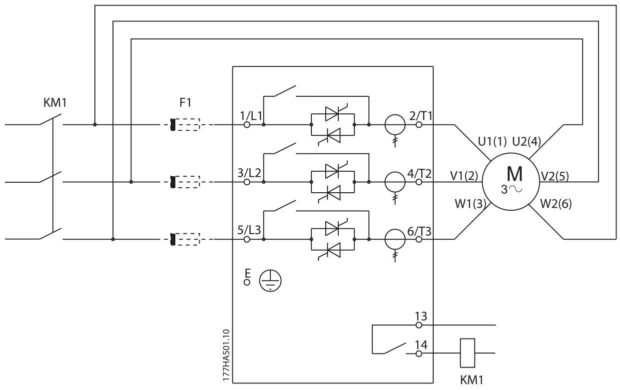


Illustration 4.8

KM1	Main contactor
F1	Fuses (optional)

Table 4.9

4.2.3.2 Inside Delta Installation, Non-bypassed

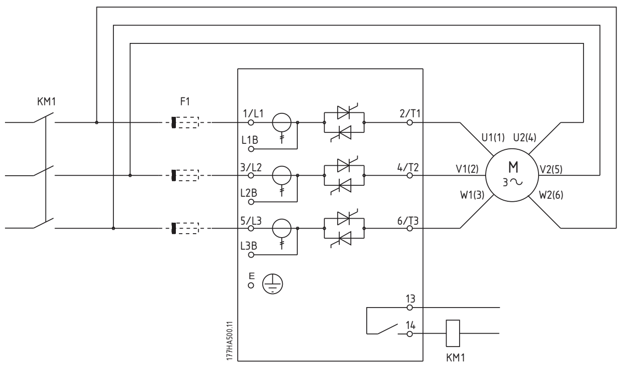


Illustration 4.9

KM1	Main contactor
F1	Fuses (optional)

Table 4.10

4.2.3.3 Inside Delta Installation, Externally Bypassed

Non-bypassed models have dedicated bypass terminals, which allow the MCD 500 to continue providing protection and monitoring functions even when bypassed via an external bypass contactor. The bypass relay must be connected to the bypass terminals and controlled by a programmable output configured to Run (see parameters 4-1 through 4-9).

4

NOTE

The bypass terminals on MCD5-0245C are T1B, T2B, T3B. The bypass terminals on MCD5-0360C - MCD5-1600C are L1B, L2B, L3B.
The fuses can be installed on the input side if required.

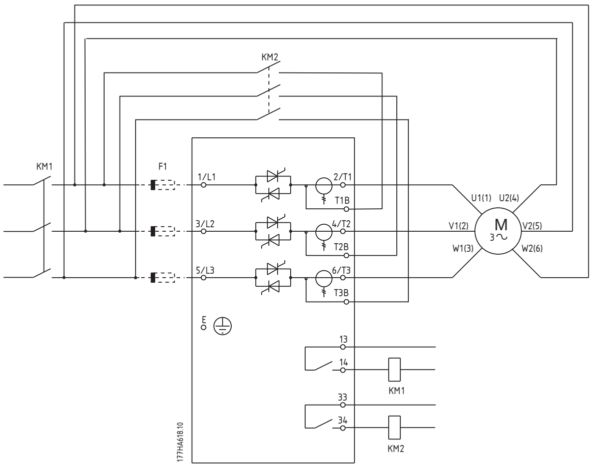


Illustration 4.10 MCD5-0245C

KM1	Main contactor
KM2	Bypass contactor (external)
F1	Semicondutcor fuses (optional)

Table 4.11

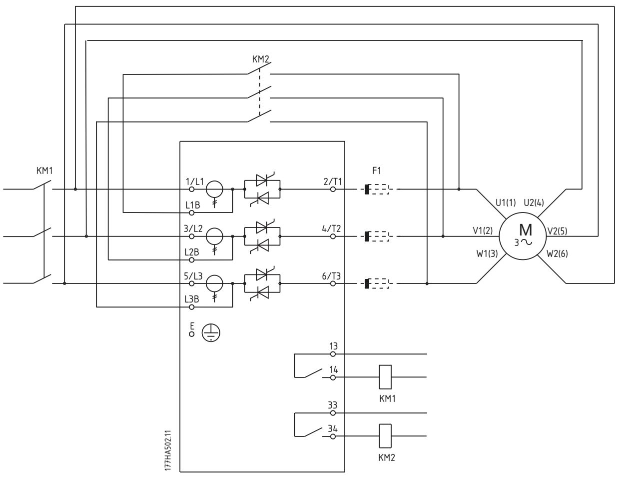


Illustration 4.11 MCD5-0360C ~ MCD5-1600C

KM1	Main contactor
KM2	Bypass contactor (external)
F1	Semiconductor fuses (optional)

Table 4.12

4.3 Current Ratings

Contact your local supplier for ratings under operating conditions not covered by these ratings charts.

All ratings are calculated at altitude of 1000 metres and ambient temperature of 40° C.

4.3.1 In-line Connection (Bypassed)

NOTE

Models MCD5-0021B - MCD5-0215B are internally bypassed. Models MCD5-0245C - MCD5-1600C require an external bypass contactor.

	AC-53b 3-30:330	AC-53b 4-20:340	AC-53b 4.5-30:330
MCD5-0021B	21 A	17 A	15 A
MCD5-0037B	37 A	31 A	26 A
MCD5-0043B	43 A	37 A	30 A
MCD5-0053B	53 A	46 A	37 A
	AC-53b 3-30:570	**AC-53b 4-20:580**	**AC-53b 4.5-30:570**
MCD5-0068B	68 A	55 A	47 A
MCD5-0084B	84 A	69 A	58 A
MCD5-0089B	89 A	74 A	61 A
MCD5-0105B	105 A	95 A	78 A
MCD5-0131B	131 A	106 A	90 A
MCD5-0141B	141 A	121 A	97 A
MCD5-0195B	195 A	160 A	134 A
MCD5-0215B	215 A	178 A	148 A
MCD5-0245C	255 A	201 A	176 A
MCD5-0360C	360 A	310 A	263 A
MCD5-0380C	380 A	359 A	299 A
MCD5-0428C	430 A	368 A	309 A
MCD5-0595C	620 A	540 A	434 A
MCD5-0619C	650 A	561 A	455 A
MCD5-0790C	790 A	714 A	579 A
MCD5-0927C	930 A	829 A	661 A
MCD5-1200C	1200 A	1200 A	1071 A
MCD5-1410C	1410 A	1319 A	1114 A
MCD5-1600C	1600 A	1600 A	1353 A

Table 4.13

4.3.2 AC-53 Rating for Bypassed Operation

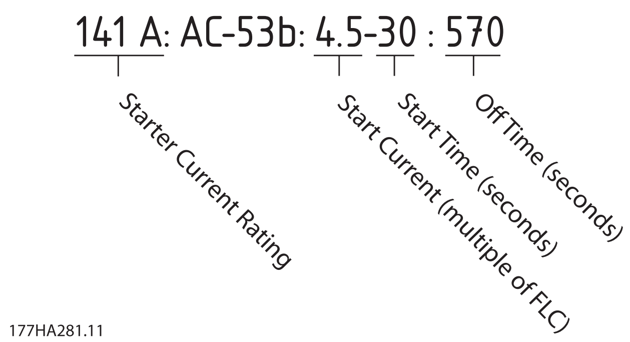


Illustration 4.12

All ratings are calculated at altitude of 1000 metres and ambient temperature of 40° C.

4.3.3 In-line Connection (Non-bypassed/Continuous)

	AC-53a 3-30:50-6	AC-53a 4-20:50-6	AC-53a 4.5-30:50-6
MCD5-0245C	245 A	195 A	171 A
MCD5-0360C	360 A	303 A	259 A
MCD5-0380C	380 A	348 A	292 A
MCD5-0428C	428 A	355 A	300 A
MCD5-0595C	595 A	515 A	419 A
MCD5-0619C	619 A	532 A	437 A
MCD5-0790C	790 A	694 A	567 A
MCD5-0927C	927 A	800 A	644 A
MCD5-1200C	1200 A	1135 A	983 A
MCD5-1410C	1410 A	1187 A	1023 A
MCD5-1600C	1600 A	1433 A	1227 A

Table 4.14

4.3.4 AC-53 Rating for Continuous Operation

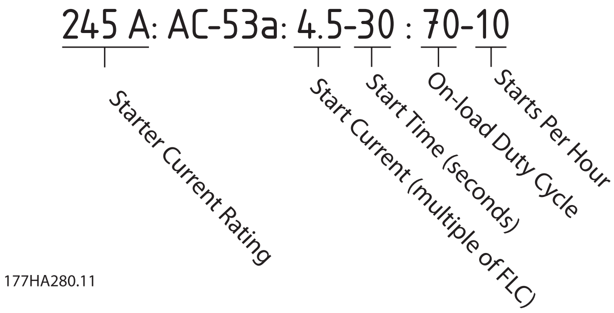


Illustration 4.13

All ratings are calculated at altitude of 1000 metres and ambient temperature of 40° C.

4.3.5 Inside Delta Connection (Bypassed)

NOTE

Models MCD5-0021B ~ MCD5-0215B are internally bypassed. Models MCD5-0245C ~ MCD5-1600C require an external bypass contactor.

	AC-53b 3-30:330	**AC-53b 4.20-:340**	**AC-53b 4.5-30:330**
MCD5-0021B	32 A	26 A	22 A
MCD5-0037B	56 A	47 A	39 A
MCD5-0043B	65 A	56 A	45 A
MCD5-0053B	80 A	69 A	55 A
	AC-53b 3-30:570	**AC-53b 4-20:580**	**AC-53b 4.5-30:570**
MCD5-0068B	102 A	83 A	71 A
MCD5-0084B	126 A	104 A	87 A
MCD5-0089B	134 A	112 A	92 A
MCD5-0105B	158 A	143 A	117 A
MCD5-0131B	197 A	159 A	136 A
MCD5-0141B	212 A	181 A	146 A
MCD5-0195B	293 A	241 A	201 A
MCD5-0215B	323 A	268 A	223 A
MCD5-0245C	383 A	302 A	264 A
MCD5-0360C	540 A	465 A	395 A
MCD5-0380C	570 A	539 A	449 A
MCD5-0428C	645 A	552 A	463 A
MCD5-0595C	930 A	810 A	651 A
MCD5-0619C	975 A	842 A	683 A
MCD5-0790C	1185 A	1072 A	869 A
MCD5-0927C	1395 A	1244 A	992 A
MCD5-1200C	1800 A	1800 A	1607 A
MCD5-1410C	2115 A	1979 A	1671 A
MCD5-1600C	2400 A	2400 A	2030 A

Table 4.15

4.3.6 AC-53 Rating for Bypassed Operation

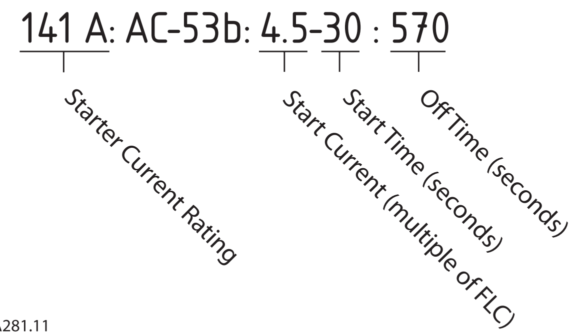


Illustration 4.14

All ratings are calculated at altitude of 1000 metres and ambient temperature of 40° C.

4.3.7 Inside Delta Connection (Non-bypassed/Continuous)

	AC-53a 3-30:50-6	AC-53a 4-20:50-6	AC-53a 4.5-30:50-6
MCD5-0245C	368 A	293 A	257 A
MCD5-0360C	540 A	455 A	389 A
MCD5-0380C	570 A	522 A	438 A
MCD5-0428C	643 A	533 A	451 A
MCD5-0595C	893 A	773 A	629 A
MCD5-0619C	929 A	798 A	656 A
MCD5-0790C	1185 A	1042 A	851 A
MCD5-0927C	1391 A	1200 A	966 A
MCD5-1200C	1800 A	1702 A	1474 A
MCD5-1410C	2115 A	1780 A	1535 A
MCD5-1600C	2400 A	2149 A	1841 A

Table 4.16

4.3.8 AC-53 Rating for Continuous Operation

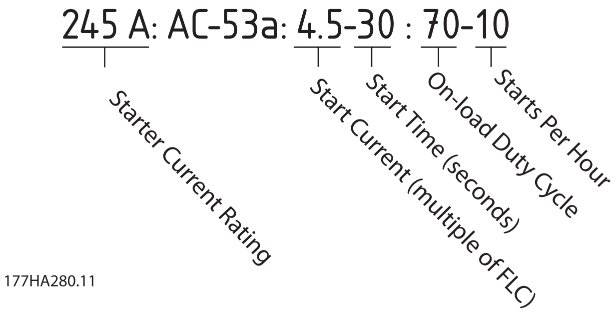


Illustration 4.15

All ratings are calculated at altitude of 1000 metres and ambient temperature of 40° C.

4.4 Minimum and Maximum Current Settings

The MCD 500's minimum and maximum full load current settings depend on the model:

	In-line Connection		Inside Delta Connection	
Model	Minimum	Maximum	Minimum	Maximum
MCD5-0021B	5 A	23 A	7 A	34 A
MCD5-0037B	9 A	43 A	13 A	64 A
MCD5-0043B	10 A	50 A	15 A	75 A
MCD5-0053B	11 A	53 A	16 A	79 A
MCD5-0068B	15 A	76 A	23 A	114 A
MCD5-0084B	19 A	97 A	29 A	145 A
MCD5-0089B	20 A	100 A	30 A	150 A
MCD5-0105B	21 A	105 A	32 A	157 A
MCD5-0131B	29 A	145 A	44 A	217 A
MCD5-0141B	34 A	170 A	51 A	255 A
MCD5-0195B	40 A	200 A	60 A	300 A
MCD5-0215B	44 A	220 A	66 A	330 A
MCD5-0245C	51 A	255 A	77 A	382 A
MCD5-0360C	72 A	360 A	108 A	540 A
MCD5-0380C	76 A	380 A	114 A	570 A
MCD5-0428C	86 A	430 A	129 A	645 A
MCD5-0595C	124 A	620 A	186 A	930 A
MCD5-0619C	130 A	650 A	195 A	975 A
MCD5-0790C	158 A	790 A	237 A	1185 A
MCD5-0927C	186 A	930 A	279 A	1395 A
MCD5-1200C	240 A	1200 A	360 A	1800 A
MCD5-1410C	282 A	1410 A	423 A	2115 A
MCD5-1600C	320 A	1600 A	480 A	2400 A

Table 4.17

4.5 Bypass Contactor

MCD 500 soft starters with model numbers MCD5-0021B - MCD5-0215B are internally bypassed and do not require an external bypass contactor.

MCD 500 soft starters with model numbers MCD5-0245C - MCD5-1600C are not internally bypassed and may be installed with an external bypass contactor. Select a contactor with an AC1 rating greater than or equal to the full load current rating of the connected motor.

4.6 Main Contactor

A main contactor must be installed if the MCD 500 is connected to the motor in inside delta format and is optional for in-line connection. Select a contactor with an AC3 rating greater than or equal to the full load current rating of the connected motor.

4.7 Circuit Breaker

A shunt trip circuit breaker may be used instead of a main contactor to isolate the motor circuit in the event of a soft starter trip. The shunt trip mechanism must be powered from the supply side of the circuit breaker or from a separate control supply.

4.8 Power Factor Correction

If power factor correction is used, a dedicated contactor should be used to switch in the capacitors. Power factor correction capacitors must be connected to the input side of the soft starter.

CAUTION

Power factor correction capacitors must be connected to the input side of the soft starter. Connecting power factor correction capacitors to the output side will damage the soft starter.

4.9 Fuses

4.9.1 Power Supply Fuses

Semiconductor fuses can be used for Type 2 coordination (according to IEC 60947-4-2 standard) and to reduce the risk of damage to SCRs from transient overload currents.

HRC fuses (such as Ferraz AJT fuses) can be used for Type 1 coordination according to IEC 60947-4-2 standard.

NOTE

Adaptive Acceleration Control (AAC) controls the motor's speed profile, within the programmed time limit. This may result in a higher level of current than traditional control methods.

For applications using Adaptive Acceleration Control to soft stop the motor with stop times greater than 30 seconds, motor branch protection should be selected as follows:

- Standard HRC line fuses: Minimum 150% motor full load current
- Motor rated line fuses: Minimum rating 100/150% motor full load current
- Motor control circuit breaker minimum long time setting: 150% motor full load current
- Motor control circuit breaker minimum short time setting: 400% motor full load current for 30 seconds

Fuses recommendations are calculated for 40° C, up to 1000 m.

NOTE

Fuse selection is based on a 400% FLC start for 20 seconds in conjunction with standard published starts per hour, duty cycle, 40° C ambient temperature and up to 1000 m altitude. For installations operating outside these conditions, consult your local supplier.

NOTE

These fuse tables contain recommendations only, always consult your local supplier to confirm the selection for your particular application.

For models marked - there is no suitable fuse.

4.9.2 Bussman Fuses - Square Body (170M)

Model	SCR I^2t (A^2s)	Supply Voltage (≤ 440 VAC)	Supply Voltage (≤ 575 VAC)	Supply Voltage (≤ 690 VAC)
MCD5-0021B	1150	170M1314	170M1314	170M1314
MCD5-0037B	8000	170M1316	170M1316	170M1316
MCD5-0043B	10500	170M1318	170M1318	170M1318
MCD5-0053B	15000	170M1318	170M1318	170M1318
MCD5-0068B	15000	170M1319	170M1319	170M1318
MCD5-0084B	512000	170M1321	170M1321	170M1319
MCD5-0089B	80000	170M1321	170M1321	170M1321
MCD5-0105B	125000	170M1321	170M1321	170M1321
MCD5-0131B	125000	170M1321	170M1321	170M1321
MCD5-0141B	320000	170M2621	170M2621	170M2621
MCD5-0195B	320000	170M2621	170M2621	170M2621
MCD5-0215B	320000	170M2621	170M2621	170M2621
MCD5-0245C	320000	170M2621	170M2621	170M2621
MCD5-0360C	320000	170M6010	170M6010	170M6010
MCD5-0380C	320000	170M6011	170M6011	-
MCD5-0428C	320000	170M6011	170M6011	-
MCD5-0595C	1200000	170M6015	170M6015	170M6014
MCD5-0619C	1200000	170M6015	170M6015	170M6014
MCD5-0790C	2530000	170M6017	170M6017	170M6016
MCD5-0927C	4500000	170M6019	170M6019	170M6019
MCD5-1200C	4500000	170M6021	-	-
MCD5-1410C	6480000	-	-	-
MCD5-1600C	12500000	170M6019*	-	-

Table 4.18

** Two parallel connected fuses required per phase.*

4.9.3 Bussman Fuses - British Style (BS88)

Model	SCR I^2t (A^2s)	Supply Voltage (< 440 VAC)	Supply Voltage (< 575 VAC)	Supply Voltage (< 690 VAC)
MCD5-0021B	1150	63FE	63FE	63FE
MCD5-0037B	8000	120FEE	120FEE	120FEE
MCD5-0043B	10500	120FEE	120FEE	120FEE
MCD5-0053B	15000	200FEE	200FEE	200FEE
MCD5-0068B	15000	200FEE	200FEE	200FEE
MCD5-0084B	512000	200FEE	200FEE	200FEE
MCD5-0089B	80000	280FM	280FM	280FM
MCD5-0105B	125000	280FM	280FM	280FM
MCD5-0131B	125000	280FM	280FM	280FM
MCD5-0141B	320000	450FMM	450FMM	450FMM
MCD5-0195B	320000	450FMM	450FMM	450FMM
MCD5-0215B	320000	450FMM	450FMM	450FMM
MCD5-0245C	320000	450FMM	450FMM	450FMM
MCD5-0360C	320000	-	-	-
MCD5-0380C	320000	400FMM*	400FMM	400FMM*
MCD5-0428C	320000	-	-	-
MCD5-0595C	1200000	630FMM*	630FMM*	-
MCD5-0619C	1200000	630FMM*	630FMM*	-
MCD5-0790C	2530000	-	-	-
MCD5-0927C	4500000	-	-	-
MCD5-1200C	4500000	-	-	-
MCD5-1410C	6480000	-	-	-
MCD5-1600C	12500000	-	-	-

Table 4.19

** Two parallel connected fuses required per phase.*

4.9.4 Ferraz Fuses - HSJ

Model	SCR I^2t (A^2s)	Supply Voltage (< 440 VAC)	Supply Voltage (< 575 VAC)	Supply Voltage (< 690 VAC)
MCD5-0021B	1150	HSJ40**	HSJ40**	Not suitable
MCD5-0037B	8000	HSJ80**	HSJ80**	
MCD5-0043B	10500	HSJ90**	HSJ90**	
MCD5-0053B	15000	HSJ110**	HSJ110**	
MCD5-0068B	15000	HSJ125**	HSJ125**	
MCD5-0084B	51200	HSJ175	HSJ175**	
MCD5-0089B	80000	HSJ175	HSJ175	
MCD5-0105B	125000	HSJ225	HSJ225	
MCD5-0131B	125000	HSJ250	HSJ250**	
MCD5-0141B	320000	HSJ300	HSJ300	
MCD5-0195B	320000	HSJ350	HSJ350	
MCD5-0215B	320000	HSJ400**	HSJ400**	
MCD5-0245C	320000	HSJ450**	HSJ450**	
MCD5-0360C	320000	Not suitable	Not suitable	
MCD5-0380C	320000			
MCD5-0428C	320000			
MCD5-0595C	1200000			
MCD5-0619C	1200000			
MCD5-0790C	2530000			
MCD5-0927C	4500000			
MCD5-1200C	4500000			
MCD5-1410C	6480000			
MCD5-1600C	12500000			

Table 4.20

*** Two series connected fuses required per phase*

4.9.5 Ferraz Fuses - North American Style (PSC 690)

Model	SCR I^2t (A^2s)	Supply Voltage < 440 VAC	Supply Voltage < 575 VAC	Supply Voltage < 690 VAC
MCD5-0021B	1150	A070URD30XXX0063	A070URD30XXX0063	-
MCD5-0037B	8000	A070URD30XXX0125	A070URD30XXX0125	A070URD30XXX0125
MCD5-0043B	10500	A070URD30XXX0125	A070URD30XXX0125	A070URD30XXX0125
MCD5-0053B	15000	A070URD30XXX0125	A070URD30XXX0125	A070URD30XXX0125
MCD5-0068B	15000	A070URD30XXX0160	A070URD30XXX0160	A070URD30XXX0160
MCD5-0084B	51200	A070URD30XXX0200	A070URD30XXX0200	A070URD30XXX0200
MCD5-0089B	80000	A070URD30XXX0200	A070URD30XXX0200	A070URD30XXX0200
MCD5-0105B	125000	A070URD30XXX0315	A070URD30XXX0315	A070URD30XXX0315
MCD5-0131B	125000	A070URD30XXX0315	A070URD30XXX0315	A070URD30XXX0315
MCD5-0141B	320000	A070URD30XXX0315	A070URD30XXX0315	A070URD30XXX0315
MCD5-0195B	320000	A070URD30XXX0450	A070URD30XXX0450	A070URD30XXX0450
MCD5-0215B	320000	A070URD30XXX0450	A070URD30XXX0450	A070URD30XXX0450
MCD5-0245C	320000	A070URD30XXX0450	A070URD30XXX0450	A070URD30XXX0450
MCD5-0360C	320000	A070URD33XXX0630	A070URD33XXX0630	A070URD33XXX0630
MCD5-0380C	320000	A070URD33XXX0700	A070URD33XXX0700	-
MCD5-0428C	320000	A070URD33XXX0700	A070URD33XXX0700	-
MCD5-0595C	1200000	A070URD33XXX1000	A070URD33XXX1000	A070URD33XXX1000
MCD5-0619C	1200000	A070URD33XXX1000	A070URD33XXX1000	A070URD33XXX1000
MCD5-0790C	2530000	A070URD33XXX1400	A070URD33XXX1400	A070URD33XXX1400
MCD5-0927C	4500000	A070URD33XXX1400	A070URD33XXX1400	A070URD33XXX1400
MCD5-1200C	4500000	A055URD33XXX2250	-	-
MCD5-1410C	6480000	A055URD33XXX2250	-	-
MCD5-1600C	12500000	-	-	-

Table 4.21

XXX = blade type. Refer to Ferraz catalog for details.

4.9.6 UL Tested Fuses - Short Circuit Ratings

Model	Nominal Rating (A)	Short Circuit Rating 480V AC (kA)	Short Circuit Rating 600V AC (kA)	Fuse Ferraz	
MCD5-0021B	23	65	10	AJT50	A070URD30XXX0063
MCD5-0037B	43	65	10	AJT50	A070URD30XXX0125
MCD5-0043B	50	65	10	AJT50	A070URD30XXX0125
MCD5-0053B	53	65	10	AJT60	A070URD30XXX0125
MCD5-0068B	76	65	10	AJT80	A070URD30XXX0200
MCD5-0084B	97	65	10	AJT100	A070URD30XXX0200
MCD5-0089B	100	65	10	AJT100	A070URD30XXX0200
MCD5-0105B	105	65	10	AJT125	A070URD30XXX0315
MCD5-0131B	145	65	18	AJT150	A070URD30XXX0315
MCD5-0141B	170	65	18	AJT175	A070URD30XXX0315
MCD5-0195B	200	65	18	AJT200	A070URD30XXX0450
MCD5-0215B	220	65	18	AJT250	A070URD30XXX0450
MCD5-0245C	255	85	85	AJT300	A070URD30XXX0450
MCD5-0360C	360	85	85	AJT400	A070URD33XXX0630
MCD5-0380C	380	85	85	AJT450	A070URD33XXX0700
MCD5-0425B	430	85	85	AJT450	A070URD33XXX0700
MCD5-0595C	620	85	85	A4BQ800	A070URD33XXX1000
MCD5-0619C	650	85	85	A4BQ800	A070URD33XXX1000
MCD5-0790C	790	85	85	A4BQ1200	070URD33XXX1400
MCD5-0927C	930	85	85	A4BQ1200	A070URD33XXX1400
MCD5-1200C	1200	100	100	A4BQ1600	A065URD33XXX1800
MCD5-1410C	1410	100	100	A4BQ2000	A055URD33XXX2250
MCD5-1600C	1600	100	100	A4BQ2500	A055URD33XXX2250

Table 4.22

4

4.10 Schematic Diagrams

4.10.1 Internally Bypassed Models

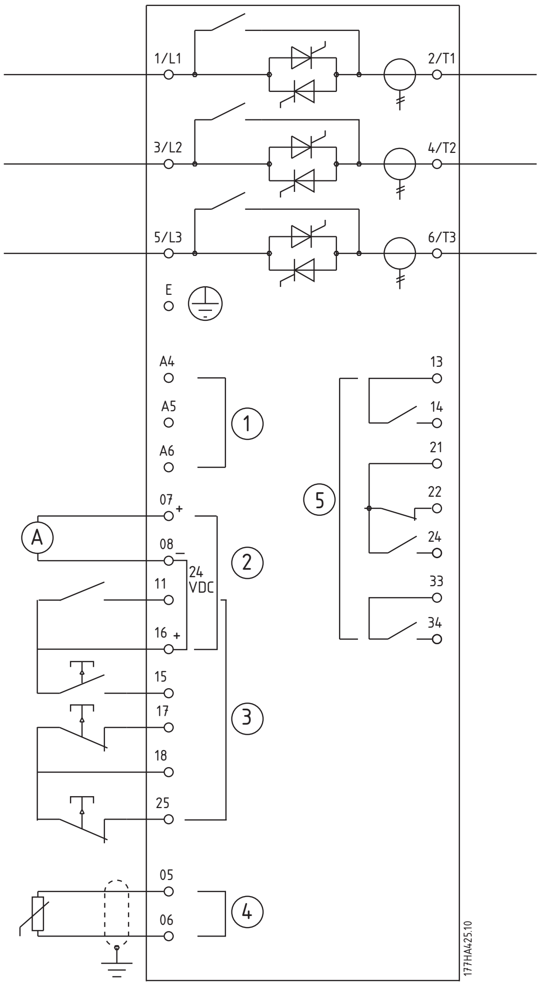


Illustration 4.16

1	Control supply (model dependent)
2	Outputs
07, 08	Programmable analog output
16, 08	24 VDC output
3	Remote control inputs
11, 16	Programmable input
15, 16	Start
17, 18	Stop
25, 18	Reset
4	Motor thermistor input (PTC only)
5	Relay outputs
13, 14	Relay output A
21, 22, 24	Relay output B
33, 34	Relay output C

Table 4.23

4.10.2 Non-bypassed Models

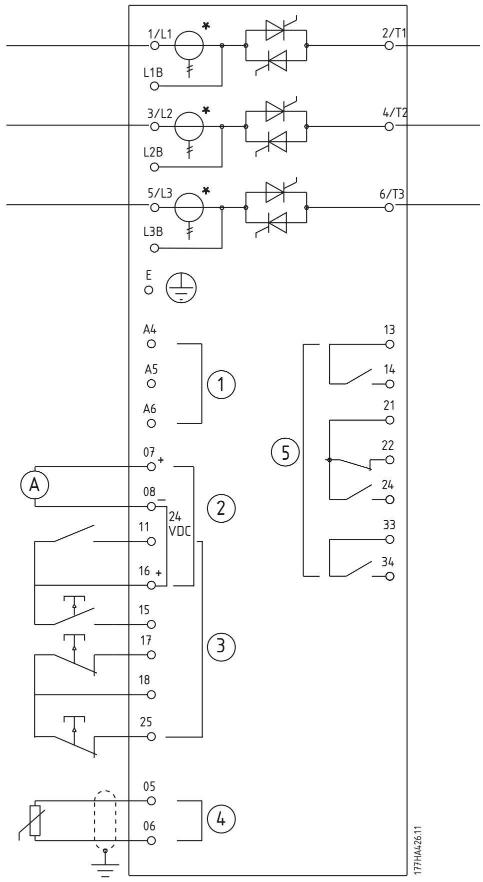


Illustration 4.17

1	Control supply (model dependent)
2	Outputs
07, 08	Programmable analog output
16, 08	24 VDC output
3	Remote control inputs
11, 16	Programmable input
15, 16	Start
17, 18	Stop
25, 18	Reset
4	Motor thermistor input (PTC only)
5	Relay outputs
13, 14	Relay output A
21, 22, 24	Relay output B
33, 34	Relay output C

Table 4.24

NOTE

*** MCD5-0245C current transformers are located on the output. Bypass terminals are labelled T1B, T2B and T3B.**

5

5 Application Examples

5.1 Motor Overload Protection

The thermal model used for motor overload in the MCD 500 has two components:

- Motor windings: These have a low thermal capacity and affects the short term thermal behaviour of the motor. This is where the heat is generated by the current.
- Motor Body: This has a large thermal capacity and affects the long term behaviour of the motor. The thermal model includes considerations for the following:
  - Motor current, iron losses, winding resistance losses, motor body and winding thermal capacities, cooling during run and cooling at standstill.
  - The percentage of the rated capacity of the motor. This sets the displayed value for the winding model and is affected by the motor FLC setting amongst others.

NOTE

***1-1 Motor FLC* should be set to the motor's rated FLC. Do not add the overload rating as this is computed by the MCD500.**

The thermal overload protection used in MCD500 has a number of advantages over the thermal relays.

- The effect of fan cooling is accounted for when the motor is running
- The actual full load current and locked rotor time can be used to more accurately tune the model. The thermal characteristics of the windings are treated separately from the rest of the motor (ie. the model recognises that the windings have low thermal mass and high thermal resistance).
- The winding portion of the thermal model responds very rapidly compared with the body portion, meaning the motor can be run closer to its safe maximum operating temperature while still being protected from thermal damage.
- The percentage of motor thermal capacity used during each start is stored in memory. The starter can be configured to automatically determine whether or not the motor has sufficient thermal capacity remaining to successfully complete another start.
- The memory function of the model means that the motor is fully protected in "warm start" situations. The model uses data from the real time clock to account for elapsed cooling time, even if control power has been removed.

The overload protection function provided by this model is compliant with a NEMA 10 curve, but will provide superior protection at low levels of overload due to the separation of the winding thermal model.

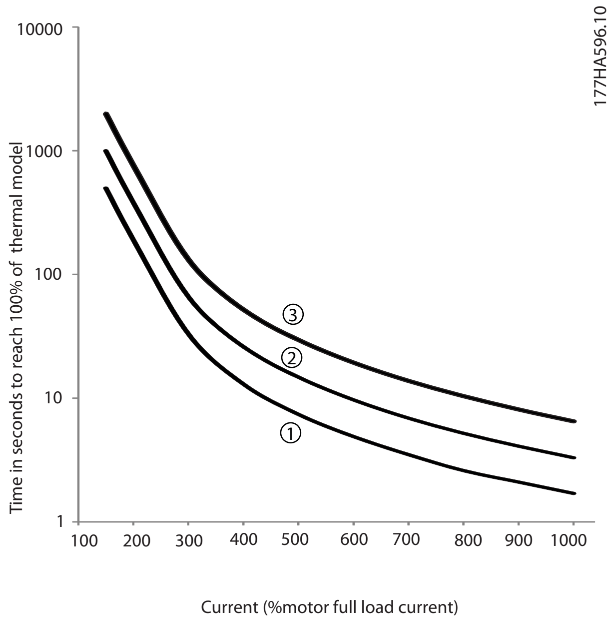


Illustration 5.1

1. MSTC[1] = 5
2. MSTC[1] = 10
3. MSTC[1] = 20

[1] MSTC is the Motor Start Time Constant and is defined as the Locked Rotor Time (in *1-2 Locked Rotor Time*) when the Locked Rotor Current is 600% of FLC.

5.2 AAC Adaptive Acceleration Control

AAC Adaptive Acceleration Control is a new form of motor control based on the motor's own performance characteristics. With AAC, the user selects the starting or stopping profile that best matches the load type and the starter automatically controls the motor to match the profile. The MCD 500 offers three profiles - early, constant and late acceleration and deceleration.

AAC uses two algorithms, one to measure the motor's characteristics and one to control the motor. The MCD 500 uses the first start to determine the motor's characteristics at zero speed and at maximum speed. During each subsequent start and stop, the starter dynamically adjusts its control to ensure the motor's actual performance matches the selected profile throughout the start. The starter increases power to the motor if the actual speed is too low for the profile, or decreases power if the speed is too high.

5.3 Starting Modes

5.3.1 Constant Current

Constant current is the traditional form of soft starting, which raises the current from zero to a specified level and keeps the current stable at that level until the motor has accelerated.

Constant current starting is ideal for applications where the start current must be kept below a particular level.

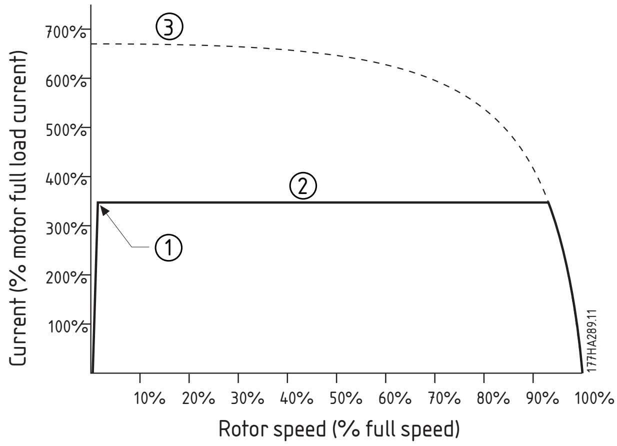


Illustration 5.2

1: *1-5 Initial current*
2: *1-4 Current limit*
3: Full voltage current

Table 5.1

5.3.2 Current Ramp

Current ramp soft starting raises the current from a specified starting level (1) to a maximum limit (3), over an extended period of time (2).

Current ramp starting can be useful for applications where:

- the load can vary between starts (for example a conveyor which may start loaded or unloaded). Set *1-5 Initial Current* to a level that will start the motor with a light load, and *1-4 Current Limit* to a level that will start the motor with a heavy load.
- the load breaks away easily, but starting time needs to be extended (for example a centrifugal pump where pipeline pressure needs to build up slowly).
- the electricity supply is limited (for example a generator set), and a slower application of load will allow greater time for the supply to respond.

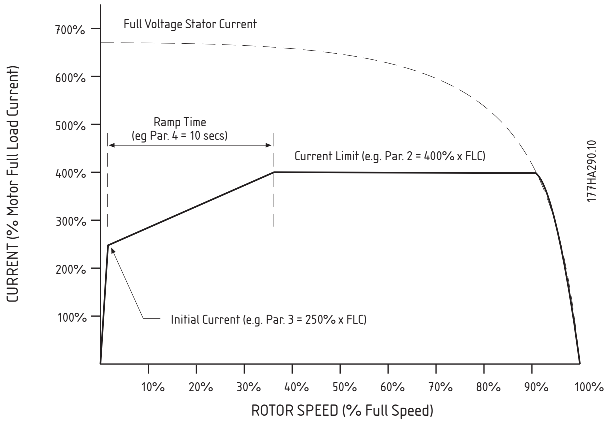


Illustration 5.3

5.3.3 AAC Adaptive Acceleration Control

To use AAC Adaptive Acceleration Control to control starting performance:

1. Select Adaptive Control in *1-3 Start Mode*.
2. Set *1-6 Start Ramp Time*.
3. Select the desired profile in *1-13 Adaptive Start Profile*.
4. Set *1-4 Current Limit* sufficiently high to allow a successful start. The first AAC start will be a Constant Current start. This allows the MCD 500 to learn the characteristics of the connected motor. This motor data is used by the MCD 500 during subsequent AAC Adaptive Acceleration Control starts.

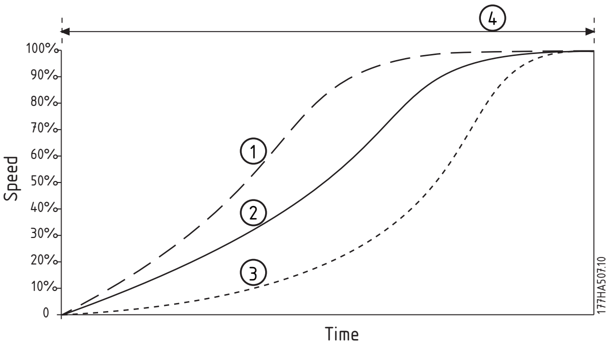


Illustration 5.4

1. Early acceleration
2. Constant acceleration
3. Late acceleration
4. *1-16 Start Ramp Time*

Table 5.2 1-13 Adaptive Start Profile

NOTE

AAC Adaptive Acceleration Control will control the load according to the programmed profile. Start current will vary according to the selected acceleration profile and the programmed start time.
If replacing a motor connected to an MCD 500 programmed for AAC Adaptive Control starting or stopping, or if the starter has been tested on a different motor prior to actual installation, the starter will need to learn the characteristics of the new motor. The MCD 500 will automatically re-learn the motor's characteristics if *1-1 Motor Full Load Current* or *1-12 Adaptive Control Gain* is changed.

5.3.4 Kickstart

Kickstart provides a short boost of extra torque at the beginning of a start, and can be used in conjunction with current ramp or constant current starting.

Kickstart can be useful to help start loads that require high breakaway torque but then accelerate easily (for example flywheel loads such as presses).

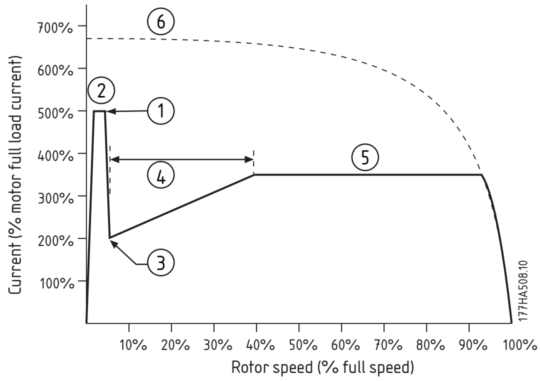


Illustration 5.5

1: *1-7 Kickstart Level*
2: *1-8 Kickstart Time*
3: *1-5 Initial Current*
4: *1-6 Start Ramp Time*
5: *1-4 Current Limit*
6: Full voltage current

Table 5.3

5.4 Stopping Modes

5.4.1 Coast to Stop

Coast to stop lets the motor slow at its natural rate, with no control from the soft starter. The time required to stop will depend on the type of load.

5.4.2 TVR Soft Stop

Timed voltage ramp reduces the voltage to the motor gradually over a defined time. The load may continue to run after the stop ramp is complete.

Timed voltage ramp stopping can be useful for applications where the stop time needs to be extended, or to avoid transients on generator set supplies.

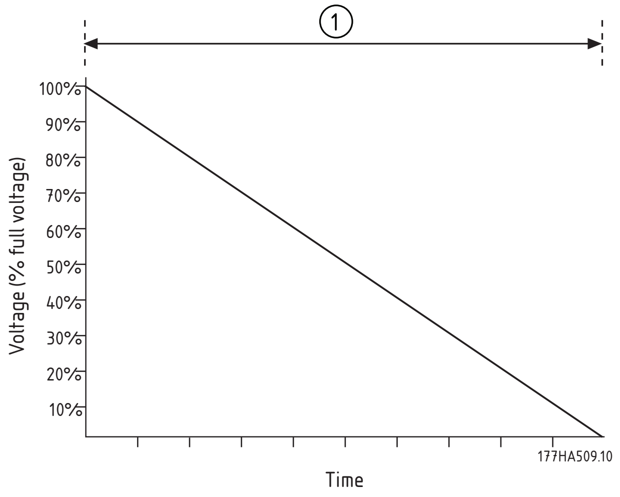


Illustration 5.6

1: *1-11 Stop Time*

Table 5.4

5.4.3 AAC Adaptive Acceleration Control

To use AAC Adaptive Acceleration Control to control stopping performance:

1. Select Adaptive Control in *1-10 Stop Mode*.
2. Set *1-11 Stop Time*.
3. Select the required profile in *1-14 Adaptive Stop Profile*.

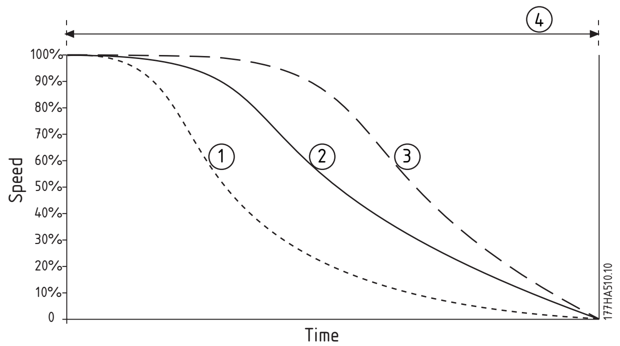


Illustration 5.7

1. Early deceleration
2. Constant deceleration
3. Late deceleration
4. *1-10 Stop Time*

Table 5.5 1-14 AAC Adaptive Stop Profile

NOTE

Adaptive control does not actively slow the motor down and will not stop the motor faster than a coast to stop. To shorten the stopping time of high inertia loads, use brake.

The first AAC Adaptive Deceleration Control stop will be a normal soft stop. This allows the MCD 500 to learn the characteristics of the connected motor. This motor data is used by the MCD 500 during subsequent Adaptive Control stops.

NOTE

Adaptive Control will control the load according to the programmed profile. Stopping current will vary according to the selected deceleration profile and stop time.
If replacing a motor connected to an MCD 500 programmed for AAC Adaptive Control starting or stopping, or if the starter has been tested on a different motor prior to actual installation, the starter will need to learn the characteristics of the new motor. The MCD 500 will automatically re-learn the motor's characteristics if *1-1 Motor Full Load Current* or *1-12 Adaptive Control Gain* is changed.

5.4.4 Brake

Brake reduces the time the motor requires to stop.

During braking an increased noise level from the motor may be audible. This is a normal part of motor braking.

CAUTION

If the brake torque is set too high, the motor will stop before the end of the brake time and the motor will suffer unnecessary heating which could result in damage. Careful configuration is required to ensure safe operation of the starter and motor.

CAUTION

A high brake torque setting can result in peak currents up to motor DOL being drawn while the motor is stopping. Ensure protection fuses installed in the motor branch circuit are selected appropriately.

NOTE

Brake operation causes the motor to heat faster than the rate calculated by the motor thermal model. If you are using brake, install a motor thermistor or allow sufficient restart delay (*2-11 Restart Delay*).

When brake is selected, the MCD 500 uses DC injection to slow the motor.

MCD 500 braking

- Does not require the use of a DC brake contactor
- Controls all three phases so that the braking currents and associated heating are evenly distributed through the motor

Braking has two stages

1. Pre-brake: provides an intermediate level of braking to slow motor speed to a point where full brake can be operated successfully (approximately 70% speed).
2. Full brake: brake provides maximum braking torque but is ineffective at speeds greater than approximately 70%.

To configure the MCD 500 for brake operation

1. Set *1-11 Stop Time* for the desired stopping time duration (1). This is the total braking time and must be set sufficiently longer than the brake time (*1-16 Brake Time*) to allow the pre-braking stage to reduce motor speed to approximately 70%. If the stop time is too short, braking will not be successful and the motor will coast to stop.
2. Set *1-16 Brake Time* to approximately one quarter of the programmed Stop Time. This sets the time for the Full Brake stage (2).
3. Adjust *1-15 Brake Torque* so that the desired stopping performance is achieved. If set too low, the motor will not stop completely and will coast to stop by the end of the braking period.

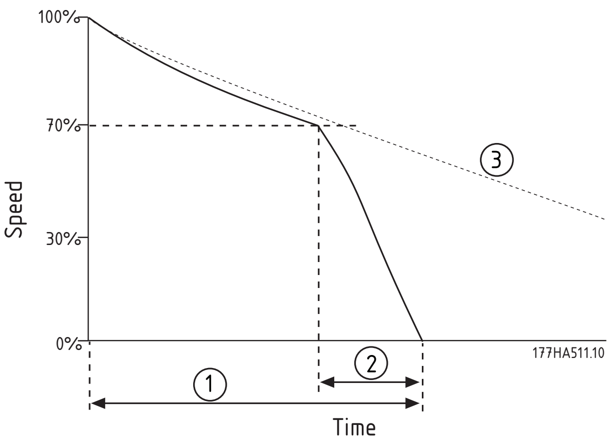


Illustration 5.8

1: *1-11 Stop Time*
2: *1-16 Brake Time*
3: Coast to stop time

Table 5.6

NOTE

When using DC brake, the mains supply must be connected to the soft starter (input terminals L1, L2, L3) in positive phase sequence and *2-1 Phase Sequence* must be set to Positive only.

NOTE

For loads which may vary between braking cycles, install a zero speed sensor to ensure that the soft starter ends DC braking when the motor stops. This avoids unnecessary heating of the motor.

For more information on using the MCD 500 with an external speed sensor, see *5.12 DC Brake with External Zero Speed Sensor*.

5.5 Jog Operation

Jog runs the motor at reduced speed, to allow alignment of the load or to assist servicing. The motor can be jogged in either forward or reverse direction.

The maximum available torque for jog is approximately 50% - 75% of motor full load torque (FLT) depending on the motor. Available jog torque in reverse is approximately 50% - 75% of the jog torque in forward direction. To set the jog torque level, use *15-8 Jog Torque*.

NOTE

Setting *15-8 Jog Torque* above 50% may cause increased shaft vibration.

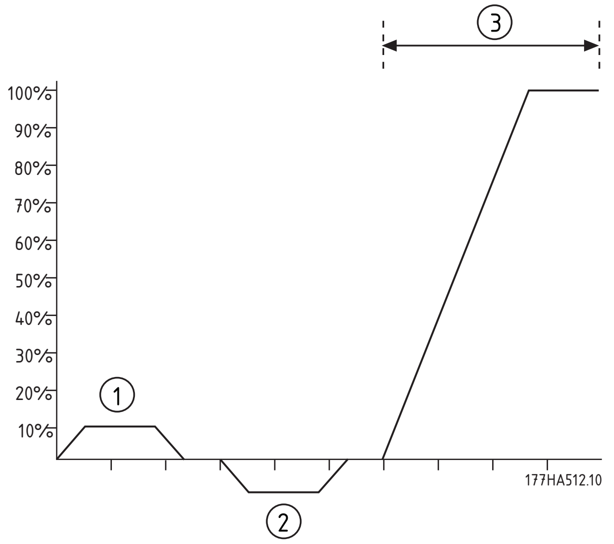


Illustration 5.9

1. Jog Forward	
2. Jog Reverse	
3. Normal Operation	

Table 5.7

To activate jog operation, use a programmable input (*3-3 Input A Function*).

To stop a jog operation, perform either of the following:

- Remove the jog command
- Press the OFF button on the LCP
- Activate Emergency Stop using the LCP programmable inputs

Jog will recommence at the end of a restart delay if the jog command is still present. All other commands except the above will be ignored during jog operation.

NOTE

Jog will operate in 2-wire mode regardless of the state of the remote Start, Stop and Reset inputs.

NOTE

Jog is only available for the primary motor (for more information on primary and secondary sets, see Secondary motor set. Soft start and soft stop are not available during jog operation.

CAUTION

Slow speed running is not intended for continuous operation due to reduced motor cooling. Jog changes the motor's heating profile and reduced the accuracy of the motor thermal model. Do not rely on motor overload protection to protection to protect the motor during jog operation.

5.6 Inside Delta Operation

AAC, Jog and Brake functions are not supported in inside delta (six-wire) operation. If these functions are programmed when the starter is connected inside delta the behaviour is as given below:

AAC Start	The starter performs a Constant Current Start.
AAC Stop	The starter performs a TVR Soft Stop if Stop Time is >0 secs. If Stop Time is set to 9 secs the starter performs a Coast to Stop.
Jog	The starter issues a warning with the error message Unsupported Option.
Brake	The starter performs a Coast to Stop.

Table 5.8

NOTE

When connected in inside delta, current imbalance is the only phase loss protection that is active during run. Do not disable current imbalance protection during inside delta operation.

NOTE

Inside delta operation is only possible with mains voltage ≤ 600 VAC.

5.7 Typical Start Currents

Use this information to determine the appropriate start current for your application.

NOTE

These start current requirements are appropriate and typical in most circumstances, However, the performance and start torque requirements of motors and machines do vary. For further assistance, contact your local supplier.

Application	Typical Start Current
General & Water	
Agitator	4.0 x FLC
Centrifugal pump	3.5 x FLC
Compressor (Screw, unloaded)	3.0 x FLC
Compressor (Reciprocating, unloaded)	4.0 x FLC
Conveyor	4.0 x FLC
Fan (damped)	3.5 x FLC
Fan (undamped)	4.5 x FLC
Mixer	4.5 x FLC
Positive displacement pump	4.0 x FLC
Submersible pump	3.0 x FLC
Metals & Mining	
Belt conveyor	4.5 x FLC
Dust collector	3.5 x FLC
Grinder	3.0 x FLC
Hammer mill	4.5 x FLC
Rock crusher	4.0 x FLC
Roller conveyor	3.5 x FLC
Roller mill	4.5 x FLC
Tumbler	4.0 x FLC
Wire draw machine	5.0 x FLC
Food Processing	
Bottle washer	3.0 x FLC
Centrifuge	4.0 x FLC
Dryer	4.5 x FLC
Mill	4.5 x FLC
Palletiser	4.5 x FLC
Separator	4.5 x FLC
Slicer	3.0 x FLC
Pulp and Paper	
Dryer	4.5 x FLC
Re-pulper	4.5 x FLC
Shredder	4.5 x FLC
Petrochemical	
Ball mill	4.5 x FLC
Centrifuge	4.0 x FLC
Extruder	5.0 x FLC
Screw conveyor	4.0 x FLC
Transport & Machine Tool	
Ball mill	4.5 x FLC
Grinder	3.5 x FLC
Material conveyor	4.0 x FLC
Palletiser	4.5 x FLC
Press	3.5 x FLC
Roller mill	4.5 x FLC
Rotary table	4.0 x FLC

Table 5.9

Application	Typical Start Current
Lumber & Wood products	
Bandsaw	4.5 x FLC
Chipper	4.5 x FLC
Circular saw	3.5 x FLC
Debarker	3.5 x FLC
Edger	3.5 x FLC
Hydraulic power pack	3.5 x FLC
Planer	3.5 x FLC
Sander	4.0 x FLC

Table 5.10

5.8 Installation with Main Contactor

The MCD 500 is installed with a main contactor (AC3 rated). Control voltage must be supplied from the input side of the contactor.

The main contactor is controlled by the MCD 500 Main Contactor output, which by default is assigned to Output Relay A (terminals 13, 14).

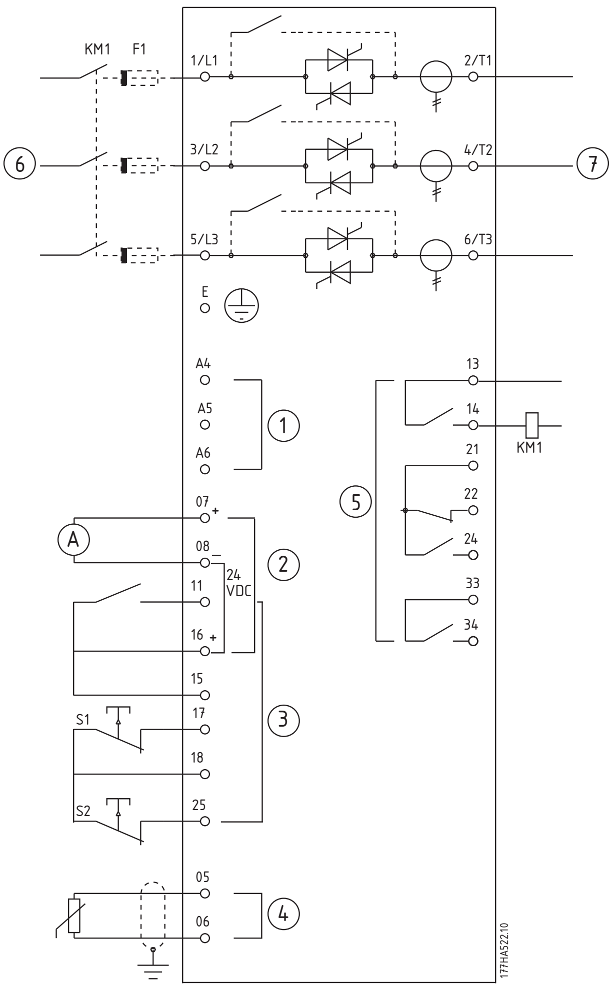


Illustration 5.10

1	Control voltage (model dependent)	KM1	Main contactor
2	24 VDC output	F1	Semiconductor fuses (optional)
3	Remote control inputs	S1	Start /stop
4	Motor thermistor input (PTC only)	S2	Reset contact
5	Relay outputs	13, 14	Relay output A
6	3-phase supply	21, 22, 24	Relay output B
7	Motor terminals	33, 34	Relay output C

Table 5.11

Parameter settings:

- *4-1 Relay A Function*
    - Select Main Contactor - assigns the Main Contactor function to Relay Output A (default value).

5.9 Installation with Bypass Contactor

The MCD 500 is installed with a bypass contactor (AC1 rated). The bypass contactor is controlled by the MCD 500 Run Output which by default is assigned to Output Relay B (terminals 21, 22, 24).

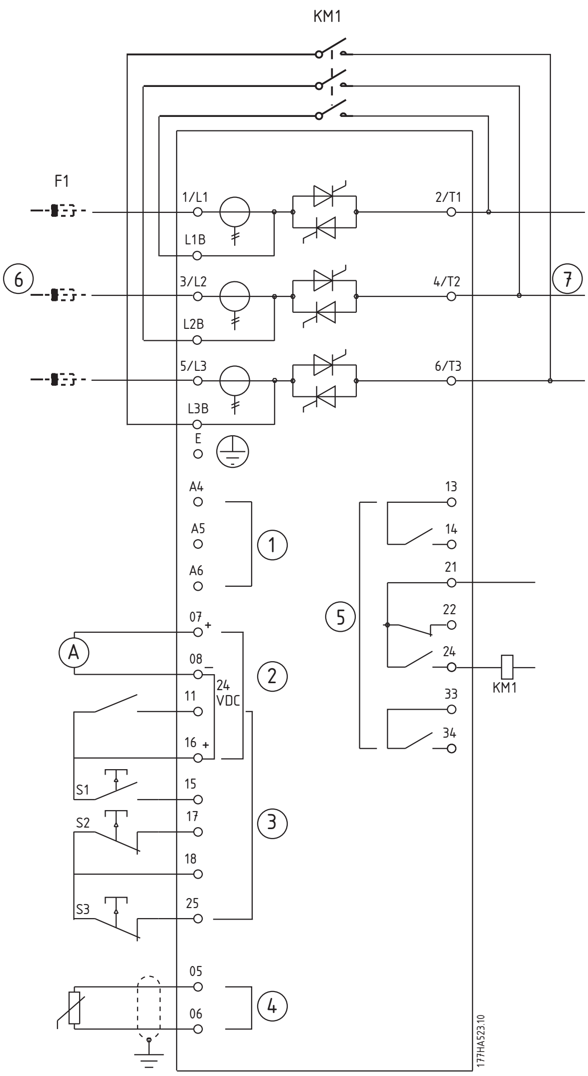


Illustration 5.11

1	Control voltage (model dependent)	KM1	Bypass contactor
2	24 VDC output	F1	Semiconductor fuses (optional)
3	Remote control inputs	S1	Start contact
4	Motor thermistor input (PTC only)	S2	Stop contact
5	Relay outputs	S3	Reset contact
6	3-phase supply	13, 14	Relay output A
7	Motor terminals	21, 22, 24	Relay output B
		33, 34	Relay output C

Table 5.12

Parameter settings:

- *4-4 Relay B Function*
    - Select Run - assigns the run output function to Relay Output B (default value).

5

5.10 Emergency Run Operation

In normal operation the MCD 500 is controlled via a remote two wire signal (terminals 17, 18).

Emergency Run is controlled by a two wire circuit connected to Input A (terminals 11, 16). Closing Input A causes the MCD 500 to run the motor and ignore all trip conditions.

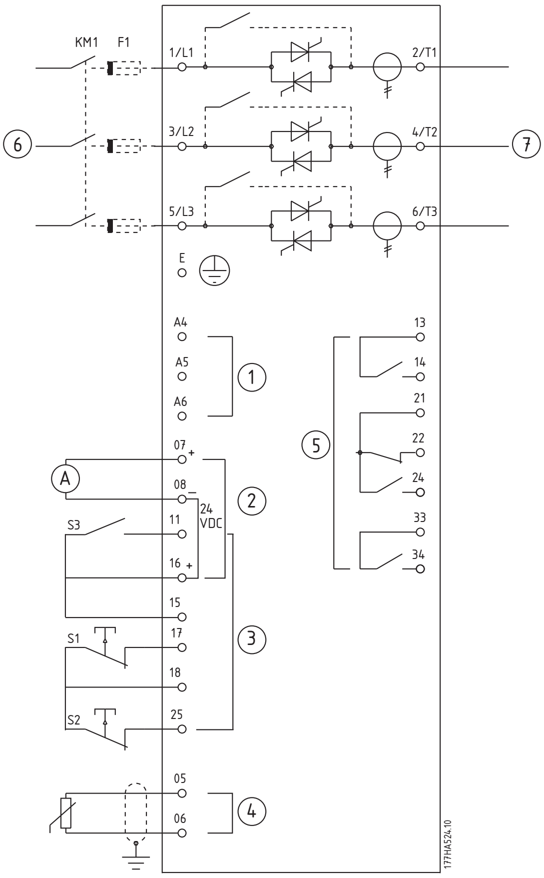


Illustration 5.12

1	Control voltage (model dependent)	S1	Start/stop contact
2	24 VDC output	S2	Reset contact
3	Remote control inputs	S3	Emergency Run contact
4	Motor thermistor input (PTC only)	13, 14	Relay output A
5	Relay outputs	21, 22, 24	Relay output B
6	3-phase supply	33, 34	Relay output C
7	Motor terminals		

Table 5.13

Parameter settings:

- *3-3 Input A Function*
    - Select Emergency Run - assigns Input A to Emergency Run Function
- *15-3 Emergency Run*
    - Select Enable - Enables the Emergency Run mode

5

5.11 Auxiliary Trip Circuit

In normal operation the MCD 500 is controlled via a remote two wire signal (terminals 17, 18).

Input A (terminals 11, 16) is connected to an external trip circuit (such as a low pressure alarm switch for a pumping system). When the external circuit activates, the soft starter trips, which stops the motor.

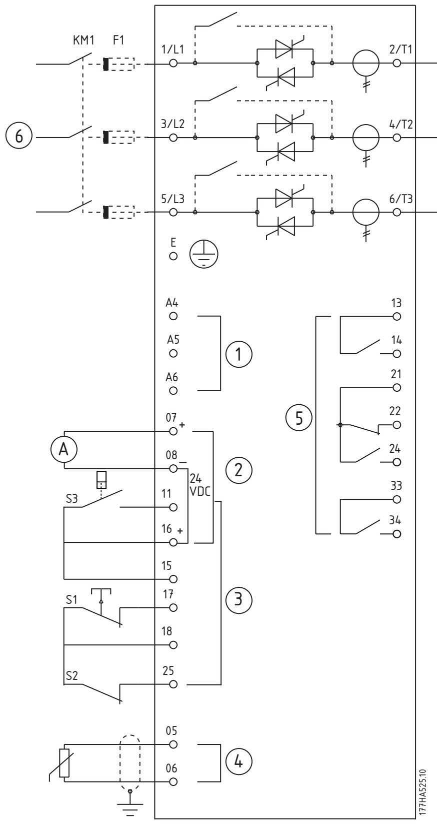


Illustration 5.13

1	Control voltage (model dependent)	S1	Start/stop contact
2	24 VDC output	S2	Reset contact
3	Remote control inputs	S3	Auxiliary trip contact
4	Motor thermistor input (PTC only)	13, 14	Relay output A
5	Relay outputs	21, 22, 24	Relay output B
6	3-phase supply	33, 34	Relay output C
7	Motor terminals		

Table 5.14

Parameter settings:

- *3-3 Input A Function*
  - Select Input Trip (N/O) assigns the Input A to Auxiliary Trip (N/O) function
- *3-4 Input A Name*
  - Select a name e.g. Low Pressure - assigns a name to Input A.
- *3-8 Remote Reset Logic*
  - Select as required e.g. Normally Closed - the input behaves like a normally closed contact.

5

5.12 DC Brake with External Zero Speed Sensor

For loads which may vary between braking cycles, there are benefits in using an external zero-speed sensor to interface with the MCD 500 for brake shut-off. This control method ensures that the MCD 500 braking will always shut off when the motor has reached a standstill, thus avoiding unnecessary motor heating.

The following schematic diagram shows how you can use a zero-speed sensor with the MCD 500 to turn the brake function off at motor standstill. The zero-speed sensor (-A2) is often referred to as an under-speed detector. Its internal contact is open at zero-speed and closed at any speed above zero-speed. Once the motor has reached a standstill, the MCD 500 will go into Emergency Stop mode and remain in this state until the next start command is given (i.e. next application of –KA1).

The MCD 500 must be operated in remote mode and *3-3 Input A Function* must be set to emergency stop.

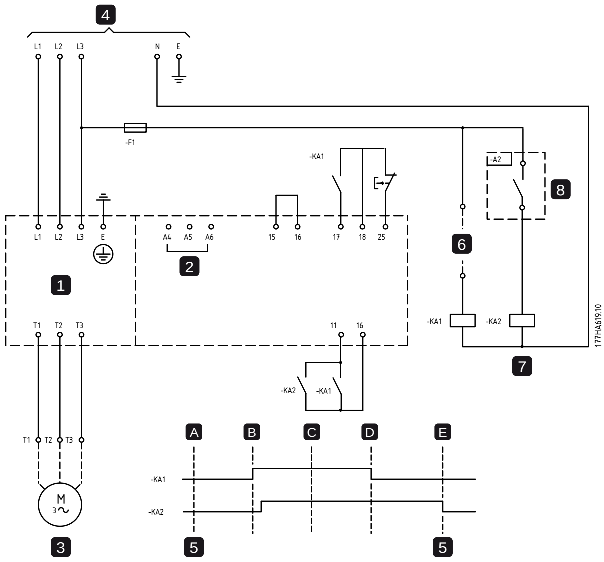


Illustration 5.14

1	Soft starter	4	Emergency stop mode (shown on starter display)
2	Control voltage	A	Off (ready)
15, 16	Start	B	Start
17, 18	Stop	C	Run
25, 18	Reset	D	Stop
2	Motor	E	Zero speed
3	Three-phase supply	5	Start signal (2, 3, or 4-wire)
		6	Zero speed detect
		7	Zero speed sensor

Table 5.15

For details on configuring DC Brake, see *5.4.4 Brake*.

NOTE

When using DC brake, the mains supply must be connected to the soft starter (input terminals L1, L2, L3) in positive phase sequence and *2-1 Phase Sequence* must be set to *Positive only*.

5.13 Soft Braking

For high inertia loads the MCD 500 can be configured for soft braking.

In this application the MCD 500 is employed with forward run and braking contactors. When MCD 500 receives a start signal (button S1), it closes the forward run contactor (KM1) and controls the motor according to the programmed primary motor settings.

When the MCD 500 receives a stop signal (button S2), it opens the forward run contactor (KM1) and closes the braking contactor (KM2) after a delay of approximately 2-3 seconds (KT1). KA3 is also closed to activate the secondary motor settings, which should be user programmed for the desired stopping performance characteristics.

When motor speed approaches zero, the external shaft rotation sensor (A2) stops the soft starter and opens the braking contactor (KM2).

Some shaft rotation sensors perform a self-test upon power-up and momentarily close the output relay. In these cases, also install a delay timer (KT3).

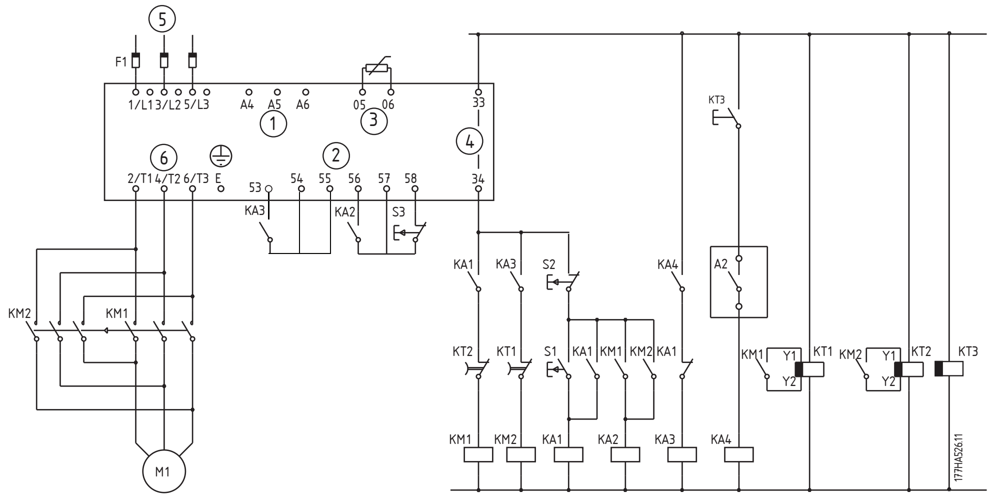


Illustration 5.15

1	Control voltage (model dependent)	KA1	Run relay
2	Remote control inputs	KA2	Start relay
3	Motor thermistor input (PTC only)	KA3	Brake relay
4	Relay outputs	KA4	Rotation sensing relay
5	3-phase supply	KM1	Line contactor (Run)
6	Motor terminals	KM2	Line contactor (Brake)
A2	Shaft rotation sensor	KT1	Run delay timer
S1	Start contact	KT2	Brake delay timer
S2	Stop contact	KT3	Shaft rotation sensor delay timer
S3	Reset contact		

Table 5.16

Parameter settings:

- *3-3 Input A Function*
    - Select Motor Set Select - assigns Input A for Motor set selection
    - Set starting performance characteristics using the primary motor set (parameter group 1)
    - Set braking performance characteristics using the secondary motor settings (parameter group 7)
- *4-7 Relay C Function*
    - Select Trip - assigns Trip function to Relay Output C

NOTE

If the MCD-500 trips on supply frequency (*16-5 Frequency*) when the braking contactor KM2 opens, modify the setting of Parameters 2-8 through 2-10.

5.14 Two Speed Motor

The MCD 500 can be configured for control of dual speed Dahlander type motors, using a high speed contactor (KM1), low speed contactor (KM2) and a star contactor (KM3).

NOTE

Pole Amplitude Modulated (PAM) motors alter the speed by effectively changing the stator frequency using external winding configuration. Soft starters are not suitable for use with this type of two-speed motor.

When the soft starter receives a high speed start signal, it closes the high speed contactor (KM1) and star contactor (KM3), then controls the motor according to the primary motor settings (parameters 1-1 through 1-16.)

When the soft starter receives a low speed start signal, it closes the low speed contactor (KM2). This closes Input A and the MCD 500 controls the motor according to the secondary motor settings (parameters 7-1 through 7-16).

NOTE

If the MCD 500 trips on supply frequency (*16-5 Frequency*) when the high-speed start signal (7) is removed, modify the setting of parameters 2-8 through 2-10.

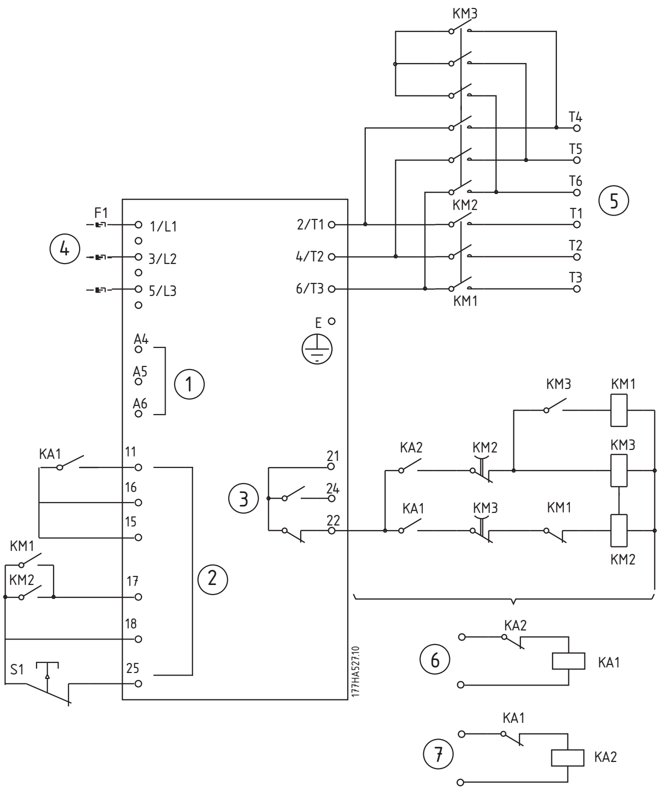


Illustration 5.16

1	Control voltage	6	Remote low-speed start input	KM2	Line contactor (low speed)
2	Remote control inputs	7	Remote high-speed start input	KM3	Star contactor (high speed)
3	Relay outputs	KA1	Remote start relay (low speed)	S1	Reset contact
4	3-phase supply	KA2	Remote start relay (high speed)	21, 22, 24	Relay output B
5	Motor terminals	KM1	Line contactor (high speed)		

Table 5.17

NOTE

Contactors KM2 and KM3 must be mechanically interlocked.

Parameter settings:

- *3-3 Input A Function*
    - Select Motor Set Select - assigns Input A for Motor set selection
    - Set high speed performance characteristics using parameters 1-1 - 2-9
    - Set low speed performance characteristics using parameters 7-1 - 7-16.
- *4-4 Relay B Function*
    - Select Trip - assigns Trip function to Relay Output B

6

6 Operation

6.1 Operation and LCP

6.1.1 Operating Modes

In Hand On mode:

- To soft start the motor, press [**Hand On**] on the LCP
- To stop the motor, press [**Off**] on the LCP
- To reset a trip on the starter, press [**Reset**] on the LCP
- To emergency stop the motor, press the local [**Off**] and [**Reset**] buttons at the same time. The soft starter will remove power from the motor and open the main contactor, and the motor will coast to stop. Emergency stop can also be controlled via a programmable input.

In Auto On mode:

- To soft start the motor, activate the Start remote input
- To stop the motor, activate the Stop remote input
- To reset a trip on the starter, activate the Reset remote input

NOTE

Brake and Jog functions operate only with in-line connected motors (see Inside Delta Operation)

6.1.2 The LCP

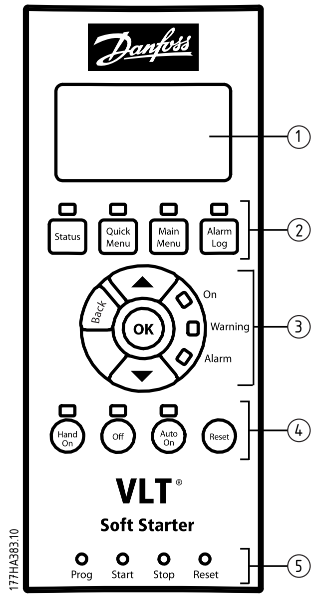


Illustration 6.1

1	Four-line display for status and programming details.
2	Display control buttons:
	Status: Return to the status displays **Quick Menu**: Open the Quick Menu **Main Menu**: Open the Main Menu **Alarm Log**: Open the Alarm Log
3	Menu navigation buttons:
	[**Back**]: Exit the menu or parameter, or cancel a parameter change [**OK**]: Enter a menu or parameter, or save a parameter change [▲] [▼]: Scroll to the next or previous menu or parameter, change the setting of the current parameter or scroll through the status screens.
4	Soft starter local control buttons:
	[**Hand On**]: Start the motor and enter local control mode. [**Off**]: Stop the motor (only active in Hand On mode). [**Auto On**]: Set the starter to Auto On mode. [**Reset**]: Reset a trip (Hand On mode only).
5	Remote input status LEDs.

Table 6.1

6.2 Remote Mounted LCP

A remote mounted LCP can be installed with the MCD 500. The Control Panel LCP501 can be mounted up to 3 metres away from the starter, for control and monitoring.

The starter can be controlled and programmed from either the remote LCP or the LCP on the starter. Both displays show the same information.

6.2.1 Synchronising the LCP and the Starter

The DB9 cable can be connected/disconnected from the LCP while the starter is running.

The first time a LCP is plugged into a starter, the starter will copy its parameter settings to the LCP.

New display detected

Table 6.2

If the LCP has previously been used with a MCD 500, the operator can select whether to copy the parameters to the starter, or to copy the MCD 500's parameter settings into the LCP.

Select the required option using the [▲] and [▼] buttons. The selected option is surrounded by a dotted line. Press OK to proceed with the selection. Copy Parameters Display to Starter Starter to Display

Copy parameters
Display to starter Starter to display

Table 6.3

NOTE

If the parameter software version in the LCP is different from the software version of the starter, only *Starter to Display* will be available.

NOTE

While the LCP is synchronising, only the [▲], [▼], [OK], and [Off] buttons are enabled.

6.3 Welcome Screen

When control power is applied, the starter will display the welcome screen

Ready	S1
Welcome 1.05 / 2.0 / 1.13 MCD5-0053-T5-G1-CV2	

Table 6.4

3rd display line: Software versions for Remote LCP, Control software, Model software
4th display line: Product model number

NOTE

The LCP version is only displayed if a Remote LCP 501 is connected when control power is applied. If no remote LCP is present, only the control software and model software versions will be displayed.

6

6.4 Control Methods

The MCD 500 can be controlled via the control buttons on the LCP (local control), via the remote inputs (remote control) or via the serial communication network.

- Local control is only available in Hand On mode.
- Remote control is only available in Auto On mode.
- Control via the serial communication network is always disabled in Hand On mode, and Start/Stop commands via the serial network may be enabled or disabled in Auto On mode by changing the setting of *3-2 Comms in Remote*.

The MCD 500 can also be configured to auto-start or auto-stop. Auto-start/stop operation is only available in Auto On mode, and must be configured using parameters 5-1 - 5-4. In Hand On mode, the starter will ignore any auto-start/stop setting.

To switch between Hand On and Auto On modes, use the local control buttons on the LCP.

[Hand On]: Start the motor and enter Hand On mode.
[Off]: Stop the motor and enter Hand On mode.
[Auto On]: Set the starter to Auto On mode.
[Reset]: Reset a trip (Hand On mode only).

The MCD 500 can also be set to allow local control only or remote control only, using *3-1 Local/Remote*.

If *3-1 Local/Remote* is set to *Remote Control Only*, the [Off] button is disabled and the motor must be stopped by remote control or via the serial communication network.

	Hand On mode	Auto On mode
To soft start the motor	press [Hand On] on the LCP	activate the Start remote input
To stop the motor	press [Off] on the LCP	activate the Stop remote input
To reset a trip on the starter	press [Reset] on the LCP	activate the Reset remote input
Auto start/stop operation	Disabled	Enabled

Table 6.5

To emergency stop the motor, press the local [Off] and [Reset] buttons at the same time. The soft starter will remove power from the motor and open the main contactor, and the motor will coast to stop. Emergency stop can also be controlled via a programmable input.

NOTE

Brake and Jog functions operate only with in-line connected motors (see *5.6 Inside Delta Operation*)

6

6.5 Local Control Buttons

If *3-1 Local/Remote* is set to *LCL/RMT Anytime* or *LCL/RMT When OFF*, the [Hand On] and [Auto On] buttons are always active. If the MCD 500 is in Auto On mode, pressing [Hand On] will enter Hand On mode and start the motor.

If *3-1 Local/Remote* is set to *Remote Control Only*, the [Off] button is disabled and the motor must be stopped by remote control or via the serial communication network.

6.6 Displays

The LCP displays a wide range of performance information about the soft starter. Press [Status] to access the status display screens, then use [▲] and [▼] to select the information to display. To return to the status screens from within a menu, press [Back] repeatedly or press [Status].

- Temperature monitoring
- Programmable screen (see parameters 8-2 - 8-5)
- Current
- Frequency
- Motor power
- Last start information
- Date and time
- SCR Conduction bar-graph
- Performance graphs

NOTE

Screens shown here are with the default settings.

6.6.1 Temperature Monitoring Screen (S1)

The temperature screen shows the temperature of the motor as a percentage of total thermal capacity, and also shows which motor data set is in use.

The temperature monitoring screen is the default status screen.

Ready		S1
MS1	000.0A	000.0kW
	Primary Motor Set	
M1 000%		

Table 6.6

6.6.2 Programmable Screen (S2)

The MCD 500's user-programmable screen can be configured to show the most important information for the particular application. Use parameters 8-2 to 8-5 to select which information to display.

Ready		S2
MS1	000.0A	000.0kW
	-.-- pf	
00000 hrs		

Table 6.7

6.6.3 Average Current (S3)

The average current screen shows the average current of all three phases.

Ready		S3
MS1	000.0A	000.0kW
	0.0A	

Table 6.8

6.6.4 Current Monitoring Screen (S4)

The current screen shows real-time line current on each phase.

Ready		S4
MS1	000.0A	000.0kW
	Phase currents	
000.0A	000.0A	000.0A

Table 6.9

6.6.5 Frequency Monitoring Screen (S5)

The frequency screen shows the mains frequency as measured by the soft starter.

Ready		S5
MS1	000.0A	000.0kW
	00.0Hz	

Table 6.10

6.6.6 Motor Power Screen (S6)

The motor power screen shows motor power (kW, HP and kVA) and power factor.

Ready		S6
MS1	000.0A	000.0kW
000.0kW		0000HP
0000kVA		-. - - pf

Table 6.11

6.6.7 Last Start Information (S7)

The last start information screen shows details of the most recent successful start:

- start duration (seconds)
- maximum start current drawn (as a percentage of motor full load current)
- calculated rise in motor temperature

Ready		S7
MS1	000.0A	000.0kW
Last start		000 s
000 % FLC		ΔTemp 0%

Table 6.12

6.6.8 Date and Time (S8)

The date/time screen shows the current system date and time (24 hour format). For details on setting the date and time, see *8.1 Set Date and Time*.

Ready		S8
MS1	000.0A	000.0kW
	YYYY MMM DD	
	HH:MM:SS	

Table 6.13

6.6.9 SCR Conduction Bargraph

The SCR conduction bargraph shows the level of conduction on each phase.

Illustration 6.2

6.6.10 Performance Graphs

The MCD 500 can display real-time performance information for:

- Current
- Motor temperature
- Motor kW
- Motor kVA
- Motor power factor

The newest information is displayed at the right hand edge of the screen. Older data is not stored. The graph can also be paused, to allow past performance to be analysed. To pause or unpause the graph, press and hold [**OK**] for more than 0.5 seconds.

NOTE

The MCD 500 will not collect data while the graph is paused. When graphing resumes, a small gap will be shown between the old data and the new data.

7 Programming

It is possible to access the programming menus at any time, including while the soft starter is running. All changes take effect immediately.

7.1 Access Control

Critical parameters (parameter group 15 and higher) are protected by a four-digit security access code, preventing unauthorised users from viewing or modifying parameter settings.

When a user attempts to enter a restricted parameter group, the LCP prompts for an access code. The access code is requested once for the programming session, and authorisation continues until the user closes the menu.

To enter the access code, press [Back] and [OK] to select a digit, and [▲] and [▼] to change the value. When all four digits match the access code, press [OK]. The LCP will display an acknowledgement message before continuing.

To change the access code, use *15-1 Access Code*.

Enter Access Code ####	
	OK
Access Allowed SUPERVISOR	

Table 7.1

NOTE

The protection simulation and output simulation are also protected by the security access code. The counters and thermal model reset can be viewed without entering an access code, but an access code must be entered in order to reset.
The default access code is 0000.

Lock the menus to prevent users from altering parameter settings. The adjustment lock can be set to allow *Read & Write*, *Read Only* or *No Access* in *15-2 Adjustment Lock*.

If a user attempts to change a parameter value or access the Main Menu when the adjustment lock is active, an error message is displayed:

Access Denied Adj Lock is On

Table 7.2

7.2 Quick Menu

7.2.1 Quick Setup

Quick setup provides access to commonly used parameters, allowing the user to configure the MCD 500 as required for the application. For details of individual parameters, see *Parameter Descriptions*.

1	**Primary Mtr Set**
1-1	Motor FLC
1-3	Start Mode
1-4	Current Limit
1-5	Initial Current
1-6	Start Ramp Time
1-9	Excess Start Time
1-10	Stop Mode
1-11	Stop Time
2	**Protection**
2-1	Phase Sequence
2-4	Undercurrent
2-5	Undercurrent Dly
2-6	Inst Overcurrent
2-7	Inst Overcurrent Dly
3	Inputs
3-3	Input A Function
3-4	Input A Name
3-5	Input A Trip
3-6	Input A Trip Dly
3-7	Input A Initial Dly
4	Outputs
4-1	Relay A Function
4-2	Relay A On Delay
4-3	Relay A Off Delay
4-4	Relay B Function
4-5	Relay B On Delay
4-6	Relay B Off Delay
4-7	Relay C Function
4-8	Relay C On Delay
4-9	Relay C Off Delay
4-10	Low Current Flag
4-11	High Current FLag
4-12	Motor Temp Flag
5	Start/Stop Timers
5-1	Auto-Start Type
5-2	Auto-Start Time
5-3	Auto-Stop Type
5-4	Auto-Stop Time
8	Display
8-1	Language
8-2	User Scrn Top L
8-3	User Scrn Top R
8-4	User Scrn Btm L
8-5	User Scrn Btm R

Table 7.3

7

7.2.2 Application Setups

The application setups menu makes it easy to configure the MCD 500 for common applications. The MCD 500 selects the parameters relevant to the application and suggests a typical setting, and you can adjust each parameter to suit your exact requirements.

On the display the highlighted values are suggested values and the values indicated by a ▶ are the loaded values.

Always set *1-1 Motor FLC* to match the motor's nameplate full load current. The suggested value for motor FLC is the starter's minimum FLC.

Pump Centrifugal	**Suggested Value**	**Compressor Recip**	**Suggested Value**
Motor Full Load Current		Motor Full Load Current	
Start Mode	Adaptive Control	Start Mode	Constant Current
Adaptive Start Profile	Early Acceleration	Start Ramp Time	10 seconds
Start Ramp Time	10 seconds	Current Limit	450%
Stop Mode	Adaptive Control		
Adaptive Stop Profile	Late Deceleration		
Stop Time	15 seconds		
Pump Submersible		**Conveyor**	
Motor Full Load Current		Motor Full Load Current	
Start Mode	Adaptive Control	Start Mode	Constant Current
Adaptive Start Profile	Early Acceleration	Start Ramp Time	5 seconds
Start Ramp Time	5 seconds	Current Limit	400%
Stop Mode	Adaptive Control	Stop Mode	Adaptive Control
Adaptive Stop Profile	Late Deceleration	Adaptive Stop Profile	Constant Deceleration
Stop Time	5 seconds	Stop Time	10 seconds
Fan Damped		**Crusher Rotary**	
Motor Full Load Current		Motor Full Load Current	
Start Mode	Constant Current	Start Mode	Constant Current
Current Limit	350%	Start Ramp Time	10 seconds
		Current Limit	400%
		Excess Start Time	30 seconds
		Locked Rotor Time	20 seconds
Fan Undamped		**Crusher Jaw**	
Motor Full Load Current		Motor Full Load Current	
Start Mode	Adaptive Control	Start Mode	Constant Current
Adaptive Start Profile	Constant Acceleration	Start Ramp Time	10 seconds
Start Ramp Time	20 seconds	Current Limit	450%
Excess Start Time	30 seconds	Excess Start Time	40 seconds
Locked Rotor Time	20 seconds	Locked Rotor Time	30 seconds
Compressor Screw			
Motor Full Load Current			
Start Mode	Constant Current		
Start Ramp Time	5 seconds		
Current Limit	400%		

Table 7.4

7.2.3 Loggings

The Loggings menu allows the user to view performance information in real-time graphs.

- Current (%FLC)
- Motor Temp (%)
- Motor kW (%)
- Motor kVA (%)
- Motor pf

The newest information is displayed at the right hand edge of the screen. The graph can be paused to analyse data by pressing and holding the [OK] button. To re-start the graph, press and hold [OK].

7.3 Main Menu

The Main Menu button provides access to menus for setting up the MCD 500 for complex applications and for monitoring its performance.

7.3.1 Parameters

Parameters allows viewing and changing all programmable parameters that control how the MCD 500 operates.

To open Parameters, press [Main Menu] then select Parameters.

To navigate through Parameters:

- to scroll through parameter groups, press [▲] or [▼].
- to view the parameters in a group, press [OK].
- to return to the previous level, press [Back].
- to close Parameters, press the [Back].

To change a parameter value:

- scroll to the appropriate parameter and press [OK] to enter edit mode.
- to alter the parameter setting, use the [▲] and [▼] buttons.
- to save changes, press [OK]. The setting shown on the display will be saved and the LCP will return to the parameter list.
- to cancel changes, press [Back]. The LCP will return to the parameter list without saving changes.

7.3.2 Parameter Shortcut

The MCD 500 also includes a parameter shortcut, which allows you to directly access a parameter within the Parameters menu.

- To access the parameter shortcut, press [Main Menu] for three seconds
- Use [▲] or [▼] to select the parameter group.
- Press [OK] or [Back] to move the cursor.
- Use [▲] or [▼] to select the parameter number.

Parameter shortcut
Please enter a Parameter number 01-01

Table 7.5

7

7.3.3 Parameter List

1	**Primary Mtr Set**	**4**	**Outputs**	7-12	Adaptv Ctrl Gain-2
1-1	Motor FLC	4-1	Relay A Function	7-13	Adaptv Start Prof-2
1-2	Locked Rotor Time	4-2	Relay A On Delay	7-14	Adaptv Stop Prof-2
1-3	Start Mode	4-3	Relay A Off Delay	7-15	Brake Torque-2
1-4	Current Limit	4-4	Relay B Function	7-16	Brake Time-2
1-5	Initial Current	4-5	Relay B On Delay	**8**	**Display**
1-6	Start Ramp Time	4-6	Relay B Off Delay	8-1	Language
1-7	Kickstart Level	4-7	Relay C Function	8-2	User Scrn Top L
1-8	Kickstart Time	4-8	Relay C On Delay	8-3	User Scrn Top R
1-9	Excess Start Time	4-9	Relay C Off Delay	8-4	User Scrn Btm L
1-10	Stop Mode	4-10	Low Current Flag	8-5	User Scrn Btm R
1-11	Stop Time	4-11	High Current FLag	8-6	Graph Timebase
1-12	Adaptv Control Gain	4-12	Motor Temp Flag	8-7	Graph Max Adj
1-13	Adaptv Start Profile	4-13	Analog Output A	8-8	Graph Min Adj
1-14	Adaptv Stop Profile	4-14	Analog A Scale	8-9	Mains Ref Volt
1-15	Brake Torque	4-15	Analog A Max Adj	**15**	**Restrict Paramtr**
1-16	Brake Time	4-16	Analog A Min Adj	15-1	Access Code
2	**Protection**	**5**	**Start/Stop Timers**	15-2	Adjustment Lock
2-1	Phase Sequence	5-1	Auto-Start Type	15-3	Emergency Run
2-2	Current Imbalance	5-2	Auto-Start Time	15-4	Current Calibrat
2-3	Current Imbal Dly	5-3	Auto-Stop Type	15-5	Main Cont Time
2-4	Undercurrent	5-4	Auto-Stop Time	15-6	Bypass Cont Time
2-5	Undercurrent Dly	**6**	**Auto-Reset**	15-7	Motor Connection
2-6	Inst Overcurrent	6-1	Auto-Reset Action	15-8	Jog Torque
2-7	Inst Ocrnt Dly	6-2	Maximum Resets	**16**	**Protection Action**
2-8	Frequency Check	6-3	Reset Dly Grp A & B	16-1	Motor Overload
2-9	Freq Variation	6-4	Reset Delay Grp C	16-2	Current Imbalance
2-10	Frequency Delay	**7**	**Secondary Mtr Set**	16-3	Undercurrent
2-11	Restart Delay	7-1	Motor FLC-2	16-4	Inst Overcurrent
2-12	Motor Temp Check	7-2	Lock Rotor Time-2	16-5	Frequency
3	**Inputs**	7-3	Start Mode-2	16-6	Heatsink Overtemp
3-1	Local/Remote	7-4	Current Limit-2	16-7	Excess Start Time
3-2	Comms in Remote	7-5	Initial Crnt-2	16-8	Input A Trip
3-3	Input A Function	7-6	Start Ramp-2	16-9	Motor Thermistor
3-4	Input A Name	7-7	Kickstart Lvl-2	16-10	Starter Comms
3-5	Input A Trip	7-8	Kickstart Time-2	16-11	Network Comms
3-6	Input A Trip Dly	7-9	Excess Strt Time-2	16-12	Battery/Clock
3-7	Input A Initial Dly	7-10	Stop Mode-2	16-13	Low Control Volts
3-8	Remote Reset Logic	7-11	Stop Time-2		

Table 7.6

7.4 Primary Motor Settings

NOTE

Default settings are marked with *.

The parameters in Primary Motors Settings configure the soft starter to match the connected motor. These parameters describe the motor's operating characteristics and allow the soft starter to model the motor's temperature.

1-1 Motor FLC

Option:	Function:
Model dependent	Matches the starter to the connected motor's full load current. Set to the full load current (FLC) rating shown on the motor nameplate.

1-2 Locked Rotor Time

Range:		Function:
10 secs*	[0:01 - 2:00 (min:sec)]	Sets the maximum length of the time the motor can run at locked rotor current from cold before reaching its maximum temperature. Set according to the motor datasheet. If this information is not available, we recommend the value should be less than 20 seconds.

1-3 Start Mode

Option:	Function:
	Selects the soft start mode. See *5.3 Starting Modes* for more details.
Constant Current*	
Adaptive Control	

1-4 Current Limit

Range:		Function:
350%*	[100% - 600% FLC]	Sets the current limit for constant current and current ramp soft starting, as a percentage of motor full load current. See *5.3 Starting Modes* for more details.

1-5 Initial Current

Range:		Function:
350%*	[100% - 600% FLC]	Sets the initial start current level for current ramp starting, as a percentage of motor full load current. Set so that the motor begins to accelerate immediately after a start is initiated. If current ramp starting is not required, set the initial current equal to the current limit. See *5.3 Starting Modes* for more details.

1-6 Start Ramp Time

Range:		Function:
10 secs*	[1 - 180 secs]	Sets the total start time for an AAC Adaptive Control start or the ramp time for current ramp starting (from the initial current to the current limit). See *5.3 Starting Modes* for more details.

1-7 Kickstart Level

Range:		Function:
500%*	[100% - 700% FLC]	Sets the level of the kickstart current. **CAUTION** **Kickstart subjects the mechanical equipment to increased torque levels. Ensure the motor, load and couplings can handle the additional torque before using this feature.**

1-8 Kickstart Time

Range:		Function:
0000 msecs*	[0 - 2000 msecs]	Sets the kickstart duration. A setting of 0 disables kickstart. See *5.3 Starting Modes* for more details. **CAUTION** **Kickstart subjects the mechanical equipment to increased torque levels. Ensure the motor, load and couplings can handle the additional torque before using this feature.**

1-9 Excess Start Time

Range:		Function:
		Excess start time is the maximum time the MCD 500 will attempt to start the motor. If the motor does not reach full speed within the programmed limit, the starter will trip. Set for a period slightly longer than required for a normal healthy start. A setting of 0 disables excess start time protection.
20 secs*	[0:00 - 4:00 (min:secs)]	Set as required.

1-10 Stop Mode

Option:	Function:
	Selects the stop mode. See *5.4 Stopping Modes* for more details.
Coast to Stop*	
TVR Soft Stop	

7

1-10 Stop Mode

Option:	Function:
Adaptive Control	
Brake	

1-11 Stop Time

Range:		Function:
0 secs*	[0:00 - 4:00 (min:secs)]	Sets the time for soft stopping the motor using timed voltage ramp or Adaptive Control (AAC). If a main contactor is installed, the contactor must remain closed until the end of the stop time. Use a programmable output configured to Run to control the main contactor. Sets the toal stopping time when using brake. See *5.4 Stopping Modes* for more details.

1-12 Adaptive Control Gain

Range:		Function:
75%*	[1% - 200%]	Adjusts the performance of AAC adaptive acceleration control. This setting affects both starting and stopping control. **NOTE** **We recommend leaving the gain setting at the default level unless AAC performance is not satisfactory. If the motor accelerates or decelerates quickly at the end of a start or stop, increase the gain setting by 5%~10%. If the motor speed fluctuates during starting or stopping, decrease the gain setting slightly.**

1-13 Adaptive Start Profile

Option:	Function:
	Selects which profile the MCD 500 will use for an AAC adaptive acceleration control soft start. See *5.4 Stopping Modes* for more details.
Early Acceleration	
Constant Acceleration*	
Late Acceleration	

1-14 Adaptive Stop Profile

Option:	Function:
	Selects which profile the MCD 500 will use for an AAC adaptive acceleration control soft stop. See *5.4 Stopping Modes* for more details.
Early Deceleration	
Constant Deceleration*	
Late Acceleration	

7.4.1 Brake

Brake uses DC injection to actively slow the motor. See *5.4 Stopping Modes* for more details.

1-15 Brake Torque

Range:		Function:
20%*	[20 - 100%]	Sets the amount of brake torque the MCD 500 will use to slow the motor.

1-16 Brake Time

Range:		Function:
1 sec*	[1 - 30 secs]	Sets the duration for DC injection during a braking stop. **NOTE** **This parameter is used in conjunction with *1-11 Stop Time*. See for details.**

7.5 Protection

2-1 Phase Sequence

Option:	Function:
	Selects which phase sequences the soft starter will allow at a start. During its pre-start checks, the starter examines the sequence of the phases at its input terminals and trips of the actual sequence does not match the selected option.
Any sequence*	
Positive only	
Negative only	

7.5.1 Current Imbalance

The MCD 500 can be configured to trip if the currents on the three phases vary from each other by more than a specified amount. The imbalance is calculated as the difference between the highest and lowest currents on all three phases, as a percentage of the highest current.

Current imbalance detection is desensitised by 50% during starting and soft stopping.

2-2 Current Imbalance

Range:		Function:
30%*	[10% - 50%]	Sets the trip point for current imbalance protection.

2-3 Current Imbalance Delay

Range:		Function:
3 secs*	[0:00 - 4:00 (min:secs)]	Slows the MCD 500's response to current imbalance, avoiding trips due to momentary fluctuations.

7.5.2 Undercurrent

The MCD 500 can be configured to trip if the average current of all three phases drops below a specified level while the motor is running.

2-4 Undercurrent

Range:		Function:
20%*	[0% - 100%]	Sets the trip point for undercurrent protection, as a percentage of motor full load current. Set to a level between the motor's normal working range and the motor's magnetising (no load) current (typically 25% to 35% of full load current). A setting of 0% disables undercurrent protection.

2-5 Undercurrent Delay

Range:		Function:
5 secs*	[0:00 - 4:00 (min:secs)]	Slows the MCD 500's response to undercurrent, avoiding trips due to momentary fluctuations.

7.5.3 Instantaneous Overcurrent

The MCD 500 can be configured to trip if the average current of all three phases exceeds a specified level while the motor is running.

2-6 Instantaneous Overcurrent

Range:		Function:
400%*	[80% - 600% FLC]	Sets the trip point for instantaneous overcurrent protection, as a percentage of motor full load current.

2-7 Instantaneous Overcurrent Delay

Range:		Function:
0 secs*	[0:00 - 1:00 (min:secs)]	Slows the MCD 500's response to overcurrent, avoiding trips due to momentary overcurrent events.

7.5.4 Frequency Trip

The MCD 500 monitors mains frequency throughout operation, and can be configured to trip is the frequency varies beyond a specified tolerance.

2-8 Frequency Check

	Option:	Function:
	Do not Check	
	Start Only	
	Start/Run*	
	Run Only	
		Determines when the starter will monitor for a frequency trip.

2-9 Frequency Variation

	Option:	Function:
		Selects the soft starter's tolerance for frequency variation. Running a motor outside its specified frequency for long periods can cause damage and premature failure.
	± 2 Hz	
	± 5 Hz*	
	± 10 Hz	
	± 15 Hz	

2-10 Frequency Delay

Range:		Function:
1 sec*	[0:01 - 4:00 (min:sec)]	Slows the MCD 500's response to frequency disturbances, avoiding trips due to momentary fluctuations. **NOTE** **If the mains frequency drops below 35 Hz or rises above 75 Hz, the starter will trip immediately.**

2-11 Restart Delay

Range:		Function:
10 secs*	[00:01 - 60:00 (min:secs)]	The MCD 500 can be configured to force a delay between the end of a stop and the beginning of the next start. During the restart delay, the display shows the time remaining before another start can be attempted. **NOTE** **The restart delay is measured from the end of each stop. Changes to the restart delay setting take effect immediately.**

2-12 Motor Temperature Check

	Option:	Function:
		Selects whether the MCD 500 will verify the motor has sufficient thermal capacity for a successful start. The soft starter compares the motor's calculated temperature with the temperature rise from the last motor start and only operates if the motor is cool enough to start successfully.
	Do not Check*	
	Check	

7.6 Inputs

3-1 Local/Remote

Option:	Function:
	Selects when the [Auto On] and [Hand On] buttons can be used to switch to Hand On or Auto On modes.
Lcl/Rmt anytime*	The user can change between local and remote control at any time.
Local Control Only	All remote inputs are disabled.
Remote Control Only	Selects whether the starter can be used in Hand On or Auto On modes.

3-2 Comms in Remote

Option:	Function:
	Selects whether the starter will accept Start and Stop commands from the serial communication network when in Remote mode. The Force Comms Trip, Local/Remote Control and Test Start and Reset commands are always enabled.
Disable Ctrl in RMT	
Enable Ctrl in RMT*	

3-3 Input A Function

Option:	Function:
	Selects the function of Input A.
Motor Set Select*	The MCD 500 can be configured with two separate sets of motor data. The primary motor data is programmed using Parameters 1-1 to 1-16. The secondary motor data is programmed using Parameters 7-1 to 7-16. To use the secondary motor data, this parameter must be set to *Motor Set Select* and 11, 16 must be closed when a start command is given. The MCD 500 checks which motor data to use at a start, and will use that motor data for the entire start/stop cycle.
Input Trip (N/O)	Input A can be used to trip the soft starter. When this parameter is set to *Input Trip (N/O)*, a closed circuit across 11, 16 trips the soft starter (Parameters 3-5, 3-6, 3-7).
Input Trip (N/C)	When this parameter is set to *Input Trip (N/C)*, an open circuit across 11, 16 trips the soft starter (Parameters 3-5, 3-6, 3-7).
Local/Remote Select	Input A can be used to select between local and remote control, instead of using the buttons on theLCP. When the input is open, the starter is in local mode and can be controlled via the LCP. When the input is closed, the starter is in remote mode. The [Hand On] and [Auto On] buttons are disabled, and the soft starter will ignore any Local/Remote select command from the serial communications network. To use Input A to select between local and remote control, *3-1 Local/Remote* must be set to *LCL/RMT Anytime*.
Emergency Run	In emergency run the soft starter continues to run until stopped, ignoring all trips and warnings (see *15-3 Emergency Run* for details). Closing the circuit across 11, 16 activates emergency run. Opening the circuit ends emergency run and the MCD 500 stops the motor.
Emergency Stop	The MCD 500 can be commanded to emergency stop the motor, ignoring the soft stop mode set in *1-10 Stop Mode*. When the circuit across 11, 16 is opened, the soft starter allows the motor to coast to stop.
Jog Forward	Activates jog operation in a forward direction (will operate only in Remote mode).
Jog Reverse	Activates jog operation in reverse direction (will operate only in Remote mode).

3-4 Input A Name

Option:	Function:
	Selects a message for the LCP to display when Input A is active.
Input Trip*	
Low Pressure	
High Pressure	
Pump Fault	
Low Level	
High Level	
No Flow	
Emergency Stop	
Controller	
PLC	
Vibration Alarm	

3-5 Input A Trip

Option:	Function:
	Selects when an input trip can occur.
Always Active*	A trip can occur at any time when the soft starter is receiving power.
Operating Only	A trip can occur while the soft starter is running, stopping or starting.
Run Only	A trip can only occur while the soft starter is running.

3-6 Input A Trip Delay

Range:		Function:
0 secs*	[0:00 - 4:00 (min:secs)]	Sets delay between the input activating and soft starter tripping.

3-7 Input A Initial Delay

Range:		Function:
0 secs*	[00:00 - 30:00 (min:secs)]	Sets a delay before an input trip can occur. The initial delay is counted from the time a start signal is received. The state of the input is ignored until the initial delay has elapsed.

3-8 Remote Reset Logic

Option:	Function:
	Selects whether the MCD 500's remote reset input (terminals 25, 18) is normally open or normally closed.
Normally Closed*	
Normally Open	

7.7 Outputs

4-1 Relay A Function

Option:	Function:
	Selects the function of Relay A (normally open).
Off	Relay A is not used
Main Contactor*	The relay closes when the MCD 500 receives a start command, and remains closed as long as the motor is receiving voltage.
Run	The relay closes when the starter changes to run state.
Trip	The relay closes when the starter trips.
Warning	The relay closes when the starter issues a warning.
Low Current Flag	The relay closes when the low current flag activates (*4-10 Low Current Flag*).
High Current Flag	The relay closes when the high current flag activates (*4-11 High Current Flag*).
Motor Temp Flag	The relay closes when the motor temperature flag activates (*4-12 Motor Temperature Flag*).

7.7.1 Relay A Delays

The MCD 500 can be configured to wait before opening or closing Relay A.

4-2 Relay A On Delay

Range:		Function:
0 secs*	[0:00 - 5:00 (min:secs)]	Sets the delay for closing Relay A.

4-3 Relay A Off Delay

Range:		Function:
0 secs*	[0:00 - 5:00 (min:secs)]	Sets the delay for re-opening Relay A.

7.7.2 Relays B and C

Parameters 4-4 to 4-9 configure the operation of Relays B and C in the same way as parameters 4-1 to 4-3 configure Relay A.

4-4 Relay B Function

Option:	Function:
	Selects the function of Relay B (changeover).
Off	Relay B is not used
Main Contactor	The relay closes when the MCD 500 receives a start command, and remains closed as long as the motor is receiving voltage.
Run*	The relay closes when the starter changes to run state.
Trip	The relay closes when the starter trips.
Warning	The relay closes when the starter issues a warning.
Low Current Flag	The relay closes when the low current flag activates (*4-10 Low Current Flag*).
High Current Flag	The relay closes when the high current flag activates (*4-11 High Current Flag*).
Motor Temp Flag	The relay closes when the motor temperature flag activates (*4-12 Motor Temperature Flag*).

4-5 Relay B On Delay

Range:		Function:
0 secs*	[0:00 - 5:00 (min:secs)]	Sets the delay for closing Relay B.

4-6 Relay B Off Delay

Range:		Function:
0 secs*	[0:00 - 5:00 (min:secs)]	Sets the delay for re-opening Relay B.

4-7 Relay C Function

Option:	Function:
	Selects the function of Relay C (normally open).
Off	Relay C is not used
Main Contactor	The relay closes when the MCD 500 receives a start command, and remains closed as long as the motor is receiving voltage.
Run	The relay closes when the starter changes to run state.
Trip*	The relay closes when the starter trips.
Warning	The relay closes when the starter issues a warning.
Low Current Flag	The relay closes when the low current flag activates (*4-10 Low Current Flag*).
High Current Flag	The relay closes when the high current flag activates (*4-11 High Current Flag*).
Motor Temp Flag	The relay closes when the motor temperature flag activates (*4-12 Motor Temperature Flag*).

4-8 Relay C On Delay

Range:		Function:
0 secs*	[0:00 - 5:00 (min:secs)]	Sets the delay for closing Relay C.

4-9 Relay C Off Delay

Range:		Function:
0 secs*	[0:00 - 5:00 (min:secs)]	Sets the delay for re-opening Relay C.

7.7.3 Low Current Flag and High Current Flag

The MCD 500 has low and high current flags to give early warning of abnormal operation. The current flags can be configured to indicate an abnormal current level during operation, between the normal operating level and the undercurrent or instantaneous overcurrent trip levels. The flags can signal the situation to external equipment via one of the programmable outputs. The flags clear when the current returns within the normal operating range by 10% of the programmed motor full load current.

4-10 Low Current Flag

Range:		Function:
50%*	[1% - 100% FLC]	Sets the level at which the low current flag operates, as a percentage of motor full load current.

4-11 High Current Flag

Range:		Function:
100%*	[50% - 600% FLC]	Sets the level at which the high current flag operates, as a percentage of motor full load current.

7.7.4 Motor Temperature Flag

The MCD 500 has a motor temperature flag to give early warning of abnormal operation. The flag can indicate that the motor is operating above its normal operating temperature, but lower than the overload limit. The flag can signal the situation to external equipment via one fo the programmable outputs.

4-12 Motor Temperature Flag

Range:		Function:
80%*	[0% - 160%]	Sets the level at which the motor temperature flag operates, as a percentage of the motor's thermal capacity.

7.7.5 Analog Output A

The MCD 500 has an analog output, which can be connected to associated equipment to monitor motor performance.

4-13 Analog Output A

Option:	Function:
	Selects which information will be reported via analog output A.
Current (% FLC)*	Current as a percentage of motor full load current.
Motor Temp (%)	Motor temperature as a percentage of the motor service factor (calculated by the soft starter's thermal model).
Motor kW (%)	Motor kilowatts. 100% is motor FLC (*1-1 Motor FLC*) multiplied by mains reference voltage (*8-9 Mains Reference Voltage*). Power factor is assumed to be 1.0. $\frac{\sqrt{3} \times V \times I_{FLC} \times pf}{1000}$
Motor kVA (%)	Motor kilovolt amperes. 100% is motor FLC (*1-1 Motor FLC*) multiplied by mains reference voltage (*8-9 Mains Reference Voltage*). $\frac{\sqrt{3} \times V \times I_{FLC}}{1000}$
Motor pf	Motor power factor, measured by the soft starter.

4-14 Analog A Scale

Option:	Function:
	Selects the range of the output.
0-20 mA	
4-20 mA*	

4-15 Analog A Maximum Adjustment

Range:		Function:
100%*	[0% - 600%]	Calibrates the upper limit of the analog output to match the signal measured on an external current measuring device.

4-16 Analog A Minimum Adjustment

Range:		Function:
0%*	[0% - 600%]	Calibrates the lower limit of the analog output to match the signal measured on an external current measuring device.

7.8 Start/Stop Timers

⚠CAUTION

The auto-start timer overrides any other form of control. The motor may start without warning.

5-1 Auto-Start Type

Option:	Function:
	Selects whether the soft starter will auto-start after a specified delay, or at a time of day.
Off*	The soft starter will not auto-start.
Timer	The soft starter will auto-start after a delay from the next stop, as specified in *5-2 Auto-start Time*.
Clock	The soft starter will auto-start at the time programmed in *5-2 Auto-start Time*.

5-2 Auto-Start Time

Range:		Function:
1 min*	[00:01 - 24:00 (hrs:min)]	Sets the time for the soft starter to auto-start, in 24 hour clock format.

5-3 Auto-Stop Type

Option:	Function:
	Selects whether the soft starter will auto-stop after a specified delay, or at a time of day.
Off*	The soft starter will not auto-stop.
Time	The soft starter will auto-stop after a delay from the next start, as specified in *5-4 Auto-stop Time*.
Clock	The soft starter will auto-stop at the time programmed in *5-4 Auto-stop Time*.

5-4 Auto-Stop Time

Range:		Function:
1 min*	[00:01 - 24:00 (hrs:min)]	Sets the time for the soft starter to auto-stop, in 24 hour clock format. **CAUTION** **This function should not be used in conjunction with remote two-wire control. The soft starter will still accept start and stop commands from the remote inputs or serial communication network. To disable local or remote control, use *3-1 Local/Remote*. If auto-start is enabled and the user is in the menu system, auto-start will become active if the menu times out (if no LCP activity is detected for five minutes).**

7.9 Auto-Reset

The MCD 500 can be programmed to automatically reset certain trips, which can help minimise operating downtime. Trips are divided into three categories for auto-reset, depending on the risk to the soft starter:

Group	
A	Current Imbalance
	Phase Loss
	Power Loss
	Mains Frequency
B	Undercurrent
	Instantaneous Overcurrent
	Input A Trip
C	Motor Overload
	Motor Thermistor
	Starter Overtemperature

Table 7.7

Other trips cannot be automatically reset.

This function is ideal for remote installations using 2-wire control in Auto On mode. If the 2-wire start signal is present after an auto-reset, the MCD 500 will restart.

6-1 Auto-Reset Action

Option:	Function:
	Selects which trips can be auto-reset.
Do not Auto-Reset*	
Reset Group A	
Reset Group A & B	
Reset Group A, B & C	

6-2 Maximum Resets

Range:		Function:
1*	[1 - 5]	Sets how many times the soft starter will auto-reset, if it continues to trip. The reset counter increases by one each time the soft starter auto-resets, and decreases by one after each successful start/stop cycle.

NOTE
The reset counter will return to 0 if the starter is manually reset.

7.9.1 Auto-Reset Delay

The MCD 500 can be configured to wait before auto-resetting a trip. Separate delays can be set for trips in Groups A and B, or in Group C.

6-3 Reset Delay Groups A & B

Range:		Function:
5 secs*	[00:05 - 15:00 (min:secs)]	Sets the auto-reset delay for Group A and Group B trips.

6-4 Reset Delay Group C

Range:		Function:
5 min*	[5 - 60 (minutes)]	Sets the auto-reset delay for Group C trips.

7.10 Secondary Motor Set

7-1 Motor FLC-2

Range:	Function:
[Motor dependent]	Matches the starter to the second motor's full load current. Set to the full load current (FLC) rating shown on the motor nameplate.

7

7-2 Locked Rotor Time-2

Range:		Function:
10 secs*	[0:01 - 2:00 (min:secs)]	Sets the maximum length of the time the motor can run at locked rotor current from cold before reaching its maximum temperature. Set according to the motor datasheet. If this information is not available, we recommend the value should be less than 20 seconds.

7-3 Start Mode-2

Option:	Function:
	Selects the start mode for the secondary motor.
Constant Current*	
Adaptive Control	

7-4 Current Limit-2

Range:		Function:
350%*	[100% - 600% FLC]	Sets the current limit for constant current and current ramp soft starting, as a percentage of motor full load current.

7-5 Initial Current-2

Range:		Function:
350%*	[100% - 600% FLC]	Sets the initial start current level for current ramp starting, as a percentage of motor full load current. Set so that the motor begins to accelerate immediately after a start is initiated. If current ramp starting is not required, set the initial current equal to the current limit.

7-6 Start Ramp Time-2

Range:		Function:
10 secs*	[1 - 180 secs]	Sets the total start time for an AAC Adaptive Control start or the ramp time for current ramp starting (from the initial current to the current limit).

7-7 Kickstart Level-2

Range:		Function:
500%*	[100% - 700% FLC]	Sets the level of the kickstart current.

7-8 Kickstart Time-2

Range:		Function:
0000 msecs*	[0 - 2000 msecs]	Sets the kickstart duration. A setting of 0 disables kickstart.

7-9 Excess Start Time-2

Range:		Function:
		Excess start time is the maximum time the MCD 500 will attempt to start the motor. If the motor does not reach full speed within the programmed limit, the starter will trip. Set for a period slightly longer than required for a normal healthy start. A setting of 0 disables excess start time protection.
20 secs*	[0:00 - 4:00 (min:secs)]	Set the excess time for the secondary motor.

7-10 Stop Mode-2

Option:	Function:
	Selects the stop mode for the secondary motor.
Coast to Stop*	
TVR Soft Stop	
Adaptive Control	
Brake	

7-11 Stop Time-2

Range:		Function:
0 secs*	[0:00 - 4:00 (min:secs)]	Sets the time for soft stopping the motor using timed voltage ramp or Adaptive Control (AAC). If a main contactor is installed, the contactor must remain closed until the end of the stop time. Use a programmable output configured to Run to control the main contactor. Sets the toal stopping time when using brake.

7-12 Adaptive Control Gain-2

Range:		Function:
75%*	[1% - 200%]	Adjusts the performance of AAC adaptive acceleration control. **NOTE** **We recommend leaving the gain setting at the default level unless AAC performance is not satisfactory.** **If the motor accelerates or decelerates quickly at the end of a start or stop, increase the gain by setting by 5% - 10%. If the motor speed fluctuates during starting or stopping, decrease the gain setting slightly.**

7-13 Adaptive Start Profile-2

Option:	Function:
	Selects which profile the MCD 500 will use for an AAC adaptive acceleration control soft start.
Early Acceleration	
Constant Acceleration*	
Late Acceleration	

7-14 Adaptive Stop Profile-2

Option:	Function:
	Selects which profile the MCD 500 will use for an AAC adaptive acceleration control soft stop.
Early Deceleration	
Constant Deceleration*	
Late Acceleration	

7-15 Brake Torque-2

Range:		Function:
20%*	[20 - 100%]	Sets the amount of brake torque the MCD 500 will use to slow the motor.

7-16 Brake Time-2

Range:		Function:
1 sec*	[1 - 30 secs]	Sets the duration for DC injection during a braking stop. **NOTE** **This parameter is used in conjunction with *7-11 Stop Time-2*.**

7.11 Display

8-1 Language

Option:	Function:
	Selects which language the LCP will use to display messages and feedback.
English*	
Chinese (中文)	
Spanish (Español)	
German (Deutsch)	
Portuguese (Português)	
French (Français)	
Italian (Italiano)	
Russian (Русский)	

7.11.1 User Programmable Screen

Selects which four items will be displayed on the programmable monitoring screen.

8-2 User Screen - Top Left

Option:	Function:
	Selects the item displayed in the top left part of the screen.
Blank	Displays no data in the selected area, allowing long messages to be shown without overlapping.
Starter State	The starter's operating state (starting, running, stopping or tripped). Only available for “Top L” and “Btm L”.
Motor Current	The average current measured on three phases.
Motor pf*	The motor's power factor, measured by the soft starter.
Mains Frequency	The average frequency measured on three phases.
Motor kW	The motor's running power in kilowatts.
Motor HP	The motor's running power in horsepower.
Motor Temp	The motor's temperature, calculated by the thermal model.
kWh	The number of kilowatt hours the motor has run via the soft starter.
Hours Run	The number of hours the motor has run via the soft starter.

8-3 User Screen - Top Right

Option:	Function:
	Selects the item displayed in the top right part of the screen.
Blank*	Displays no data in the selected area, allowing long messages to be shown without overlapping.
Starter State	The starter's operating state (starting, running, stopping or tripped). Only available for “Top L” and “Btm L”.
Motor Current	The average current measured on three phases.
Motor pf	The motor's power factor, measured by the soft starter.
Mains Frequency	The average frequency measured on three phases.
Motor kW	The motor's running power in kilowatts.
Motor HP	The motor's running power in horsepower.
Motor Temp	The motor's temperature, calculated by the thermal model.
kWh	The number of kilowatt hours the motor has run via the soft starter.
Hours Run	The number of hours the motor has run via the soft starter.

7

7

8-4 User Screen - Bottom Left

Option:	Function:
	Selects the item displayed in the bottom left part of the screen.
Blank	Displays no data in the selected area, allowing long messages to be shown without overlapping.
Starter State	The starter's operating state (starting, running, stopping or tripped). Only available for “Top L” and “Btm L”.
Motor Current	The average current measured on three phases.
Motor pf	The motor's power factor, measured by the soft starter.
Mains Frequency	The average frequency measured on three phases.
Motor kW	The motor's running power in kilowatts.
Motor HP	The motor's running power in horsepower.
Motor Temp	The motor's temperature, calculated by the thermal model.
kWh	The number of kilowatt hours the motor has run via the soft starter.
Hours Run*	The number of hours the motor has run via the soft starter.

8-5 User Screen - Bottom Right

Option:	Function:
	Selects the item displayed in the bottom right part of the screen.
Blank*	Displays no data in the selected area, allowing long messages to be shown without overlapping.
Starter State	The starter's operating state (starting, running, stopping or tripped). Only available for “Top L” and “Btm L”.
Motor Current	The average current measured on three phases.
Motor pf	The motor's power factor, measured by the soft starter.
Mains Frequency	The average frequency measured on three phases.
Motor kW	The motor's running power in kilowatts.
Motor HP	The motor's running power in horsepower.
Motor Temp	The motor's temperature, calculated by the thermal model.
kWh	The number of kilowatt hours the motor has run via the soft starter.
Hours Run	The number of hours the motor has run via the soft starter.

7.11.2 Performance Graphs

The loggings menu allows the user to view performance information in real-time graphs.

The newest information is displayed at the right hand edge of the screen. The graph can be paused to analyse data by pressing and holding the OK button. To re-start the graph, press and hold OK.

8-6 Graph Timebase

Option:	Function:
	Sets the graph time scale. The graph will progressively replace the old data with new data.
10 secs*	
30 secs	
1 min	
5 minutes	
10 minutes	
30 minutes	
1 hour	

8-7 Graph Maximum Adjustment

Range:		Function:
400%*	[0% - 600%]	Adjusts the upper limit of the performance graph

8-8 Graph Minimum Adjustment

Range:		Function:
0%*	[0% - 600%]	Adjusts the lower limit of the performance graph.

8-9 Mains Reference Voltage

Range:		Function:
400 V*	[100 - 690 V]	Sets the nominal voltage for the LCP's monitoring functions. This is used to calculate motor kilowatts and kilovolt amperes (kVA), but does not affect the MCD 500's motor control protection. Enter the measured mains voltage.

7.12 Restricted Parameters

15-1 Access Code

Range:		Function:
0000*	[0000 - 9999]	Sets the access code to enter the simulation tools and counter resets or the restricted section of the Programming Menu (parameter group 15 and higher). Use [Back] and [OK] to select which digit to alter and use [▲] and [▼] to change the value. **NOTE** **In the event of a lost access code, contact your supplier for master access code that allows you to re-program a new access code.**

15-2 Adjustment Lock

Option:	Function:
	Selects whether the LCP will allow parameters to be changed via the Programming Menu.
Read & Write*	Allows users to alter parameter values in the Programming Menu
Read Only	Prevents users altering parameter values in the Programming Menu. Parameter values can still be viewed.
No Access	Prevents users adjusting parameters in the Programming Menu unless an access code is entered.
	NOTE **Changes to the Adjustment Lock setting take effect only after the Programming Menu has been closed.**

15-3 Emergency Run

Option:	Function:
	Selects whether the soft starter will permit emergency run operation. In emergency run, the soft starter will start (if not already running) and continue to operate until emergency run ends, ignoring stop commands and trips. Emergency run is controlled using a programmable input. When Emergency Run is activated in internally bypassed models which are not running, the starter will attempt a normal start while ignoring all trips. If a normal start is not possible, a DOL start via the internal bypass relays will be attempted. For non-bypassed models, an external emergency run bypass contactor may be used.

15-4 Current Calibration

Range:		Function:
100%*	[85% - 115%]	Motor Current Calibration calibrates the soft starter's current monitoring circuits to match an external current metering device. Use the following formula to determine the necessary adjustment: $Calibration\ (\%) = \frac{Current\ shown\ on\ MCD\ 500\ display}{Current\ measured\ by\ external\ device}$ $e.g.\ 102\ \% = \frac{66\ A}{65\ A}$ **NOTE** **This adjustment affects all current-based functions.**

15-5 Main Contactor Time

Range:		Function:
400 msecs*	[100 - 2000 msecs]	Sets the delay period between the starter switching the main contactor output (terminals 13, 14) and beginning the pre-start checks (before start) or entering the not ready state (after a stop). Set according to the specifications of the main contactor used.

15-6 Bypass Contactor Time

Range:		Function:
150 msecs*	[100 - 2000 msecs]	Sets the starter to match the bypass contactor closing time. Set according to the specifications of the bypass contactor used. If the time is too short, the starter will trip.

15-7 Motor Connection

Option:	Function:
	Selects the soft starter will automatically detect the format of the connection to the motor.
Auto-Detect*	
In-line	
Inside Delta	

15-8 Jog Torque

Range:		Function:
50%*	[20% - 100%]	Sets the torque level for jog operation. See the section *Jog Operation* for more details.

NOTE

Setting this parameter above 50% may cause increased shaft vibration.

7

7

7.13 Protection Action

16-1 - 16-12 Protection Action

Option:	Function:
	Selects the soft starter's response to each protection. • 16-1 Motor Overload • 16-2 Current Imbalance • 16-3 Undercurrent • 16-4 Inst Overcurrent • 16-5 Frequency • 16-6 Heatsink Overtemp • 16-7 Excess Start Time • 16-8 Input A Trip • 16-9 Motor Thermistor • 16-10 Starter/Comms • 16-11 Network/Comms • 16-12 Battery/Clock • 16-13 Low Control Volts
Trip Starter*	
Warn and Log	
Log Only	

7.14 Factory Parameters

These parameters are restricted for Factory use and are not available to the user.

8 Tools

To access Tools, open the Main Menu, scroll to Tools and press [OK].

8.1 Set Date and Time

To set the date and time:

1. Open the Tools Menu.
2. Scroll to *Set Date & Time*.
3. Press [OK] to enter edit mode.
4. Press [OK] to select which part of the date or time to edit.
5. Use [▲] and [▼] to change the value.

To save changes, press [OK] repeatedly. The MCD 500 will confirm the changes. To cancel changes, press [Back] repeatedly.

8.2 Load/Save Settings

The MCD 500 includes options to:

- Load defaults: Load the MCD 500's parameters with default values
- Load User Set 1: Reload previously saved parameter settings from an internal file
- Save User Set 1: Save the current parameter settings to an internal file

In addition to the factory default values file, the MCD 500 can store a user-defined parameter file. This file contains default values until a user file is saved.

To load or save parameter settings:

1. Open the Tools Menu.
2. Use [▼] to select the required function, then press [OK].
3. At the confirmation prompt, select YES to confirm or NO to cancel and then [OK] to load/save the selection or exit the screen.

Tools
Load Defaults
Load User Set 1
Save User Set 1

Table 8.1

Load Defaults
No
Yes

Table 8.2

When the action has been completed, the screen will briefly display a confirmation message, then return to the status screens.

8.3 Reset Thermal Model

NOTE

This function is protected by the security access code.

The MCD 500's advanced thermal modelling software constantly monitors the motor's performance. This allows the MCD 500 to calculate the motor's temperature and ability to start successfully at any time.

The thermal model can be reset if required.

1. Open Tools.
2. Scroll to Reset Thermal Model and press [OK].
3. At the confirmation prompt, press [OK] to confirm then enter the access code, or press [Back] to cancel the action.
4. Select Reset or Do Not Reset, then press [OK]. When the thermal model has been reset, the MCD 500 will return to the previous screen.

Reset Thermal Model
M1 X%
OK to Reset

Table 8.3

Reset Thermal Model
Do Not Reset
Reset

Table 8.4

CAUTION

Adjusting the motor thermal model may compromise motor life and should only be done in the case of emergency.

8

8.4 Protection Simulation

NOTE
This function is protected by the security access code.

Software simulation functions let you test the soft starter's operation and control circuits without connecting the soft starter to mains voltage.

The MCD 500 can simulate each different protection, in order to confirm that the soft starter is responding correctly and reporting the situation on the display and across the communication network.

To use the protection simulation:

1. Open the Main Menu.
2. Scroll to Protection Sim and press [OK].
3. Use [▲] and [▼] to select the protection you want to simulate.
4. Press [OK] to simulate the selected protection.
5. The protection message is displayed while [OK] is pressed. The soft starter's response depends on the Protection Action setting (parameter group 16).
6. Press [Back] to return to the simulation list.
7. Use [▲] or [▼] to select another simulation, or press [Back] to return to the Main Menu.

MS1	000.0A	0000.0kW
Tripped		
Selected Protection		

Table 8.5

NOTE
If the protection trips the soft starter, reset before simulating another protection. If the protection action is set to *Warn or Log*, no reset is required.
If the protection is set to *Warn & Log*, the warning message can be viewed only while [OK] is pressed.
If the protection is set to *Log only*, nothing appears on the screen but an entry will appear in the log.

8.5 Output Signal Simulation

NOTE
This function is protected by the security access code.

The LCP allows the user to simulate output signalling in order to confirm that the output relays are operating correctly.

NOTE
To test operation of the flags (motor temperature and low/high current), set an output relay to the appropriate function and monitor the relay's behaviour.

To use the output signal simulation:

1. Open the Main Menu.
2. Scroll to Output Signal Sim and press [OK], then enter the access code.
3. Use [▲] and [▼] to select a simulation, then press [OK].
4. Use [▲] and [▼] to turn the signal on and off. To confirm correct operation, monitor the state of the output.
5. Press [Back] to return to the simulation list.

Prog Relay A
Off
On

Table 8.6

8.6 Digital I/O State

This screen shows the current status of the Digital I/O in order.

The top line of the screen shows the start, stop, reset and programmable input.

The bottom line of the screen shows programmable outputs A, B and C.

The screen shot shows the stop input (17) as closed (1) and the start, reset and Input A inputs (15, 25, 11) as open (0). Relay A (13, 14) is closed and relays B and C (21, 22, 24 and 33, 34) are open.

Digital I/O State
Inputs: 0100
Outputs: 100

Table 8.7

8.7 Temp Sensors State

This screen shows the state of the motor thermistor.
The screen shot shows the thermistor state as O (open).

Temp Sensors State
Thermistor: O
S = shrt H=hot C=cld O=opn

Table 8.8

8.8 Alarm Log

The [Alarm Log] button opens the Alarm Logs, which contains a Trip Log, Event Log, and Counters which store information on the MCD 500's operating history.

8.8.1 Trip Log

The Trip Log stores details of the eight most recent trips, including the date and time the trip happened. Trip 1 is the most recent and trip 8 is the oldest stored trip.

To open the Trip Log:

1. Open the Alarm Logs.
2. Scroll to Trip Log and press [OK].
3. Use [▲] and [▼] to select a trip to view, and press [OK] to display details.

To close the log and return to the main display, press [Back].

8.8.2 Event Log

The Event Log stores time-stamped details of the starter's 99 most recent events (actions, warnings and trips), including the date and time of the event. Event 1 is the most recent and event 99 is the oldest stored event.

To open the Event Log:

1. Open the Alarm Logs.
2. Scroll to Event Log and press [OK].
3. Use [▲] and [▼] to select an event to view, and press [OK] to display details.

To close the log and return to the main display, press [Back].

8.8.3 Counters

NOTE

This function is protected by the security access code.

The performance counters store statistics on the starter's operation:

- Hours run (lifetime and since counter last reset)
- Number of starts (lifetime and since counter last reset)
- Motor kWh (lifetime and since counter last reset)
- Number of times the thermal model has been reset

The resettable counters (hours run, starts and motor kWh) can only be reset if the correct access code is entered.

To view the counters:

1. Open the Alarm Logs.
2. Scroll to Counters and press [OK].
3. Use [▲] and [▼] buttons to scroll through the counters. Press [OK] to view details.
4. To reset a counter, press [OK] then enter the access code. Select Reset, then press [OK] to confirm.

To close the counter and return to the Alarm Logs, press [Back].

9 Troubleshooting

When a protection condition is detected, the MCD 500 will write this to the event log and may also trip or issue a warning. The soft starter's response to some protections may depend on the Protection Action settings (parameter group 16).

If the MCD 500 trips you will need to reset the soft starter before restarting. If the MCD 500 has issued a warning, the soft starter will reset itself once the cause of the warning has been resolved.

Some protections cause a fatal trip. This response is pre-defined and cannot be overridden. These protection mechanisms are designed to protect the soft starter, or can be caused by a fault within the soft starter.

9.1 Trip Messages

This table lists soft starter's protection mechanisms and the probable cause of the trip. Some of these can be adjusted using parameter group 2 *Protection* and parameter group 16 *Protection Action*, other settings are built-in system protections and cannot be set or adjusted.

Display	Possible cause/Suggested solution
Battery/Clock	A verification error has occurred on the real time clock, or the backup battery voltage is low. If the battery is low and the power is off, date/time settings will be lost. Reprogram the date and time. Related Parameter: *16-12 Battery Clock*
Current Imbalance	Current imbalance can be caused by problems with the motor, the environment or the installation, such as: - An imbalance in the incoming mains voltage - A problem with the motor windings - A light load on the motor Current imbalance can also be caused by incorrect cabling between the external bypass contactor and the soft starter or an internal problem with the soft starter, particularly an SCR that has failed open circuit. A failed SCR can only be definitely diagnosed by replacing the SCR and checking the starter's performance. Related Parameters: 2-3 - 2-3 and 16-2
Excess Start Time	Excess start time trip can occur in the following conditions: • *1-1 Motor Full Load Current* is not appropriate for the motor • *1-4 Current Limit* • *1-6 Start Ramp Time* has been set greater than the setting for *1-9 Excess Start Time Setting* • *1-6 Start Ramp Time* is set too short for a high inertia load when using Adaptive Acceleration Control Related Parameters: 1-1, 1-6, 1-4, 1-9, 7-9, 7-1, 7-6, 7-4, and 16-7
FLC Too High	The MCD 500 can support higher motor FLC values when connected to the motor using inside delta configuration rather than in-line connection. If the soft starter is connected in-line but the programmed setting for *1-1 Motor Full Load Current* is above the in-line maximum, the soft starter will trip at start. Related Parameters: *1-1 Motor FLC*, *7-1 Motor FLC-2*
Frequency	The mains frequency has gone beyond the specified range. Check for other equipment in the area that could be affecting the mains supply (particularly variable speed drives). If the MCD 500 is connected to a generator set supply, the generator may be too small or could have a speed regulation problem. Related Parameters: 2-8, 2-9, 2-10, and 16-5

Display	Possible cause/Suggested solution
Heatsink Overtemp	Check if cooling fans are operating. If mounted in an enclosure, check if ventilation is adequate. Fans operate during Start, Run and for 10 minutes after the starter exits the Stop state. **NOTE** **Models MCD5-0021B to MCD4-0053B and MCD5-0141B do not have a cooling fan. Models with fans will operate the cooling fans from a Start until 10 minutes after a Stop.** Related Parameters: *16-6 Heatsink Overtemp*
Input A Trip	Identify and resolve the condition which caused Input A to activate. Related Parameters: 3-3, 3-4, 3-5, 3-6, 3-7, and 16-8
Inst Overcurrent	The motor has experienced a sharp rise in motor current, probably caused by a locked rotor condition (shearpin) while running. This may indicate a jammed load. Related Parameters: 2-6, 2-7, and 16-4
Internal Fault X	The MCD 500 has tripped on an internal fault. Contact your local supplier with the fault code (X). Related Parameters.: None
L1 Phase Loss L2 Phase Loss L3 Phase Loss	During prestart checks the starter has detected a phase loss as indicated. In run state, the starter has detected that the current on the affected phase has dropped below 3.3% of the programmed motor FLC for more than 1 second, indicating that either the incoming phase or connection to the motor has been lost. Check the supply and the input and output connections at the starter and at the motor end. Phase loss can also be caused by a failed SCR, particularly an SCR that has failed open circuit. A failed SCR can only be definitely diagnosed by replacing the SCR and checking the starter's performance. Related Parameters: None
L1-T1 Shorted L2-T2 Shorted L3-T3 Shorted	During prestart checks the starter has detected a shorted SCR or a short within the bypass contactor as indicated. Related Parameters: none
Low Control Volts	The MCD 500 has detected a drop in the control voltage. • Check the external control supply (terminals A4, A5, A6) and reset the starter. If the external control supply is stable: • the 24 V supply on the main control PCB may be faulty; or • the bypass driver PCB may be faulty (internally bypassed models only). This protection is not active in Ready state. Related Parameters: *16-13 Low Control Volts*
Motor Overload/ Motor 2 Overlaod	The motor has reached its maximum thermal capacity. Overload can be caused by: - The soft starter protection settings not matching the motor thermal capacity. - Excessive starts per hour - Excessive throughput - Damage to the motor windings. Resolve the cause of the overload and allow the motor to cool. Related Parameters: 1-1, 1-2, 1-3, 1-4, 7-1, 7-2, 7-3, 7-4, and 16-1
Motor Connection	The motor is not connected correctly to the soft starter for inline or inside delta use. - Check individual motor connections to the soft starter for power circuit continuity. - Check connections at the motor terminal box. Related Parameters: *15-7 Motor Connection*

<table>
<tr><th>Display</th><th>Possible cause/Suggested solution</th></tr>
<tr><td>Motor Thermistor</td><td>The motor thermistor input has been enabled and:
- The resistance at the thermistor input has exceeded 3.6 kΩ for more than one second.
- The motor winding has overheated. Identify the cause of the overheating and allow the motor to cool before restarting.
- The motor thermistor input has been open.
NOTE
If a valid motor thermistor is no longer used, a 1.2 kΩ resistor must be fitted across terminals 05, 06.
Related Parameters: 16-9 Motor Thermistor</td></tr>
<tr><td>Network Comms</td><td>The network master has sent a trip command to the starter, or there may be a network communication problem.
Check the network for causes of communication inactivity.
Related Parameters: 16-11 Network/Comms</td></tr>
<tr><td>Parameter out of Range</td><td>- A parameter value is outside the valid range.
The starter will load the default value for all affected parameters. Press [Main Menu] to go to the first invalid parameter and adjust the setting.
Related Parameters: None</td></tr>
<tr><td>Phase Sequence</td><td>The phase sequence on the soft starter's input terminals (L1, L2, L3) is not valid.
Check the phase sequence on L1, L2, L3 and ensure the setting in 2-1 Phase Sequence is suitable for the installation.
Related Parameters: 2-1 Phase Sequence</td></tr>
<tr><td>Power Loss</td><td>The starter is not receiving mains supply on one or more phases when a Start Command is given.
Check that the main contactor closes when a start command is given, and remains closed until the end of a soft stop.
If testing the soft starter with a small motor, it must draw at least 2% of its minimum FLC setting on each phase.
Related Parameters: None</td></tr>
<tr><td>Starter/Comms</td><td>- There is a problem with the connection between the soft starter and the optional communications module. Remove and reinstall the module. If the problem persists, contact your local distributor.
- There is an internal communications error within the soft starter. Contact your local distributor.
Related Parameters: 16-10 Starter/Comms</td></tr>
<tr><td>Thermistor Cct</td><td>The thermistor input has been enabled and:
- The resistance at the input has fallen below 20 Ω (the cold resistance of most thermistors will be over this value) or
- A short circuit has occurred. Check and resolve this condition.
Check that a PT100 (RTD) is not connected to 05, 06.
Related Parameters: None.</td></tr>
<tr><td>Time - Overcurrent</td><td>The MCD 500 is internally bypassed and has drawn high current during running. (The 10 A protection curve trip has been reached or the motor current has risen to 600% of the motor FLC setting.)
Related Parameters: None</td></tr>
<tr><td>Undercurrent</td><td>The motor has experienced a sharp drop in current, caused by loss of load. Causes can include broken components (shafts, belts or couplings), or a pump running dry.
Related Parameters: 2-4, 2-5, and 16-3</td></tr>
<tr><td>Unsupported Option</td><td>The selected function is not available (e.g. jog is not supported in inside delta configuration).
Related Parameters: None</td></tr>
</table>

Table 9.1

9

9.2 General Faults

This table describes situations where the soft starter does not operate as expected but does not trip or give a warning.

Symptom	Probable Cause
Soft starter does not respond to commands.	- If the soft starter does not respond to the [Reset] button on the LCP: The soft starter may be in Auto On mode and will only accept commands from the remote control inputs. In Auto On mode, the Auto On LED on the LCP is illuminated. Press the [Hand On] or [Off] button to enable control via the LCP (this will also send a start or stop command to the MCD 500). - If the soft starter does not respond to commands from the control inputs: The soft starter may be in Hand On mode and will only accept commands from the LCP. When the soft starter is in Hand On control mode, the Off or Hand On LED on the LCP is active. To change to Auto On mode, press the [Auto On] button once. The control wiring may be incorrect. Check that the remote start, stop and reset inputs are configured correctly (see *Control Wiring* for details). The signals to the remote inputs may be incorrect. Test the signalling by activating each input signal in turn. The appropriate remote control input LED should activate on the LCP. The soft starter will only execute a start command from the remote inputs if the remote stop input is inactive and the remote reset input is activated (the Reset LED on the starter will be on). - If the soft starter does not respond to a start command from either the local or remote controls: The soft starter may be waiting for the restart delay to elapse. The length of the restart delay is controlled by Par. 2-11 *Restart Delay*. The motor may be too hot to permit a start. If Par. 2-12 *Motor Temperature Check* is set to Check, the soft starter will only permit a start when it calculates that the motor has sufficient thermal capacity to complete the start successfully. Wait for the motor to cool before attempting another start. The emergency stop function may be active. If Par. 3-3 is set to Emergency Stop and there is an open circuit on the corresponding input, the MCD 500 will not start. If the emergency stop situation has been resolved, close the circuit on the input.
The soft starter does not control the motor correctly during starting.	- Start performance may be unstable when using a low Motor Full Load Current setting Par. 1-1). This can affect use on a small test motor with full load current between 5 A and 50 A. - Power factor correction (PFC) capacitors must be installed on the supply side of the soft starter. To control a dedicated PFC capacitor contactor, connect the contactor to run relay terminals.
Motor does not reach full speed.	- If the start current is too low, the motor will not produce enough torque to accelerate to full speed. The soft starter may trip on excess start time. **NOTE** **Make sure the motor starting parameters are appropriate for the application and that you are using the intended motor starting profile. If Par. 3-3 is set to Motor Set Select, check that the corresponding input is in the expected state.** - The load may be jammed. Check the load for severe overloading or a locked rotor situation.
Erratic motor operation.	- The SCRs in the MCD 500 require at least 5 A of current to latch. If you are testing the soft starter on a motor with full load current less than 5 A, the SCRs may not latch correctly.

Symptom	Probable Cause
Soft stop ends too quickly.	- The soft stop settings may not be appropriate for the motor and load. Review the settings of Pars. 1-10, 1-11, 7-10 and 7-11. - If the motor is very lightly loaded, soft stop will have limited effect.
AAC adaptive acceleration control, DC brake and Jog functions not working	- These features are only available with in-line installation. If the MCD 500 is installed inside delta, these features will not operate.
A reset does not occur after an Auto-Reset, when using a remote 2-wire control.	- The remote 2-wire start signal must be removed and reapplied for a re-start.
Remote start/stop command is overriding Auto Start/Stop settings when using remote 2-wire control.	- Auto Start/Stop function should only be used in HAND ON mode or in tandem with HAND OFF mode, 3 and 4-wire control.
After selecting AAC the motor used an ordinary start and/or the second start was different to the first.	- The first AAC start is current limit so that the starter can learn from the motor characteristics. Subsequent starts use AAC.
Non-resettable THERMISTOR CCT trip, when there is a link between Thermistor input 05, 06 or when the motor thermistor connected between 05, 06 is permanently removed.	- The thermistor input is enabled once a link is fitted and short circuit protection has activated. Remove the link then load the default parameter set. This will disable the thermistor input and clear the trip. Place a 1k2 Ω resistor across the thermistor input. Turn thermistor protection to 'Log only' (Par. 16-9).
Parameter settings cannot be stored.	- Make sure you are saving the new value by pressing the [OK] button after adjusting a parameter setting. If you press [BACK], the change will not be saved. - Check that the adjustment lock (Par. 15-2) is set to Read/Write. If the adjustment lock is on, settings can be viewed but not changed. You need to know the security access code to change the adjustment lock setting. - The EEPROM may be faulty on the Main Control PCB. A faulty EEPROM will also trip the soft starter, and the LCP will display the message *Par. Out of Range*. Contact your local supplier for advice.

Table 9.2

10 Specifications

Supply	
Mains voltage (L1, L2, L3)	
MCD5-xxxx-T5	200 VAC - 525 VAC (± 10%)
MCD5-xxxx-T7	380 VAC - 690 VAC (± 10%) (in-line connection)
MCD5-xxxx-T7	380 VAC - 600 VAC (± 10%) (inside delta connection)
Control voltage (A4, A5, A6)	
CV1 (A5, A6)	24 VAC/VDC (± 20%)
CV2 (A5, A6)	110~120 VAC (+ 10% / - 15%)
CV2 (A4, A6)	220~240 VAC (+ 10% / - 15%)
Current consumption (maximum)	
CV1	2.8 A
CV2 (110 - 120 VAC)	1 A
CV2 (220 - 240 VAC)	500 mA
Mains frequency	50/60 Hz (± 10%)
Rated insulation voltage to earth	600 VAC
Rated impulse withstand voltage	4 kV
Form designation	Bypassed or continuous, semiconductor motor starter form 1

Short circuit capability	
Coordination with semiconductor fuses	Type 2
Coordination with HRC fuses	Type 1
MCD5-0021B to MCD5-0215B	prospective current 65 kA
MCD5-0245C to MCD5-0927B	prospective current 85 kA
MCD5-1200C to MCD5-1600C	prospective current 100 kA

Electromagnetic capability (compliant with EU Directive 89/336/EEC)	
EMC Emissions	IEC 60947-4-2 Class B and Lloyds Marine No 1 Specification
EMC Immunity	IEC 60947-4-2

Inputs	
Input Rating	Active 24 VDC, 8 mA approx
Start (15, 16)	Normally open
Stop (17, 18)	Normally closed
Reset (25, 18)	Normally closed
Programmable input (11, 16)	Normally open
Motor thermistor (05, 06)	Trip >3.6 kΩ, reset <1.6kΩ

Outputs	
Relay Outputs	10A @ 250 VAC resistive, 5A @ 250 VAC AC15 pf 0.3
Programmable Outputs	
Relay A (13, 14)	Normally open
Relay B (21, 22, 24)	Changeover
Relay C (33, 34)	Normally open
Analog Output (07, 08)	0-20 mA or 4-20 mA (selectable)
Maximum load	600 Ω (12 VDC @ 20 mA)
Accuracy	± 5%
24 VDC Output (16, 08) Maximum load	200 mA
Accuracy	± 10%

Environmental	
Protection	
MCD5-0021B - MCD5-0105B	IP20 & NEMA, UL Indoor Type 1
MCD5-0131B - MCD5-1600C	IP00, UL Indoor Open Type
Operating temperature	-10° C to 60° C, above 40° C with derating

10

Storage temperature	- 25° C to + 60° C
Operating Altitude	0 - 1000 m, above 1000 m with derating
Humidity	5% to 95% Relative Humidity
Pollution degree	Pollution Degree 3

Heat Dissipation	
During start	4.5 watts per ampere
During run	
MCD5-0021B - MCD5-0053B	= 39 watts approx
MCD5-0068B - MCD5-0105B	= 51 watts approx
MCD5-0131B - MCD5-0215B	= 120 watts approx
MCD5-0245C - MCD5-0927C	4.5 watts per ampere approx
MCD5-1200C - MCD5-1600C	4.5 watts per ampere approx

Certification	
C✓	IEC 60947-4-2
UL/ C-UL	UL 508
CE	IEC 60947-4-2
CCC	GB 14048-6
Marine (MCD5-0021B - MCD5-0215B only)	Lloyds Marine No 1 Specification
RoHS	Compliant with EU Directive 2002/95/EC

10.1 Accessories

10.1.1 LCP Remote Mounting Kit

The MCD 500 LCP can be mounted up to 3 metres away from the soft starter, allowing remote control and monitoring. The remote LCP also allows parameter settings to be copied between soft starters.

- 175G0096 Control Panel LCP501

10.1.2 Communication Modules

MCD 500 soft starters support network communication using the Profibus, DeviceNet and Modbus RTU protocols, via an easy-to-install communications module. The communications module plugs directly onto the side of the starter.

- 175G9000 Modbus Module
- 175G9001 Profibus Module
- 175G9002 DeviceNet Module
- 175G9009 MCD USB Module

10.1.3 PC Software

MCD PC Software can be used in conjunction with a communications module to provide the following functionality for networks of up to 99 soft starters.

Feature	MCD-201	MCD-202	MCD500
Operational control (Start, Stop, Reset, Quick Stop)	•	•	•
Starter status monitoring (Ready, Starting, Running, Stopping, Tripped)	•	•	•
Performance monitoring (motor current, motor temperature)		•	•
Upload parameter settings			•
Download parameter settings			•

Table 10.1

The PC software available from Danfoss's website is:

- WinMaster: VLT® Soft Starter software for control, configuration and management
- : VLT® software for configuration and management.

10.1.4 Finger Guard Kit

Finger guards may be specified for personnel safety and can be used on MCD 500 soft starter models 0131B - 1600C. Finger guards fit over the soft starter terminals to prevent accidental contact with live terminals. Finger guards provide IP20 protection.

- MCD5-0131B ~MCD5-0215B: 175G5662
- MCD5-245C: 175G5663
- MCD5-0360C ~MCD5-0927C: 175G5664
- MCD5-1200C ~MCD5-1600C: 175G5665

10.1.5 Surge Protection Kit (Lightning Protection)

As standard, MCD 500 rated impulse withstand voltage is limited to 4 kV. The surge protection kits protect the system and make the soft starter immune to high voltage impulses.

6kV

- 175G0100 SPD Surge protection kit for G1
- 175G0101 SPD Surge protection kit, G2-G5

12kV

- 175G0102 SPD Surge protection kit for G1
- 175G0103 SPD Surge protection kit, G1-G5

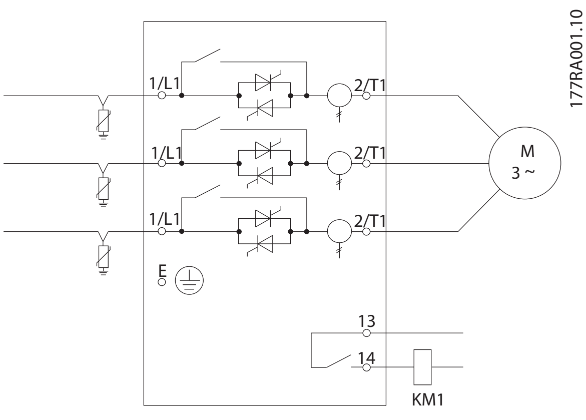


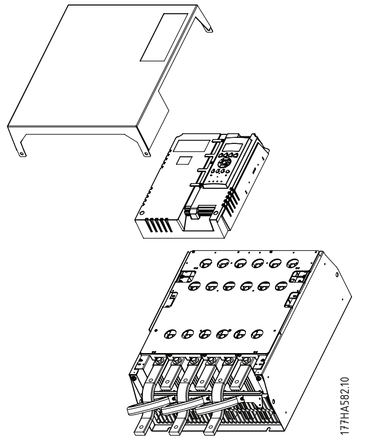
Illustration 10.1

11 Bus Bar Adjustment Procedure (MCD5-0360C - MCD5-1600C)

NOTE

Many electronic components are sensitive to static electricity. Voltages so low that they cannot be felt, seen or heard, can reduce the life, affect performance, or completely destroy sensitive electronic components. When performing service, proper ESD equipment should be used to prevent possible damage from occurring.

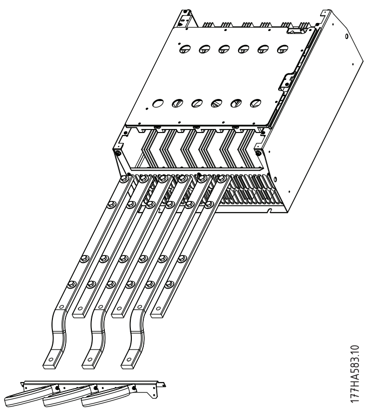
All units are manufactured with input and output bus bars at the bottom of the unit as standard. The input and/or output bus bars can be moved tot he top of the unit if required.



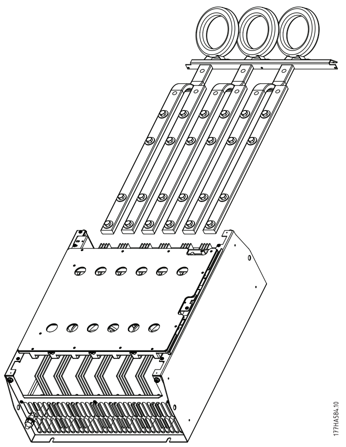
1. Remove all wiring and links from the soft starter before dismantling the unit.
2. Remove the unit cover (4 screws).
3. Unscrew the main plastic and fold away from the starter (4 screws).
4. Unplug the keypad loom from CON 1 (see note).
5. label each SCR firing loom with the number of the corresponding terminal on the main control PCB, then unplug the looms.
6. Unplug the thermistor, fan and CT wires from the main control PCB.

NOTE

Remove the main plastic slowly to avoid damaging the keypad wiring loom which runs between the main plastic and the backplane PCB.



1. Unscrew and remove the magnetic bypass plates (models MCD5-0620C to MCD5-1600c ONLY).
2. Remove the CT assembly (three screws).
3. Identify which bus bars are to be moved. Remove the bolts holding these bus bars in place then slide the bus bars out through the bottom of the starter (four bolts per bus bar).



1. Slide the bus bars in through the top of the starter. For input bus bars, the short curved end should be outside the starter. For output bus bars, the unthreaded hole should be outside the starter.
2. Replace the dome washers with the flat face towards the bus bar, then tighten the bolts holding the bus bars in place to 20 Nm.
3. Place the CT assembly over the input bus bars and screw the assembly to the body of the starter (see note).
4. Run all wiring to the side of the starter and secure with cable ties.

Table 11.1

NOTE

If moving the input bars, the CTs must also be reconfigured.

1. **Label the CTs L1, L2 and L3 (L1 is leftmost when working from the front of the starter). Remove the cable ties and unscrew the CTs from the bracket.**
2. **Move the CT bracket to the top of the starter. Position the CTs for the correct phases, then screw the CTs to the bracket. For models MCD5-0360C - MCD5-0930, the CTs must be placed on an angle (the left hand legs of each CT will be on the top row of holes and the right hand legs will be on the bottom tabs).**

11

www.danfoss.com/drives

175R0549 MG17K402 Rev. 2012–03–05

TLX-400 Wireless I/O Module

User Manual

ELPRO Technologies Pty Ltd, 9/12 Billabong Street, Stafford Q 4053, Australia.

Tel: +61 7 33528600 Fax: +61 7 33528677   Email: sales@elprotech.com

Web: www.elprotech.com

Thank you for your selection of the TLX-400 module. We trust it will give you many years of valuable service.

ATTENTION!

Incorrect termination of supply wires may

cause internal damage and will void warranty.

To ensure your TLX-400 enjoys a long life,

double check ALL your connections with

the user's manual

before turning the power on.

All equipment must be properly grounded

for safe operation.

All equipment should be serviced only

by a qualified technician.

Important Notice

ELPRO products are designed to be used in industrial environments, by experienced industrial engineering personnel with adequate knowledge of safety design considerations. These products should not be used in non-industrial applications, or life-support systems without consulting ELPRO Technologies first.

Limited Lifetime Warranty, Disclaimer and Limitation of Remedies

ELPRO products are warranted to be free from manufacturing defects for the “serviceable lifetime” of the product. The “serviceable lifetime” is limited to the availability of electronic components. If the serviceable life is reached in less than three years following the original purchase from ELPRO, ELPRO will replace the product with an equivalent product if an equivalent product is available.

This warranty does not extend to:

- failures caused by operation of the equipment outside the particular product's specification, or
- use of the module not in accordance with this User Manual, or
- abuse, misuse, neglect or damage by external causes, or
- repairs, alterations, or modifications undertaken other than by an authorized Service Agent.

ELPRO’s liability under this warranty is limited to the replacement or repair of the product. This warranty is in lieu of and exclusive of all other warranties. This warranty does not indemnify the purchaser of products for any consequential claim for damages or loss of operations or profits and ELPRO is not liable for any consequential damages or loss of operations or profits resulting from the use of these products. ELPRO is not liable for damages, losses, costs, injury or harm incurred as a consequence of any representations, warranties or conditions made by ELPRO or its representatives or by any other party, except as expressed solely in this document.

How to Use This Manual

This manual has been written to enable the quick look-up of information, as well as detailed descriptions of the TLX features.

The section FEATURES & CONFIGURATION provides detailed information about the TLX functions and how to configure them. Use this section to find out about a particular feature or what the TLX can do.

The section MENU ITEMS provides a way to look up specific items from the menu to find out what they do or how to configure them. Use this section as a quick reference to the menu items.

The TROUBLESHOOTING section provides a list of common problems and configuration mistakes. Check this section if MENU ITEMS and FEATURES & CONFIGURATION don’t help with configuration problems.

CONTENTS

Chapter 1 INTRODUCTION

1.1 Overview

The TLX-400 is an advanced telemetry unit ideal for a wide range of applications. It is equally suited to small-scale systems with a few units and simple control, or large and complex computer-controlled systems. It is highly flexible, offering the following configuration options:

- Remote terminal unit (RTU) with local I/O
- Pre-processor (PP)
- Standalone monitoring facility (SMF)
- Store and forward repeater functionality with multi-hop capability
- Local control options
- Modbus RTU communications
- RS232 (DB9 or RJ45), RS485 serial connections
- Modem option
- Pager option
- Radio communications with user-configurable options
- Comms fail message logging
- Message logging via local control commands
- Dual-redundant configuration

The TLX-400 is fully compatible with the ELPRO TLC product line, and supports several TLC emulation modes for easy system upgrades.

The Modbus interface on the TLX allows a variety of I/O expansion options. The ELPRO 115S product line of I/O modules has been developed for use with the TLX. The TLX menu system provides convenient automatic configuration of the 115S modules.

Chapter 2 FEATURES & CONFIGURATION

This chapter describes in detail the features of the TLX, and how to configure them.

2.1 Menu

The TLX-400 is configured via a built-in menu. The menu is accessed by connecting one of the serial ports to a PC and using a terminal program (such as PROCOMM or HyperTerminal) to communicate in ASCII. The menu is invoked by pressing <enter> 3 times in quick succession.

The rest of this chapter describes how to configure the TLX using the built-in menu. For information on specific menu items, refer to the chapter MENU ITEMS later in this document.

To invoke the TLX menu:

1. Connect a serial cable to the TLX (DB9 connector or RJ45 connector) and to the PC
2. Start PROCOMM or HyperTerminal
3. Choose port, baud rate, parity (TLX default is 9600, N-8-1)
4. Hit <enter> three times in quick succession and the menu should appear on screen.Operation

2.2 LED Indicators

- Power LED - red when power is on, turns green after self test/initialization passed ok.
- Rx LED - active when receiving, normally green or yellow, red if low signal strength.
- Tx LED - on when radio is transmitting.
- Link LED on the RTU - green when comms OK and red when in comms fail (ie. when not polled longer than timeout or cannot send messages to the computer).
- Link LED on pre-processor - red when PP disabled, green when PP enabled.
- Link LED on control unit - the LED turns GREEN if all of the configured remote devices are communicating successfully. It turns RED if some of the configured remote devices are in commfail, and goes OFF if all of the configured devices are in commfail.
- RS232 LED - Flashes during Host (RS232) port activity (Tx or Rx).
- RS485 LED - as above but for Expansion (RS485) port.
- I/O LED - indicates state of onboard digital in/output in normal mode, in dual redundant mode the duty cycle of the I/O LED gives a visual indication of the status of the dual-redundancy system. In redundant mode, with the primary active and the secondary on standby, the led shows a long-on, short-off cycle. If primary fails and the secondary takes over the I/O LED then shows a short-on, long-off duty cycle. If

the primary is active and the secondary fails, the I/O LED shows an equal on / off time, to indicate there is no functioning backup unit.

2.3 Operating Modes

The TLX-400 may operate in one of several different modes, or combinations of these modes. Note that the TLX must be reset after setting any menu items relating to these operating modes (addresses, routing lists etc).

2.3.1 RTU

As an RTU (remote terminal unit), the TLX will relay incoming messages according to its configured routing list. It may also have some digital or analog I/O connected, which it controls according to messages received. To set the RTU address, choose the menu option:

Configure site / Address of local RTU

A valid RTU address is less than 255. An address of 255 disables the RTU and all monitoring and control of its local I/O.

Fill in the routing list for the RTU under the menu item:

Configure site /Routing

Enter the *COS addresses* where change-of-state messages should be routed to. For more information on routing, see the section Message Routing.

2.3.2 PP

The TLX may be configured as a pre-processor (PP), where it operates as an interface between a SCADA computer and the network of RTUs. The PP may be configured as dual-state, where its communications become restricted after a specified timeout. To re-activate a dual-state PP it must receive an enable message from the SCADA computer. To set the PP address, choose the menu option:

Configure site / Address of pre-processor

A valid PP address is less than 255. An address of 255 disables the pre-processor function of the TLX. Choose single or dual-state from the menu, and the dual-state disable timeout if relevant.

The next question asks about the presence of an SMF (standalone monitoring facility) in the system. If the PP has a serial connection to another device, these messages will not be registered by the SMF. The PP needs to send out these messages via radio for the SMF to register them. Answer *yes* to this question if there is an SMF anywhere in the system.

Fill in the routing list for the PP under the menu item:

Configure site /Routing

The *Enabled* routing list refers to when the pre-processor has been enabled by a message from the SCADA computer. The *Disabled* routing list reflects the routing supported when the pre-processor has timed out and disabled itself. The Disabled routing list would usually be quite short and possibly only include routing to the SCADA computer, while the Enabled routine list would include the other RTUs in the system. For more information on routing, see the section Message Routing.

2.3.3 SMF

A standalone monitoring facility (SMF) enables a technician to view all communications messages occurring in a system via a computer set up anywhere in the system. An SMF consists of a TLX set to SMF mode and connected to a PC by the DB9 (*HOST*) port. An SMF TLX does not relay any incoming messages out its radio port, but routes all radio messages to the connected PC. The messages can be viewed by a terminal program such as PROCOMM or HyperTerminal, without invoking the menu.

The computer may send SCADA commands to the system via the SMF TLX if necessary.

To set up the TLX to function as an SMF, use menu item

Configure site / SMF option

Set the routing list as required.

2.3.4 Local Control

A TLX may be configured to provide control in a system. This may be in a system where the control is simple and a SCADA computer is not required, or it may be some confined, local control in a small part of a system to simplify the overall SCADA computer's tasks. Set the control address by the menu item

Configure site / Address of Control RTU

For more information on control within a TLX, refer to the section Local Control.

2.4 Message Routing

The routing list specifies to the TLX how to locate other devices in the system. Specify the routing list using menu option

Configure site / Routing

The menu will then prompt for which devices are connected via the Terminal port (RJ45 connector). Enter the device addresses separated by space characters or commas. If there are no devices connected to the port press enter. The menu will also prompt for Host port (DB9 connector), Radio, and Expansion port (RS485).

If the TLX has been given an RTU address, the menu will also prompt for a list of COS (change-of-state) addresses. Enter the device addresses which should receive COS messages.

Configure site / Store and Forward Configuration

In some radio networks it is necessary to pass radio messages to the CMF via an intervening RTU due to the radio path not being good enough. This process is call a store and forward (S&F). Enter the store and forward addresses here. Note that the SCADA database must also be set to have this store and forward information. Radio Signal Strength

2.5 Messaging Protocol

The type of messaging frames used by the TLC communications protocol may be selected from the menu option

Configure site / Frame type

An ELPRO TLC frame is composed of a header, a data section, and an error check. The data section contains a list of digital I/O and analog I/O information. For more detail on TLC frames, consult the document *Prot_Protocol_1.1.pdf*.

The TLX replaces some of the I/O information in the frame with special information relating to its operating conditions. The tables below show the special information the TLX adds to the frame. See the section TLC Emulation for situations where this data is different.

2.5.1 Digital Data Space

No redundancy:

Mains fail	Battery low	Antenna fault	On-board DIO
Last DIN	2nd-last DIN	3rd-last DIN	4th-last DIN

Dual-redundancy mode:

Mains fail	Battery low	Secondary fail	Primary fail
Last DIN	2nd-last DIN	3rd-last DIN	4th-last DIN

2.5.2 Analog Data Space

Radio temperature	RSSI	Battery level (volts * 10)
3rd-last AIN	2nd-last AIN	Last AIN

The messages received by the TLX in a system may be viewed via the menu item:

Service Menu / Monitor Comms

The Monitor Comms function displays the messages received by the firmware's internal messaging center, and the channels or ports they were received on. The messages transmitted by the RTU are not displayed. Each message is appended with a special symbol indicating the following:

~ Internally generated message.

< A valid message received on the serial port.

<< A valid message received on the radio port.

* A corrupted message received on the serial port.

** A corrupted message received on the radio port

? Received a message from an invalid port. This usually occurs when an upgrade in firmware has been issued and the unit has been configured but not turned off and then on again.

2.6 I/O

The TLX contains only one on-board digital I/O pin, but is able to interface with external I/O modules via Modbus communications. The ELPRO 115S I/O expansion modules are developed for use with the TLX, and can be easily set up via the Modbus menu. However any 3rd-party Modbus I/O device can be configured for use with the TLX.

A change in an input connected to a TLX will cause a change-of-state message to be generated (with the exception of pulsed inputs). This message reflects the state of the TLX's inputs at the current time, and is routed to any devices listed in the COS routing list (see the section Message Routing).

2.6.1 On-board Digital I/O Pin

There is one on-board digital I/O pin on the TLX which may be used as multi-purpose I/O. Input is given priority over output, so if a '1' input (ground) has been applied to the pin, the DIO cannot be cleared if the TLX receives a message with '0' as an on-board DIO output. If there is no input applied to the pin (0 = open pin), DIO can be controlled as a digital output via TLC messages or the Test I/O menu function.

The on-board DIO is mapped to the 4th-last digital input or output in the message frame, in native TLX mode. In the other TLC emulation modes (TLC 01-05, TLC 02-01, TLC 09-02), the on-board DIO is not used, and does not appear in the message frame.

If the TLX is operating in dual-redundancy mode, the DIO pin is used to control redundancy operation between the dual units. In this situation it is not sent in the message frame and cannot be controlled via messages or the Test I/O menu function.

2.6.2 Using ELPRO 115S I/O modules with the TLX

The 115S serial I/O units are designed to provide I/O for a TLX module. The available I/O from 115S includes digital input / output, analog input, and analog output. A combination of 115S modules may be connected to the TLX to provide the appropriate set of I/O.

The 115S units communicate with the TLX using MODBUS over the RS485 port. The 115S must be set up to use MODBUS RTU protocol as the TLX does not support MODBUS ASCII.

A maximum of 16 115S modules may be connected to any TLX. The 115S addresses must be in the range 1 to 16. Addresses outside of this range will not be recognized by the TLX.

Steps to set up one or more 115S units with a TLX:

1. Configure the 115S modules for the desired I/O functionality according to the 115S user manual.
2. Set the 115S units to communicate in MODBUS RTU protocol. This may be done using the 115S configuration software, or write 0x0101 to MODBUS register 30201 (Holding register) using ModScan.
3. Set the address switches on each 115S to a unique address.
4. Connect the 115S modules to the TLX via the RS485 port and apply power.
5. From the TLX menu, choose *Modbus Configuration*.
6. Choose *Auto Detect 115S Configuration*. The software will attempt to detect the 115S modules connected.
7. The user will be asked to decide on the combination of digital inputs and outputs required. The software will prompt for the number of digital inputs. These will start from DIO1. The remaining digital I/O pins will be designated as digital outputs.
8. Modbus must now be set up to read the I/O information from the 115S. Choose *Set Modbus Slave Address*, and set it to zero for Modbus master.
9. The delay between polls reflects how quickly the TLX will update its internal information relating to its local I/O. Set this delay to an appropriate value for the speed of the system being implemented (eg. 500mS).
10. If required, set the 115S analog range to E-series (*Set 115S Analog Range*). This means that the data from the 115S, which is in the range $4000 to $C000, will be seamlessly translated to $00 to $FF in the TLX, for easy interpretation by the SCADA computer.

2.6.3 Using Other Modbus Devices with the TLX

TLX as Modbus slave

The TLX can be configured to operate as a Modbus slave by giving it a slave address via the *Modbus Configuration* menu. Upon receiving a poll message from a Modbus master, the TLX reports its inputs or outputs (digital or analog) starting from Modbus address 1. The maximum number of digitals or analogs supported by the TLX Modbus protocol is governed by the I/O limits given in SPECIFICATIONS.

2.6.4 TLX as Modbus master

The TLX can be manually configured to operate as a Modbus master by setting its slave address to 0. The delay between polls should also be set (eg. 500mS), and master poll commands must be added. The TLX then sends the poll commands and stores the response data according to the command configuration.

2.6.5 Digital Inputs

All digital inputs connected to the TLX are affected by the input debounce time. This is the amount of time an input must be set before a change-of-state is triggered. It is set via the menu option

Configure Site / Input Debounce Time

If an input changes and remains in its new state for longer than the debounce time, a COS message is generated (except when the input is set as pulsed input) and routed to any addresses in the COS routing list. The input debounce time may range from 0.01 seconds to 600 seconds.

2.6.6 Digital Outputs

Digital outputs are set or cleared whenever the TLX receives a command message. The digital outputs are updated with the appropriate data in the message. Masking may be used to prevent outputs from being changed in response to command messages. See the section Masking for more information.

2.6.7 Pulsed Inputs

The TLX supports three types of native pulsed inputs (accumulators):

1. Counting the pulses of the digital input.
2. Accumulating the “On” time of digital input.
3. Integrating (accumulating) the analog input value.

TLX-400 also supports dedicated pulsed inputs on ELPRO 115S-11 modules (these act as pulse counters only). The main difference between TLX native pulse accumulators and dedicated 115S-11 pulse accumulators is speed – 115S-11 can count shorter and faster rate pulses comparing to TLX (the limitation is caused by Modbus polling frequency).

Any digital input will not cause change-of-state message when configured as pulsed input. On the other hand analog inputs work as usual even when used as a source of an accumulator.

The pulsed inputs count from 0 to 4,294,967,295 and then wrap around back to 0. When TLX-400 is depowered the counts are lost and start from 0 after powering up.

2.6.7.1 TLX-400 native pulse counters

This pulsed input will count a number of pulses on a digital input, the count is incremented on low to high pulse edge. Typically a plant run signal is used as source and the accumulator shows total number of starts. Any of the first 32 DINs can be configured as pulsed input, the configuration value for the sensitivity message is simply the input number.

TLX-400 Pulse Counter Input Addressing												
DIN	1	2	3	4	5	6	7	8	9	10	11	12
cfg. value	1	2	3	4	5	6	7	8	9	10	11	12
DIN	13	14	15	16	17	18	19	20	21	22	23	24
cfg. value	13	14	15	16	17	18	19	20	21	22	23	24
DIN	25	26	27	28	29	30	31	32				
cfg. value	25	26	27	28	29	30	31	32				

2.6.7.2 "On" time accumulators

This accumulator will increment by 1 every second when relevant digital input is on/high state. The resulting count is the total number of seconds the input was on – typically used for accumulating plants' runtimes. The source input can be any of first 32 DINs and the configuration value is input number plus 88.

TLX-400 On Time Accumulator Addressing												
DIN	1	2	3	4	5	6	7	8	9	10	11	12
cfg. value	89	90	91	92	93	94	95	96	97	98	99	100
DIN	13	14	15	16	17	18	19	20	21	22	23	24
cfg. value	101	102	103	104	105	106	107	108	109	110	111	112
DIN	25	26	27	28	29	30	31	32				
cfg. value	113	114	115	116	117	118	119	120				

2.6.7.3 Integrating analog inputs

Analog input raw 8 bit value is added to the accumulator every minute. Typically it is used to work out total flows on the older flowmeters which provided flowrate but not pulsed outputs. Any of 24 analog inputs can be integrated, the configuration value is input number plus 64.

TLX-400 Analog Integrating Addressing												
AIN	1	2	3	4	5	6	7	8	9	10	11	12
cfg. value	65	66	67	68	69	70	71	72	73	74	75	76
AIN	13	14	15	16	17	18	19	20	21	22	23	24
cfg. value	77	78	79	80	81	82	83	84	85	86	87	88

2.6.7.4 115S-11 dedicated pulsed inputs

115S-11 DIO module has dedicated pulsed inputs on its first 4 digital inputs, these can count short and frequent pulses, the count increments on the falling edge of the pulse. TLX-400 supports up to 8 115S-11 pulsed inputs so two 115S-11 units with the lowest Modbus addresses are seen by the TLX. The configuration value depends on Modbus address of the unit and input used, they range from 153 to 216.

115S-11 Pulsed Inputs Addressing

Unit Modbus Address	DIN on the 115S-11 unit			
	1	2	3	4
1	153	154	155	156
2	157	158	159	160
3	161	162	163	164
4	165	166	167	168
5	169	170	171	172
6	173	174	175	176
7	177	178	179	180
8	181	182	183	184
9	185	186	187	188
10	189	190	191	192
11	193	194	195	196
12	197	198	199	200
13	201	202	203	204
14	205	206	207	208
15	209	210	211	212
16	213	214	215	216

2.6.8 Analog Inputs

The TLX accepts and stores analog inputs as 16-bit numbers. In frames which only allow 8-bit representation of analogs, the most-significant 8 bits are used.

The analog sensitivity is also treated as a 16-bit number. The default sensitivity may be entered into the menu, and this should be a 16-bit number in decimal format. To convert from a percentage to a 16-bit sensitivity number, multiply the percentage by 655, so 2% would result in a sensitivity number 2% x 655 scale = 1310.

The default sensitivity is set by choosing menu items:

Configure Site / Default sensitivity

The sensitivity may also be set via a sensitivity message. If the sensitivity message contains 8-bit values, these are stored as the most significant 8 bits in the sensitivity variables. See the protocol document for more detail on sensitivity messages.

The sensitivity values are absolute values, in the same units as the analog inputs. So if an input increases or decreases by more than the sensitivity value, a change-of-state message may be generated.

The configured Input Debounce Time also applies to the analog inputs. This is set via the menu items:

Configure Site / Input Debounce Time

The analog input value must change by at least its sensitivity amount, and remain there for at least the debounce time, in order for a change-of-state message to be generated.

The analog inputs may also be filtered, or the square root taken. These functions are selectable from the menu items:

Configure Site / Analog inputs to square root

Configure Site / Analog inputs to filter

The square root option gives the analog input values a square-root relationship with the actual analog stimulus on the pins. With some analog transducers it is necessary to linearise the input. This is most prevalent with flow meters which give a square law output. The analog input square root option provides an easy way to linearise these devices.

Filtering allows an analog input signal to be smoothed out. The filter time-constant is entered into the menu in arbitrary units ranging from 1 to 255. A time-constant of 255 results in approximately a 75-second step response.

The input analog signal is always filtered with a short time constant, even if no filtering is specified.

The square-root or filtered analog values can be seen via the menu option:

Test I/O / Show All Inputs

Note that the menu item below shows the actual analog input values from the 115S, and not the square root or filtered values.

Test I/O / Read 115S-12 @ n

2.6.9 Analog Outputs

Analog outputs are also stored as 16-bit numbers. The 8 most significant bits are used in data message frames which do not support 16-bit analogs.

Analog outputs are updated each time a command message is received. The output is assigned the appropriate value from the message. See the section Masking for how to prevent analog outputs from being changed every time a command message is received.

2.7 Masking

Where there is more than one controller in a system, conflicts may arise in the transmission of command messages. If two controllers send command messages to the same RTU, they will each change the other's settings of the RTU's I/O, because a command message must contain data for every output. If a controller does not wish to change all of the I/O of an RTU, it can first send a mask message specifying which I/O it would like control of. By sending a mask message, a controller tells an RTU that it only wants control of specific outputs, and that no-one else is allowed to control these outputs. They are for the exclusive use of the requesting controller. The masking settings apply for as long as the RTU has power.

The format of a mask message follows the mod frame type as shown (mod1 shown):

05	CC	DA	NA	SA	DD	DD	DD	DD	an	an	an	an	an	an	an	an

header digitals analogs

The frame flag for a mask message is 0x*05*.

DD refers to eight bits representing eight digital outputs. A digital 1 signifies that the corresponding digital output should be masked for exclusive use by the sender of the message.

an refers to one analog output. A value of 0xFF signifies that the corresponding analog output should be masked for exclusive use by the sender of the message. Any other value signifies the output is not masked.

Note that the on-board DIO can also be masked by writing a 1 to its location in the frame (3^{rd}-last position for Native TLX emulation).

2.8 Ports

The TLX-400 has three physical ports, all of which can be used for routing messages.

The Terminal port, also known as Config, is an RS232 port and requires an RJ45 connector. This port is most commonly used to invoke the on-board menu and configure the TLX. It can also be used to route messages, by adding the appropriate addresses to the routing list. This port is fixed at 9600 baud, no parity, 8 data bits, and 1 stop bit.

The Host port is also an RS232 port and requires a DB9 connector. This port may be used to configure the TLX via the on-board menu, and is also able to route messages according to the routing list. The baud rate and data format of this port may be configured via the menu items:

Serial Ports Configuration / Set HOST Port Baudrate

Serial Ports Configuration / Set HOST Port Data Format

The Host port may also be configured to route messages via a modem or a pager. Use the following menu items to set up modem or pager operation:

Serial Ports Configuration / Configure HOST for modem

Serial Ports Configuration / Configure HOST for pager

See the section Pager Feature for more detail.

The Expansion port is an RS485 port and connection is made via two screw-terminals. This port is intended for I/O expansion and communicates using Modbus for this purpose. The data format and baud rate of this port are configurable via the menu items:

Serial Ports Configuration / Set EXPANSION Port Baud rate

Serial Ports Configuration / Set EXPANSION Port Data Format

2.9 Radio

The radio is the main method for routing messages in a system. It uses V.23 signaling, and may be configured via the menu item:

Configure Radio /

The radio supports V.23 or "NotV.23" tones, and 300 or 1200 baud. The receive and transmit frequencies can be set by the user, within the allowable range and only on the frequency step. The allowable range and frequency step can be modified by an ELPRO service technician. The transmit power is also configurable via the menu.

A radio signal is preceded by a lead-in tone in order to facilitate receiver lock. The lead-in is adjustable via the menu and may range from 30 to 1000 mS.

The software measures the radio's received signal strength for each message. The RSSI is displayed after each message in Monitor Comms mode. The RSSI can be calibrated via the menu:

Service Menu / RSSI menu / Automatic RSSI Calibration

If the calibration values are already known, they can be entered via the menu:

Service Menu / RSSI menu / Manual RSSI Calibration

Radio status and temperature are reported from the menu item:

Service Menu / Radio Status and Temp

The radio can report four alarms as follows:

VSWR: High antenna VSWR has been detected. There is a problem with the antenna, feeding cable or antenna connections. Could be an open or short circuit.

PLL-Lock: There is an internal problem with the phase lock loop system and it is out of lock. Return to ELPRO for repair or re-alignment.

PTT-Timeout: The transmitter has been on for longer than the maximum timeout time (usually 2 minutes). There might be a problem with the microprocessor circuits driving this signal.

Over-temperature: The radio temperature has exceeded the maximum temperature allowed (default is 85degC). The transmitter will not operate once this maximum temperature has been exceeded and will return to normal operation once the temperature returns to normal.

2.10 Pager Feature

The TLX may be configured to send messages to pager units. This is done via a modem connected to the HOST port. The modem is configured with the phone number of the paging service via the menu item:

Serial Ports Configuration / Configure HOST for pager

The paging function of the TLX has its own unique address. This is set via the menu

Configure Site / Address of Pager RTU

Command messages sent to the pager address are routed to the paging system.

A sensitivity message should be sent to the pager address to set up its internal pager list. This message consists of a list of 24-bit pager identification numbers, which the TLX may send messages to. There may be up to 8 pagers in the sensitivity message.

A POLL message sent to the pager address results in a response message containing the current pager status. The polling software should decode the status byte, as listed here:

0x01: Modem did not respond

0x02: Modem failed to connect after dialing

0x04: Pager computer did not respond

0x08: Password not accepted

0x10: Pager number or message not accepted

0x00: Message accepted

A command message to the pager address should contain the 24-bit pager ID, and the pager message to be sent. Upon receipt of such a command message, the TLX dials the paging service via the modem, and sends the message to the specified pager using PET protocol.

The paging setup may be tested via the menu

Pager/modem options / Test Pager/Modem

2.11 Modem Feature

A modem may be connected to the HOST port for routing messages via a telephone line. Modem setup is done via the menu items:

Serial Ports Configuration / Configure HOST for modem

Set the telephone number the modem is to dial, and extra modem initialisation here.

Supported modem line communication rates are 300, 1200, and 2400bps. The HOST port must therefore also be set to the required communication rate (eg. 2400). The modem may have to be restricted to a maximum rate of 2400bps using AT commands, to ensure it connects at the correct rate. The AT commands to restrict the line rate generally vary between modems, and may appear in an s-register.

Any AT commands required for modem setup or initialisation can be added to the initialisation string accessible from the menu.

A tail-circuit cable is preferred for connecting the modem to the TLX. This cable provides the necessary loop-back signals for a DCE-DCE connection.

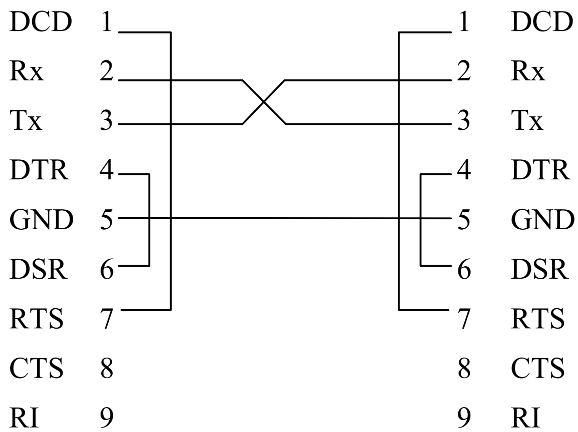


Figure 1: Wiring diagram for tail-circuit cable.

If a tail-circuit cable is used, modem factory defaults (AT&F) are generally OK for flow-control and signal settings. These should be:

Hardware flow control (AT&K3)

Standard DTR operation (AT&D2)

Note that these AT commands may not be the same for all modems.

A simple crossover cable may also be used to connect the TLX to the modem if required.

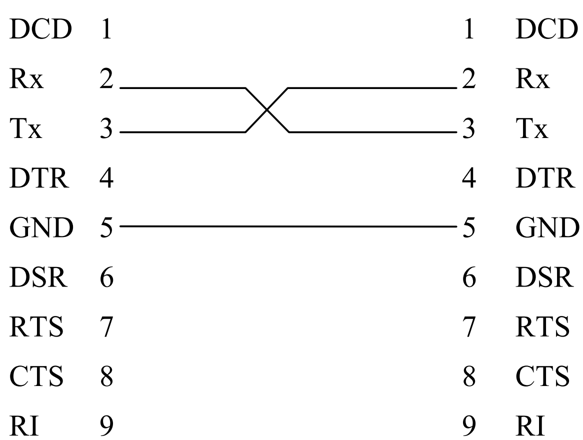


Figure 2: Wiring diagram for simple crossover cable.

If a simple crossover cable is used, the following settings must be applied:

Disable flow control (AT&K0)

Ignore DTR (AT&D0)

Note that these AT commands may not be the same for all modems.

These AT settings may be added to the modem initialisation string in the menu.

The modem is initialised at startup, with various modem settings and the initialisation string specified in the menu. When a message is to be routed out the HOST port, the modem dials the number and connects, and sends the message. It stays connected and hangs up after a timeout of 60 to 90 seconds if no more messages are sent or received.

2.12 Redundancy

The TLX-400 offers a dual-redundancy mode where a pair of units provides redundant backup in any of the operational modes (RTU, PP, etc). The status of the redundant pair is indicated by the DIO pin, which also serves as the communication link between the two units.

Under normal operation, the *Primary* unit performs the functions of the site, when in the *active* state. The *Secondary* unit has all the same connections as the *Primary*, but does not communicate any external messages. It waits in the *standby* state, and is connected to the *Primary* via the DIO pin.. Both units monitor and control the DIO signal, to indicate normal operation, and to sense any faults that may occur.

If the *Primary* suffers a fault, the *Secondary* will detect this and change to the *active* state. The *Primary* will change to the s*tandby* state to allow the *Secondary* to take control. A change-of-state message is generated whenever changes in redundancy states occur.

If the *Primary* then recovers, it regains control from the *Secondary*, and the *Secondary* returns to the *standby* state.

The status of the redundant pair is indicated by the duty cycle of the DIO led as follows:

Condition	**DIO LED behaviour**
Primary active, Secondary standby	Long on, short off
Secondary active, primary fault	Short on, long off
Primary active, secondary fault	Equal on - off

The condition of the Primary and Secondary units is passed in the TLC message frame in response to a change-of-state. The Primary fail and Secondary fail bits constitute the 4th-last and 3rd-last bits of the digital I/O data, as shown:

Mains fail	**Battery low**	**Secondary fail**	**Primary fail**
Last DIO	2nd-last DIO	3rd-last DIO	4th-last DIO

To set up a pair of dual-redundant units:

1. Connect the DIO pin of both units together. Ensure also that the units have a common ground.

2. Set up the primary unit with the menu, allocating unit address, routing, I/O, and other setup items. Generate some COS messages and ensure there is no antenna fail flag, and at least one power input is not in fail.
3. Once the module has been set up, go to the redundancy menu and select Primary. Switch this unit off while configuring the secondary.
4. Set up the secondary unit with the same configuration as the primary. Generate some COS messages and ensure the module is not in fail, as for the primary.
5. Once the module has been set up, go to the redundancy menu and select Secondary.

Reset both units. If no module faults exist, the DIO led should have a long-on, short-off duty cycle. If faults exist, the modules will attempt to set the Secondary active, and will generate a COS message in doing so.

The *Force changeover* menu function allows the user to force the active and standby units to swap roles. The *Force active to standby* menu selection should only be applied to a unit that is currently in the active state.

When applied to the Primary unit, a primary fault condition is simulated to cause the Secondary to become active. If the Secondary develops a fault while active, it remains as the active unit since it believes the primary is in fault. However if the Secondary incurs a serious fault and loses power, the Primary senses this and takes over the active role.

The *Forced Changeover Timeout* allows the user to specify a time interval, after which the Primary will regain control and active status.

If, in normal operation, the Primary incurs a module fault, the Secondary will become the active unit. If a *Force changeover* command is then given to the active Secondary, it will attempt to relinquish control to the Primary. If the Primary is still in fail, it will refuse control and the Secondary will remain active. However if the Primary has recovered, it will take over the active role. This is useful in cases where the Primary has failed due to an antenna fault. A module cannot detect that its antenna has recovered unless it attempts to transmit (which is illegal for a module on standby). The *Force changeover* command, when applied to an active Secondary, allows the Primary to attempt to gain control and check its own antenna after a repair.

2.13 Logging

The logging feature in the TLX allows messages or data to be stored in flash RAM for later retrieval. 128k of flash has been allocated for logging storage. If more than 128k of logging events occurs, the new log records will overwrite the oldest log records.

Data logging may be initiated in two ways: either from the Logging Options menu, or via the local control code.

The logging options menu enables logging of TLX messages under comms fail conditions. To initiate this logging, choose menu item:

Logging Options / Enable Automatic Logging of Commfail Data

Messages are logged under two different conditions:

1. If a “comms fail” message is received in response to sending a message, the current I/O state is logged in the form of a radio message. Note that this is NOT the actual message

that caused the comms fail, but a snapshot of the I/O state at the time the module registered the comms fail. This type of logged message is identified by the absence of a frame flag and destination / next addresses in the message header (see the section on TLC frames for an explanation of message parts). This log record is also identified as coming from source 1.

2. If the module is already in comms fail and a COS or other factor triggers a message transmit, that message is logged prior to transmit. This ensures that messages generated while in comms fail are not lost. This type of logged message has a valid frame flag and destination / next addresses. It is identified as coming from source 2.

The local control code allows the user to log different types of data and messages via the *log_data* command. The data type must be specified as either radio message, string, bits, bytes, words, longs, or floats, and a user-defined source is given to the log record.

The logged data is retrieved via the menu:

Logging Options / Recover Logged Data

The menu allows the user to search for records with particular parameters, list all records, and clear all records. The output display may be set for on-screen viewing or .csv format if the data is to be imported into a software package such as Excel.

2.14 Local Control

The Local Control feature allows a TLX unit to provide custom control functions. The customer specifies the control behaviour by writing a C program which includes libraries provided by ELPRO. The program is downloaded into the TLX, and once a Control address is assigned, the control code begins executing. For more information consult the manual for TLX Distributed Local Control.

Control programs may also be written in-house at ELPRO to provide custom control functions. The control code is downloaded to the TLX by the following steps:

Obtain the file to download. It should have extension “.sx”.

1. Bring up the TLX menu and ensure the controller is off by disabling the control address and resetting the unit.
2. Choose Configure Local Control / Load Control from File. You will be prompted to send the data.
3. Use the terminal’s function to send the .sx file to the TLX.
4. To activate the control code, a control address must be assigned and the unit reset. The control code will then execute automatically.

2.14.1 Control Parameters

A set of eight parameters are provided to enable simple changes to the control behaviour via the menu. The parameters are 32-bit variables and their values may be edited via the menu. The parameters are accessible by the control code, which may perform specific functions according to the parameter values. The control code may only read the parameters; it cannot change their values.

2.15 TLC Emulation

The TLX may be used as a direct replacement for an older TLC unit. For this purpose the TLX can be configured to emulate specific models of TLC. The TLX emulates the TLC by treating message frames in the same way the TLC would have used them. The TLX emulates 3 kinds of TLC frames, and has its own native TLX frame. The different emulation modes include module information such as battery low or power fail in different locations in the frame as shown:

2.15.1 Digital Frames

Native TLX:

No redundancy:

Mains fail	**Battery low**	**Antenna fault**	**On-board DIO**
Last DIN	2nd-last DIN	3rd-last DIN	4th-last DIN

Dual-redundancy mode:

Mains fail	**Battery low**	**Secondary fail**	**Primary fail**
Last DIN	2nd-last DIN	3rd-last DIN	4th-last DIN

TLC-01-05 emulation

Mains fail	Battery low
Last DIN	2nd-last DIN

TLC-02-01 emulation

Mains fail	Battery low
DIN16	DIN15

TLC-09-02 emulation

Mains fail	Battery low
DIN8	DIN7

2.15.2 Analog Frames

Native TLX:

Radio temperature	RSSI	Battery level (volts * 10)
3^{rd}-last AIN	2^{nd}-last AIN	Last AIN

TLC-02-01 emulation

AIN1	AIN2	Battery level (volts * 10)
AIN1	AIN2	AIN3

The emulation mode is chosen from the menu item:

Configure Site / TLC Emulation Mode

2.16 Test Functions

The test I/O menu function allows a user to manipulate outputs and alarms for testing. Analog and digital inputs can also be read. Choose the menu option:

Service Menu / Test I/O

Digital and analog outputs on a local 115S are written to via the “Write Digital Outputs” and “Write Analog Outputs” menu selections.

The “Write on-board DIO” menu selection is used to set or reset the single on-board digital output.

Note that for the I/O to function properly during testing the unit must be given a local RTU address.

The “Test Local Alarms” menu option allows a user to manipulate and test the unit’s warnings and alarms. Once this menu is entered, the alarms are not updated via the normal software operation, but are controlled by the user via the menu. The unit still responds to the alarms as if they had occurred during normal operation. The effect of each alarm can be checked by reading the module fault flag via the “Read alarms” menu option. Once the Test Local Alarms menu is exited, the alarms will be updated by the software as normal.

2.16.1 Tone Reversals

The radio can be tuned and tested via the Tone Reversals menu. This menu is located at:

Service Menu / Tone Reversals menu

This menu can be used to transmit tone reversals (alternating marks and spaces) from the radio, or a constant mark tone or a space tone.

Chapter 3 INSTALLATION

3.1 General

The TLX-400 is housed in a plastic case suitable for DIN-rail mounting. Terminals will accept wires up to 2.5 sqmm (12 gauge) in size.

Normal 110-240V AC supply should not be connected to any terminal of the TLX-400 module.

To operate this equipment legally the user must operate on a designated license-free radio channel and within the operating parameters of the license-free channel, or obtain a radio operating license from the responsible government agency. This is done so the government can coordinate radio users in order to minimize interference.

Before installing a new system, it is preferable to bench test the complete system. Configuration problems are easier to recognize when the system units are adjacent. Following installation, the most common problem is poor communications caused by incorrectly installed antennas, or radio interference on the same channel, or the radio path being inadequate. If the radio path is a problem (e.g. path too long, or obstructions in the way) then higher performance antennas or a higher mounting point for the antenna may rectify the problem. Alternately, use an intermediate TLX-400 as a repeater.

The TLX-400 ***Installation Guide*** included with the product provides an installation drawing appropriate to most applications. Further information is detailed below.

Each TLX-400 should be earthed via the "GND" terminal on the module. This is to ensure that the surge protection circuits inside the module are effective.

The TLX has two RS232 ports which allow configuration via a PC. The CONFIG port requires an RJ45 connector and the HOST port requires a DB9 connector. Both ports expect a standard straight-through RS232 cable. Either port may be used to configure the TLX via the menu. Use a terminal program such as ProComm or HyperTerminal to communicate with the TLX. The menu is invoked by hitting the <enter> key three times in quick succession.

3.2 Power Supply

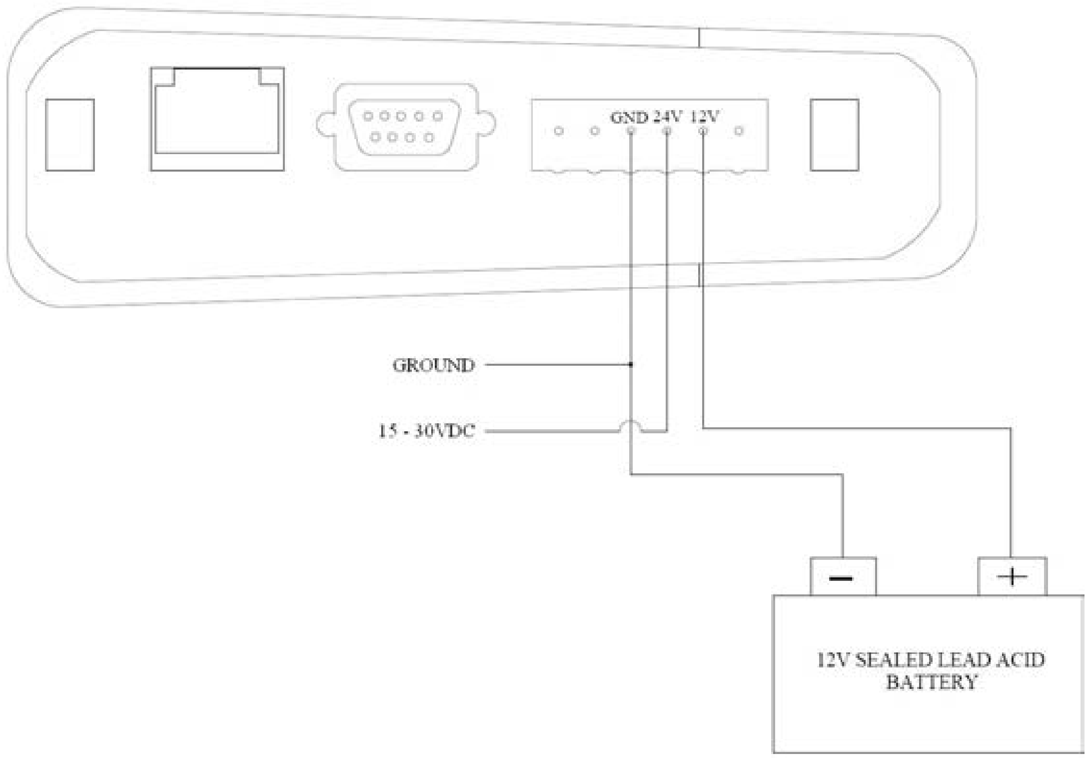
There are several options for powering the TLX-400. Power may be derived from the mains or a solar array and applied to the +24VDC power input. The +12VDC pin may be used for a back-up battery. The battery is charged while the +24V input is powered; otherwise the battery powers the TLX. The following table shows the input voltage requirements.

VOLTAGE INPUT	+24VDC	+12VDC
Allowable Input Voltage Range	15 – 30VDC	9 – 15VDC
Maximum current draw/supply	2.5A	1.8A

Only DC voltages are accepted. Inputting AC power can damage the TLX-400.

3.2.1 Mains Power for the TLX-400.

The TLX-400 has two inputs for power: +24VDC and +12VDC. The +24VDC input is the mains (and solar) input and accepts 15 – 30VDC. The +12VDC input is usually connected to a 12V SLA (sealed lead acid) battery and can also output current to charge the battery if required. For mains powered sites, the battery typically should range between 7Ah and 30Ah depending on the expected transmission duty cycle and I/O connected. Below is a wiring diagram showing how to connect the TLX-400 to power and battery.



For sites with small amounts of I/O (up to 8 digitals and 8 analogs) and low transmission duty cycles (does not transmit frequently) then a 7 or 12Ah battery should be sufficient with 7Ah being the bare minimum. If the TLX-400 is to be setup as a store and forward/repeater, is expecting a high transmission duty cycle or has large amounts of I/O then a 20 - 30Ah battery is recommended.

3.2.2 Solar Power for the TLX-400

In some remote sites, solar power is the only option to supply the TLX-400. Due to the effects of night-cycles and weather, solar powered sites require larger batteries than their mains-powered counterparts. Battery sizes are mainly dependant on the transmission power, the transmission duty cycle and I/O connected to the TLX-400 (such as the 115S-xx modules). The TLX-400 has an onboard regulator which is only suitable for recharging the battery of a standard remote site (one TLX-400 with 8 DIO and 8 analog I/O). The maximum current that the battery can be charged at via the onboard regulator is 1.8A.

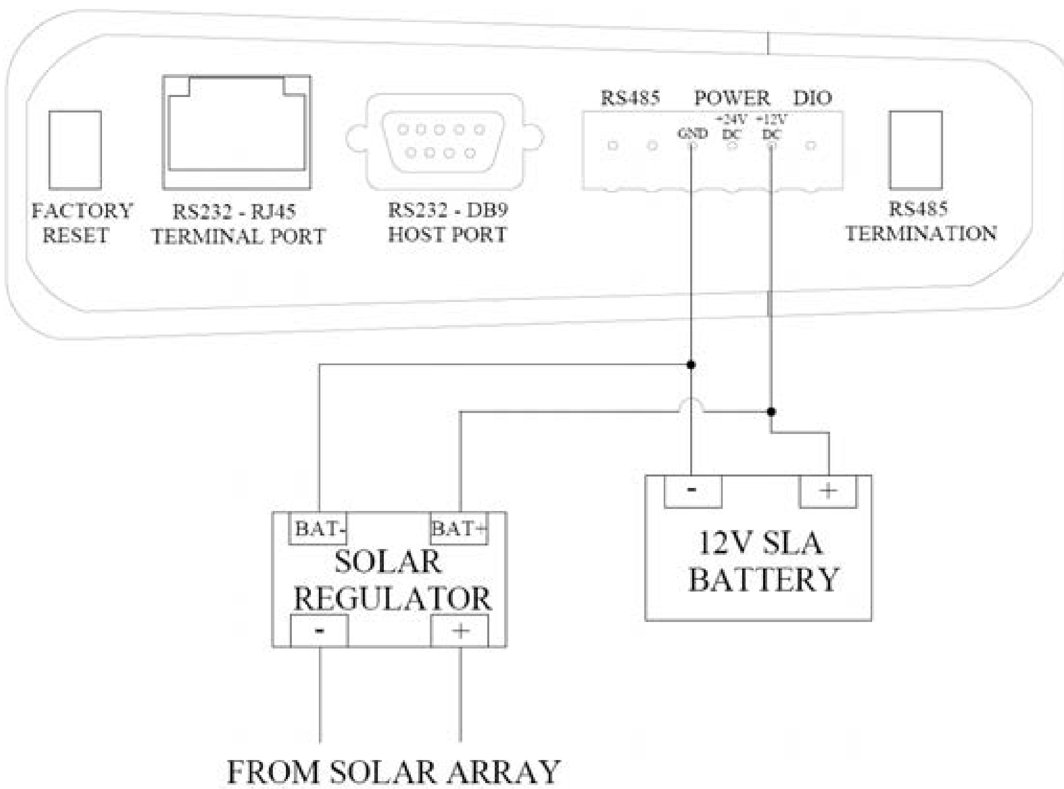
3.2.3 Solar Panel and Battery Sizing

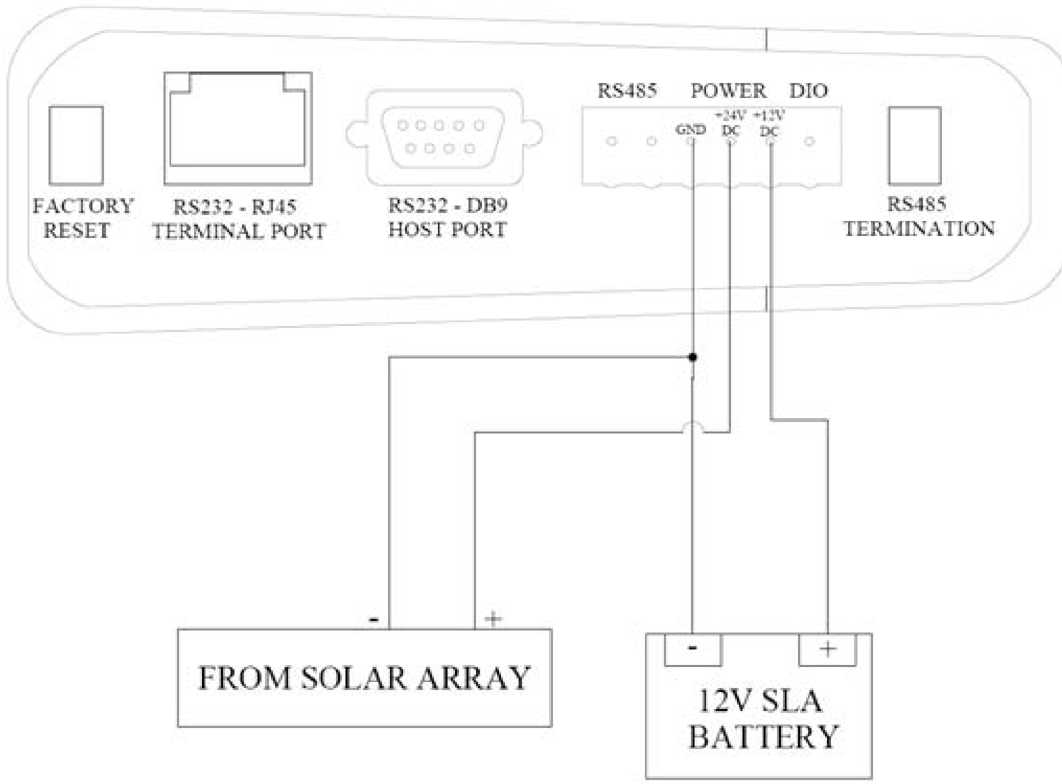
A TLX-400 when charging a low battery can require up to 2.5A (from 16V supply) so it is important to ensure that any solar panels can supply at least 2.5A at 16V. This gives a minimum rated panel of 40W. A 40W panel with a 40-50Ah battery will support a standard site (low transmit duty cycle with about 8 DIO and 8 analog I/O). For such sites, the TLX-

400's onboard regulator can be used to charge the battery. If a larger solar panel is used then an external solar regulator is recommended to get the full benefit of the panel.

If the TLX-400 is to be used as a store and forward/repeater, is transmitting large amounts of data or has large amounts of I/O then a high-current external regulator must be used in conjunction with a larger battery. Having an external regulator ensures that the battery can be charged at a reasonable rate and can support high power solar panels. For a large/busy site, the solar panel power could be increased to 80W – 100W with an 80Ahr battery and an external regulator to match the selected battery and panel. These figures should be increased/reduced to match the site conditions as each site will be different. It is often better to overpower store and forward/repeaters due to several sites being affected if it loses power. Extremely remote sites should also fall under this category as accessing them due to a power failure is difficult.

See below for wiring diagrams with and without a regulator.





3.3 Antenna Installation

The TLX-400 will operate reliably over large distances. The distance which may be reliably achieved will vary with each application, depending on the type and location of antennas, the degree of radio interference, and obstructions (such as hills or trees) to the radio path. The expected range for radio data rates of 4800 bits/sec is up to 60km (40 miles), depending on installation, site and path terrain. The expected range at 19200 bits/sec (with 25KHz bandwidth) or 9600 bit/sec (with 12.5KHz), is up to 30 km (20 miles) line-of-sight.

Where it is not possible to achieve reliable communications between two TLX-400 modules, then a third module may be used to receive the message and re-transmit it using the Store-and-Forward function. This module is referred to as a repeater.

An antenna must be connected to each TLX using the female SMA connector at the top of the module.

To achieve the maximum transmission distance, the antennas should be raised above intermediate obstructions such that the radio path is true “line of sight”. Because of the curvature of the earth, the antennas will need to be elevated at least 5 metres (15 feet) above ground for paths of 5 km (3 miles). For short distances, the modules will operate reliably with some obstruction of the radio path. Obstructions which are close to either antenna will have more of a blocking effect than obstructions in the middle of the radio path. For example, a group of trees around the antenna is a large obstruction, and the antenna should be raised above the trees. However if there is at least 100 metres (300 feet) of clear path before a group of trees, the trees will have less effect on the radio path. To help in planning radio systems, ELPRO provides a free utility for estimating path performance.

The modules provide test diagnostics to test the radio path and display radio signal strength.

An antenna should be connected to the module via 50 ohm coaxial cable (eg RG58, Cellfoil or RG213) terminated with a male SMA connector. The higher the antenna is mounted, the greater the transmission range will be, however as the length of coaxial cable increases so do cable losses. For use on unlicensed frequency channels, there are several types of antennas suitable for use. It is important antennas are chosen carefully to avoid contravening the maximum allowed power limit on the on the radio channel. If in doubt refer to an authorized service provider.

The gains and losses of some typical antennas and cable types are

Antenna	**Gain (dB)**
Dipole with integral cable	0
3dBd Collinear	5
6dBd Collinear	8
6 element Yagi	9
9 element Yagi	12
16 element Yagi	15
Cable type	**Loss (dB per 10 m)**
RG58	-4.5
RG213	-1.65
Cellfoil	-2.25

The net gain of the antenna/cable configuration is determined by adding the antenna gain and the cable loss. For example, a 6dBd Collinear with 20 metres of RG58 has a net loss of 1 dB (8dB – ((20/10) x 4.5) dB) = 8dB – 9dB = -1dB

Another important consideration when installing the antenna system is RF exposure. The antenna can radiate a large amount of RF energy. It is important to ensure that a person cannot approach the antennas within the recommended minimum safe distances in the table below.

Antenna Type	**Minimum safe distance**
Dipole	0.4 metres
3dBd Collinear	0.7 metres
6dBd Collinear	0.9 metres
6 element Yagi	1.2 metres
9 element Yagi	1.5 metres
16 element Yagi	2.3 metres

Connections between the antenna and coaxial cable should be carefully taped to prevent ingress of moisture. Moisture ingress in the coaxial cable is a common cause for problems with radio systems, as it greatly increases the radio losses. We recommend that the connection be taped with a layer of PVC insulating tape, then a layer of vulcanizing tape such as "3M 23 tape", with a final layer of PVC insulating tape.

Where antennas are mounted on elevated masts, the masts should be effectively earthed to avoid lightning surges. Although the TLX-400 is fitted with surge protection, additional surge suppression devices are recommended if lightning surge problems are experienced. If the antenna is not already shielded from lightning strike by an adjacent earthed structure, a lightning rod may be installed above the antenna to provide shielding.

Figure 3 shows a diagram of the antenna installation.

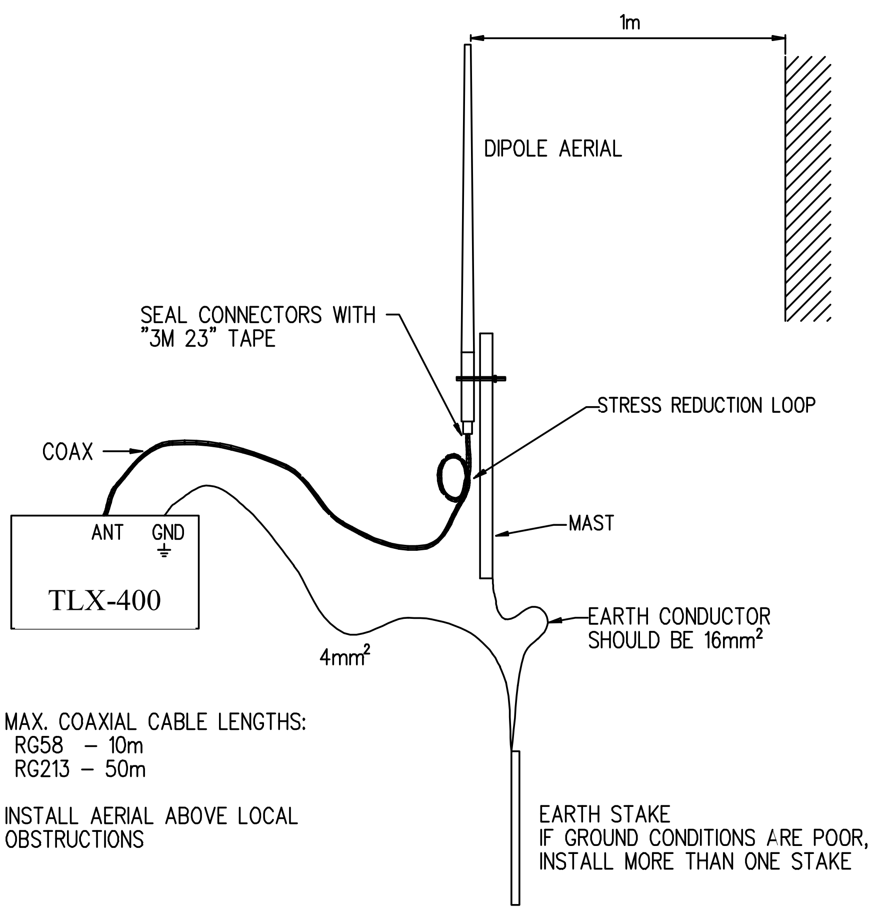


Figure 3: Antenna installation for TLX-40

Chapter 4 MENU ITEMS

This chapter provides information about each menu item available on the TLX. It describes each menu item's function and acceptable values to enter as inputs.

4.1 Configure Site

Display Configuration

Displays the current configuration from all the menus located under the Configure Site menu.

TLC Emulation Mode

TLX native mode

No TLC emulation. See the chapter Messaging Protocol for local data inserted into message frame in TLX native mode.

TLC 01-05

Adds module data in the message frame to emulate that of a TLC 01-05 (an existing ELPRO product) for backwards compatibility with existing SCADA systems.

TLC 02-01

Adds module data in the message frame to emulate that of a TLC 02-01 (an existing ELPRO product) for backwards compatibility with existing SCADA systems.

TLC 09-02

Adds module data in the message frame to emulate that of a TLC 09-02 (an existing ELPRO product) for backwards compatibility with existing SCADA systems.

See the section TLC Emulation for more detail on the data added to the message frames.

Redundancy Options

Configures redundancy between two TLX modules. If the primary unit fails, the secondary unit will assume control. See the chapter Redundancy for more information.

Redundancy Mode

No Redundancy

Disable redundancy.

Primary

Enable redundancy with the unit as the primary controller.

Secondary

Enable redundancy with the unit as the secondary controller.

Forced Changeover Timeout

Restores original Primary / Secondary operation after a Force Changeover has been initiated by the menu, and the set timeout has elapsed.

Valid Input format: hh:mm:ss

Force changeover

Applied to active unit only, force the module to give control to the standby unit. Also use this menu to cancel a forced changeover that does not time out.

Address of Pre-Processor

Configures the unit as a Pre-Processor which is commonly used for the computer to TLX interface.

Valid Address: Integer in the range 0 – 255 (entering 255 disables the pre-processor)

Address of Pager RTU

Configures the unit to use an external modem to dial into a paging network. The pager must be connected to the RS-232 DB9 port and configured in the pager/modem menu.

Valid Address: Integer in the range 0 – 255 (entering 255 disables the pager)

Address of Control RTU

Configures the unit as a controller resembling a basic SCADA system. When given a valid Control RTU address, the unit executes the user control code, previously downloaded via the menu. See the chapter Local Control for more information.

Valid Address: Integer in the range 0 – 255 (entering 255 disables the controller)

SMF option

Configures the unit to connect to an SMF (standalone monitoring facility). In practice, this option inhibits radio transmission from the unit. The receiver is still enabled, sending received data out of the HOST port so that a computer can utilise the data.

Valid Input: y/n

Address of local RTU

Gives the unit its own address and activates I/O and change-of-state detection. Other RTUs use this address to communicate with the unit.

Valid Address: Integer in the range 0 – 255 (entering 255 disables the RTU address)

Input Debounce Time

Specifies the amount of time (in seconds) an input must remain constant before generating a COS (change of state) message.

Valid Input: 0.01 to 100.00 (seconds)

Comms Fail Timeout

Specifies the amount of time (in minutes) that the local RTU will wait before deciding it is in comms fail. At this point it clears its outputs.

Valid Input: Integer in the range 0 – 35 (minutes)

Frame type

Sets the frame type that the unit will transmit (from MOD1 to SB05). Different frame types contain different amounts of IO. See the protocol document for more information on frame types.

Default sensitivity

Sets the minimum change that must occur in an analog input for a COS message to be generated. This initial value can be altered if a sensitivity frame addressed to the unit is received.

Valid input: Integer in the range 1 – 65535. (1966 ~ 3%)

Analogue inputs to square root

Specifies which analog inputs should have their square root taken before processing or storage. Refer to the section Analog Inputs for more information.

Valid Inputs: Integers referring to the analogs (separated by spaces).

Analogue inputs to filter

This option provides extra filtering for the analog inputs. If this option is not selected, the TLX will take an average of the last 10 seconds from the analog reading to give the present reading. If a larger running average is required, this menu is used to setup specific analogs to change the running average time. The time constant refers to the time over which the averaging process will take place. Refer to the section Analog Inputs for more information.

Routing

Configures which addresses the unit can communicate with on radio, host, terminal and expansion ports. Also sets the COS (change of state) address which is typically the control unit in the network (0 in a SCADA-C system).

Valid inputs: Integers in the range 0 – 255

Store and Forward Configuration

Specifies which address the radio messages from the unit are to route through to get to the destination. Useful if a poor radio path prevents direct communication. The message is sent to the store and forward address which then relays the message to its destination.

Valid inputs: Integers in the range 0 – 255

4.2 Configure Radio

Display Configuration

Displays the current radio configuration, including transmit and receive frequency, baud rate, tones and Power.

Tx/Rx Frequency

Alters the Transmit and Receive frequencies. Valid inputs will vary depending on the radio frequency range

Example Input: 461.08125

Tx Power

Sets transmit power. The unit can transmit at 500mW, 1.0W, 2.0W or 5.0W.

Baud Rate

Sets data transmission speed over the radio, either 300 baud or 1200 baud.

Radio Tones

Selects the protocol for communication: *V.23* or *Not V.23*.

Lead-in

Specifies the amount of lead-in time (in milliseconds) the unit will transmit for prior to sending the message. Lead-in time allows other units to lock on to the transmission before receiving the message.

Valid inputs: Integers in the range 30-1000 (milliseconds)

4.3 Configure Local Control

The TLX can be programmed to exhibit basic SCADA functions that would normally be controlled by a PLC such as toggling inputs when certain analog setpoints have been reached.

Load Control From File

Upload a pre-prepared control program to the TLX. See the section Local Control in this manual more information.

Save Control To File

Download the current control program stored in the TLX to a computer.

Control Parameters

Edits values specified in the control program such as analog setpoints.

Show Masks

Displays which inputs and outputs are currently masked by the given control RTU. If an input is masked, it can only be written to by the unit that masked it.

4.4 Load Configuration From File

Configures the TLX using a text file stored on the computer. Upload the text file using the send text file option in HyperTerminal. Radio settings will remain unchanged as they are not stored in the text file.

4.5 Save Configuration To File

Saves a text file containing configuration data to the computer which can be uploaded to the TLX at a later date. The radio settings are not transferred. Store data by using the capture text menu in HyperTerminal or an equivalent program.

4.6 Service Menu

The service menu contains a number of tools to test communications and TLX IO status.

Monitor Comms

Displays communications being sent and received from both the radio and serial ports frame by frame.

Send Tone Reversals

Transmits alternating mark / space tones for radio calibration purposes. Mark-only or space-only tones can also be selected.

RSSI menu

Display RSSI

Displays the current received signal strength in dBm.

Automatic RSSI Calibration

Calibrates the offset and span for the RSSI automatically by requesting and internally comparing set signal power levels (-70dBm and -100dBm). An RF generator is required to perform this task.

Manual RSSI Calibration

Calibrates the RSSI by requesting direct input of the offset and span.

Radio Status and Temp

Displays the current temperature of the radio in degrees Celsius followed by any active radio alarms.

Set Clock

Sets the internal clock of the TLX in 24hr time format The clock will reset if the TLX remains un-powered for more than approximately two days.

Input Format: hh:mm:ss dd/mm/yyyy

Notepad

Basic two-line text storage. Useful for making notes and storing general information about the site.

Test I/O

In this menu, internal alarms and added IO can be read from and written to. This section is primarily used for testing.

Test Local Alarms

Write mains fail alarm

Sets or clears a mains fail alarm. This alarm typically occurs if the main supply is switched off whilst the battery is connected and operational.

Write battery alarm

Sets or clears a battery low alarm. This alarm typically occurs when the battery voltage drops below 11.7V

Write antenna alarm

Sets or clears an antenna alarm (VSWR). This alarm typically occurs when there is no antenna connected or the antenna is faulty.

Write radio ptt timeout alarm

Sets or clears a transmission timeout alarm. This alarm is typically generated if the radio transmitter has been on continuously for a long period (usually two minutes).

Write radio PLL alarm

Forces a Phase Locked Loop alarm. This alarm is typically generated when the onboard PLL frequency is out of lock. This alarm usually results in the radio having trouble detecting tones.

Write radio overtemperature alarm

Sets or clears an overtemperature alarm. This typically occurs due to a high temperature at the radio transmitter.

Read alarms

Displays all of the onboard alarms' current states (1 = on, 0 = off).

Clear all

Clear all onboard alarms.

The applied alarm settings remain until the Test Local Alarms menu is exited. The alarms are then set normally by the firmware.

Write Digital Outputs

Sets or clears a digital output on the attached I/O expansion module. To exit, enter digital input 0 and press enter.

Write on-board DIO

Sets the on-board DIO pin to either on or off. The state of this pin can be seen by the IO light on the TLX.

Write Analog Outputs

Writes a value to the specified analog output. The value will be reflected in whatever I/O expansion module is attached to the TLX, providing it has analog outputs.

Show All Inputs

Displays all the input mappings in TLX memory (128 digitals, 40 Analogs and 16 pulsed inputs). All inputs will be displayed regardless of what IO may actually be attached to the TLX.

Read 115S-XX @ #

Displays the input on a specific 115S module connected to the TLX. XXX is replaced by the board type (DIO, AIN or AOT) and # is the address assigned to the 115S (01 – 16).

Display serial number

Displays the 11 digit product serial number (example: 03061030000).

Display hardware version

Displays the hardware version of the TLX (example: 1.4J)

Enter Elpro Password

ELPRO internal usage, gives additional options used for factory configuration.

4.7 Pager/Modem Options

This menu selection can be used to ensure that the attached pager modem is working correctly. The modem must be attached to the HOST port (DB9) and the menu brought up via the CONFIG port (RJ45).

Test Pager/Modem

Tests the pager modem by sending a test pager message to the first configured pager.

Monitor Pager/Modem

Displays the status of the pager modem during the process of sending a page message.

4.8 Logging Options

The TLX can store data locally if a comms fail error has occurred.

Enable Automatic Logging Of Commfail Data

Enable or disable the storage of data generated whilst in comms-fail. The maximum amount of memory that the comms-fail log can occupy on the unit is 128kb. Once this limit has been reached, data will be overwritten starting with the oldest entry.

Recover Logged Data

Set search parameters

Allows filtering for certain events (such as radio messages or COS messages) by time period.

Search by parameters

Shows the results corresponding to the settings in Set Search Parameters.

List all

Shows all messages stored in the TLX

Clear all

Clears all the messages stored in the TLX memory.

Display options

Specifies how the log records should be displayed on the screen. *Display for Screen* lists the records in a format that is easy to read on the screen. *CSV format* lists the records in a comma-separated format that is convenient if the data is to be saved to file and viewed with a spreadsheet program.

4.9 Serial Ports Configuration

The DB9 RS-232 (HOST) and RS485 (EXPANSION) port settings can be changed to match a wide array of connection options. This menu gives access to the BAUD rates, data format and modem/pager setup.

Display Port Configuration

Displays port settings for the HOST and EXPANSION ports in addition to modem/pager configurations on the HOST port

Set HOST Port Baudrate

Sets the port speed for the HOST (DB9) port. There are pre-set selections available in addition to a custom BAUD rate option.

Set HOST Port Data Format

Sets the number of data bits, stop bits and type of parity for the HOST (DB9) port from preset selections.

Set EXPANSION Port Baudrate

Sets the number of data bits, stop bits and type of parity for the EXPANSION (two-wire RS485) port from preset selections.

Set EXPANSION Port Data Format

Sets the number of data bits, stop bits and type of parity for the EXPANSION (two-wire RS485) port from preset selections.

Configure HOST for modem

This menu option is used to configure a modem attached to the HOST (DB9) port. Initialization strings and phone number settings can be stored using this menu. For more detail on how to properly interface a modem to a TLX, see the section Modem Feature in this manual.

Modem on HOST port

Configures the unit to support a modem connected to the HOST (DB9) port.

Valid Input: y/n

Set phone number

Stores a phone number to dial and send the message to if an event occurs (such as a change of state).

Set extra modem initialization

Allows the addition of modem initialization strings to allow alternate configuration of the modem. These strings are run prior to dialing the given number.

Configure HOST for pager

Set phone number

Stores the phone number to dial for the paging network.

Set password

Stores the password required for the paging network.

4.10 Modbus Configuration

This menu item configures the TLX to communicate with additional hardware (such as 115S IO modules) using the Modbus protocol.

Show 115S module Configuration

Displays the current 115S modules that have been setup on the TLX including their type, their address and the number of digital inputs configured.

Auto Detect 115S Configuration

Auto-detects 115S IO modules which have been connected to the TLX. Requests number of digital inputs for each detected 115S.

Valid Input: Integer in range 0 – 8 for AIN and AOT boards

Integer in range 0 – 16 for DIO boards

Manually Configure 115S Modules

Allows configuration of 115S units by manually entering in the address, 115S type and number of digital inputs.

Valid Address: Integer in range 1 – 16

Valid Type: D, I, O or N (D=DIO, I=AIN,O=AOT, N=None)

Valid DIN: Integer in range 0 – 8 for AIN and AOT boards

Integer in range 0 – 16 for DIO boards

Show Modbus Configuration

Displays the specifics of the master poll commands in addition to poll time and current Modbus address.

Set Modbus Slave Address (0 for master. 255 for disable)

Sets the Modbus address of the TLX. In order to communicate with IO modules, this must be set to 0 (Master).

Valid Input: Integer in range 0 – 255

Set Delay Between Polls (mSec)

Sets the time between Modbus poll queries. The TLX will poll all configured 115S modules sequentially with this delay between polls. The greater the number of 115S modules attached, the smaller this time should be.

Valid Inputs: 0 - 10000

Add Master Poll Commands

Used to map IO from an entered Modbus address to different memory locations on the TLX. This enables greater customization of IO.

Valid Address: Integer in range 1 – 128

Valid Timeout: Integer in range 1 – 50000 (ms)

Valid Retries: Integer in range 0 – 10

Valid Location: Integer in range 1 – 49999 (see selection for IO)

Valid TLX Location: Integer in range 0 – 100

Valid Number Points: Integer in range 0 - 128

Edit an existing command

As more master poll commands are entered, they are given a unique index. To edit a chosen command, select the index number corresponding to the entry for editing.

Valid Input: Integer with range dependant on number of poll commands entered.

Delete the final command

Deletes the master poll command with the highest index (usually the most recent one entered).

4.11 Factory Defaults

Resets the TLX configuration to factory default settings. The radio is not affected by this, retaining its calibration and Tx/Rx frequencies.

4.12 Reset

Resets the TLX without disconnecting power. It is recommended to reset via this menu option after any setting changes.

4.13 Exit

Exits completely out of the TLX menu. The menu must be invoked again if any additional changes are to be made.

Chapter 5 TROUBLESHOOTING

This chapter provides information about each menu item available on the TLX. It describes each menu item's function and acceptable values to enter as inputs.

5.1 115S Connection

- **TLX does not auto-detect 115S module(s)**
  The 115S may not be set for MODBUS RTU protocol. Set the 115S modules to use MODBUS RTU as described in the manual. Also check that the address switches on the 115S unit(s) are between 01 and 16. A change in address requires a reset on the 115S (power off and on again).
- **TLX autodetects 115S modules but will not poll them**
  This problem can occur if the TLX Modbus slave address is not set to 0 (master). Set this to 0 via the MODBUS configuration menu.
- **After removing a 115S, the TLX continues trying to poll**
  Go into Manual Configuration located in the Modbus Configuration menu, enter the address of the unit recently removed and select its type as none (N).
- **TLX does not detect more than one 115S**
  Check to ensure that each attached 115S has a different address via the address switches (between 1 and 16). Also ensure that each 115S has been connected to the TLX's RS485 port. If the connection wires are particularly long (several meters) then try turning on the RS485 termination switch on the 115S in question.
- **Digital or Analog XX doesn't read correctly on the TLX**
  This problem could be caused by using an emulation mode. Different IO locations have been reserved for alarms such as Mains Fail and Battery Low. For example DIN 15 and DIN 16 are reserved when emulating a TLC 02-01. This problem can be solved by either utilizing the master poll commands to change input locations or not using those particular IO locations. For a list of reserved locations, see the TLC Emulation section. Another cause of this problem could be that the 115S is not setup to accommodate the desired analog input range. See the 115S Manual for instruction on how to configure the 115S analog I/O.
- **Pulsed inputs are not being displayed accurately on the TLX**
  If using a digital input other than 1-4 on an 115S, check to ensure that the poll time is higher than that of the maximum expected pulse rate.

5.2 Local Control

- User control code does not download completely, or does not run properly
  The downloading program may be supplying characters too quickly. Try increasing the character time and line time of the terminal program.

5.3 Menu

- **The menu does not come up when 3 [CR] characters are pressed**
  The com port, baud rate, or data format could be wrong. Turn off flow control. Also check that the TLX to computer cable is a straight-through serial cable.

5.4 Communications

- **Radio messages do not get through**
  Ensure the radio settings match that of the network (Tx and Rx frequencies, baud rate and tones). Try raising the power level. Check for antenna fault (via Test I/O menu) and try elevating the antenna (by a few meters). Ensure routing list is correct. Try transmitting a MARK tone, and check the Rx LED glows on the receiving unit. Also ensure that the unit has adequate power (20W minimum).
- **Serial messages do not get through**
  Ensure the menu is not running on the serial port. Check the routing list is correct. Check the baud rate and data format settings. If expecting messages to be sent over the serial port (e.g. a pre-processor) check the routing to ensure that the unit is enabled to talk over the tested port.
- **Modem does not function properly under TLX control**
  Ensure that the modem is correctly connected to the HOST port and does not require any additional initialization (this can be entered in the menu). Check the TLX is configured to talk to the modem.

Chapter 6 SPECIFICATIONS

Power

Supply Voltage: 15 – 30VDC on 24V input, 11 – 15VDC on 12V input
Current @ 13.5VDC:
Receive: 150mA;
Transmit: 450mA @ 0.5W, 800mA @ 1W, 1.25A @ 2W, 2A @5W
Battery Charger: Float charge voltage 13.8VDC with 1.6A current limit (minimum supply voltage 15V)

Operating environment

Temp Range: -30°C to +60°C / -22 to +140 °F
Humidity: 0 to 99% non-condensing

Menu

ASCII via either RS-232 serial port.
Invoke menu by 3 successive [CR] characters separated by min 50mS and max 500mS.

I/O Capabilities

Connects to Modbus devices via Modbus RTU protocol.
Auto-configurable with ELPRO 115S- series, analog and digital I/O.

General

Numbers of I/O limited by frame type.
Supported frame types: sb_06, sb_05, mod_1, mod_2, mod_3, mod_5, mod_6, mod_7, mod_8, mod_9, mod_10, mod_11

Maximum I/O limits (frame type Mod3)
Digital inputs: 16 bytes (128 digitals)
Digital outputs: 16 bytes (128 digitals)
Analog inputs: 40
Analog outputs: 40

Input debounce time: 0.01 seconds to 600 seconds.

Sensitivity: 0 to $FFFF (0 to 65535)

115S expansion

Maximum number of 115S units connected to one TLX: 16

Modbus

Supported Modbus commands:
1: Read coil status
2: Read input status
3: Read holding registers
4: Read input registers
5: Force single coil
6: Preset single register
7: Read exception status
8: Loopback diagnostic test
11: Fetch event counter
15: Force multiple coils

16: Preset multiple registers

Master poll time: 0 to 10 seconds.

Ports

RS-232 Terminal / Config port (RJ45)
Baud rate: 9600
Parity: None
Data bits: 8
Stop bits: 1
Not configurable.

RS-232 Host port (DB9)
Configurable baud rates:
300, 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 115200, Custom

Configurable data formats:

Data bits	Parity	Stop bits
8	None	1
8	None	2
7	Even	1
7	Odd	1
8	Even	1
8	Odd	1

RS-485 Expansion port
Configurable baud rates:
300, 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 115200, Custom

Configurable data formats:

Data bits	Parity	Stop bits
8	None	1
8	None	2
7	Even	1
7	Odd	1
8	Even	1
8	Odd	1

Radio

Transceiver:

Single channel	Synthesized, fixed band 12.5, 20 or 25KHz 380 –520 MHz (In 20 MHz bands)
Transmit power:	Four levels 5W, 2W, 1W and 0.5W
Lightning surge protection:	Internal gas discharge arrester
Signal detect / RSSI:	-120 to -60 dBm
Antenna Connector:	Female SMA.

Standards:

Australia:	AS 4768.1, AS4295
Europe:	EN 300 113, EN 300 220
USA / Canada:	RSS-119, FCC Part 90

Logging

Logging memory available: 128kbyte
Log record overhead: 14 bytes
Log record data size: 2 - 498 bytes
Number of log records: 8191 (2 bytes data) - 4096 (Mod 1)
Additional log records overwrite the oldest records.

Local Control

User configurable control allows control of the local module and other remote modules to implement full-time local control or as fall-back in case of main computer fail. Max code size: 16k bytes

TLC Emulation

Emulation options:

- TLX native
- TLC 01-05
- TLC 02-01
- TLC 09-02

Index

K SERIES HEAVY DUTY LEVEL REGULATOR

FEATURES

- **Low differential switching**
- **All position tilt action**
- **S.P.D.T three wire single point switch**
- **Polypropylene, SAN & CPE construction**
- **Wide range of cable lengths available**
- **Stable repeatable switching action**
- **No mercury or lead components**
- **Compact size. 75 mm diameter**
- **Optional cable weight available**

APPLICATIONS

- **Basic liquid level control**
- **Multi- point level control**
- **Sewerage level control**
- **Chemical level control**
- **High & low level alarms**
- **Self powered signalling**
- **Pump protection**

The K series heavy duty level regulator is a compact three-wire float switch for highly accurate and repeatable single point level sensing and control applications. It is ideal for use in water, sea water and most acids and alkali solutions. It will provide a stable switching action with a very high degree of reliability. The teardrop shape of the float makes it ideal for effluent and sewerage usage, as the float cell has no shoulders or edges for solids to build on. These float switches can be reliably and safely used in potable water systems, as they do not contain hazardous materials such as mercury or lead.

OPERATING PRINCIPAL

The K series level regulator houses a heavy ball that is balanced on the actuating arm of a high precision switch. When rising liquid level causes the float to lift and tilt, the centre of gravity of the ball moves away from the actuating axis of the switch and allows it to de-actuate. A falling liquid level allows the float to straighten up and the centre of gravity of the ball shifts back onto the switch causing it to again actuate. This simple reliable action only requires the float to tilt by 45 degrees in any direction for the switch to operate.

CONSTRUCTION

The K series heavy duty level regulator is constructed from polypropylene and high compliance three core CPE cable. The float chamber is a double moulded hermetically sealed cell with a double moulded barrier of solid polypropylene sealing the cable entry. The switch housed within the float cell is a precision single pole double throw device rated at 0 to 240V AC at up to 15 Amps resistive load.

HAZARDOUS APPLICATIONS

This level regulator is classed as a simple device and does not require separate certification to be used in hazardous applications. In any such installation the level regulator should be isolated by an intrinsically safe barrier, a zener barrier.

IMPORTANT SAFETY NOTE

The K series level regulators are rated for mains voltage operation. However, in the interest of safety we recommend that they are only ever operated at low voltage, preferably at 24 to 48V AC. Where mains voltage operation is unavoidable an earth leakage circuit breaker should always be installed in the control circuit. The application and wiring of this float switch should always be carried out by qualified electrical personnel and must always conform to local wiring rules.

K SERIES

CABLE DATA

Cable type	Heavy duty EPR / CPE
Outer sheathing	CPE
Inner sheathing	R-EP-90
Cores	3 Cores, each 0.75 mm Sq Copper
Cable diameter	7.5 mm nominal
Core colours	Blue (Common) Black (Normally Closed) Brown (Normally Open)
Cable voltage rating Uo/U	600V / 1Kv
AC Test voltage	2.5 Kv
Cable current carrying capacity	18 Amps Continuous at a temperature of 30.5ºC
Cable maximum tensile strength	30 N/mm2
Minimum benr radii	40 mm
Maximum ambient operating temperature	80ºC
Minimum permissible ambient temperature	-40ºC
Minimum permissible ambient temperature for fully flexible operation	-25ºC
Cable maximum permissible short circuit temperature	250ºC
Standard of construction	CNELEC HD 22.4 S4 & VDE0282-4/2005
Cable lengths available	4, 6, 10, 20, 30, 50 Metres

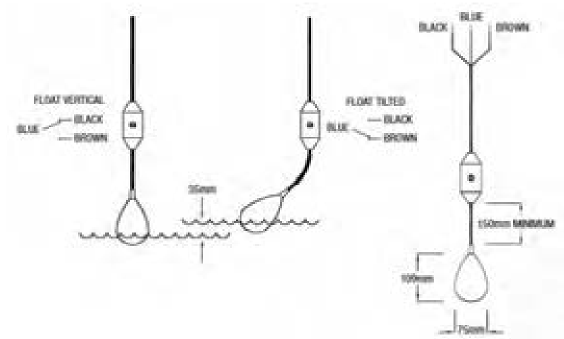
SWITCH DATA

Switch type	Single pole double throw
Contact type	0.5 mm
Contact material	Silver Alloy
Contact resistance	15 Mega Ohms maximum
Rated voltage AC	0 - 240V AC
Rated voltage DC	0 - 250V DC
Currant rating resistive AC	15 Amps at 250V AC, 15A at 125V DC
Motor load current rating AC	1.5 Amps at 250V AC, 2.5A at 125V AC (1/4HP)
Current rating resistive DC	15 Amps at 14V DC, 6 Amps at 30V DC
Maximum lamp load AC	1.25 Amps at 250V AC
Maximum lamp load DC	1.5 Amps at 30V DC
Minimum operating load	100 mA at 12V, or 60mA at 24V
Maximum operating frequency, electrical	24 operations per minute
Dielectric strength between contacts	1000V AC at 50 to 60Hz for 1 minute
Insulation resistive	100 Mega Ohms minimum (At 500V DC)
Dielectric strength between contacts	2000 VAC, 50/60 Hz for 1 minimum
Life expectancy mechanical	20,000,000 operations minimum
Life expectancy electrical	500,000 operations minimum
Approved standards	UL508 E41515 CSA C22.2 No.55 (File No LR21642)

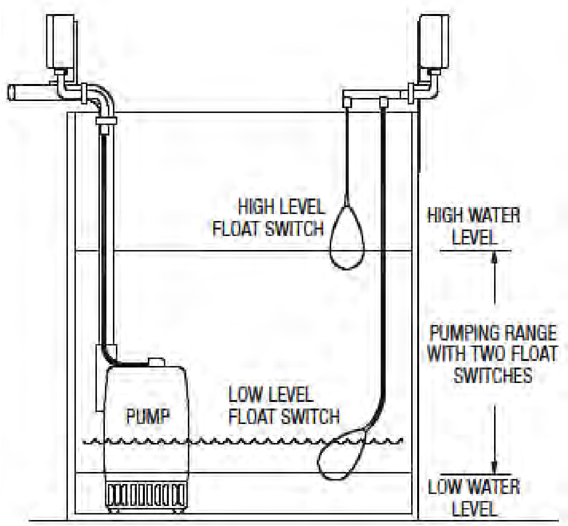
OPERATING ENVIRONMENT

Maximum submergence	30 Meters, 300 kPa Static Pressure
Maximum liquid temperature	60ºC
Minimum liquid temperature	-20ºC
Liquid specific gravity	>0.82
Liquid Ph	1 to 14
Smallest diameter well that the switch can operate in	Within a 160 mm inside diameter vertically mounted pipe
Liquid level change for the switch to operate	35 mm
Closest switching point to tank floor	50 mm
Smallest opening through which the switch will fit	75 mm
Minimum distance between float and closest tethering point/cable weight	150 mm
Suitability for use in sodium hypochlorite	Fully compatible
Suitability for use in sea water	Fully compatible
Suitability for use in potable water	Fully compatible

OPERATION & DIMENSIONS



TYPICAL INSTALLATION

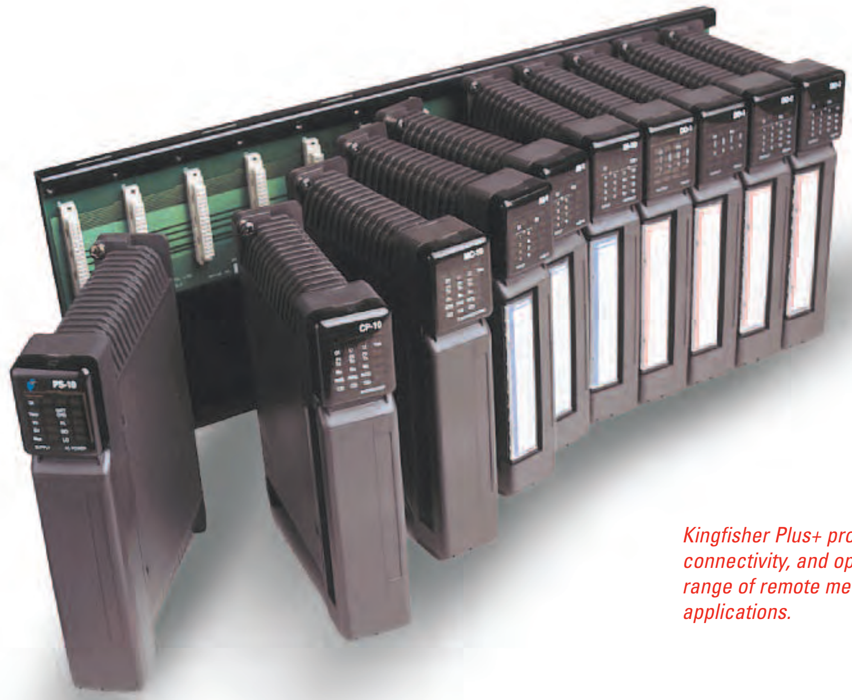


The Kelco K Series level regulator is protected by a 12 months return to base warranty. Full details of our warranty can be downloaded from: - http://www.kelco.com.au/menu/information/warranty-statement/

MADE IN AUSTRALIA BY KELCO Engineering Pty Ltd
ABN 20 002 834 844 Head office and factory:
9/9 Powells Road Brookvale NSW 2100 Australia
Postal Address: PO Box 496 Brookvale NSW 2100 Australia
Phone: +61 2 9905 6425 Fax: +61 2 9905 6420
Email: sales@kelco.com.au Web: www.Kelco.com.au

KINGFISHER

CSE Semaphore Kingfisher Plus+



Kingfisher Plus+ provides advanced capabilities, IP connectivity, and open programming to a broad range of remote measurement and control applications.

The Kingfisher Plus+ RTU is an advanced automation technology platform for SCADA applications. Designed as an enabling technology, Kingfisher Plus+ brings only strengths without the technical constraints that have traditionally limited RTU applications.

The high-performance, 32-bit processing platform works with intelligent communications and I/O modules to meet all scanning and throughput requirements. Numerous advanced features include three levels of redundancy — communications, power, and processor — in order to satisfy a range of availability specifications.

A complete array of communication modules and extensive protocols library provide broad network compatibility. In addition, the Kingfisher DNP3 protocol implementation is among the strongest in the industry. It exceeds level 3 and includes such functionality as Secure Authentication master.

Kingfisher's open, programmable automation environment is based on ISaGRAF version 5 and supports all IEC 61131-3 languages as well as IEC 61499 for distributed processing. A rich library provides numerous pre-engineered function blocks, which project engineers find invaluable.

Kingfisher Plus+ combines the benefits of advanced technologies with proven hardware and software in an easy-to-configure RTU that achieves exceptional performance.

www.cse-semaphore.com

Kingfisher Plus+ advanced hardware platform

The modular construction of Kingfisher Plus+ allows it to perfectly match the needs of practically any application. Multiple backplanes can be chained together to provide communications and I/O expansion. Kingfisher Plus+ configurations range from 3 to 16 communication ports and 4 to 1024 I/O points.

Processor modules

Kingfisher Plus+ processor modules are available in three levels of processing capability and memory capacity to allow users to best match applications requirements and budget constraints.

	CP-30	CP-12	PC-1	MC-12/31
DESCRIPTIONS	Toolbox Plus+ IEC 61131-3 programming	Toolbox32 ladder logic programming	Integrated processor & power supply	3 port communications module

Redundancy

For users who demand reduced risk of systems failures, Kingfisher Plus+ can be ordered with redundant processors, power supply modules, and communications modules. The CP-12 and CP-30 processor modules support hot standby redundancy. A switchover from the primary to the backup processor will occur upon failure of an I/O module scan, communications failure on selected ports, Toolbox command, or a ladder logic command.

High-performance I/O modules

Intelligent I/O modules are designed for applications that require high accuracy and performance. Advanced capabilities include high-speed scanning; input counting up to 10 kHz; quadrature counting; sequence-of-events (SOE) monitoring on a 1 ms interval; and configurable, fail-safe output settings.

	AI-1	AI-10	DI-5	DI-10	AO-3	DO-1	DO-2	DO-6	IO-2	IO-3/IO-5	IO-4
DI Digital inputs			16	16					8	4	8
DO Digital outputs						8	16	16	8	4	2
AI Analog inputs	8	8								4	2
AO Analog outputs					4					1	
DESCRIPTIONS	0-20 or 4-20 mA inputs	High performance	Dry contact inputs	Sequence-of-events (SOE)	Analog outputs	Relay outputs N.O./N.C.	Relay output N.O.	Open drain FETs	Multi 10	Multi 10	Multi 10

Communication option cards

A broad offering of communication options provides connectivity with the intelligent devices and networks that are used throughout today's measurement and control systems. Communication option cards are compatible with Kingfisher Plus+ processor modules and the MC-12 and MC-31 communications modules.

	OPT-A3	OPT-D	OPT-F	OPT-H	OPT-I	OPT-L	OPT-R2/R3/R4	OPT-T3
Name	Fiber Ethernet	Dial-up modem	Fibre serial	HART	Isolated	Line & radio FSK	Spread spectrum	Ethernet
DESCRIPTIONS	Optically isolated Ethernet communications	PSTN modem for worldwide phone system V.34	Optically isolated serial communications	Communicate using HART protocol	Isolated serial communications RS-232/485/422	Leased line & pocket radio interface V.23	Wireless license free communications	Communicate over 10/100 Mbit Ethernet RJ-45

Users can quickly become familiar with the Outlook-style displays Toolbox Plus+ provides for advanced configuration and diagnostics.

Communication protocols

For compatibility with a broad range of SCADA networks and intelligent devices, Kingfisher Plus+ supports many protocols. These include Kingfisher, DNP3 (master/slave), Modbus (master/slave), Allen Bradley DF1, and SNMP.

Toolbox software

CSE Semaphore's Toolbox Plus+ integrated operating environment combines configuration, program development, and maintenance in one simple-to-use package. Systems integrators and end users alike can view, edit, and diagnose a Kingfisher Plus+ solution with a highly intuitive, Outlook-style user interface.

Toolbox Plus+ eliminates the need to open — and switch between — multiple software packages, or engage in complicated programming. Toolbox Plus+ embeds the ISaGRAF IEC-61131-compliant environment and supports all five of the control languages it offers. This is also the first IEC 61499-compliant configuration environment that is intended for RTU products. In addition, the Kingfisher library of preprogrammed function blocks, which includes operations such as AGA flow calculations, simplifies applications development and makes it easy to add new capabilities to a Kingfisher Plus+ RTU solution.

Toolbox Plus+ is used in conjunction with the CP-30 processor module.

Systems using the CP-12 processor module are programmed using Semaphore's Toolbox 32 environment, which supports ladder logic as well as the Kingfisher library of proven function blocks. Toolbox 32 capabilities, including drag & drop, on-line help, and applications examples, are designed to streamline programming, testing, and startup efforts.

Applications

The Kingfisher Plus+ RTU brings IP connectivity, powerful processing, advanced I/O capabilities, and open programming to applications in CSE Semaphore's traditional end-user industries. Users in the broadcast/telecom, oil & gas, power, transportation, and water/wastewater industries will find a Kingfisher Plus+ configuration cost-effective over a broad range of installations.

KINGFISHER Plus+ SPECIFICATIONS

Designation	Industrial-grade remote terminal unit (RTU)

INPUTS & OUTPUTS

Maximum I/O points	1024
Backplanes	Up to 4 x 12 slot backplanes and 4 x 4 slot backplanes per RTU
I/O configuration	Automatic/manual
Backplane sizes	4 / 6 / 12 slots
Removable I/O connectors	Yes
Digital modules	Max. 16 inputs or 16 outputs/module
Analog modules	Max. 8 inputs or 4 outputs/module

PROCESSOR UNIT

Type	PC-1: 80C188/IA188ES, 16 MHz
	CP-12: x86, 40 MHz
	CP-30: Cirrus ARM9 166 MHz
Flash RAM	PC-1: 128 KB
	CP-12: 512 KB
	CP-30: 16 MB
RAM	PC-1: 256 KB
	CP-12: 512 KB
	CP-30: 32 MB
Real-time clock	Yes
Battery backup	RAM/RTC — Lithium >7 years
RTU address	1 to 255 or 1-65535 (protocol-dependent)

SCAN RATE

Digital	0.5 ms/module
Analog	1.5 ms/module
PID	4/s

COMMUNICATIONS SUPPORTED

Total Ports / RTU	16
Master/slave	Yes
Peer-to-peer	Yes
Fallback levels	Yes
PC link	Yes
Protocol	Kingfisher, Modbus, DNP3, SNMP, Allen Bradley, and numerous other protocols available on request

OPTION CARDS

PC-1	1 x standard serial port, 1 x option port
CP-12	1 x standard serial port, 2 x option ports
CP-30	1 x standard Ethernet port, 2 x option ports
Available options	A3 (fiber Ethernet)
	D (dial-up modem)
	F (fiber serial)
	H (HART)
	I (isolated serial)
	L (line & radio FSK)
	R2 — 900 MHz Australia R3 — 2.4 GHz International R4 — 900 MHz USA
	T3 (Ethernet)

CONFIGURATION

Local (portable PC)	Yes
Remote via network	Yes
IEC 61131-3 (5 languages)	Yes
ISaGRAF flow chart (6th language)	Yes
Toolbox 32 ladder	Yes
IEC 61499 distributed processing	Yes

DIAGNOSTICS

Preprogrammed	Yes
I/O modules	LEDs
CPU modules	LEDs
Power supply modules	LEDs
Report via network	Yes
Software	Yes
Communications analyzer	Yes

DEBUG

Local watchdog timer	Yes
Communication status	Yes
Configuration display	Yes
I/O status	Yes
Debug	Yes

POWER

AC supply	90 to 260 V
DC supply	20 to 60 V or 96 to 340 V
Solar supply	12 V dc
Power down modes	Yes
Battery backup	Yes
Battery size	Various
Battery charging option	Yes

ENVIRONMENTAL

Ambient temperature	-20° to 70°C
Storage temperature	-40° to 85°C
Humidity	5% to 98% RH noncondensing

REDUNDANCY LEVELS

CPUs/RTU	2
Power supplies/rack	2

COMPLIANCE STANDARDS

Safety certifications	CE LVD 2006/95/EC, IEC60950-1:2001; CAN/CSA C22.2 No. 60950-1-07; ANSI/UL 60950-1, 2nd Edition
EMC certifications	CE EMC 2004/108/EC, 1995/5/EC R&TTE, and C-Tick EN61326-1, EN61326-1:2006; EN61326:1997, Amdt 1:1998, Amdt 2:2001, Amdt 3:2003; FCC CFR47 Part 15 Sub Part B

Above certifications exclude modules or options PC-1, F, and R4; IO-2 and IO-4 excluded from CE only

www.cse-semaphore.com

U.S.A.
CSE Semaphore Inc.
1200 Chantry Place
Lake Mary, FL 32746
U.S.A.
P +1 (407) 333 3235
F +1 (407) 386 6284

Australia
CSE-Semaphore
Unit 8, 3-5 Gilda Crt
Mulgrave, Victoria 3170
Australia
P +61 (03) 8544 8544
F +61 (03) 8544 8555

Europe
CSE-Semaphore Belgium
Waterloo Office Park — Building "M"
Dreve Richelle, 161
B-1410 Waterloo
Belgium
P +32 (2) 387 42 59
F +32 (2) 387 42 75

1061050 09/13

CSE Semaphore

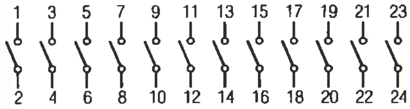
Switch Function and Configuration

C, CA, CAD Switches

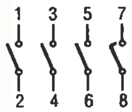
ON/OFF Switches with 60° Switching

Function	Escutch. Plate	Type/Handle: CA4, CA4-1, CAD4-1	CAD, CA10-, CA25	CA10B-, CA25B	C26, C315	Code	Stages
1 pole	0 1					A200-600	1
2 pole						A201-600	1
3 pole						A202-600	2
3 pole with red handle						A202-626	2
4 pole						A203-600	2
4 pole 1 pole preclose 6° [1]						WAA653	2
5 pole						WAA341	3
6 pole						A342-600	3
7 pole						A343-600	4
8 pole						A344-600	4
8 pole 2 pole preclose 6° [1]						WAA654	4
9 pole						WAA345	5
10 pole						A346-600	5
11 pole						WAA347	6
12 pole						A348-600	6
1 pole	OFF ON					A200-620	1
2 pole						A201-620	1
3 pole						A202-620	2
4 pole						A203-620	2
4 pole 1 pole preclose 6° [1]						WAA653	2
5 pole						WAA341	3
6 pole						A342-620	3
7 pole						A343-600	4
8 pole						A344-620	4
8 pole 2 pole preclose 6° [1]						WAA654	4
9 pole						WAA345	5
10 pole						A346-620	5
11 pole						WAA347	6
12 pole						A348-620	6
1 pole	OFF ON					A200-621	1
2 pole						A201-621	1
3 pole						A202-621	2
4 pole						A203-621	2
4 pole 1 pole preclose 6° [1]						WAA653	2
5 pole						WAA341	3
6 pole						A342-621	3
1 pole	FRÅN TILL					A200-622	1
2 pole						A201-622	1
3 pole						A202-622	2
4 pole						A203-622	2
4 pole 1 pole preclose 6° [1]						WAA653	2
5 pole						WAA341	3
6 pole						A342-622	3
1 pole	FRÅN TILL					A200-623	1
2 pole						A201-623	1
3 pole						A202-623	2
4 pole						A203-623	2
4 pole 1 pole preclose 6° [1]						WAA653	2
5 pole						WAA341	3
6 pole						A342-623	3
1 pole	HUVUDBRYTARE FRÅN TILL					A200-624	1
2 pole						A201-624	1
3 pole						A202-624	2
4 pole						A203-624	2
4 pole 1 pole preclose 6° [1]						WAA653	2
5 pole						WAA341	3
6 pole						A342-624	3
1 pole	HUVUDBRYTARE 0 1					A200-625	1
2 pole						A201-625	1
3 pole						A202-625	2
4 pole						A203-625	2
4 pole 1 pole preclose 6° [1]						WAA653	2
5 pole						WAA341	3
6 pole						A342-625	3

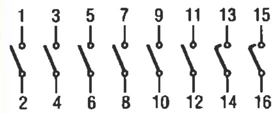
Connection Diagram



1-12 pole



4 pole 1 pole preclose 6°



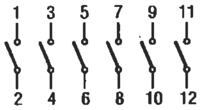
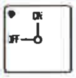
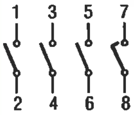
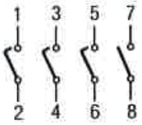
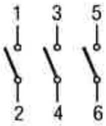
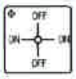
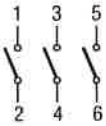
8 pole 2 pole preclose 6°

[1]for use in a three phase four-wire system with switched neutral

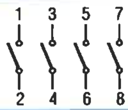
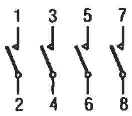
Switch Function and Configuration

C, CA, CAD Switches

ON/OFF Switches with 90° Switching

Function	Escutch. Plate	Type/Handle CA4 CA4-1 CAD4-1	Type/Handle CAD. CA10- CA25	Type/Handle CA10B- CA25B	Type/Handle C26 C315	Code	Stages	Connection Diagram
1 pole contacts						A290-600	1	 1, 2, 3, 4, 5 and 6 pole
2 pole preclose 30°						A291-600	1	
3 pole						A292-600	2	
4 pole						A324-600	2	
4 pole 1 pole preclose 60°[1]						A293-600	2	
4 pole 3 pole preclose 30°						WAA327	2	
5 pole contacts						WAA325	3	
6 pole preclose 30°						A326-600	3	
1 pole contacts						A290-620	1	 4 pole 1 pole preclose 60°
2 pole preclose 30°						A291-620	1	
3 pole						A292-620	2	
4 pole						A324-620	2	
4 pole 1 pole preclose 60°[1]						A293-620	2	 4 pole 3 pole preclose 30°
4 pole 3 pole preclose 30°						WAA327	2	
5 pole contacts						WAA325	3	
6 pole preclose 30°						A326-620	3	
3 pole 360° rotation						WAA208	2	
						WAA208	2	
3 pole for foot operation					CA40-CA63	WAA386	2	

ON/OFF Switches with 30° Switching

Function	Escutch. Plate	Type/Handle CA4 CA4-1 CAD4-1	Type/Handle CAD. CA10- CA25	Type/Handle CA10B- CA25B	Type/Handle C26 C315	Code	Stages	Connection Diagram
1 pole						WAA100	1	 1-4 pole
2 pole						WAA101	1	
3 pole						WAA102	2	
4 pole						WAA103	2	
1 pole with spring return					[3]	A204-600	1	 1-4 pole
2 pole with spring return					[3]	A205-600	1	
3 pole with spring return					[3]	WAA206	2	
4 pole with spring return			[2]			WAA207	2	
1 pole with spring return						A204-620	1	
2 pole with spring return						A205-620	1	
3 pole with spring return						WAA206	2	
4 pole with spring return			[2]			WAA207	2	

[1]for use in a three phase four-wire system with switched neutral [2]not available for switch type CA25 [3]not available for switch type C315

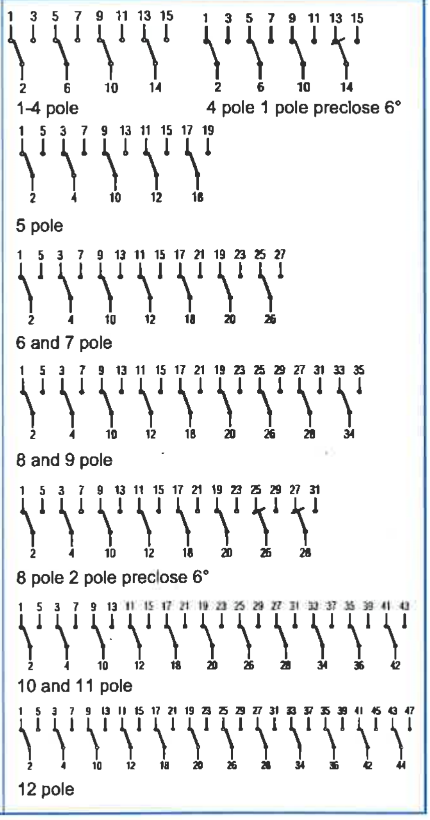
Switch Function and Configuration

C, CA, CAD Switches

Double-throw Switches without „OFF" 60° Switching

Function		Escutch. Plate	Type/Handle CA4 CA4-1 CAD4-1	CAD.. CA10- CA25	CA10B- CA25B	C26 C315	Code	Stages
1 pole			■	■	■	■	A220-600	1
2 pole			■	■	■	■	A221-600	2
3 pole			■	■	■	■	A222-600	3
4 pole			■	■	■	■	A223-600	4
4 pole	1 pole preclose 6°[2]		■	■	■	■	WAA673	4
5 pole			■	■	■	■	A369-600	5
6 pole			■	■	■	■	A370-600	6
7 pole			■	■	■	■	A371-600	7
8 pole			■	■	■	■	A372-600	8
8 pole	2 pole preclose 6°[2]		■	■	■	■	WAA972	8
9 pole			■	■	■	■	WAA373	9
10 pole				■	■	■	WAA374	10
11 pole				■	■	■	WAA375	11
12 pole				■	■	■	WAA376	12

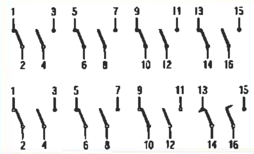
Connection Diagram



Double-throw Switches without „OFF" with electrically isolated contacts

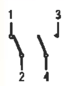
Function		Escutch. Plate	CA4 CA4-1 CAD4-1	CAD.. CA10- CA25	CA10B- CA25B	C26 C315	Code	Stages
1 pole			■	■	■	■	A720-600	1
2 pole			■	■	■	■	A721-600	2
3 pole			■	■	■	■	A722-600	3
4 pole			■	■	■	■	A723-600	4
4 pole	1 pole preclose 6°[2]		■	■	■	■	WAA973	4
1 pole	with spring return		■	■	■		A795-600	1

Connection Diagram



1-4 pole

4 pole 1 pole preclose 6°

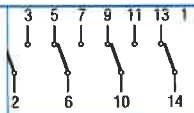


1 pole with spring return

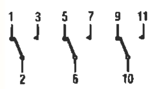
Double-throw Switches without „OFF" 30° Switching

Function		Escutch. Plate	CA4 CA4-1 CAD4-1	CAD.. CA10- CA25	CA10B- CA25B	C26 C315	Code	Stages
1 pole				■			WAA120	1
2 pole				■			WAA121	2
3 pole				■			WAA122	3
4 pole				■			WAA123	4
1 pole	with spring return		■	■	■		A295-600	1
2 pole	with spring return		■	■	■		A296-600	2
3 pole	with spring return		■	■[1]	■		WAA297	3
1 pole	with spring return	OFF ON	■	■	■		A295-620	1
2 pole	with spring return		■	■	■		A296-620	2
3 pole	with spring return		■	■[1]	■		WAA297	3

Connection Diagram



1-4 pole



1-3 pole

[1]not available for switch type CA25 [2]for use in a three phase four-wire system with switched neutral

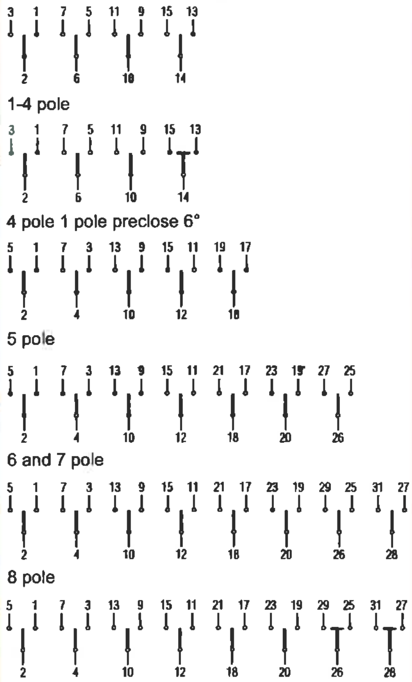
8

Switch Function and Configuration

C, CA, CAD Switches

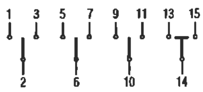
Double-throw Switches with Center „OFF“ 60° Switching

Function	Escutch. Plate	Type/Handle CA4 CA4-1 CAD4-1	CAD CA10- CA25	CA10B- C43	C80- C315	Code	Stages
1 pole	1 0 2					A210-600	1
2 pole						A211-600	2
3 pole						A212-600	3
4 pole						A213-600	4
4 pole 1 pole preclose 6°[3]						WAA913	4
5 pole						A361-600	5
6 pole						A362-600	6
7 pole						WAA363	7
8 pole						WAA364	8
8 pole 2 pole preclose 6°[3]						WAA664	8
1 pole	1 OFF 2					A210-620	1
2 pole						A211-620	2
3 pole						A212-620	3
4 pole						A213-620	4
4 pole 1 pole preclose 6°[3]						WAA913	4
5 pole						A361-620	5
6 pole						A362-620	6
7 pole						WAA363	7
8 pole						WAA364	8
8 pole 2 pole preclose 6°[3]						WAA664	8
1 pole	HAND 0 AUTO					A210-621	1
2 pole						A211-621	2
3 pole						A212-621	3
1 pole	HAND 0 AUTO					A210-622	1
2 pole						A211-622	2
3 pole						A212-622	3
1 pole	MAN OFF AUTO					A210-623	1
2 pole						A211-623	2
3 pole						A212-623	3
1 pole	AUTO OFF HAND					A210-624	1
2 pole						A211-624	2
3 pole						A212-624	3
4 pole						A213-624	4
4 pole 1 pole preclose 6°[3]						WAA913	4


1-4 pole
4 pole 1 pole preclose 6°
5 pole
6 and 7 pole
8 pole
8 pole 2 pole preclose 6°

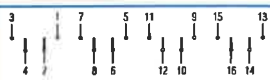
Double-throw Switches with Center „OFF“ 90° Switching

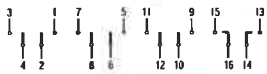
Function	Escutch. Plate	Type/Handle CA4 CA4-1 CAD4-1	CAD CA10- CA25	CA10B- C43	C80- C315	Code	Stages
1 pole	1 0 2					A218-600	1
2 pole						A219-600	2
3 pole					[1]	WAA299	3
4 pole 1 pole preclose 60°					[1]	WAA294	4
1 pole	1 OFF 2					A218-620	1
2 pole						A219-620	2
3 pole					[1]	WAA299	3
4 pole 1 pole preclose 60°					[1]	WAA294	4

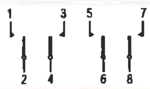

1-4 pole

Double-throw Switches with Center „OFF“ and electrically isolated contacts

Function	Escutch. Plate	Type/Handle CA4 CA4-1 CAD4-1	CAD CA10- CA25	CA10B- C43	C80- C315	Code	Stages
1 pole	1 0 2					A710-600	1
2 pole						A711-600	2
3 pole						A712-600	3
4 pole						A713-600	4
4 pole 1 pole preclose 6°[3]						WAA963	4
1 pole with spring return	1 0 2				[2]	A714-600	1
2 pole to center						A715-600	2


1-4 pole


4 pole 1 pole preclose 6°


1 and 2 pole

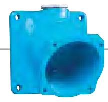
[1]switch type C315 with handle [2]not available for switch type C315 [3]for use in a three phase four-wire system with switched neutral

DS3 DECONTACTOR™ GRP

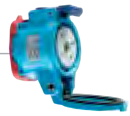
50 A
IP55

TYPICAL CONFIGURATION

WALL MOUNTING SOCKET DS3



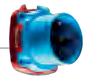
Wall box poly 30°
313A053



Socket-outlet
3134017

PLUG DS3

Straight handle poly
313A013



Inlet
3138017

MAIN FEATURES

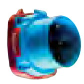
Rated current (with wiring according to standard)	50 A	Ambient temperature	-40 °C to +60 °C
Maximum voltage	1000 V	Flexible wiring (min-max)	6 - 16 mm²
IP protection lid closed	IP55	Stranded wiring (min-max)	10 - 25 mm²
IP protection connected plug	IP54	Other wiring	on request
Shock resistance	IK08	Keying positions	24

LOAD-BREAK CAPABILITY OF THE DECONTACTOR™

Comply with IEC EN 60309-1 and IEC EN 60309-4 standards	(50 A / 690 V) or (32 A / 1 000 V)
Load-break capability according to IEC EN 60947-3 / AC-22A	32 A / 690 V
Load-break capability according to IEC EN 60947-3 / AC-23A	50 A / 400 V
Short-circuit current Icc	10 kA

SOCKET-OUTLET female
DS3 (50 A)

INLET male
DS3 (50 A)



DUAL VOLTAGE SOCKET-OUTLET
(SEE P.6)

Voltage 50 Hz		Polarity	Part no. (Socket-outlet)	Part no. (Inlet)
20 - 24 V		2P	313408A	313808A
190 - 230 V		3P+E	3134033	3138033
220 - 250 V		1P+N+E	3134015	3138015
380 - 440 V		3P+E	3134013	3138013
220 - 250 V	380 - 440 V	3P+N+E	3134017	3138017
660 - 690 V		3P+E	3134193	3138193
380 - 440 V	660 - 690 V	3P+N+E	3134197	3138197
1 000 V		3P+E	3134223	3138223

Other voltages, frequencies and polarities are available on request (see page 8)

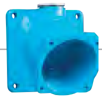
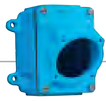
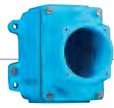
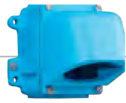
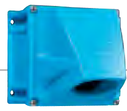
AUXILIARY CONTACTS

Socket-outlet with 2 auxiliary contacts (16 A / 400 V)	Socket no. + 972
Inlet with 2 auxiliary contacts (16 A / 400 V)	Inlet no. + 972
Socket-outlet with 4 auxiliary contacts (16 A / 400 V)	Socket no. + 264
Inlet with 4 auxiliary contacts (16 A / 400 V)	Inlet no. + 264

L C I E

CERTIFICAT N°
FR 60042266B

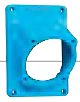
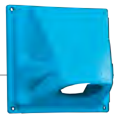
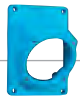
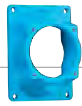
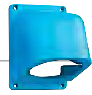
BOXES
Cable gland not included

Entry	Wall box poly 30°	Wall box metal + Inclined poly 30°	Wall box metal + straight metal sleeve	Wall box metal + Inclined metal 70°	Wall box poly + Inclined poly 70°
M20		313A653417	393A095417	873A053417	Not drilled and without cable gland Part no. 51CA058
M25	313A053	313A653	393A095	873A053	
M32		313A653419	393A095419	873A053419	
M40		313A653420	393A095420	873A053420	

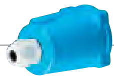

Wall box metal 20° : Part no. 393A053 for M20 entry

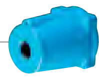
SLEEVES

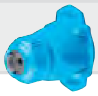






Inclined poly 30°	Inclined poly 70°	Inclined metal 30°	Straight metal	Inclined metal 70°
313A027	51CA757	393A027	393A127	873A087

HANDLES



	Straight poly		Straight poly with poly cable gland		Straight metal with metal cable gland		Straight poly without cable gland with metric threaded entry
10-30 mm	313A013	5-12 mm	313A25320P	7-13 mm	313A95320M	M20	313A253417
10-30 mm	313A473*	9-18 mm	313A753	8-16 mm	313A963	M25	313A253418
		14-25 mm	313A25332P	16-24 mm	313A95332M	M32	313A253419
		18-32 mm	313A25340P	22-32 mm	313A95340M	M40	313A253420

*With built-in finger draw plate (recommended for inline connections)

ACCESSORIES & OPTIONS

Locking with shaft for 3 padlocks ø 8 mm (padlocks not supplied)
Socket no. + 844

Lockable plug: contact us
Padlocking device 1 to 6 padlocks
873A541

E-Stop button
Socket no. + 453

Slelf-closing lid for inlet
313A226

Inlet cap
313A126

Closing mechanism (in-line connections)
(a pair of finger draw plates)
616A346

180° opening lid	Socket no. + 10
Self-returning lid	Socket no. + R
180° opening and self-returning lid	Socket no. + 18
IP66/IP67 (socket & inlet)	Part no. + 600

BS compact fuse holders

Clip-in Fast reliable fitting and removal of fuse links - DIN rail mountable [1])

		20 A	32 A	63 A
Front wired	**Cat. No.**	NV20FW	NV32FW	NV63FW
(Black)	**Price $**	21.00	22.00	53.00
Back wired	**Cat. No.**	–	NV32BBW	NV63BBW
(Black)	**Price $**		22.00	53.00
Fuse link	NNS_	*	*	
to suit	NES_			*
BS 88 Ref		F1	F1	F2
Dimensions	Height	75	75	89
(mm)	Width	25	25	32
	Depth	58	58	67
Suggested max. cable size mm^2		10	10	25

Note: Back wired type (BBW) is screw fixed.

BS compact fuse links

To suit NV fuseholders listed above

- Complies with BS 88
- Reduced dimensions
- Low watts loss
- gG general purpose fuse links

Clip-in offset tags

NNS 2

NES 20

Rating (A)	BS 88 ref.	Overall length (mm)	Overall Dia. (mm)	Cat. No. [1])	Price $
2				NNS 2	8.50
4				NNS 4	8.50
6				NNS 6	8.50
10				NNS 10	8.50
16	F1	60	14	NNS 16	8.50
20				NNS 20	13.00
25				NNS 25	13.00
32				NNS 32	13.00
20M25				NNS 20M25	13.00
20M32				NNS 20M32	13.00
20				NES 20	22.00
25				NES 25	22.00
32	F2	68	17	NES 32	22.00
40				NES 40	29.00
50				NES 50	29.00
63				NES 63	29.00

Note: [1]) 'M' in catalogue number denotes motor starting type.

Price Schedule 'B2'

COSMOTEC industrial cooling

Refer Catalogue ETC08

COSMOTEC

Fans, grills & filters

Low profile fan, grill & filter units save space

Enclosure ventilating systems

Features - GKV fan, GKF grill & filters

- High heat resistant and self-extinguishing ABS plastic housing
- Easy clip-on mounting with or without screws
- Long life ball bearing fans
- Efficient filter mats
- IP 54 protection rating
- Note – Reversible fan motor for air in or air out up to GKV 3000
- RAL 7035 colour

GKV – fan, grill & filter vertical mounting units

GKV1000220

GKV2500220

GKV30P1220

Unimpeded air flow	Voltage	Ph	Frequency	Dimensions (mm) H x W x D	Cat. No.	Price $
35 m^3/h air in	230 V AC	1	50/60 Hz	109 x 109 x 59	GKV1000220	210.00
35 m^3/h air in	115 V AC	1	50/60 Hz	109 x 109 x 59	GKV1000222	210.00
35 m^3/h air in	24 V DC	–	–	109 x 109 x 59	GKV1000211	230.00
67 m^3/h air in	230 V AC	1	50/60 Hz	150 x 150 x 59	GKV1500220	330.00
67 m^3/h air in	115 V AC	1	50/60 Hz	150 x 150 x 59	GKV1500222	340.00
67 m^3/h air in	24 V DC	–	–	150 x 150 x 59	GKV1500211	375.00
108 m^3/h air in	230 V AC	1	50/60 Hz	204 x 204 x 96	GKV2000220	380.00
108 m^3/h air in	115 V AC	1	50/60 Hz	204 x 204 x 96	GKV2000222	415.00
108 m^3/h air in	24 V DC	–	–	204 x 204 x 96	GKV2000211	485.00
190 m^3/h air in	230 V AC	1	50/60 Hz	250 x 250 x 109	GKV2500220	410.00
190 m^3/h air in	115 V AC	1	50/60 Hz	250 x 250 x 109	GKV2500222	420.00
190 m^3/h air in	24 V DC	–	–	250 x 250 x 109	GKV2500211	620.00
370 m^3/h air in	230 V AC	1	50/60 Hz	250 x 250 x 86	GKV2501220	475.00
370 m^3/h air in	115 V AC	1	50/60 Hz	250 x 250 x 86	GKV2501222	485.00
500 m^3/h air in	230 V AC	1	50/60 Hz	325 x 325 x 148	GKV3000220	600.00
500 m^3/h air in	115 V AC	1	50/60 Hz	325 x 325 x 148	GKV3000222	620.00
615 m^3/h air in	230 V AC	1	50/60 Hz	325 x 325 x 114	GKV30A1220	630.00
615 m^3/h air out	230 V AC	1	50/60 Hz	325 x 325 x 114	GKV30P1220	630.00
615 m^3/h air in	115 V AC	1	50/60 Hz	325 x 325 x 114	GKV30A1222	660.00
615 m^3/h air out	115 V AC	1	50/60 Hz	325 x 325 x 114	GKV30P1222	660.00
990 m^3/h air in	230 V AC	1	50/60 Hz	325 x 325 x 140	GKV30A2220	1040.00
990 m^3/h air out	230 V AC	1	50/60 Hz	325 x 325 x 140	GKV30P2220	1040.00
1100 m^3/h air in	400 V AC	3	50/60 Hz	325 x 325 x 140	GKV30A2207	1180.00
1100 m^3/h air out	400 V AC	3	50/60 Hz	325 x 325 x 140	GKV30P2207	1180.00

GKF – grill & filter

GKF20

To suit	Suit dimensions (mm) H x W	Cat. No.	Price $
GKV 1000 fans	109 x 109	GKF10	44.00
GKV 1500 fans	150 x 150	GKF15	50.50
GKV 2000 fans	204 x 204	GKF20	94.50
GKV 2500/1 fans	250 x 250	GKF25	119.00
GKV 3000/30 fans	325 x 325	GKF30	182.00

AVAFAGN – spare filters – for GKV & GKF units

AVAFAGN

Pkt Qty.	To suit	Suit dimensions (mm) H x W	Cat. No.	Price $
10 Filters	GKV 1000/GKF 10	109 x 109	AVAFAGN10	37.00
10 Filters	GKV 1500/GKF 15	150 x 150	AVAFAGN15	45.50
10 Filters	GKV 2000/GKF 20	204 x 204	AVAFAGN20	68.50
10 Filters	GKV 2500/1/GKF 25	250 x 250	AVAFAGN25	72.00
10 Filters	GKV 3000/30/GKF 30	325 x 325	AVAFAGN30	90.50

Note: The equipment on this page rated 115/230/400 V AC is suitable for use on 110/240/415 V AC systems as per AS 60038:2000.

11

Price Schedule 'B2'

COSMOTEC industrial cooling

Refer Catalogue ETC08

COSMOTEC

Top mounting exhaust fans, accessories

TB – Exhaust fans, top mounting units

Features

- Epoxy painted steel frame with RAL 7035 grey colour
- IP 44 protection rating (IP 54 also available on request)
- High dynamic pressure, efficient air flow
- Long life ball bearing fan with impedance protected motor

Ordering details

Air movement	Voltage	Frequency	Dimensions (mm) H x W x D	Cat. No.	Price $
575 m^3/h air out	230 V AC	50/60 Hz	108 x 460 x 380	TB19000220	1070.00
575 m^3/h air out	115 V AC	50/60 Hz	108 x 460 x 380	TB19000222	1070.00
860 m^3/h air out	230 V AC	50/60 Hz	108 x 460 x 380	TB22000220	1190.00
860 m^3/h air out	115 V AC	50/60 Hz	108 x 460 x 380	TB22000222	1190.00
1450 m^3/h air out	230 V AC	50/60 Hz	160 x 540 x 400	TB25000220	1630.00
2365 m^3/h air out	230 V AC	50/60 Hz	300 x 600 x 550	TB35000220	3920.00


AC12320BTP

Axial fans

Air flow volume	Voltage	Frequency	Dimensions (mm) H x W x D	Cat. No.	Price $
170 m^3/h	24 V DC		119 x 119 x 38	DC12312BTP	194.00
170 m^3/h	24 V AC		119 x 119 x 38	AC12332BTP	335.00
162 m^3/h	115 V AC	50/60 Hz	119 x 119 x 38	AC12322BTP	196.00
162 m^3/h	230 V AC	50/60 Hz	119 x 119 x 38	AC12320BTP	194.00
Finger guard			119 x 119 x 3	GNM12	17.00


AC17320BTP

Axial fans

Air flow volume	Voltage	Frequency	Dimensions (mm) H x W x D	Cat. No.	Price $
300 m^3/h	24 V DC		173 x 173 x 50	DC17312BTP	1090.00
300 m^3/h	115 V AC	50/60 Hz	173 x 173 x 50	AC17322BTP	360.00
300 m^3/h	230 V AC	50/60 Hz	173 x 173 x 50	AC17320BTP	360.00
Finger guard/grill			173 x 173 x 3	GNM25	9.50


KT0011 / KTS011

Accessories – thermostats

Compact thermostats

Contact rating	Temp. range	Dimensions (mm) H x W x D	Cat. No.	Price $
1 N/C 10 A 250 V AC (Heating)	0 to +60 °C	60 x 33 x 43	KT001140	94.50
1 N/O 10 A 250 V AC (Cooling)	0 to +60 °C	60 x 33 x 43	KTS01141	94.50


ZR011

Dual thermostat

Contact rating	Temp. range	Dimensions (mm) H x W x D	Cat. No.	Price $
1 N/C, N/O 10 A 250 V AC	0 to +60 °C	67 x 50 x 46	ZR01172	153.00


FZK011

Mechanical thermostat

Contact rating	Temp. range	Dimensions (mm) H x W x D	Cat. No.	Price $
1 N/C 10 A 250 V AC 1 N/O 5 A 250 V AC	+5 to +60 °C	67 x 50 x 38	FZK01100	143.00

Note: **The equipment on this page rated 115/230/400 V AC is suitable for use on 110/240/415 V AC system as per AS 60038:2000.**

finder The power in relays since 1954

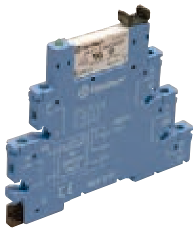
Refer catalogue F1

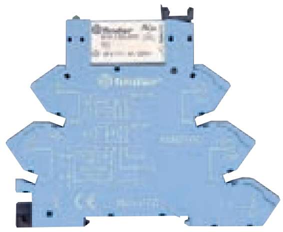
Relay interface module

DIN rail mount

Only 6.2 mm wide

- Integrated leakage current suppressor (LCS) and LED
- Ultra-slim profile, only 6.2 mm wide
- Simple removal of relay for replacement
- DIN rail mounting





Cat. No.	Price $	Cat. No.	Price $
38.51125VACDCLCS	67.50	38.51240VACLCS	68.50

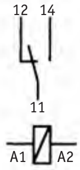
Contact specifications

Contact configuration	1 C/O
Rated current	6 A
Rated voltage	250 V AC
Rated load in AC 1	1,500 VA
Rated load in AC 15 (230 V AC)	300 VA
Breaking capacity in DC 1 : 30/110/220 V	6/0.2/0.15 A
Maximum peak current	10 A
Maximum switching voltage	400 V AC
Minimum switching load	500 mW

Coil specifications

Nominal voltage (U_N) @ 50/60 Hz	125 V AC/DC	240 V AC
Rated power (U_N)	1 W	0.5 W
Operation range	94 V min. - 138 V max. (AC/DC)	184 V min. - 264 V max. (AC)
Holding voltage	0.6 U_N (AC/DC)	0.6 U_N (AC)
Must drop-out voltage	44 V (AC/DC)	72 V (AC)

Technical data

Mechanical life AC/DC	10.10^6	
Electrical life @ rated load AC 1	60.10^3	
Insulation between coil and contacts	6 kV	
Ambient temperature range	-40 °C...+55 °C	
Protection rating	IP 20	
Connection diagram		
Dimensions	Refer page 8 - 36	
Accessories	**93.01** Isolating plate **93.20** Jumperlink 20 way **93.64** Identification labels For more details refer page 8 - 18	
Replacement relays	34.51.60 V DC	34.51.60 V DC

Note: **The equipment on this page is rated 230/400 V and is suitable for use on 240/415 V systems as per AS 60038:2000.**

8

Price Schedule 'B2'

The power in relays since 1954 finder

Refer catalogue F1

Relay interface module

DIN rail mount

38.52

- 2 Pole 8 Amp screw terminal
- Narrow profile of 14 mm
- Ideal PLC interface relay
- Integrated LED and diode
- Simple removal of relay for replacement
- DIN rail mountable

Cat. No.	Price $
38.52 24 V DC	68.00

38.81

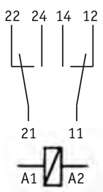
- Single output SSR interface module
- Ultra slim 6.2 mm wide profile
- Ideal PLC interface
- Integrated LED and diode
- High speed switching
- Long life solid state
- DIN rail mountable
- Screw terminal only

	Cat. No.	Price $
Input 24 V DC / Output 24 V DC	38.81.9024.724 V DC	76.50
Input 24 V DC / Output 240 V AC	38.81.8240.24 V DC	76.50

38.52

Contact specifications		
Contact configuration		**2 C/O (DPDT)**
Rated current		**8 A**
Rated voltage		250 V AC
Rated load AC 1		2,000 VA
Rated load AC 15		400 VA
Single phase motor rating (230 V AC)		0.3 kW
Breaking capacity DC 1: 30/110/220 V		8/0.3/0.12 A
Maximum switching voltage		400 V AC
Minimum switching load		300 mW
Coil specifications		
Nominal voltage (Un)	V DC	24
Rated power	DC	0.5W (50Hz)
Operating range	DC	(0.8 to 1.2) Un
Holding voltage	DC	0.6 Un
Must drop out voltage	DC	0.05 Un
Technical data		
Ambient temperature range		-40 … +70°C
Protection rating		IP 20
Mechanical life	cycles	30.10^{6}
Electrical life at rated load AC 1	cycles	80.10^{3}
Insulation between coil & contacts		6 kV (8 mm)
Dielectric strength between open contacts		1,000 V AC

Connection diagram

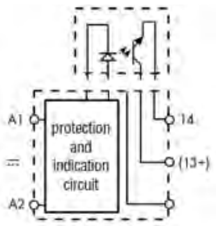


Dimensions	Refer page 8 - 36
Accessories	Refer page 8 - 18 93.01 Isolating plate 93.08 jumper link 8 way 93.64 Identification labels
Replacement relays	[i] 41.52.24 V DC

38.81

Contact specifications		
Contact configuration	**1 N/O (SPST-NO)**	
Rated current	**2 A**	
Rated voltage	24 V DC	240 V AC
Maximum peak current (10 ms)	20 A	40 A
Maximum blocking voltage	33 V DC	275 V AC
Switching voltage range	1.5 to 24 V DC	12 to 240 V AC
Minimum switching current	1 mA	22 mA
Maximum “OFF-state” leakage current	0.001 mA	1.5 mA
Maximum “ON-state” voltage drop	0.12 V	1.6 V
Input circuit (38.81 series) ¹)		
Nominal voltage	24 V DC	
Rated power	0.3 W	
Control current	10.5 mA	
Release voltage	10 V DC	
Technical data		
Operate / release time	0.2/0.6 ms	
Dielectric strength between input / output	2,500 V	
Ambient temperature range	-20…+55°C	
Protection rating	IP 20	

Connection diagram



Dimensions	Refer page 8 - 36
Accessories	Refer page 8 - 18 93.01 Isolating plate 93.20 Jumper link 20 way 93.64 Identification labels
Replacement relays	[i] 34.81.9024.24 V DC, 24 V DC input voltage:

Notes: ¹) Add coil voltage to Cat. No. when ordering.
[i] Available on indent only.

8

Price Schedule ‘B2’

GST not included

Refer catalogue F1

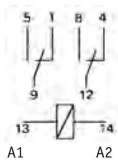
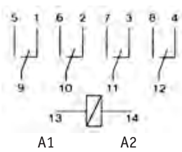
Miniature general purpose relays

Flat pin

- Lockable test button, mechanical flag and LED indicators.
- Use with 94 series bases
- Compact
- Gold contacts option [4])

Non-polarised DC relays

Cat. No. [1])	Price $	Cat. No. [1])	Price $
55.32.0054...V AC	**21.60**	**55.34.0054...V AC**	**27.80**
55.32.0074...V DC	**21.60**	**55.34.0074...V DC**	**27.80**
55.32.5054...V AC [4])	**37.00**	**55.34.5054...V AC [4])**	**46.00**
55.32.5074...V DC [4])	**40.00**	**55.34.5074...V DC [4])**	**38.00**

Contact specifications			
Contact configuration		2 C/O	4 C/O
Rated current		10 A	7 A
Rated voltage		250 V AC	
Rated load in AC 1		2,500 VA	1750 VA
Rated load in AC 15 (230 V AC)		500 VA	350 VA
Single phase motor rating (230 V AC)		0.37 kW	0.125 kW
Breaking capacity in DC 1 : 30/110/220 V		10/0.25/0.12 A	7/0.25/0.12 A
Maximum peak current		20 A	15 A
Maximum switching voltage		400 V AC	250 V AC
Minimum switching load	AgNi [3])	300 mW	
	AgNi+Au [4])	50 mW (5 V, 2 mA)	
Coil specifications [1]) [2])			
Nominal voltage (U_N)	AgNi [3]) (50/60 Hz) AC	12, 24, 32, 48, 110, 240	12, 24, 32, 48, 110, 240
	DC	12, 24, 32, 48, 110	12, 24, 32, 48, 110
	AgNi+Au [4]) (50/60 Hz) AC	240	24, 110, 240
	DC	24	24
Rated power AC/DC		1.5 VA/1W	
Operation range	(50 Hz) AC	(0.8...1.1) U_N	
	DC	(0.8...1.1) U_N	
Holding voltage AC/DC		0.8 U_N/0.5 U_N	
Must drop-out voltage AC/DC		0.2 U_N/0.1 U_N	
Technical data			
Mechanical life AC/DC		20.10^6/50.10^6 cycles	
Electrical life @ rated load AC 1		200.10^3 cycles	150.10^3 cycles
Insulation between coil and contacts		4 kV	4 kV
Ambient temperature range		-40 °C...+85 °C	
Protection rating		IP 50	
Connection diagram **Note:** New DC relays are non-polarised	 **55.32...**  **55.34...**		
Dimensions		Refer page 8 - 36	
Recommended base and accessories		**94.02** Screw terminal base c/w metal retaining clip	**94.04** Screw terminal base c/w plastic clip/lever
		For more information and other bases available refer page 8 - 33	
		94.06 6 way jumper link	

Notes:
[1]) Add coil voltage to Cat. No. when ordering.
[2]) Please contact NHP for other voltages.
[3]) Silver nickel.
[4]) Silver nickel, gold plated.

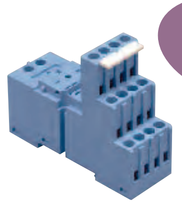
The equipment on this page is rated 230/400 V and is suitable for use on 240/415 V systems as per AS 60038:2000.

Price Schedule 'B2'

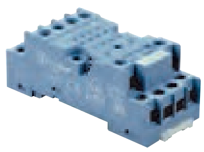
8

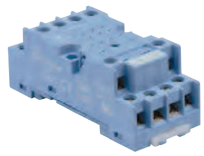
Relay bases and accessories

Bases for series 55 relays

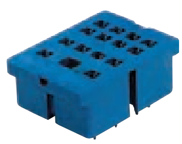


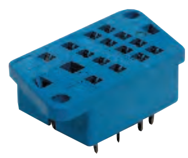
Cat. No.	Price $	94.02	13.00	94.04	17.20	94.82	16.00
Description		DIN rail mounting base open terminals. Accepts 99-02 series LED modules.		DIN rail mounting base open terminals. Accepts 99-02 series LED modules.		DIN rail mounting base. Accepts 99-01 series LED modules.	
Relay to suit		Flat pin 2 C/O (8 pin) 55.32...		Flat pin 4 C/O (14 pin) 55.34...		Flat pin 2 C/O (8 pin) 55.32...	
Retaining clip	Price $	94.71	2.00	94.71	2.00	94.71	2.00





Cat. No.	Price $	94.72	16.20	94.74	19.20	94.06	7.00
Description		DIN rail mounting base open terminals. Accepts 99-01 series LED modules.		DIN rail mounting base open terminals. Accepts 99-01 series LED modules.		Jumper link 6 way maximum 10 A, 250 V.	
Relay to suit		Flat pin 2 C/O (8 pin) 55.32...		Flat pin 4 C/O (14 pin) 55.34...		94.02, 94.04 55.34...	
Retaining clip	Price $	94.71	2.00	94.71	2.00	N/A	





Cat. No.	Price $	94.12	6.00	94.14	6.60	94.34	7.10
Description		PCB mounting base.		PCB mounting base.		Rear connection, panel mount base.	
Relay to suit		Flat pin 2 C/O (8 pin) 55.32...		Flat pin 4 C/O (14 pin) 55.34...		Flat pin 2 and 4 C/O 55.32... 55.34...	
Retaining clip	Price $	94.51	2.20	94.51	2.20	94.51	2.20

8

Notes: Please refer to page 8 - 32 for recommended LED and diode plug-in modules.
Refer page 8 - 38 for relay base dimensions.

Price Schedule 'B2'

Monitoring and control

3 Phase voltage, phase loss and sequence relays

- 3 phase 4 wire over and undervoltage monitoring
- Phase sequence and phase loss monitoring
- Upper and lower limits separately adjustable
- Measures own power supply
- Measuring range DIP switch selectable
- Adjustable voltage on relative scale
- Adjustable delay function (0.1 to 30 s)
- LED indication for relay, alarm and power supply ON

Monitoring function	Housing	Supply	Output	Cat. No.	Price $
Over and under V, phase loss & sequence	22.5 mm DIN	380-415 V AC	1 C/O	DPB-01-C-M48	365.00
Over and under V, phase loss & sequence	36 mm, 11 Pin, Plug-in	380-415 V AC	1 C/O	PPB-01-C-M48	390.00

DPB-01-C-M48

PPB-01-C-M48

Technical data

Input specifications

Measuring ranges - Measures own power supply

DPB-01-C...	323 to 475 V AC
PPB-01-C...	323 to 475 V AC
Ranges	
Upper level	+2 to +22 % of VN
Lower level	-22 to -2 % of VN

Output specifications

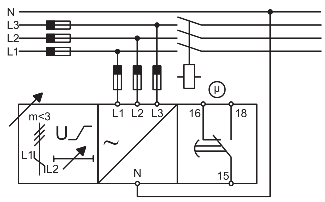
Output contacts		1 C/O
Contact ratings		
Resistive loads	**AC 1**	8 A / 250 V AC
	DC 12	5 A / 24 V DC
Small inductive loads	**AC 15**	2.5 A / 250 V AC
	DC 13	2.5 A / 24 V DC
Mechanical life		≥30 x 10^6 operations
Electrical life		≥10^5 operations (AC 1)
Operating frequency		≤7200 operations/h

Supply specifications

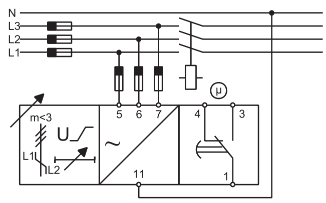
Rated operational voltage		
Star voltage:	**M48**	380 to 415 V_{L-L} AC ± 15 %
		220 to 240 V_{L-N} AC ± 15 %
		45 to 65 Hz
Power consumption AC	13 VA	

Wiring diagrams

DPB01



PPB01



Note: DPB01 & PPB01 can only be used on 3 phase, 4 wire systems (Neutral must be connected). Connect the neutral only if it is intrinsically at the star centre.

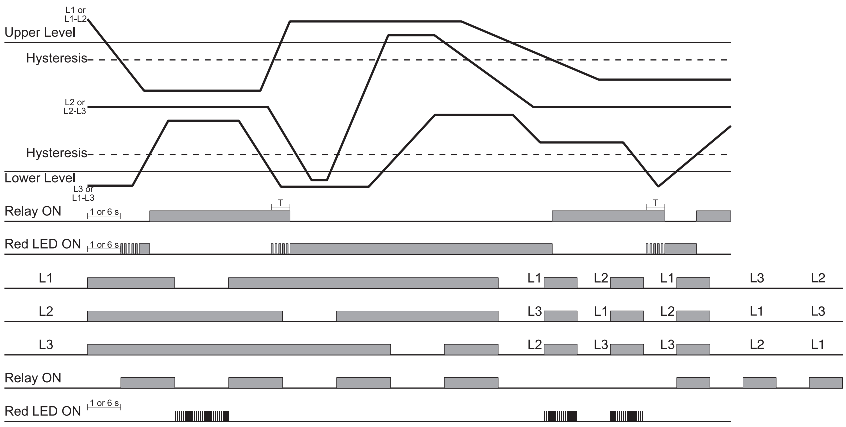
Dimensions	Refer page 9 - 42
Bases & accessories	Refer page 9 - 41

9

Operation diagrams

Note: Hysteresis is based on Asymmetry setting

Asymmetry	Hysteresis
2 % to 5 %	1 %
6 % to 22 %	2 %



IME

Analogue meters

Moving iron ammeters and voltmeters

General features

- Accuracy class 1.5
- 600 V operational voltage rating
- Insulation tested at 2 kV/min @ 50 Hz
- Operating temperature -25 to +50 °C
- Overload parameters:
  Ammeters 1.2 x In cont., 10 x In for 5 sec.
  Voltmeters 1.2 x Un cont., 2 x Un for 5 sec.
- Suitable for mounting on ferromagnetic materials
- Self-extinguishing housing
- IP 52 rated front frame
- Operates with ambient humidity rating 85 % without condensation at max. 35 °C for 60 days
- Vibration resistant with amplitude of 1-0.03 mm peak frequency on 3 axes @ 5-80 Hz (IEC 68-2-6)

Catalogue Number construction

RQ 96 E ACT 5A 5X 100A

RQ = 90 degree pointer deflection

96 = Frame size 48 mm², 72 mm², 96 mm²

E = Moving iron instrument

ACT = Ammeter, current transformer connected

5A = CT secondary current, 5 A or 1 A

5X = 5x overcurrent measurement

100A = Primary current value of CT

Ordering guide

Analogue meters can be ordered by constructing the Catalogue Number from tables 1 (meter type and size) plus table 2 (scale / input). If the input is different from the scale, select it from table 3 and clearly state when placing your order.

Example 1. To order a 90° AC ammeter – direct connect with a 96 mm x 96 mm window including a 10 A scale and input:

Customer Order
1 x RQ96EAAC10A

Example 2. To order a 90° AC ammeter – CT connect with a 72 mm x 72 mm window with a 100 A scale and a 5 A input:

Customer Order
1 x RQ72EACT5A5X100A
Input: **5 A**
Scale: **100 A**

9

90° AC ammeter - Direct connect

With 5x over-scale

Ordering

Construct the Catalogue Number by selecting the meter from table 1 and adding the scale / input from table 2 .

RQ72E AAC 100A

1 Window size	Cat. No.	Price $
48 mm x 48 mm	RQ48EAAC...	84.00
72 mm x 72 mm	RQ72EAAC...	72.00
96 mm x 96 mm	RQ96EAAC...	80.00

2 Scale / input selection	1 A, 2.5 A, 5 A, 10 A,15 A, 20 A, 25 A, 30 A, 40 A, 50 A, 60 A, 80 A, 100 A

Price Schedule 'Y8'

IME

Analogue meters

Moving iron ammeters and voltmeters

90° AC ammeter - CT connect [1])

5A Current transformer operation with 5x over-scale

Ordering

Construct the Catalogue Number by selecting the meter from table 1 and adding the scale from table 2 .
The input is 5 A. 1 A input is available on request, contact NHP for further details.

RQ72E ACT 5A 5X 750

1

Window size	Cat. No.	Price $
48 mm x 48 mm	RQ48EACT5A5X...	74.50
72 mm x 72 mm	RQ72EACT5A5X...	69.50
96 mm x 96 mm	RQ96EACT5A5X...	72.00

2

Scale selection	5 A, 10 A, 12 A, 15 A, 20 A, 25 A, 30 A, 40 A, 50 A, 60 A, 75 A, 80 A, 100 A, 120 A, 150 A, 200 A, 300 A, 400 A, 500 A, 600 A, 750 A, 800 A, 1 kA, 1.2 kA, 1.5 kA, 1.6 kA, 2 kA, 3 kA, 4 kA

90° AC Voltmeter - Direct connect

Ordering

Construct the Catalogue Number by selecting the meter from table 1 and adding the scale / input from table 2 .
E.g. RQ72EVAC500V.

RQ72E VAC 500V

1

Window size	Cat. No.	Price $
48 mm x 48 mm	RQ48EVAC...	89.50
72 mm x 72 mm	RQ72EVAC...	80.00
96 mm x 96 mm	RQ96EVAC...	88.00

2

Scale / input selection	50 V, 150 V, 300 V, 500 V

90° AC Voltmeter - VT Connect

High voltage measurement, voltage transformer operated

Ordering

Construct the Catalogue Number by selecting the meter from table 1 and adding the input from table 2 , and then state the required scale from table 3 on your order.
E.g. RQ72EVVT110V.

RQ72E VVT
110V/1.1kV

1

Window size	Cat. No.	Price $
48 mm x 48 mm	RQ48EVVT...	89.50
72 mm x 72 mm	RQ72EVVT...	80.00
96 mm x 96 mm	RQ96EVVT...	88.00

2

Input selection	24 V, 110 V, 240 V, 415 V

3

Scale selection	1.0 kV, 1.5 kV, 2 kV, 3 kV, 4 kV, 5 kV, 10 kV

9

Notes: 1A versions available upon request, please contact NHP.

IME

Analogue meters

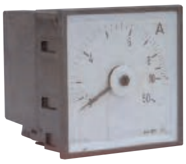
AC moving iron ammeters and voltmeters

240° AC Ammeter - Direct connect

With 5x over-scale

Ordering

Construct the Catalogue Number by selecting the meter from table 1 and adding the scale / input from table 2.
E.g. AQ96EAAC10A.



AQ96E AAC 10A

1

Window size	Cat. No.	Price $
48 mm x 48 mm	i AQ48EAAC...	250.00
72 mm x 72 mm	i AQ72EAAC...	245.00
96 mm x 96 mm	i AQ96EAAC...	250.00

2

Scale/input selection	1 A, 2.5 A, 5 A, 10 A

240° AC Ammeter - CT connect [1])

5A Current transformer operated with 5x over-scale

Ordering

Construct the Catalogue Number by selecting the meter from table 1 and adding the scale from table 2.
The input is 5 A. 1 A input is available on request, contact NHP for further details.

AQ96E ACT 5A 5X 50A

1

Window size	Cat. No.	Price $
48 mm x 48 mm	AQ48EACT5AX...	225.00
72 mm x 72 mm	AQ72EACT5AX...	245.00
96 mm x 96 mm	AQ96EACT5AX...	245.00

2

Scale selection	5 A, 10 A, 12 A, 15 A, 20 A, 25 A, 30 A, 40 A, 50 A, 60 A, 75 A, 80 A, 100 A, 120 A, 150 A, 200 A, 300 A, 400 A, 500 A, 600 A, 750 A, 800 A, 1 kA, 1.6 kA, 2 kA, 3 kA, 4 kA

240° AC Voltmeter - Direct connect

Ordering

Construct the Catalogue Number by selecting the meter from table 1 and adding the scale / input from table 2.
E.g. AQ96EVAC500V.

AQ96E VAC 500V

1

Window size	Cat. No.	Price $
48 mm x 48 mm	i AQ48EVAC...	215.00
72 mm x 72 mm	AQ72EVAC...	210.00
96 mm x 96 mm	AQ96EVAC...	215.00

2

Scale/input selection	50 V, 150 V, 300 V, 500 V

Notes: 1 A versions available upon request, please contact NHP.
i Available on indent only

9

IME

Analogue meters

Maximum demand ammeters and hour run meters

Maximum demand ammeters

- Accuracy class 1.5
- 5 A CT operation
- 1.2x overcurrent measurement
- Red slave indicator, peak measurement
- Nominal temperature range 0 - +40 °C
- 15 minute delay time operation
- Thermal movement
- Knob resettable slave pointer
- Rated burden: approx 1.5 VA

90° AC Maximum demand ammeter - CT connect, delay time 15 mins

Ordering

Construct the Catalogue Number by selecting the meter from table 1 and adding the scale/ input from table 2 . E.g. RQT72N5A50A

RQT96N 5A 100A

1

Window size	Cat. No.	Price $
72 mm x 72 mm	RQT72N5A...	142.00
96 mm x 96 mm	RQT96N5A...	144.00

2

Scale / input selection	10 A, 12 A, 15 A, 20 A, 25 A, 30 A, 40 A, 50 A, 60 A, 75 A, 80 A, 100 A, 120 A, 150 A, 200 A, 250 A, 300 A, 400 A, 500 A, 600 A, 750 A, 800 A, 1 kA, 1.5 kA, 1.6 kA, 2 kA, 2.5 kA, 3 kA, 4 kA,

Combined maximum demand ammeter - CT connect, delay time 15 mins

Instrument includes a dynamic ammeter pointer and scale

Ordering

Construct the Catalogue Number by selecting the meter from table 1 and adding the scale from table 2 .
E.g. RQTE96N5A1KA

RQTE72N 5A 100A

1

Window size	Cat. No.	Price $
72 mm x 72 mm	RQTE72N5A...	210.00
96 mm x 96 mm	RQTE96N5A...	210.00

2

Scale / input selection	10 A, 12 A, 15 A, 20 A, 25 A, 30 A, 40 A, 50 A, 60 A, 75 A, 80 A, 100 A, 120 A, 150 A, 200 A, 250 A, 300 A, 400 A, 500 A, 600 A, 750 A, 800 A, 1 kA, 2.5 kA, 3 kA, 4 kA

Hour run meters

- 7 digit (2 decimal) with run indicator, non-resettable counter
- Front frame with flange for 50 mm circular cut-out on RQ48.0 models
- Faston, fork lug or 2 x 4 mm² wire termination on RQ48.0 models

Ordering

Construct the Catalogue Number by selecting the meter from table 1 and adding the voltage range from table 2 .

E.g. RQ960240 V AC

RQ48.0 240 V AC

1

	Range	24 V AC 50 Hz	110 V AC 50 Hz	240 V AC 50 Hz	415 V AC 50 Hz	10 - 80 V DC
Window size	**Cat. No.**	**Price $**	**Price $**	**Price $**	**Price $**	**Price $**
48 mm x 48 mm	RQ480...	80.00	65.50	67.00	80.00	88.00
72 mm x 72 mm	RQ720...	131.00	127.00	127.00	143.00	170.00
96 mm x 96 mm	RQ960...	–	152.00	152.00	158.00	177.00

2

Voltage auxiliary range	24 V AC, 110 V AC, 240 V AC, 415 V AC, 10-80 V DC

Notes: Standard 5 A input from CT for all maximum demand ammeters.

9

IME

Analogue meters

Power factor, frequency and synchronising meters

Power factor meters

- Accuracy class 1.5
- Single phase 240 V AC models
- 3 phase 415 V AC (balanced load) models
- 5 A CT operated
- Scale Cos φ, inductive 0.5-1-0.5 capacitive
- Meter and transducer supplied separately 48 + 72
- Meter and transducer are integrated in frame size 96

Ordering

Construct the Catalogue Number by selecting the meter from table 1 and adding the input from table 2 .

RQC72 240VAC

1

Window size	Cat. No.	Price $
72 mm x 72 mm	RQC72...	580.00
96 mm x 96 mm	RQCE96...	600.00

2

Input selection	240 V AC or 415V AC

Frequency meter

- Single phase 110 V AC and 240 V AC models
- 3 phase 415 V AC models
- The transducer and moving operation coil meter offers relative immunity to external vibration
- Moving coil meter and transducer, accuracy class 0.5
- Voltage level tolerance +15 %, 4 VA burden
- Range of 45-55 Hz

Ordering

Construct the Catalogue Number by selecting the meter from table 1 and adding the input from table 2 .

RQ72FI 240VAC

1

Window size	Cat. No.	Price $
48 mm x 48 mm	RQ48FI...	245.00
72 mm x 72 mm	RQ72FI...	230.00
96 mm x 96 mm	RQ96FI...	230.00

2

Input selection	110 V AC, 240 V AC, 415 V AC

Synchronising meter

LED Static synchroscope

Synchronism is achieved when the rectangular LED under the arrow is illuminated and the 2 phase LEDs are off. The lighting of the LEDs clockwise or anti-clockwise means the generator to be synchronised is lagging or leading.

RQ96SL

Window size	Synchroscope	Cat. No.	Price $
96 mm x 96 mm	415 V AC	i RQ96SL	580.00

9

Notes: i Available on indent only

Price Schedule 'Y8'

IME

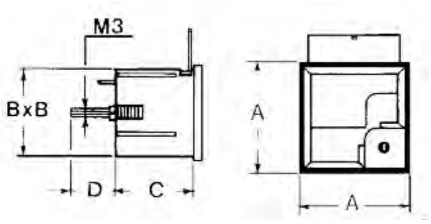
Dimensions and shunts

Analogue meters

Overall dimensions (mm) and weight – RQ/90° and AQ/240° Instruments

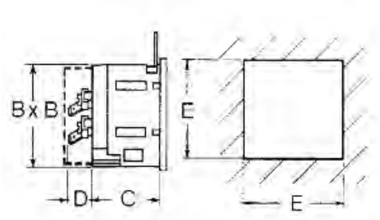
Cat. No.	A	B	C	D	E	Weight (g)
RQ48	48 x 48	44.5 x 44.5	40	22	45	100
AQ48	48 x 48	44.5 x 44.5	57.5	22	45	200
RQ72	72 x 72	66.5 x 66.5	44	12	68	150
AQ72	72 x 72	66.5 x 66.5	59	12	68	300
RQ96	96 x 96	91 x 91	44	12	92	210
AQ96	96 x 96	91 x 91	59	12	92	400

RQ/90°



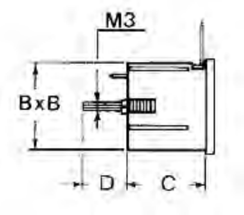
RQ48

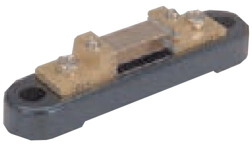
RQ/90°



RQ72-96

AQ/240°





NHP100-50 mV Shunt

Shunts (50 mV)

Current rating Amps DC	Cat. No. [1]) Output	Price $	Current rating Amps DC	Cat. No. [1]) Output	Price $
10 A	**NHP 10-50MV**	**89.00**	250 A	**NHP 250-50MV**	**132.00**
20 A	**NHP 20-50MV**	**89.00**	300 A	**NHP 300-50MV**	**132.00**
30 A	[i] **NHP 30-50MV**	**89.00**	400 A	[i] **NHP 400-50MV**	**187.00**
40 A	**NHP 40-50MV**	**89.00**	500 A	**NHP 500-50MV**	**310.00**
50 A	**NHP 50-50MV**	**89.00**	600 A	[i] **NHP 600-50MV**	**320.00**
60 A	**NHP 60-50MV**	**89.00**	800 A	[i] **NHP 800-50MV**	**530.00**
75 A	**NHP 75-50MV**	**89.00**	1000 A	[i] **NHP 1000-50MV**	**580.00**
80 A	[i] **NHP 80-50MV**	**89.00**	1200 A	[i] **NHP 1200-50MV**	**680.00**
100 A	**NHP 100-50MV**	**89.00**	1500 A	[i] **NHP 1500-50MV**	**690.00**
150 A	**NHP 150-50MV**	**89.00**	2000 A	[i] **NHP 2000-50MV**	**820.00**
200 A	**NHP 200-50MV**	**132.00**		-	–

9

Notes: [1]) 75 mV shunts available on indent locally, P.O.A. Replace 50 mV in Cat. No. with 75 mV when ordering shunt. Shunts available up to 12000 A, 75 mV on indent.
[i] Available on indent only.

IME

Analogue meters

90º DC moving coil ammeters and voltmeters

Catalogue Number construction

RQ 96 M ADC-4 100A

RQ = 90 degree pointer deflection
AQ = 240 degree pointer deflection

Frame size 48 mm², 72 mm², 96 mm²

M = Moving coil instrument

Code for measurement range i.e: 4-20 mA

Scale range and caption

RQ96 M ADC 25 A

90° Instruments

Ordering

Construct the Catalogue Number by selecting the meter kit from table below and clearly state required **input** and **scale** and **full scale** reading information when ordering.

E.g. RQ72MADC4
Input: 4 - 20 mA
Scale: 0 - 100 A
Full scale: 20 mA input = 100 A scale

E.g. RQ96MADC5
Shunt input: 50 mV 200 A
Scale: 0 - 200 A
Full scale: 50 mV input = 200 A scale

DC ammeters

Input type	Cat. No. ²) Price $ RQ48M-ADC	Price $ RQ72M-ADC	Price $ RQ96M-ADC	add input code
0-200 µA	–	141.00	–	200
0-1 mA to 0-10 mA	137.00	126.00	142.00	M1 ²)
0-20 mA to 0-800 mA	137.00	126.00	142.00	M2 ²)
1, 5 A ²)	137.00	137.00	142.00	-
10, 15, 20, 25, 30, 40, 60 A ²)	–	137.00	142.00	-
4-20 mA mech. suppressed	156.00	141.00	145.00	4

Shunt connect ammeters ¹)

Input type	Cat. No. ²) Price $ RQ48M-ADC	Price $ RQ72M-ADC	Price $ RQ96M-ADC	add input code
0-10 A to 0-2000 A 50 mV	i 130.00	126.00	135.00	5
0-20 A to 0-2000 A 75 mV	i 130.00	126.00	135.00	7
10-0-10 A to 1000-0-1000 A 50 mV	i 130.00	126.00	135.00	0

DC voltmeter

Input type	Cat. No. ²) Price $ RQ48M-VDC	Price $ RQ72M-VDC	Price $ RQ96M-VDC	add input code
0-1 V to 0-600 V	130.00	126.00	135.00	V
1-0-1 V to 600 V-0-600 V	130.00	126.00	135.00	0

(Rectified AC) Voltmeter

Input type	Cat. No. ²) Price $ RQ48M-VAC	Price $ RQ72M-VAC	Price $ RQ96M-VAC	add input code
0-10 V to 0-600 V	142.00	126.00	142.00	V

Notes:
¹) Price of meter does not include shunt. Refer to page 9 - 7 for shunt pricing.
²) Clearly define all required information when ordering (input / scale / full scale), check with NHP for custom meters.
i Available on indent only.

9

Price Schedule 'Y8'

IME

Analogue meters

240° DC moving coil ammeters and voltmeters

240° Instruments

AQ96M-VDC 500V

DC ammeters

Input type	Cat. No. [2])	Price $ AQ48M-ADC	Price $ AQ72M-ADC	Price $ AQ96M-ADC	add input code
0-1 mA to 0-8 mA		[i] 245.00	215.00	235.00	M1
0-10 mA to 0-800 mA		[i] 245.00	215.00	235.00	M2
1, 5 A [2])		[i] 245.00	215.00	235.00	-
4-20 mA mech. suppressed		[i] 275.00	270.00	270.00	4

Shunt connect ammeters [1])

Input type	Cat. No. [2])	Price $ AQ48M-ADC	Price $ AQ72M-ADC	Price $ AQ96M-ADC	add input code
0-10 A to 0-2000 A 50 mV		[i] 245.00	215.00	235.00	5
0-20 A to 0-2000 A 75 mV		[i] 245.00	215.00	235.00	7
10-0-10 A to 1000-0-1000 A 50 mV		[i] 245.00	215.00	235.00	0

DC voltmeter

Input type	Cat. No. [2])	Price $ AQ48M-VDC	Price $ AQ72M-VDC	Price $ AQ96M-VDC	add input code
0-1 V to 0-600 V		[i] 245.00	215.00	235.00	V
1-0-1 V to 600 V-0-600 V		[i] 245.00	215.00	235.00	0

(Rectified AC) Voltmeter

Input type	Cat. No. [2])	Price $ AQ48M-VAC	Price $ AQ72M-VAC	Price $ AQ96M-VAC	add input code
0-10 V to 0-600 V		[i] 245.00	215.00	235.00	V

9

Notes:
[1]) Price of meter does not include shunt. Refer to page 9 - 7 for shunt pricing.
[2]) Clearly define all required information when ordering (input / scale / full scale), check with NHP for custom meters.
[i] Available on indent only.

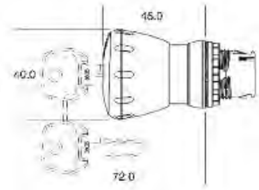
sprecher+ schuh

D7 Emergency stop operators 22.5 mm
Complete

Emergency stop operators

D7PMT44PX01

- IP 66
- Choice of "Auto Break" or standard normally closed contacts
- Extra security key release
- Complies with AS/NZS 3947.5.5:2000



Dimensions in (mm)

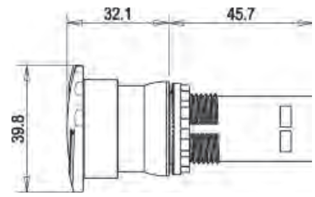
Pushbutton & Key operated types

Description	Contact	Plastic body Cat. No.	Price $	Metal body Cat. No.	Price $
Twist To Reset/Standard contact blocks					
30 mm Operator		D7P-MT34-PX01	82.50	D7M-MT34-MX01	90.50
40 mm Operator		D7P-MT44-PX01	86.00	D7M-MT44-MX01	94.00
Key To Reset/Standard contact blocks		D7P-MK44-PX01	124.00	D7M-MK44-MX01	167.00
40 mm Operator					
40 mm Operator		D7P-MT44-PX01S	106.00	D7M-MT44-MX01S	115.00

Monolithic eco-emergency stop operators

D7DMT44X01

- Complete one-piece thermoplastic operators with 40 mm red mushroom head and non-removable contacts
- Non-illuminated, push-pull and 'twist to release' mechanism in one operation
- Trigger action anti-tease operation



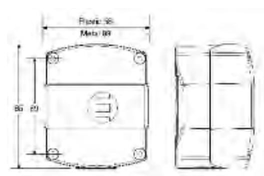
Emergency stop operator [2])

Description	Cat. No.	Price $
Emergency stop operator with 1 N/C contact	D7D-MT44-X01	59.00
Emergency stop operator with 2 N/C contacts	D7D-MT44-X02	69.50
Emergency stop operator with 1 N/O and 1 N/C contacts	D7D-MT44-X11	69.50

Enclosed emergency stop operators

D71YM1

- Modern low profile enclosures
- Metric cable entry knockout M16/20 mm



Description	Contact	Cat. No.	Price $
Plastic enclosures with emergency stop "Twist To Reset" operator			
Yellow enclosure 40 mm plastic operator		D71YM1	150.00
Metal enclosures with emergency stop "Twist To Reset" operator			
Grey enclosure 40 mm metal operator		D71MM1 [1])	190.00

D71MM1

Notes: [1]) Yellow metal enclosure also available. Contact NHP.
[2]) Refer page 2 - 52 for technical infomation.

sprecher+schuh

2

D7 Emergency stop operators 22.5 mm

Components

D7P-MT44

- Protection class IP 66
- Individually packaged
- 3 part ordering

1 2 3

Operator head | Coupling plate | Contact Blocks

1 Mushroom operators

Description	Non-illuminated Plastic Cat. No.	Price $	Non-illuminated Metal Cat. No.	Price $	Illuminated Plastic Cat. No. [1]	Price $	Illuminated Metal Cat. No. [1]	Price $
30 mm Red operator	D7P-MT34	67.00	D7M-MT34	74.50	-	–	-	–
40 mm Red operator	D7P-MT44	70.50	D7M-MT44	75.00	D7P-LMT44	90.00	D7M-LMT44	95.50
60 mm Red operator	D7P-MT64	79.00	D7M-MT64	82.50	D7P-LMT64	110.00	[i] D7M-LMT64	118.00
40 mm Red operator	D7P-MK44	113.00	D7M-MK44	124.00	-	–	-	–

D7ALP

2 Coupling plates

Description	Cat. No.	Price $
Plastic coupling plate	D7-ALP	4.50
Metal coupling plate	D7-ALM	6.50

D7-X01

3 Contact blocks

Description	Operator Colour	Contacts	Panel Mount Cat. No.	Price $	DIN/Base Mount Cat. No.	Price $
Normally closed contact block	Red	1 N/C	D7-X01	11.80	D7-BX01	13.20
Normally closed contact block with spring clamp terminals	Red	1 N/C	D7-Q01	16.80	D7-BQ01	18.00
Normally closed late break	Brown	N/C L.B.	D7-X01L	15.40	D7-BX01L	16.80
Normally closed early break	Brown	N/C E.B.	D7-X01B	15.40	D7-BX01B	16.80
Normally closed low voltage (*Quadfurcated* gold contacts)	Blue	1 N/C	D7-X01V	26.20	D7-BX01V	27.40
Dual circuit 2 normally closed [2])	Red	2 N/C	D7-X02D	27.40	-	–
"Auto break" safety contact block for emergency stop operators [2])	Yellow	1 N/C safety	D7-X01S	32.00	-	–

D7PX10

2 + 3 Combined contact block and coupling plate

Description	Screw Cap Cat. No.	Price $	Metal Screw Cap Cat. No.	Price $
1 N/O contact block + coupling plate	D7PX10	16.80	D7MX10	19.60
1 N/C contact block + coupling plate	D7PX01	16.80	D7MX01	19.60
1 N/O and 1 N/C contact block + coupling plate	D7PX11	28.60	D7MX11	32.00

Notes: [1]) For LED 2 lamps refer 2 - 33.
[2]) Dual circuit and 'Auto Break' cannot be mounted in D7 low profile enclosures.
For Accessories refer 2 - 34.
[i] Available on indent only.

Price Schedule 'A2'

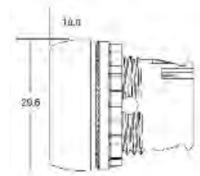
sprecher+schuh

2

D7 Non-illuminated momentary pushbuttons 22.5 mm
Complete

D7M-F301-MX10

- Metal or plastic options
- Improved momentary action for fast response
- Low mounting depth from panel
- Protection class IP 66
- Laser etched markings for improved abrasion resistance

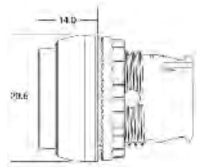


Dimensions in (mm)

Flush pushbuttons [1])

Description	Contact	Plastic body Cat. No.	Price $	Metal body Cat. No.	Price $
With Green insert	1 N/O	D7P-F3-PX10	34.00	D7M-F3-MX10	38.00
With Red insert	1 N/C	D7P-F4-PX01	34.00	D7M-F4-MX01	39.50
With Blue insert	1 N/O	D7P-F6-PX10	34.00	D7M-F6-MX10	39.50
With Green insert labelled "Start"	1 N/O	D7P-F301-PX10	37.00	D7M-F301-MX10	42.00
With Red insert labelled "Stop"	1 N/C	D7P-F402-PX01	37.00	D7M-F402-MX01	42.00
With Blue insert labelled "Reset"	1 N/O	D7P-F607-PX10	38.00	D7M-F607-MX10	41.00

D7M-F4-MX01



Dimensions in (mm)

D7P-E402-PX01

Extended pushbuttons [1])

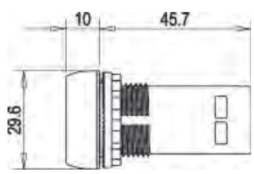
Description	Contact	Plastic body Cat. No.	Price $	Metal body Cat. No.	Price $
With Red insert labelled "stop"	1 N/C	D7P-E402-PX01	40.00	D7M-E402-MX01	43.00

D7DE4X01

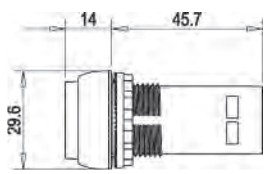
Monolithic pushbuttons

Description	1 N/O Contact Cat. No.	Price $	1 N/C Contact Cat. No.	Price $	1 N/O 1 N/C Contact Cat. No.	Price $
Flush Green	D7DF3X10	24.00	-	–	D7DF3X11	38.00
Flush Red	-	–	i D7DF4X01	24.00	D7DF4X11	38.00
Flush Blue	D7DF6X10	24.00	-	–	D7DF6X11	38.00
Flush Black	D7DF2X10	24.00	D7DF2X01	24.00	D7DF2X11	38.00
Extended Red	-	–	D7DE4X01	24.00	D7DE4X11	40.50

Flush



Extended



Notes: [1]) Extra contact blocks refer page 2 - 32.

Price Schedule 'A2'

sprecher+schuh

D7 Illuminated momentary pushbuttons 22.5 mm
Complete

Illuminated momentary pushbuttons with integrated LED lamp block and contact blocks

- Long life integrated LED illumination
- 24 V, 110 V and 240 V versions
- Protection class IP 66

D7P-LF5-PN3Y-X10

24 V AC/DC Illuminated pushbuttons [1])

Description	Contact	Plastic body Cat. No.	Price $	Metal body Cat. No.	Price $
Green pushbutton/Green LED	1 N/O	D7P-LF3-PN3G-X10	77.00	D7M-LF3-MN3G-X10	85.50
Red pushbutton/Red LED	1 N/C	D7P-LF4-PN3R-X01	77.00	D7M-LF4-MN3R-X01	82.00
Blue pushbutton/Blue LED	1 N/O	D7P-LF6-PN3B-X10	78.50	D7M-LF6-MN3B-X10	85.50

D7M-LF6-MN5B-X10

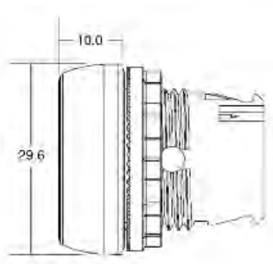
110 V AC/DC Illuminated pushbuttons [1])

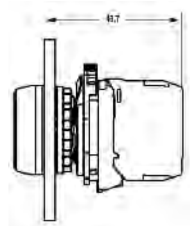
Description	Contact	Plastic body Cat. No.	Price $	Metal body Cat. No.	Price $
Green pushbutton/Green LED	1 N/O	D7P-LF3-PN5G-X10	83.00	D7M-LF3-MN5G-X10	85.50
Red pushbutton/Red LED	1 N/C	D7P-LF4-PN5R-X01	83.00	D7M-LF4-MN5R-X01	85.50
Blue pushbutton/Blue LED	1 N/O	D7P-LF6-PN5B-X10	83.00	D7M-LF6-MN5B-X10	85.50

D7P-LF5-PN7Y-X10

240 V AC/DC Illuminated pushbuttons [1])

Description	Contact	Plastic body Cat. No.	Price $	Metal body Cat. No.	Price $
Green pushbutton/Green LED	1 N/O	D7P-LF3-PN7G-X10	86.00	D7M-LF3-MN7G-X10	94.50
Red pushbutton/Red LED	1 N/C	D7P-LF4-PN7R-X01	87.50	D7M-LF4-MN7R-X01	94.50
Blue pushbutton/Blue LED	1 N/O	D7P-LF6-PN7B-X10	91.50	D7M-LF6-MN7B-X10	96.00





Integrated LED lamp block
shown with coupling plate

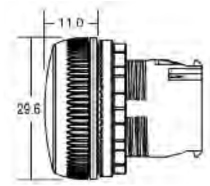
Notes: [1]) Extra contact blocks refer page 2 - 32.

Price Schedule 'A2'

sprecher+schuh

2

D7 Pilot Lights 22.5 mm
Complete



Complete pilot light with integrated LED lamp block

- Superior LED illumination qualities
- Scratch resistant lenses

D7P-P6

D7M-P4

24 V AC/DC pilot lights

Description	Plastic body Cat. No.	Price $	Metal body Cat. No.	Price $
Green pilot light/Green LED	D7P-P3-PN3G	51.00	D7M-P3-MN3G	58.00
Red pilot light/Red LED	D7P-P4-PN3R	51.00	D7M-P4-MN3R	58.00
Blue pilot light/Blue LED	D7P-P6-PN3B	51.00	D7M-P6-MN3B	58.00
Amber pilot light/Yellow LED [2]	D7P-P0-PN3A	51.00	D7M-P0-MN3A	58.00
Yellow pilot light/Yellow LED	D7P-P5-PN3Y	51.00	D7M-P5-MN3Y	58.00
Translucent pilot light/White LED	D7P-P7-PN3W	51.00	D7M-P7-MN3W	58.00

D7P-P5-PN3Y

110 V AC/DC pilot lights

Description	Plastic body Cat. No.	Price $	Metal body Cat. No.	Price $
Green pilot light/Green LED	D7P-P3-PN5G	61.00	D7M-P3-MN5G	65.00
Red pilot light/Red LED	D7P-P4-PN5R	61.00	D7M-P4-MN5R	65.00
Blue pilot light/Blue LED	D7P-P6-PN5B	61.00	D7M-P6-MN5B	65.00
Amber pilot light/Yellow LED [2]	D7P-P0-PN5A	61.00	D7M-P0-MN5A	65.00
Yellow pilot light/Yellow LED	D7P-P5-PN5Y	61.00	D7M-P5-MN5Y	65.00
Translucent pilot light/White LED	D7P-P7-PN5W	61.00	D7M-P7-MN5W	65.00

D7M-P3-MN3G

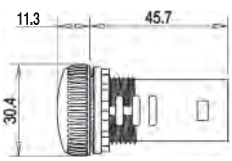
240 V AC/DC pilot lights

Description	Plastic body Cat. No.	Price $	Metal body Cat. No.	Price $
Green pilot light/Green LED	D7P-P3-PN7G	61.00	D7M-P3-MN7G	67.00
Red pilot light/Red LED	D7P-P4-PN7R	61.00	D7M-P4-MN7R	67.00
Blue pilot light/Blue LED	D7P-P6-PN7B	61.00	D7M-P6-MN7B	67.00
Amber pilot light/Yellow LED [2]	D7P-P0-PN7A	61.00	D7M-P0-MN7A	67.00
Yellow pilot light/Yellow LED	D7P-P5-PN7Y	61.00	D7M-P5-MN7Y	67.00
Translucent pilot light/White LED	D7P-P7-PN7W	61.00	D7M-P7-MN7W	67.00

D7D-P3D3

Monolithic pilot lights

Voltage	BA9S Lamp Cat. No. [1]	Price $	Integrated LED Cat. No. [1][2][3]	Price $
6 V AC/DC (D1)	[i] D7D-P_D1	35.50	-	–
12 V AC/DC (D2)	[i] D7D-P_D2	35.50	-	–
24 V AC/DC (D3/N3)	D7D-P_D3	35.50	D7D-P-_N3	45.00
48 V AC/DC (D4)	[i] D7D-P_D4	35.50	-	–
120 V AC/DC (D5/N5)	D7D-P_D5	35.50	D7D-P-_N5	51.00
240 V AC/DC (N7)	-	–	D7D-P-_N7	51.00



Notes:
[1]) Enter colour 0 = Amber, 3 = Green, 4 = Red, 5 = Yellow, 6 = Blue, 7 = Translucent (white), 9 = No lens
E.g. D7D-P4 N7 is 240 V with red LED.
[2]) Optically enhanced lens suitable for ECO - pilot light only. Not interchangeable with standard pilot lights.
[3]) Lamp supplied complete with operator.
For technical data on monolithic pilot lights, refer page 2 - 52.
[i] Available on indent only.

Price Schedule 'A2'

sprecher+schuh

2

D7 Multi-function momentary pushbuttons and potentiometers 22.5 mm
Complete

Multi-function operators with contact blocks

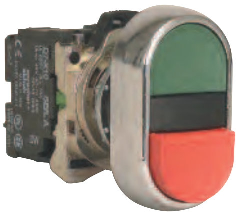
D7P-U2E4F3-PX11

Time saving
- Central nut fixing
- Snap fitting of components

Space efficient
- 2 or 3 functions in a minimum of space
- Single 22.5 mm hole mounting

Economical
- Negates the need for 3 separate devices
- Less mounting time

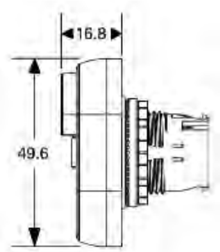
Flexible
- Uses standard D7 rear elements
- 2 contact levels possible
- Choice of plastic or metal body
- IP 66 protection



D7M-U2E4F3-MX11

Dual pushbuttons

Description	Contact	Plastic body Cat. No.	Price $	Metal body Cat. No.	Price $
Momentary operation Blank inserts (Red/Green)	1 N/O, 1 N/C	D7P-U2E4F3-PX11	66.50	D7M-U2E4F3-MX11	73.50
O-I (Red/Green)	1 N/O, 1 N/C	D7P-UZEFFE-PX11	70.00	D7M-UZEFFE-MX11	73.50



Potentiometer

- Supplied as operator only or with resistive elements
- Thermoplastic body

D7P-POT

Description	Plastic body Cat. No. [1])	Price $
Operator without resistive element	D7P-POT	117.00
Operator with 1000 Ω resistive element	D7P-POT3	163.00
Operator with 5000 Ω resistive element	D7P-POT5	163.00
Operator with 10000 Ω resistive element	D7P-POT6	163.00

Notes: [1]) For technical information and spare resistive element refer page 2 - 47.
Accessories refer page 2 - 34.

Price Schedule 'A2'

sprecher+ schuh

2

D7 Selector and key selector switches 22.5 mm
Complete

D7P-SM22-PX10

D7M-KM34-MX20

Short lever rotary switches and key operated rotary switches

- Improved sealing
- Raised detent for improved switching capabilities
- Ergonomic handles

Description	Contact	Plastic body Cat. No.	Price $	Metal body Cat. No.	Price $
Maintained operation					
2 pos Rotary SW 60°	1 N/O	D7P-SM22-PX10[1]	52.50	D7M-SM22-MX10[1]	58.50
3 pos Rotary SW 2 x 60°	2 N/O	D7P-SM32-PX20[1]	63.00	D7M-SM32-MX20[1]	75.00
2 pos Key SW 60°	1 N/O	D7P-KM21-PX10[1]	132.00	D7M-KM21-MX10[1]	136.00

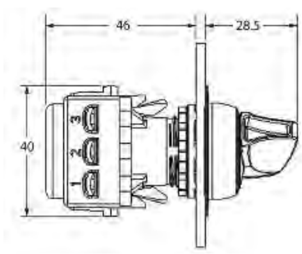
D7DSM22X10

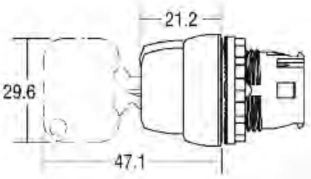
Monolithic rotary switches

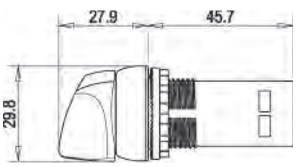
- Complete one-piece thermoplastic operator with rotary head and non-removable contacts

Rotary switch

Description	2 position Cat. No.	Price $	3 position Cat. No.	Price $
Maintained with 1 N/O contact	D7D-SM22X10	29.80	-	–
Maintained with 1 N/C contact	D7D-SM22X01	29.80	-	–
Maintained with 2 N/O contact	[i] D7D-SM22X20	45.00	D7D-SM32X20	43.50
Maintained with 2 N/C contact	[i] D7D-SM22X02	45.00	D7D-SM32X02	43.50
Maintained with 1 N/O and 1 N/C contact	D7D-SM22X11	43.50	D7D-SM32X11	43.50
Spring return with 2 N/O Contact	-	–	D7D-SB32X20	43.50
Spring return with 2 N/C Contact	-	–	D7D-SB32X02	43.50
Spring return with 1 N/O and 1 N/C contact	-	–	D7D-SB32X11	43.50







Notes: [1]) Key removable at 'o' position.
For accessories refer to page 2 - 34.
[i] Available on indent only.

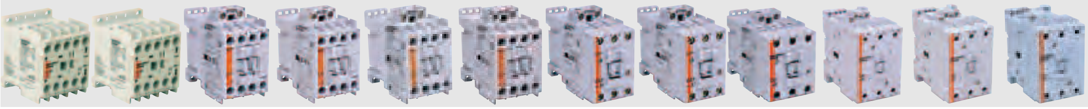
Price Schedule 'A2'

sprecher+schuh CONTACTOR

Ratings To: AS/NZS 60947.4 IEC 60947.4

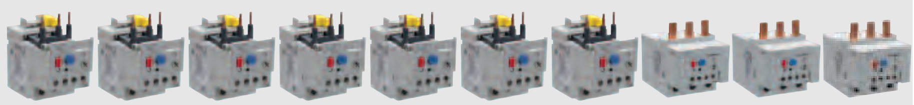
NHP

- 690 VOLTS -

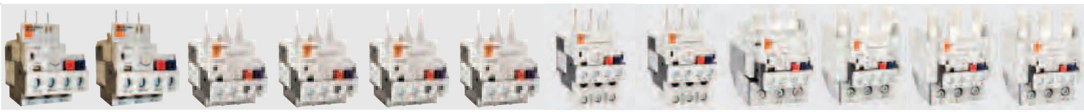


			CA8-5	CA 8-9 [CA 8-12]	CA 7-9	CA 7-12	CA 7-16	CA 7-23	CA 7-30	CA 7-37	CA 7-43	CA 7-60	CA 7-72	CA 7-85
CURRENT RATINGS AT OPERATIONAL VOLTAGE 400/415 V [12]) 1000 VOLT RATINGS IN ( )														
40 °C Ith	AC 1	Amps	20	20	32	32	32	32	65	65	85	100	100	100
60 °C	AC 1	Amps	16	16	32	32	32	32	65	65	80	100	100	100
	AC 2, AC 3, AC 4 [8])	Amps	5	9 [12]	9	12	16	23	30	37	43	60	72	85
AC 3	@ 690 V	Amps	5	9 [12]	5	7	9	23	18	21	25	34	42	49
MOTOR STARTER RATINGS AT OPERATIONAL VOLTAGE 400/415 V. ALL KW RATINGS APPROXIMATE [12])														
AC 2, AC 3 (Slip-ring and squirrel cage motors)	@ 400/415 V	kW	2.6	4.5 [6.1]	4	5.5	7.5	11	15	20	22	32	40	45
	@ 1000 V	kW	-	-	-	-	-	-	-	-	-	-	-	-
AC 2, AC 3	@ 690 V	kW	2.6	4.5 [6.1]	4	5.5	7.5	11	15	18.5	22	32	40	45
AC 4 (Inching/plugging)	@ 400/415 V	kW	2.6	4.5 [6.1]	4	5.5	7.5	11	15	20	22	32	40	45
Star-delta [1]) [3])	Line.delta	kW	4	7.5 [11]	7.5	11	15	22	25	37	40	55	63	80
	Star point Y	kW	-	-	14	19	25	37	50	60	72	100	125	145
	Star point Δ	kW	-	-	18.5	25	34	50	63	85	95	135	150	190
Auto transformer [2])	Line	kW	-	-	4	5.5	7.5	11	15	18.5	22	30	37	45
and	Transformer	kW	-	-	5.5	7.5	12	18.5	22	33	37	55	63	75
liquid resistance [8])	Star point Y	kW	-	-	11	15	18.5	22	37	45	55	75	90	110
	Star point Δ	kW	-	-	18.5	22	30	37	55	75	90	110	150	185
CAPACITOR AND LAMP SWITCHING AT OPERATIONAL VOLTAGE 415 V														
Capacitor switching	40 °C [14])	kvar	-	-	8	8	10	12.5	20	25	35	50	50	50
at 400/415 volts	60 °C [14])[15])	kvar	pending	pending	8	8	10	12.5	20	22	30	42	50	50
Incandescent Lamps AC5b	40 °C	Amps	9	9	12	16	18	22	30	37	43	60	70	76
Elec discharge Lamps AC5a (compensated)	40 °C	Amps	18	18	28.5	25	28	29	40.5	45	77	81	85	90
MECHANICAL, ELECTRICAL AND COIL DATA														
Mechanical life		Ops	15 mill	15 mill	13 mill	13 mill	13 mill	13 mill	13 mill	13 mill	12 mill	10 mill	10 mill	10 mill
Electrical life at AC 3, 400/415 V		Ops	0.7 mill	0.7 mill	1.3 mill	1.3 mill	1.3 mill	1.3 mill	1.3 mill	1.3 mill	1 mill	1 mill	1 mill	1 mill
Contactor operations	(Max. no load)	Ops/Hr	8000 [20])	8000 [20])	8000	8000	8000	8000	8000	8000	8000	6000	6000	6000
Switching delay	Make	ms	15-40	15-40	15-30	15-30	15-30	15-30	15-30	15-30	15-30	20-40	20-40	20-40
AC coil	Break	ms	15-25	15-25	10-60	10-60	10-60	10-60	10-60	10-60	10-60	10-60	10-60	10-60
Coil data AC	Pick-up	VA	22	22	70	70	70	70	80	80	130	200	200	200
		W	20	20	50	50	50	50	60	60	90	110	110	110
	Hold in	VA	4	4	8	8	8	9	9	9	10	16	16	16
			1.4	1.4	2.6	2.6	2.6	3	3	3	3.2	4.5	4.5	4.5
Coil data DC	Pick-up	W	3	3	6.5	6.5	6.5	9.2	9.2	9.2	10.1	200	200	200
	Hold	W	3	3	6.5	6.5	6.5	9.2	9.2	9.2	10.1	4.5	4.5	4.5
Auxiliary contacts	Available	Std/Max.	1/4	1/4	1/9 [17])	1/9 [17])	1/9 [17])	1/9 [17])	-/8 [17])	-/8 [17])	-/8 [17])	-/8 [17])	-/8 [17])	-/8
Integral auxiliary	AC 12 60 °C	Amps	10	10	20	20	20	20	-	-	-	-	-	-
contact	AC 15, 415 V	Amps	pending	pending	6	6	6	6	-	-	-	-	-	-
Add-on auxiliary	AC 1 60 °C	Amps	6	6	6	6	6	6	6	6	6	6	6	6
block	AC 15, 415 V	Amps	pending	pending	3	3	3	3	3	3	3	3	3	3

MOTOR PROTECTION SELECTION - ALTERNATIVE ELECTRONIC OVERLOAD SELECTION - CEP7: REFER SECTION 1, CEP5: REFER SECTION 7



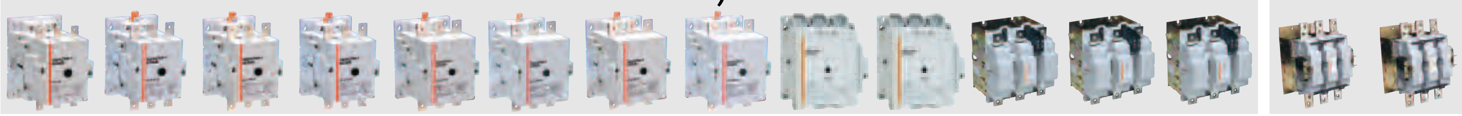
			CEP 7 E	CEP 7 E	CEP 7 E [16])	CEP 7 E [16])	CEP 7 E [16])	CEP 7 E	CEP 7 E	CEP 7 E	CEP 7 E	CEP 7 E
Overload range Standard electronic overload	Amps		0.1-16	0.1-16	5.4-27	5.4-27	5.4-27	9-45	9-45	18-90	18-90	18-90



		CT 8	CT 8	CT 7N-23	CT 7N-23	CT 7N-23	CT 7N-23	CT 7N-37	CT 7N-37	CT 7N-43	CT 7N-85	CT 7N-85	CT 7N-85
Alternative thermal & electronic overload range	Amps	0.1-6.3	0.1-10 [0.1-12.5]	0.1-10	0.1-12.5	0.1-25	0.1-25	15-30	15-38	17-47	35-60	35-60	35-90

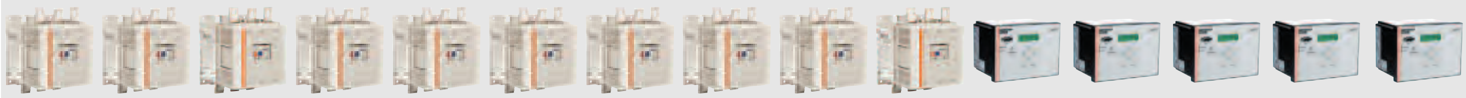
Notes: Contactor ratings chart notes refer to page 1 - 4

RATINGS CHART



- 1000 VOLTS - [10])													- 690 VOLTS -	
CA 6-95 [12]) CA 6-95-EI	*CA 6 110 [10]) CA 6-110-EI [7])*	*CA 6 140 [10]) CA 6-140-EI [7])*	*CA 6 180 [10]) CA 6-180-EI [7])*	*CA 6-210-EI [7])*	*CA 6-250-EI*	*CA 6-300-EI [7])*	*CA 6-420-EI [12])*	*CA 6-630-EI*	*CA 6-860-EI*	*CA 5-550 [6])*	*CA 5-700 [6])*	*CA 5-860 [6])*	*CA 5-1000*	*CA 5-1200*
CURRENT RATINGS AT OPERATIONAL VOLTAGE 400/415 V [12]) 1000 VOLT RATINGS IN ( )														
160	160	250	250	350	350	450	500	800	1000	760	1000	1100	1200	1350
135	135	210	210	300	300	380	425	-	-	605	800	870	960	1085
95 (33)	130 (40)	155 (55)	181 (65)	227 (80)	258 (95)	315 (115)	420 (160)	630	860	550 [18]) (250)	700 [18]) (340)	860 [18]) (380)	1000 [18])	1200 [18])
95	110	115	140	210	250	300	420	492	Pending	500	630	700	860	1000
MOTOR STARTER RATINGS AT OPERATIONAL VOLTAGE 400/415 V. ALL KW RATINGS APPROXIMATE [12])														
55	75	90	110	132	150	185	250	355	500	325	430	528	628	737
45	55	75	90	110	132	160	225	-	-	355	500	550	-	-
80	106	114	137	205	250	293	424	500	600	510	657	730	897	1043
55	75	90	110	132	150	185	250	355	500	206	247	300	359	424
90	132	160	173	231	263	335	452	615	850	561	745	915	1088	1278
165	225	270	300	390	450	550	750	1000	1150	850	1000	-	-	-
240	320	380	420	560	630	780	1050	-	-	1100	-	-	-	-
55	75	90	110	132	150	185	250	355	500	325	430	528	628	737
90	125	150	170	220	250	308	425	600	850	480	600	750	-	-
120	150	190	230	310	410	435	580	815	1150	710	900	-	-	-
-	-	-	-	-	-	-	-	-	-	975	-	-	-	-
CAPACITOR AND LAMP SWITCHING AT OPERATIONAL VOLTAGE 415 V														
84	84	126	126	176	176	226	252	170	220	350	430	500	550	630
68	68	100	100	151	151	191	214	155	200	300 [19])	360 [19])	450 [19])	500 [19])	600 [19])
107	120	140	170	210	250	300	420	-	-	315	440	500	560	630
144	144	225	225	315	315	405	450	pending	pending	360	460	550	660	800
MECHANICAL, ELECTRICAL AND COIL DATA														
10 mill	10 mill	10 mill	10 mill	10 mill	10 mill	10 mill	10 mill	2 mill	2 mill	5 mill	5 mill	5 mill	5 mill [9])	5 mill
0.8 mill	1 mill	1 mill	1 mill	1 mill	1 mill	1 mill	1 mill	-	-	0.6 mill	0.6 mill	0.6 mill	0.6 mill	0.6 mill
3000	1200	1200	1200	1200	1200	1200	1000	-	-	1200	1200	1200	300	300
20...45	20...45	20...45	20...45	20...45	20...45	20...45	20...45	60-100	60-100	50-100	50-100	50-100	50-100	50-100
25...110	25...110	25...110	25...110	25...110	25...110	25...110	25...110	70-145	70-145	150-200 [7])	150-200 [7])	150-200 [7])	25-50	25-50
380 [22])	380 [22])	380 [22])	380 [22])	380 [22])	380 [22])	380 [22])	490 [22])	1915	1915	950	1600	1600	2400	2400
240	240	240	240	240	240	240	270	1720	1720	850	1550	1550	2100	2100
13	13	13	13	13	13	13	18	33	33	11	25	25	70	70
6	6	6	6	6	6	6	7	30	30	10	22	22	60	60
265 [22])	265 [22])	265 [22])	265 [22])	265 [22])	265 [22])	265 [22])	340 [22])	1980	1980	850	1550	1550	2100	2100
6	6	6	6	6	6	6	7	30	30	10	22	22	60	60
2/8	2/8	2/8	2/8	2/8	2/8	2/8	2/8	2/8	2/8	4/8	4/8	4/8	2/7	2/7
-	-	-	--	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2	2	2	2	2

MOTOR PROTECTION SELECTION - ALTERNATIVE ELECTRONIC OVERLOAD SELECTION - CEP7: REFER SECTION 1, CEP5: REFER SECTION 7



CEP 7-EEHF	*CEP 7-EEHF*	*CEP 7-EEHF*	*CEP 7-EEJF*	*CEP 7-EEJG*	*CEP 7-EEKG*	*CEP 7-EELG*	*CEP 7-EELG*	*CEP 7-EENH*	*CEP 7-EENH*	*CET 5 [13]) [16])*	*CET 5 [13])*	*CET 5 [13])*	*CET 5 [13])*	*CET 5 [13])*
30-150	30-150	30-150	40-200	40-200	60-300	100-500	100-500	160-800	160-800	0.5-5000	0.5-5000	0.5-5000	0.5-5000	0.5-5000

CEF 1-11/12	*CEF 1-11/12*	*CEF 1-11/12*	*CEF 1-11/12*	*CEF 1-*	*CEF 1-*	*CEF 1-*	*CEF 1-*	*CEF 1-*	*CEF 1-P*	*CEF 1-P*	*CEF 1-P [16])*	*CEF 1-P [16])*	*CEF 1-P [16])*	*CEF 1-P [16])*
20-180	20-180	20-180	20-180	41/42/52 [16]) 160-630	41/42/52 [16]) 160-630	41/42/52 [16]) 160-630	41/42/52 [16]) 160-630	41/42/52 [16]) 160-630	300-1200	300-1200	300-1200	300-1200	300-1200	300-1200

1

sprecher+schuh

AC contactors

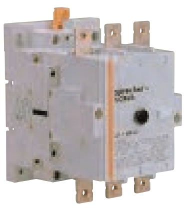
AC 3 rating at 60°C

3 pole open type with AC coil

CA 8-5

CA 7-9

CA 7-72



CA 6-95-EI

CA 6-250-EI

CA 6-860-EI

AC 3 400/415 V kW [1])	AC 3 400/415 V Amps [1])	AC 3 690 V kW	AC 1 Amps 40 °C	Auxiliary contacts standard N/O	N/C	Max.	Cat. No. [2])	With standard coil Price $
2.2	4.9	2.2	20	1	0	5	CA 8-5-10...V AC	96.00
2.2	4.9	2.2	20	0	1	5	CA 8-5-01...V AC	96.00
4	8.5	4	20	1	0	5	CA 8-9-10...V AC	109.00
4	8.5	4	20	0	1	5	CA 8-9-01...V AC	109.00
5.5	11.5	5.5	20	1	0	5	CA 8-12-10...V AC	132.00
5.5	11.5	5.5	20	0	1	5	CA 8-12-01...V AC	132.00
4	9	4	32	1	0	9	CA 7-9-10...V AC	116.00
				0	1	9	CA 7-9-01...V AC	116.00
5.5	12	5.5	32	1	0	9	CA 7-12-10...V AC	145.00
				0	1	9	CA 7-12-01...V AC	145.00
7.5	16	7.5	32	1	0	9	CA 7-16-10...V AC	188.00
				0	1	9	CA 7-16-01...V AC	188.00
11	23	11	32	1	0	9	CA 7-23-10...V AC	285.00
				0	1	9	CA 7-23-01...V AC	285.00
15	30	15	65	0	0	8	CA 7-30-00...V AC	365.00
18.5	37	18.5	65	0	0	8	CA 7-37-00...V AC	440.00
22	43	22	85	0	0	8	CA 7-43-00...V AC	550.00
32	60	32	100	0	0	8	CA 7-60-00...V AC	770.00
40	72	40	100	0	0	8	CA 7-72-00...V AC	850.00
45	85	45	100	0	0	8	CA 7-85-00...V AC	990.00
55	97	55	130	0	0	8	CA 7-97-00...V AC	1240.00
55 (45)	95 (33)	80	160	1	1	8	CA 6-95-11...V AC	1390.00
55 (45)	95 (33)	80	160	1	1	8	CA 6-95-EI-11...V AC [3])	1560.00
75 (55)	130 (40)	100	160	1	1	8	CA 6-110-11...V AC	1610.00
75 (55)	130 (40)	100	160	1	1	8	CA 6-110-EI-11...V AC [3])	1850.00
90 (75)	155 (55)	110	250	1	1	8	CA 6-140-11...V AC	1990.00
90 (75)	155 (55)	132	250	1	1	8	CA 6-140-EI-11...V AC [3])	2280.00
110 (90)	180 (65)	135	250	1	1	8	CA 6-180-11...V AC	2320.00
110 (90)	180 (65)	135	250	1	1	8	CA 6-180-EI-11...V AC [3])	2520.00
132 (110)	225 (80)	205	350	1	1	8	CA 6-210-EI-11...V AC [3])	3200.00
150 (132)	258 (95)	250	350	1	1	8	CA 6-250-EI-11...V AC [3])	4150.00
185 (160)	315 (115)	300	450	1	1	8	CA 6-300-EI-11...V AC [3])	4600.00
250 (225)	420 (160)	425	540	1	1	8	CA 6-420-EI-11...V AC [3])	6030.00
355	630	500	800	1	1	8	CA 6-630-EI-11...V AC	9580.00
500	860	600	1000	1	1	8	CA 6-860-EI-11...V AC	15650.00
257 (280)	450 (200)	375	700	2	2	8	CA 5-450...V AC	5950.00
315 (355)	550 (250)	500	800	2	2	8	CA 5-550...V AC	7950.00
415 (500)	700 (340)	630	1000	2	2	8	CA 5-700...V AC	9270.00
515 (550)	860 (380)	710	1100	2	2	8	CA 5-860...V AC	15480.00
600	1000	850	1250	1	1	8	CA 5-1000...V AC	25620.00
710	1200	1000	1350	1	1	8	CA 5-1200...V AC	27800.00

Notes:

[1]) 1000 volt ratings in ( ).

[2]) Add control voltage to Cat. No. when ordering: 24, 32, 110, 240, 415, 440 V 50 Hz.
(CA6 conventional coils)
Standard voltages for CA 6-95-EI...250-EI are 24, 110, 240 and 415 V 50 Hz.
Standard voltages for CA 6-300-EI...420-EI 110, 240 and 415 V 50 Hz.
Standard voltages for CA 5-370...1200, 110, 240 and 415 V 50 Hz.

[3]) Electronically controlled mechanism (ECM) with interface suffix (EI).

240/415 V rated coils are suitable for use on 230/400 V in accordance with AS 60038: 2000.

Price Schedule
CA 7 'AA', CA 8 'A1'
CA 6 up to 420 'AA'
CA 6 - 630/860 & CA5, 'A1'

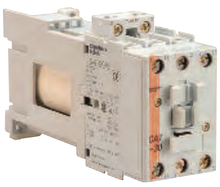
DC operated AC contactors

3 pole open type

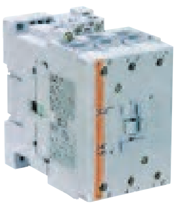
For DC operated AC contactors with continuously rated coils

CA 8-5C

CA 7-9C



CA 7-30C



CA 7-85D

CA 6-110...VDC

CA 6-860...VDC

AC 3 400/415 V kW [1]	AC 3 400/415 V Amps [1]	AC 3 690 V kW	AC 1 Amps 40 °C	Auxiliary contacts standard N/O	N/C	Max.	Cat. No. [2]	With standard coil Price $
2.2	4.9	2.2	20	1	0	5	CA 8-5C-10...VDC	200.00
2.2	4.9	2.2	20	0	1	5	CA 8-5C-01...VDC	200.00
4	8.5	4	20	1	0	5	CA 8-9C-10...VDC	210.00
4	8.5	4	20	0	1	5	CA 8-9C-01...VDC	210.00
5.5	11.5	5.5	20	1	0	5	CA 8-12C-10...VDC	230.00
5.5	11.5	5.5	20	0	1	5	CA 8-12C-01...VDC	230.00
4	9	4	32	1	0	9	CA 7-9C-10...VDC	340.00
				0	1	9	CA 7-9C-01...VDC	340.00
5.5	12	5.5	32	1	0	9	CA 7-12C-10...VDC	385.00
				0	1	9	CA 7-12C-01...VDC	385.00
7.5	16	7.5	32	1	0	9	CA 7-16C-10...VDC	440.00
				0	1	9	CA 7-16C-01...VDC	440.00
11	23	11	32	1	0	9	CA 7-23C-10...VDC	590.00
				0	1	9	CA 7-23C-01...VDC	590.00
15	30	15	65	0	0	8	CA 7-30C-00...VDC	650.00
18.5	37	18.5	65	0	0	8	CA 7-37C-00...VDC	870.00
22	43	22	85	0	0	8	CA 7-43C-00...VDC	950.00
32	60	32	100	0	0	8	CA 7-60D-00...VDC	1210.00
40	72	40	100	0	0	8	CA 7-72D-00...VDC	1290.00
45	85	45	100	0	0	8	CA 7-85D-00...VDC	1380.00
55	97	55	130	0	0	8	CA 7-97D-00...VDC	1510.00
55 (45)	95 (33)	80	160	1	1	6	CA 6-95-L-22...VDC	1660.00
55 (45)	95 (33)	80	160	1	1	8	CA 6-95-EI-11...VDC [3]	1630.00
75 (55)	130 (40)	100	160	1	1	6	CA 6-110-L-22...VDC	1790.00
75 (55)	130 (40)	100	160	1	1	8	CA 6-110-EI-11...VDC [3]	1850.00
90 (75)	155 (55)	110	250	1	1	6	CA 6-140-L-22...VDC	2160.00
90 (75)	155 (55)	132	250	1	1	8	CA 6-140-EI-11...VDC [3]	2280.00
110 (90)	180 (65)	135	250	1	1	6	CA 6-180-L-22...VDC [3]	2160.00
110 (90)	180 (65)	135	250	1	1	8	CA 6-180-EI-11...VDC [3]	2520.00
132 (111)	225 (80)	205	350	1	1	8	CA 6-210-EI-11...VDC [3]	3200.00
150 (133)	258 (95)	250	350	1	1	8	CA 6-250-EI-11...VDC [3]	4150.00
185 (163)	315 (115)	300	450	1	1	8	CA 6-300-EI-11...VDC [3]	4600.00
250 (225)	425 (160)	425	500	1	1	8	CA 6-420-EI-11...VDC [3]	6030.00
355	630	500	800	1	1	8	CA 6-630-EI-11...VAC [4]	9580.00
500	860	600	1000	1	1	8	CA 6-860-EI-11...VAC [4]	15650.00
257 (280)	450 (200)	375	600	2	2	8	CA 5-450...V AC [4]	5950.00
315 (355)	550 (250)	500	780	2	2	8	CA 5-550...V AC [4]	7950.00
415 (500)	700 (340)	630	1000	2	2	8	CA 5-700...V AC [4]	9270.00
515 (550)	860 (380)	710	1100	2	2	8	CA 5-860...V AC [4]	15480.00

Notes:

[1] 1000 volt ratings ( ).

[2] Add control voltage to Cat. No. when ordering: 24, 36, 48, 110 and 240 V DC for CA 7.
24 V DC for CA 6-95. 24, 110 and 240 V DC for CA 6-110-EI.
Standard voltages 24, 110 and 220 V DC.
For CA 7 suffix D instead of C denotes "fitted with a suppressor or diode".
This is standard on CA 7-60...85 and optional for CA 7-9...CA 7-43 (24 V DC only)
All DC contactors use AC contactor accessories.

[3] Electronically controlled mechanism (ECM) with interface suffix (EI).

[4] For CA 5 and CA 6-630/860 DC operation the AC version should be ordered.
110 V AC = 110 V DC, 240 V AC = 220 V DC, 400/415 V AC = 380 V DC

240/415 V rated coils are suitable for use on 230/400 V in accordance with AS 60038 : 2000.

Price Schedule
CA 8 'A1', CA 7 'AA'
CA 6 up to 420 'AA'
CA 6 - 630/860 & CA 5 'A1'

1

Din-Safe

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

6 kA

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

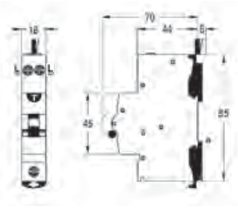
Curve type: C (5 – 10 In)

Trip sens.	No. of poles	Voltage	Short circuit cap.	In (A)	Cat. No. [1])	Price $
30 mA	1 pole	240 V AC	6 kA	6	DSRCBS0630C	330.00
				10	DSRCBS1030C	330.00
				16	DSRCBS1630C	330.00
				20	DSRCBS2030C	330.00
				25	DSRCBS2530C	330.00
				32	DSRCBS3230C	330.00

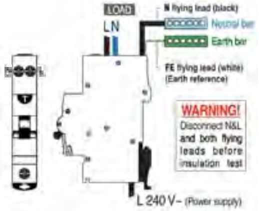
Curve type: B (3 – 5 In)

Trip sens.	No. of poles	Voltage	Short circuit cap.	In (A)	Cat. No. [1])	Price $
30 mA	1 pole	240 V AC	6 kA	6	DSRCBS0630B	330.00
				10	DSRCBS1030B	330.00
				16	DSRCBS1630B	330.00
				20	DSRCBS2030B	330.00
				25	DSRCBS2530B	330.00
				32	DSRCBS3230B	330.00

Dimensions (mm)



Connection diagram



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

1

Din-Safe

Single pole width residual current circuit breaker (RCBO)

Higher immunity to harmonics

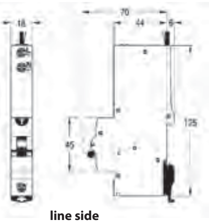
10 kA

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

Curve type: C (5 – 10 In)

Trip sens.	No. of poles	Voltage	Short circuit cap.	In (A)	Cat. No. [1][2]	Price $
30 mA	1 Pole	240 V AC	10 kA	6	DSRCBH0630A	320.00
				10	DSRCBH1030A	320.00
				16	DSRCBH1630A	320.00
				20	DSRCBH2030A	320.00
				25	DSRCBH2530A	320.00
				32	DSRCBH3230A	320.00
				40	DSRCBH4030A	320.00
10 mA	1 Pole	240 V AC	10 kA	6	DSRCBH0610A	412.00
				10	DSRCBH1010A	412.00
				16	DSRCBH1610A	412.00
				20	DSRCBH2010A	412.00
				25	DSRCBH2510A	412.00
				32	DSRCBH3210A	412.00
				40	DSRCBH4010A	412.00

Dimensions (mm)



Connection diagram

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

[1]) Neutral not switched.

[2]) Will not accept Din-T side mounting accessories.

30 mA tripping characteristics: 0.5 x IΔn = no tripping, 1 x IΔn = T ≤300 mS
2 x IΔn = T ≤150 mS, 5 x IΔn = T ≤40 mS

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

Din-Safe
MCB (RCBO)

10 kA MCB without Pigtail (RCBO)
- Standard AS/NZS 61009
- Approval No. N17482
- Switched neutral
- Suits 3 P+N NC or GB chassis or special CD chassis
- Suits loadcenters

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

Curve type: C (5 – 10 In)
Type AC RCD

Trip sens.	No. of poles	Voltage (AC)	Phase	In (A)	Cat. No.	Price $
30 mA	2 Pole	110/240	1 P+N	6	DSRCB0630	285.00
				10	DSRCB1030	285.00
				16	DSRCB1630	285.00
				20	DSRCB2030	285.00
				25	DSRCB2530	285.00
				32	DSRCB3230	285.00
				40	DSRCB4030	285.00

Type A RCD

Trip sens.	No. of poles	Voltage (AC)	Phase	In (A)	Cat. No.	Price $
30 mA	2 Pole	110/240	1 P+N	10	DSRCB1030A	295.00
				16	DSRCB1630A	295.00
				20	DSRCB2030A	295.00
				25	DSRCB2530A	295.00
				32	DSRCB3230A	295.00
				40	DSRCB4030A	295.00
10 mA	2 Pole	110/240	1 P+N	6	DSRCB0610A	295.00
				10	DSRCB1010A	295.00
				16	DSRCB1610A	295.00
				20	DSRCB2010A	295.00
100 mA	2 Pole	110/240	1 P+N	10	DSRCB10100A	295.00
				16	DSRCB16100A	315.00
				20	DSRCB20100A	315.00

Notes: 30 mA tripping characteristics: 0.5 x IΔn = no tripping, 1 x IΔn = T ≤300 mS
2 x IΔn = T ≤150 mS, 5 x IΔn = T ≤40 mS

Din-Safe
MCB (RCBO)

10 kA MCB with Pigtail (RCBO)
- Standard AS/NZS 61009
- Approval No. N17482
- Un-switched neutral
- Suits NC, CD or GB chassis

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

Curve type: C (5 – 10 In)
Type AC RCD

Trip sens.	No. of poles	Voltage (AC)	Phase	In (A)	Cat. No.	Price $
				6	**DSRCB0630P**	**290.00**
				10	**DSRCB1030P**	**290.00**
				16	**DSRCB1630P**	**290.00**
30 mA	2 Pole	110/240	1P+N	20	**DSRCB2030P**	**290.00**
				25	**DSRCB2530P**	**290.00**
				32	**DSRCB3230P**	**290.00**
				40	**DSRCB4030P**	**290.00**

Notes: 30 mA tripping characteristics: 0.5 x IΔn = no tripping, 1 x IΔn = T ≤300 mS
2 x IΔn = T ≤150 mS, 5 x IΔn = T ≤40 mS

1

Din-T6

Series 2-63 A

6 kA 'C' curve

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

Curve type: C (5 – 10 In)

Single pole

In (A)	Cat. No.	Price $	In (A)	Cat. No.	Price $
2	DTCB6102C	39.00	20	DTCB6120C	39.00
4	DTCB6104C	39.00	25	DTCB6125C	39.00
6	DTCB6106C	39.00	32	DTCB6132C	39.00
10	DTCB6110C	39.00	40	DTCB6140C	39.00
13	DTCB6113C	39.00	50	DTCB6150C	39.00
16	DTCB6116C	39.00	63	DTCB6163C	39.00

Double pole

In (A)	Cat. No.	Price $	In (A)	Cat. No.	Price $
2	DTCB6202C	135.00	20	DTCB6220C	135.00
4	DTCB6204C	135.00	25	DTCB6225C	135.00
6	DTCB6206C	135.00	32	DTCB6232C	135.00
10	DTCB6210C	135.00	40	DTCB6240C	135.00
13	DTCB6213C	135.00	50	DTCB6250C	135.00
16	DTCB6216C	135.00	63	DTCB6263C	135.00

Triple pole

In (A)	Cat. No.	Price $	In (A)	Cat. No.	Price $
2	DTCB6302C	171.00	20	DTCB6320C	171.00
4	DTCB6304C	171.00	25	DTCB6325C	171.00
6	DTCB6306C	171.00	32	DTCB6332C	171.00
10	DTCB6310C	171.00	40	DTCB6340C	171.00
13	DTCB6313C	171.00	50	DTCB6350C	171.00
16	DTCB6316C	171.00	63	DTCB6363C	171.00

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

Suitable for the following side mounted accessories:

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

Din-T6
Series 2-63 A

6 kA 'D' curve

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

Curve type: D (10 – 20 In)
Single pole

In (A)	Cat. No.	Price $	In (A)	Cat. No.	Price $
2	**DTCB6102D**	**52.50**	20	**DTCB6120D**	**52.50**
4	**DTCB6104D**	**52.50**	25	**DTCB6125D**	**52.50**
6	**DTCB6106D**	**52.50**	32	**DTCB6132D**	**52.50**
10	**DTCB6110D**	**52.50**	40	**DTCB6140D**	**57.00**
13	**DTCB6113D**	**52.50**	50	**DTCB6150D**	**57.00**
16	**DTCB6116D**	**52.50**	63	**DTCB6163D**	**57.00**

Double pole

In (A)	Cat. No.	Price $	In (A)	Cat. No.	Price $
2	**DTCB6202D**	**158.00**	20	**DTCB6220D**	**158.00**
4	**DTCB6204D**	**158.00**	25	**DTCB6225D**	**158.00**
6	**DTCB6206D**	**158.00**	32	**DTCB6232D**	**158.00**
10	**DTCB6210D**	**158.00**	40	**DTCB6240D**	**169.00**
13	**DTCB6213D**	**158.00**	50	**DTCB6250D**	**169.00**
16	**DTCB6216D**	**158.00**	63	**DTCB6263D**	**169.00**

Triple pole

In (A)	Cat. No.	Price $	In (A)	Cat. No.	Price $
2	**DTCB6302D**	**221.45**	20	**DTCB6320D**	**221.45**
4	**DTCB6304D**	**221.45**	25	**DTCB6325D**	**221.45**
6	**DTCB6306D**	**221.45**	32	**DTCB6332D**	**221.45**
10	**DTCB6310D**	**221.45**	40	**DTCB6340D**	**231.75**
13	**DTCB6313D**	**221.45**	50	**DTCB6350D**	**231.75**
16	**DTCB6316D**	**221.45**	63	**DTCB6363D**	**231.75**

Notes: The LINE-side is the OFF or bottom of the MCB, and connects to CD, NC or GB chassis tee-offs.
Suitable for the following side mounted accessories:
– AUX/ALM switches – refer page 1 - 40
– Shunt trip and UVT Trip – refer page 1 - 39
– Clip-on RCD module and Din-Safe-M module- refer page 1 - 32
– Din-T terminals and accessories – refer page 1 - 50

TemBreak 2 Thermal magnetic type
E125NJ

25 kA

Current rating: 12.5 – 125 A

Approvals and Tests: Standards AS/NZS 3947-2 and IEC 60947-2

Interrupting capacity:

	Voltage	Icu	Ics
AC use	380/415	25	19
DC use	250	25	19

3

Trip unit: Adjustable thermal (0.63 Ir to 100 % Ir) and adjustable magnetic

Dimensions (mm)

Poles	3
H	155
W	90
D (less toggle)	68
Toggle cut-out	104

Ampere Rating NRC	Adj. Ir [1] Min. – Max.	Adj. Im [1] Min. – Max.	Cat. No.	3 pole Price $
20	12.5 – 20	120 – 240	**E125 NJ 3 20**	**440.00**
32	20 – 32	192 – 384	**E125 NJ 3 32**	**440.00**
50	32 – 50	300 – 600	**E125 NJ 3 50**	**440.00**
63	40 – 63	378 – 756	**E125 NJ 3 63**	**440.00**
100	63 – 100	600 – 1200	**E125 NJ 3 100**	**630.00**
125	80 – 125	750 – 1250	**E125 NJ 3 125**	**780.00**

Notes: [1]) Adj. Ir: Adjustable thermal setting
Adj. Im: Adjustable magnetic setting
NRC: Nominal rated current
Magnetic only MCCBs are available on request.
For 4 pole MCCBs refer S125GJ type.

3

Accessories to suit 125 A TemBreak 2

External accessories		Cat. No.	Price $
Operating handles Direct mounting, fixed depth, IP 54	**Suits MCCB types E125, S125**		
	Grey/black	T2HB12UR5BN	175.00
	Red/yellow	T2HB12UR5RN	199.00
	H125, L125		
HB	Grey/black	T2HB25UR5BN	189.00
	Red/yellow	T2HB25UR5RN	210.00
	Optional MCCB identification labels	T12CAPLAB	3.60
Door interlocking variable depth handle	**E125, S125**		
	Grey IP 55 handle + 357 mm shaft	T2HS12R5GM	280.00
	Red/ yellow IP 55 handle 357 mm shaft	T2HS12R5RM	290.00
	Escutcheon plate option: 100 mm²	T2HSESC100	18.80
	90 mm T pin shaft for T2HS - no flexi coupling	T2HS250SHAFT	47.00
HS	Grey/ black IP65 handle + 420 mm shaft	T2HP12R6BN	290.00
	Red/ yellow IP65 handle + 420 mm shaft	T2HP12R6RN	300.00
HP	Padlock attachment for T2HP/HS mechanism	T2HP25PALK	49.50
	Optional MCCB identification labels	T12CAPLAB	3.60
	H125, L125		
	IP 55 handle + 357 mm shaft	T2HS25R5GM	280.00
	Red/ yellow IP 55 handle + 357 mm shaft	T2HS25R5RM	290.00
	Large escutcheon plate option: 100 mm²	T2HSESC100	18.80
	90 mm T pin shaft for T2HS - no flexi coupling	T2HS250SHAFT	47.00
	Grey/ black IP 65 handle + 420 mm shaft	T2HP25R6BN	290.00
	Red/ yellow IP 65 handle + 420 mm shaft	T2HP25R6RN	300.00
	Padlock attachment for T2HP/ HS mechanism	T2HP25PALK	49.50
	Optional MCCB identification labels	T12CAPLAB	3.60

T2HS handle mechanism with T2HP25PALK mechanism lock

T2HS handle with T2HSESC100 escutcheon plate

Accessories to suit 125 A TemBreak 2

External accessories		Cat. No.	Price $
Terminal Covers Flush IP 20	Front connected MCCBs		
	Suits MCCB types E125, S125		
CS	1 pole cover set of 2	**T2CS121SG**	**10.60**
	3 pole cover set of 2	**T2CS123SG**	**44.00**
	4 pole cover set of 2	**T2CS124SG**	**55.00**
	H125, L125		
	3 pole cover set of 2	**T2CS253SG**	**54.00**
	4 pole cover set of 2	**T2CS254SG**	**60.50**
Short terminal covers **CF**	**E125, S125**		
	3 pole cover set of 2, 22 mm long	**T2CF123SSNBA**	**60.50**
	4 pole cover set of 2, 22 mm long	**T2CF124SSNBA**	**71.00**
Standard terminal covers	**E125, S125**		
	1 pole cover set of 2, 40 mm long	**T2CF121SLNG**	**35.00**
	2 pole cover set of 2, 40 mm long	**T2CF122SLNG**	**49.50**
CF	3 pole cover set of 2, 40 mm long	**T2CF123SLNG**	**64.50**
	4 pole cover set of 2, 40 mm long	**T2CF124SLNG**	**73.00**
	H125, L125		
	3 pole cover set of 2, 40 mm long	**T2CF253LLNG**	**71.00**
	4 pole cover set of 2, 40 mm long	**T2CF254LLNG**	**77.50**

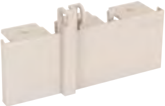
3


T2CS Flush IP20 Cover


T2CF Short terminal


Single pole terminal cover


T2CF Standard terminal covers


T2RC Rear connect terminal cover

Novaris

POWER PROTECTION - Surge Diverters

SDD DINsafe Surge Diverters

Novaris SDD DINsafe Surge Diverters offer powerful performance at domestic MSB and industrial DBs. The SDD diverters are housed in DIN compliant, fail-safe metal enclosures and are fully compliant to AS/NZS1768-2007 and to AS/NZS3000 wiring rules.

SDD 1 - 50 - 275 - A

Product Series (SDD) — **Phase** (1) — **I_{max}** (50) — **U_c** (275) — **Options** (A)

		SDD1-50-275	SDD1-50-275-A	SDD1-100-275	SDD1-100-275-A	SDD3-50-275	SDD3-50-275-A	SDD3-100-275	SDD3-100-275-A
Electrical Specifications									
Connection type		Shunt							
Modes of protection		All mode (L-N, L-PE, N-PE)							
Phases		1				3			
Nominal voltage	U_0	230V / 50Hz							
Maximum continuous voltage	U_c	275V / 50Hz							
Maximum discharge current (8/20µs)	I_{max}	50kA		100kA		50kA		100kA	
Nominal Discharge Current (8/20µs)	I_n	20kA		40kA		20kA		40kA	
Maximum switchboard fault rating	I_{SCCR}	25kA		50kA		25kA		50kA	
Voltage protection level @ 3kA (8/20µs)	U_p	<800V							
Response time	t_A	<5ns							
Earth leakage current		<10µA							
Display		LED status per phase							
Alarms (optional)		Power fail safe, thermal overload, SPDT voltage free contact							
Alarm isolation		4kV							
Maximum backup fuse (HRC)		63A		125A		63A		125A	
Recommended fuse		32A		63A		32A		63A	
Mechanical Specifications									
Operating temperature / humidity		-40 to +80ºC / 0 to 90% non-condensing							
Terminal capacity - power		16mm²							
Terminal capacity - alarms		2.5mm²							
Terminal screw torque - power		2.0Nm							
Terminal screw torque - alarm		0.5Nm							
Environmental		IP 20							
Mounting		TS35 DIN rail							
Enclosure / Colour		Metal / black							
Weight		150g	230g	250g	260g	355g	370g	485g	495g
Dimensions									
Width		18mm	36mm			54mm		72mm	
Height		95mm							
Depth		70mm							
Options									
External alarm		N/A	Standard	A	Standard	A	Standard	A	Standard
Polycarbonate enclosure		P							

Standards Compliance
IEC 61643-1 class II
AS/NZS 1768 categories B, C
IEEE C62.41 categories B, C
UL1449 third edition

Novaris

POWER PROTECTION - Surge Filters

SFD Surge Filters 2 - 10A

Novaris SFD surge filters provide the highest level of protection for critical and essential equipment up to 10A per phase.

SFD 1 - 2 - 6.5 - 275 - P

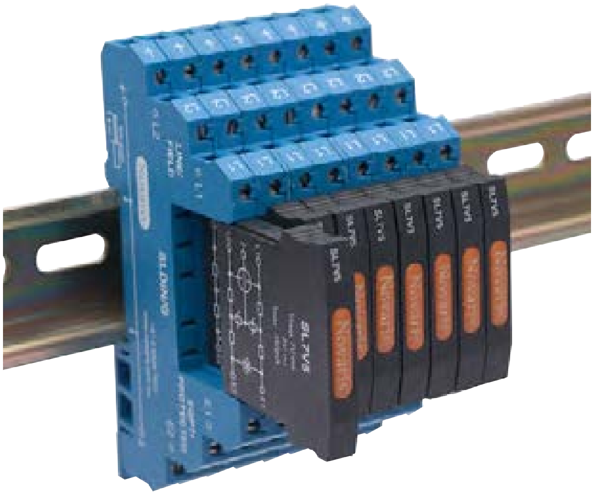
Product Series · Phase · I_L · I_{max} · U_c · Options

		SFD1-2-6.5-275	SFD1-6-6.5-275	SFD3-6-13-275-A	SFD3-6-50-275-A	SFD1-10-13-275	SFD1-10-50-275-A	SFD3-10-13-275-A	SFD3-10-50-275-A
Electrical Specifications									
Connection type		Series							
Modes of protection		All mode (L-N, L-PE, N-PE)							
Nominal voltage	U_0	230V / 50Hz							
Maximum continuous voltage	U_c	275V / 50Hz							
Phases		1		3		1		3	
Maximum discharge current (8/20µs)	I_{max}	6.5kA		13kA	50kA	13kA	50kA	13kA	50kA
Maximum load curent	I_L	2A	6A			10A			
Protection stages		Metal oxide varistor / LC filter / metal oxide varistor							
Voltage protection level @ 3kA (8/20µs)	U_P	<700V							
Response time	t_A	Instantaneous							
Earth leakage current		<500µA							
Maximum voltage drop (% of U_0)	ΔU	<1%							
Displays (optional)		LED*		LED power and status					
Alarms (optional)		-				Overcurrent / thermal, SPDT contact			
Alarm isolation to active circuitry		-				4kV			
Mechanical Specifications									
Operating temperature / humidity		-40 to +40°C / 0 to 90% non-condensing							
Terminal capacity - power		2.5mm²	16mm²			2.5mm²	16mm²		
Terminal capacity - alarm		2.5mm²							
Terminal screw torque - power		0.5Nm	1.0Nm			0.5Nm	1.0Nm		
Terminal screw torque - alarm		0.5Nm							
Environmental		IP 20							
Mounting		TS35 DIN rail							
Weight		350g		1.2kg		450g	1.05kg	1.55kg	
Dimensions									
Width* (can vary with options)		27mm (54mm with LED)*		180mm		54mm	118mm	180mm	
Height* (can vary with options)		116mm (95mm with LED)*		95mm					
Depth		78mm							
Options									
LED indication and external alarm		-		Standard		-	Standard		
LED indication only		L*		L					
Polycarbonate enclosure		P							
Voltage variation	U_c	30V / 50V / 130V		50V / 130V	130V	50V / 130V	130V	50V / 130V	130V

Standards Compliance
IEC 61643-1 class II, III
AS/NZS 1768 categories A, B
IEEE C62.41 categories A, B
BS 6651 categories A, B
CP 33 categories A, B
IEC 1000-4-5
UL1449 third edition

Novaris

PROCESS CONTROL PROTECTION



SL Slimline Signal Line Protectors

Novaris SL range of plug-in signal line protectors provide surge protection for most twisted pair signalling schemes. Ideal for the protection of PLCs, fire and security systems, telecommunications and telemetry systems, railway signalling, SCADA and other industrial monitoring and control equipment.

SL 7v5 - G

Product Series — SL
Top — 7v5
Base option — G

Electrical Specifications		SL7v5	SL18	SL36	SL68	SL-PTSN	SL-iSwitch
Connection type		Series					
Modes of protection		Transverse and common mode					
Maximum continuous voltage (DC)	U_0	7V	16V	34V	65V	200V	200V
Maximum continuous voltage (AC)	U_c	5V	11V	24V	46V	140V	140V
Discharge current 8/20µs	I_{max}	5kA					
Maximum load current	I_L	350mA					180mA
Impulse voltage 1.2/50µs	U_p	8V	19V	40V	76V	235V	30V
Line resistance		8.2Ω					17Ω
3dB Frequency @ 50Ω		250kHz				10MHz	20MHz

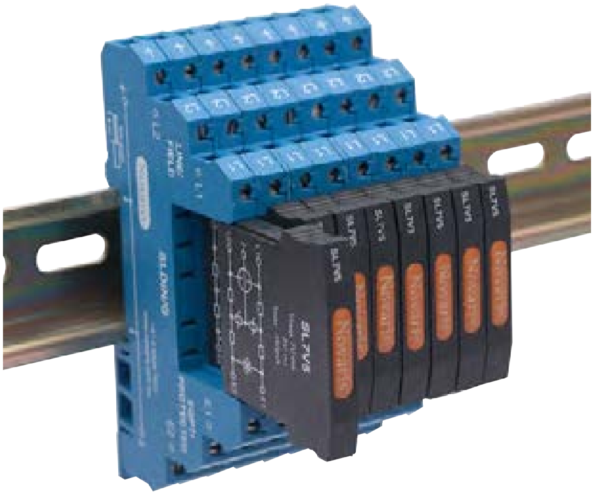
Mechanical Specifications	
Operating temperature / humidity	-20 to +40°C / 0 to 90% non-condensing
Terminal capacity	2.5mm^2
Terminal screw torque	0.5Nm
Environmental	IP 20
Mounting	TS35 DIN rail
Weight	35g

Dimensions	
Width	7mm
Height	102mm
Depth	68mm

Base Options	
Earth connected to DIN rail	G
Earth connected to DIN rail via GDT	EC90

Standards Compliance
ITU-T K.44
AS/NZS 1768
IEEE C62.41
BS 6651
CP 33
IEC 61643-21
UL497B
A-tick (PSTN & iSwitch)

Novaris **PROCESS CONTROL PROTECTION**



SL Slimline Signal Line Protectors

Novaris SL range of plug-in signal line protectors provide surge protection for most twisted pair signalling schemes. Ideal for the protection of PLCs, fire and security systems, telecommunications and telemetry systems, railway signalling, SCADA and other industrial monitoring and control equipment.

SL 485 - EC90

Product Series (SL) · **Top** (485) · **Base option** (EC90)

		SL485-EC90	SL-DH	SL-RTD
Electrical Specifications				
Connection type		Series		
Modes of protection		Transverse and common mode		
Maximum continuous voltage (DC)	U_0	8V	34V*	8V
Maximum continuous voltage (AC)	U_c	6V	24V*	6V
Discharge current 8/20µs	I_{max}	5kA		
Maximum load current	I_L	500mA		
Impulse voltage 1.2/50µs	U_p	15V	50V	15V
Line resistance		3.9Ω		
3dB Frequency @ 50Ω		20MHz		
Mechanical Specifications				
Operating temperature / humidity		-20 to +40°C / 0 to 90% non-condensing		
Terminal capacity		2.5mm²		
Terminal screw torque		0.5Nm		
Environmental		IP 20		
Mounting		TS35 DIN rail		
Weight		35g		
Dimensions				
Width		7mm		
Height		102mm		
Depth		68mm		
Base Options				
Earth connected to DIN rail		-	G	
Earth connected to DIN rail via GDT		Standard	EC90	

Standards Compliance
ITU-T K.44
AS/NZS 1768
IEEE C62.41
BS 6651
CP 33
IEC 61643-21
UL497B

* Voltage variations available by request

VALVE-REGULATED LEAD ACID BATTERIES: INDIVIDUAL DATA SHEET

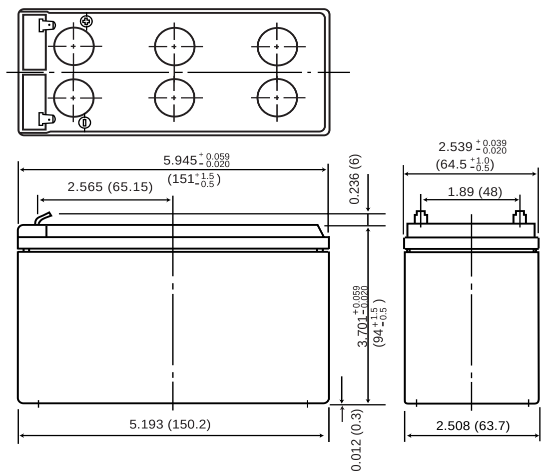
LC-R127R2P

For main and standby power supplies.
Expected trickle life: 3-5 years at 25°C, Approx. 5 years at 20°C.

Photo/Label for reference only.

Dimensions (mm)

Terminal type: Faston 187 or Faston 250



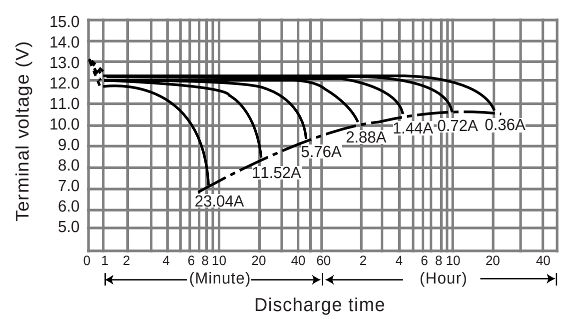
Battery case resin: Standard (UL94HB) Color is black.

Specifications

Nominal Voltage		12V
Rated Capacity (20 hour rate)		7.2Ah
Dimensions	Length	5.945 inches (151.0 mm)
	Width	2.539 inches (64.5 mm)
	Height	3.702 inches (94.0 mm)
	Total Height*	3.937 inches (100.0 mm)
Approx. mass		5.45 lbs. (2.47 kg)
Standard Terminals and Resin	UL94HB Faston 187	LC-R127R2P
	UL94HB Faston 250	LC-R127R2P1

* The total height with #250 terminal is 101.5mm.

Discharge characteristics 77°F (25°C) (Note)

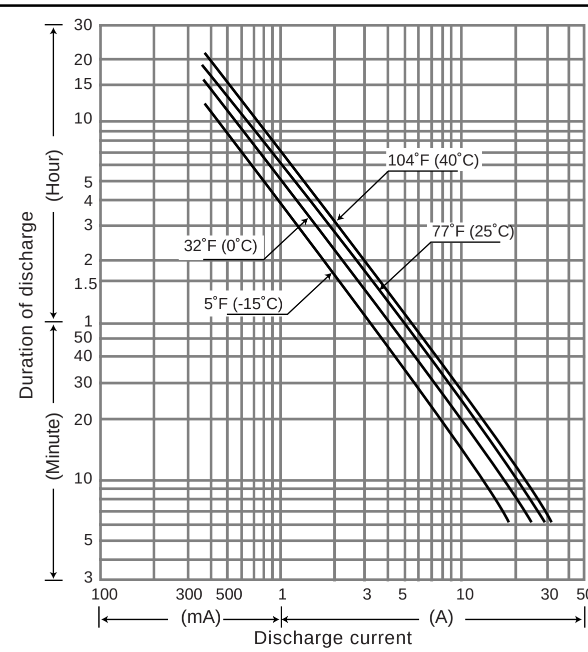


Characteristics

Capacity (note) 77˚F (25˚C)		20 hour rate (360mA) 10 hour rate (680mA) 5 hour rate (1260mA) 1 hour rate (4900mA)	7.2Ah 6.8Ah 6.3Ah 4.9Ah
		1.5 hour rate discharge Cut-off voltage 10.5 V	3.5A
Internal Resistance		Fully charged battery 77˚F (25˚C)	Approx. 40mΩ
Temperature dependency of capacity (20 hour rate)		104˚F (40˚C) 77˚F (25˚C) 32˚F (0˚C) 5˚F (-15˚C)	102% 100% 85% 65%
Self discharge 77˚F (25˚C)		Residual capacity after standing 3 months	91%
		Residual capacity after standing 6 months	82%
		Residual capacity after standing 12 months	64%
Charge Method (Constant Voltage)	Cycle use (Repeating use)	Initial current	2.88 A or smaller
		Control voltage	14.5V to 14.9V (per 12V cell 25˚C)
	Trickle use	Initial current	1.08 A or smaller
		Control voltage	13.6V to 13.8V (per 12V cell 25˚C)

(Note) The above characteristics data are average values obtained within three charge/discharge. Cycles not the minimum values.

Duration of discharge vs. Discharge current (Note)



2.5 (4) mm², 24 A, feed-through terminal block

Ex:
KEMA 06ATEX0119 U / IECEx KEM 06.0034U

Technical data

Width	Length	Height NS 35/7,5	
5.2	**42.5**	**42**	
Width	Length	Height NS 32	
5.2	**42.5**	**47**	
$I_{max.}$ [A]	$U_{max.}$ [V]	max. Ø [mm²]	AWG
24	**800**	**0.2 - 4**	**24 - 12**
IEC 60947-7-1			
IEC	UL/CUL	CSA	IEC/ EN 60079-7
800	300	300	550
24 / 2.5	20 / -	20 / -	27
2.5	-	-	2.5
24 - 12	30-12	28-12	24 - 12
solid	stranded	Ferrule	
		Without / with plastic sleeve	
0.2 - 4	0.2 - 2.5	0.25 - 2.5	0.25 - 1
0.2 - 1	0.25 - 1	0.25 - 1	-
			0.5 - 1.5
2.5	2.5		
7			
M3			
0.6 - 0.8			
PA			
V2			

Ordering data

Type	I_{max}	Order No.	Pcs. / Pkt.
UK 2,5 N		**3003347**	50
UK 2,5 N BU		**3003350**	50

Accessories¹)

Type	I_{max}	Order No.	Pcs. / Pkt.
D-UK 2,5		**3001022**	50
D-UK 2,5 BU		**3001103**	50
FBRI 10-5 N	24 A	**2770642**	10
EBL 10- 5	24 A	**2303132**	10
USBR 2-7	18 A	**2303239**	1
TS-KK 3		**2770215**	50
ATP-UK		**3003224**	50
PSB 3/10/4		**0601292**	10
PSBJ 3/13/4		**0201304**	10
SF-SL 0,6X3,5-100 S-VDE		**1212587**	10

ZB 5 (see Catalog 5)

2.5 (4) mm², 32 A, feed-through terminal block

Ex:
KEMA 98ATEX1651 U / IECEx KEM 06.0034U

Technical data

Width	Length	Height NS 35/7,5	
5.2	**42.5**	**47**	
Width	Length	Height NS 32	
5.2	**42.5**	**52**	
$I_{max.}$ [A]	$U_{max.}$ [V]	max. Ø [mm²]	AWG
32	**800**	**0.2 - 4**	**24 - 12**
IEC 60947-7-1			
IEC	UL/CUL	CSA	IEC/ EN 60079-7
800	600	600	690
24 / 2.5	20 / -	20 / -	23 / 2.5 // 29 / 4
2.5	-	-	2.5
24 - 12	28-12	28-12	24 - 12
solid	stranded	Ferrule	
		Without / with plastic sleeve	
0.2 - 4	0.2 - 2.5	0.25 - 4	0.25 - 2.5
0.2 - 1.5	0.2 - 1.5	0.25 - 1.5	-
			0.5 - 1.5
4	2.5		
8			
M3			
0.6 - 0.8			
PA			
V0			

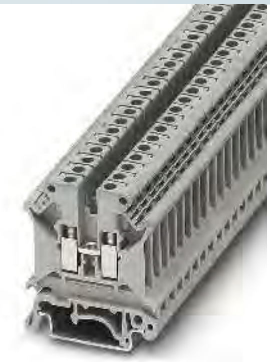
Ordering data

Type	I_{max}	Order No.	Pcs. / Pkt.
UK 3 N		**3001501**	50
UK 3 N BU		**3001514**	50

Accessories¹)

Type	I_{max}	Order No.	Pcs. / Pkt.
D-UK 4/10		**3003020**	50
D-UK 4/10 BU		**3003101**	50
FBRI 10-5 N	30 A	**2770642**	10
EBL 10- 5	24 A	**2303132**	10
TS-K		**1302215**	50
ATP-UK		**3003224**	50
PSB 3/10/4		**0601292**	10
PSBJ 3/13/4		**0201304**	10
SF-SL 0,6X3,5-100 S-VDE		**1212587**	10

ZB 5 (see Catalog 5)



4 (6) mm², 41 A, feed-through terminal block

Ex:
KEMA 98ATEX1651 U / IECEx KEM 06.0034U

Technical data

Width	Length	Height NS 35/7,5	
6.2	**42.5**	**47**	
Width	Length	Height NS 32	
6.2	**42.5**	**52**	
$I_{max.}$ [A]	$U_{max.}$ [V]	max. Ø [mm²]	AWG
41	**800**	**0.2 - 6**	**24 - 10**
IEC 60947-7-1			
IEC	UL/CUL	CSA	IEC/ EN 60079-7
800	600	600	550
32 / 4	30 / -	40 / -	32.5 / 4 // 37.5 / 6
4	-	-	4
24 - 10	30-10	28-10	24 - 10
solid	stranded	Ferrule	
		Without / with plastic sleeve	
0.2 - 6	0.2 - 4	0.25 - 4	0.25 - 2.5
0.2 - 1.5	0.2 - 1.5	0.25 - 1.5	-
			0.5 - 2.5
4	4		
8			
M3			
0.6 - 0.8			
PA			
V0			

Ordering data

Type	I_{max}	Order No.	Pcs. / Pkt.
UK 5 N		**3004362**	50
UK 5 N BU		**3004388**	50

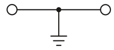
Accessories¹)

Type	I_{max}	Order No.	Pcs. / Pkt.
D-UK 4/10		**3003020**	50
D-UK 4/10 BU		**3003101**	50
FBI 10- 6	41 A	**0203250**	10
EB 10- 6	32 A	**0201139**	10
USBR 2-7	34 A	**2303239**	1
ISSBI 10- 6	30 A	**0301505**	10
IS-K 4		**1302338**	100
TS-K		**1302215**	50
ATP-UK		**3003224**	50
PSB 3/10/4		**0601292**	10
PSBJ 3/13/4		**0201304**	10
SF-SL 0,6X3,5-100 S-VDE		**1212587**	10

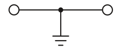
ZB 6 (see Catalog 5)

USLKG ... ground terminal blocks

Notes:
For current carrying capacity of DIN rails, see page 716.
1) For installation notes on the use of accessories for Ex e applications, see page 710.



1.5 (1.5) mm², ground terminal block



2.5 (4) mm², ground terminal block

1.5 mm² block:
Ex:
KEMA 99ATEX4487U / IECEx KEM 06.0035U

2.5 mm² block:
CCA
Ex:
KEMA 96ATEX4370 U / IECEx KEM 06.0035U

		Technical data (1.5)				**Technical data** (2.5)			
Dimensions		Width	Length	Height NS 35/7,5		Width	Length	Height NS 35/7,5	
	[mm]	**4.2**	**42.5**	**42**		**5.2**	**42.5**	**42**	
Dimensions		Width	Length	Height NS 32		Width	Length	Height NS 32	
	[mm]	**4.2**	**42.5**	**47**		**5.2**	**42.5**	**47**	
Max. electrical data				max. Ø [mm²]	AWG			max. Ø [mm²]	AWG
				0.14 - 1.5	**26 - 16**			**0.2 - 4**	**24 - 12**
		IEC 60947-7-2			Ex	IEC 60947-7-2			Ex
Rated data		IEC	UL/CUL	CSA	IEC/ EN 60079-7	IEC	UL/CUL	CSA	IEC/ EN 60079-7
Rated voltage	[V]	-	-	-	-	-	-	-	-
Nominal current / cross section	[A] / [mm²]	-	- / -	-	-	-	- / -	-	-
Rated cross section	[mm²]	1.5	-	-	1.5	2.5	-	-	2.5
Cross section range	AWG	26 - 16	30-14	-	26 - 16	24 - 12	30-12	28-12	24 - 12
Connection capacity		solid	stranded	Ferrule		solid	stranded	Ferrule	
				Without / with plastic sleeve				Without / with plastic sleeve	
1 conductor	[mm²]	0.14 - 1.5	0.14 - 1.5	0.25 - 0.75	0.25 - 0.75	0.2 - 4	0.2 - 2.5	0.25 - 2.5	0.25 - 1.5
Two conductors (of the same type)	[mm²]	0.14 - 0.75	0.14 - 0.75	0.25 - 0.34	-	0.2 - 1	0.2 - 1	0.25 - 1.5	-
Two stranded conductors with a TWIN ferrule	[mm²]				0.5 - 0.5				0.5 - 1.5
General data									
Stripping length	[mm]	7				7			
Screw thread		M2				M3			
Terminal point: thread / torque	- / [Nm]	M2 / 0.22 - 0.25				M3 / 0.6 - 0.8			
Mounting: thread / torque	- / [Nm]	M2 / 0.22 - 0.25				M2,5 / 0.5 - 0.6			
Insulating material		PA				PA			
Inflammability class according to UL 94		V0				V0			

Ordering data

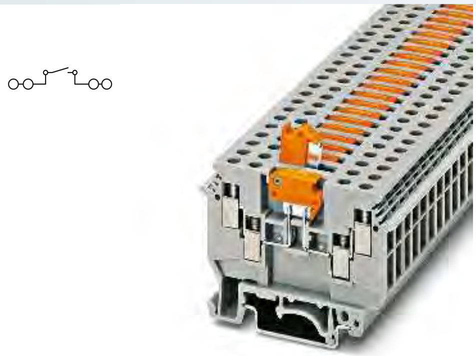
Description	Color	Type	Order No.	Pcs. / Pkt.	Type	Order No.	Pcs. / Pkt.
Ground terminal block, for mounting on NS 32... or NS 35...	green-yellow	**USLKG 1,5 N**	**3005853**	50	**USLKG 2,5 N**	**0441119**	50
Ground terminal block, for mounting on NS 35/15-2,3	green-yellow				**USLKG 2,5 N-1**	**0443081**	50

Accessories1)

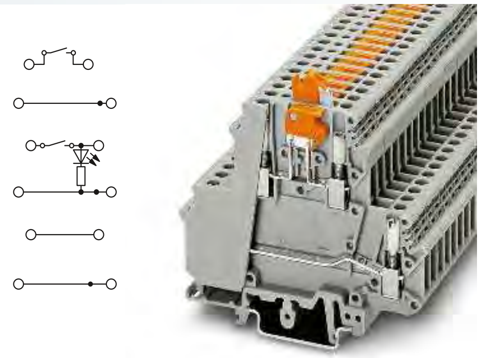
	Type	Order No.	Pcs. / Pkt.	Type	Order No.	Pcs. / Pkt.
Screwdriver	**SZS 0,4X2,5 VDE**	1205037	10	**SF-SL 0,6X3,5-100 S-VDE**	1212587	10
Lateral groove labeling	**ZB 4 (see Catalog 5)**			**ZB 5 (see Catalog 5)**		

Knife disconnect terminal blocks

- Convenient disconnect knife operation
- Closed housing of double-level terminal blocks
- The disconnect knife on the associated level is characterized by a slight vertical offset
- Space-saving design just 6.2 mm wide



4 (6) mm², 16 A, knife disconnect terminal block, 4 connections, with test socket screw



4 (4) mm², 12 A, double-level knife disconnect terminal block with test socket screw

Technical data

		4 (6) mm², 16 A				4 (4) mm², 12 A			
Dimensions		Width	Length	Height NS 35/7,5		Width	Length	Height NS 35/7,5	
	[mm]	**6.2**	**63.5**	**47**		**6.2**	**80**	**68**	
Dimensions		Width	Length	Height NS 32		Width	Length	Height NS 32	
	[mm]	**6.2**	**63.5**	**52**		**6.2**	**80**	**73**	
Max. electrical data		$I_{max.}$ [A]	$U_{max.}$ [V]	max. Ø [mm²]	AWG	$I_{max.}$ [A]	$U_{max.}$ [V]	max. Ø [mm²]	AWG
		16	**630**	**0.2 - 6**	**24 - 10**	**26**	**400**	**0.2 - 4**	**24 - 12**
Rated data		IEC 60947-7-1 IEC	UL/CUL	CSA	IEC/ EN 60079-7	IEC 60947-7-1 IEC	UL/CUL	CSA	IEC/ EN 60079-7
Rated voltage	[V]	630	600	600	-	400	300	300	-
Nominal current / cross section	[A] / [mm²]	16 / 4	15 / -	15 / -	-	26 / 4	- / -	15 / -	-
Rated cross section	[mm²]	4	-	-	-	4	-	-	-
Cross section range	AWG	24 - 10	30-10	22-10	-	24 - 12	26-12	22-12	-
Rated data, upper level		IEC	UL/CUL	CSA	IEC/ EN 60079-7	IEC	UL/CUL	CSA	IEC/ EN 60079-7
Nominal current / cross section	[A] / [mm²]	-	-	-	-	12 / 4	-	-	-
Connection capacity		solid	stranded	Ferrule Without / with plastic sleeve		solid	stranded	Ferrule Without / with plastic sleeve	
1 conductor	[mm²]	0.2 - 6	0.2 - 4	0.25 - 4	0.25 - 1.5	0.2 - 4	0.2 - 4	0.25 - 4	0.25 - 2.5
Two conductors (of the same type)	[mm²]	0.2 - 1	0.2 - 1.5	0.25 - 1.5	-	0.2 - 1.5	0.2 - 1.5	0.25 - 1.5	-
Two stranded conductors with a TWIN ferrule	[mm²]				0.5 - 1				0.5 - 1.5
Max. cross section with insertion bridge	[mm²]	2.5	2.5						
General data									
Stripping length	[mm]	8				8			
Screw thread		M3				M3			
Tightening torque	[Nm]	0.5 - 0.6				0.6 - 0.8			
Insulating material		PA				PA			
Inflammability class according to UL 94		V2				V2			

Ordering data

Description	No. of pos.	Color	Type	I_{max}	Order No.	Pcs. / Pkt.	Type	I_{max}	Order No.	Pcs. / Pkt.
Knife disconnect terminal block, for mounting on NS 32... or NS 35..., with test socket screws on both sides		gray	**UDK 4-MTK-P/P**		**2775210**	50	**UKK 5-MTK-P/P**		**2800004**	50
		blue	**UDK 4-MTK-P/P BU**		**2775223**	50				
Knife disconnect terminal block, for mounting on NS 32... or NS 35..., with test socket screws on both sides, bridgeable in both levels		gray								
Double-level terminal block, for mounting on NS 32... or NS 35..., with disconnect knife and light indicator for 12 V DC		gray					**UKK 5-MTK-P/P-LA 24RD/O-U**		**2800020**	50
Double-level terminal block, for mounting on NS 32... or NS 35..., with two through contacts, without light indicator		gray					**UKK 5-MTKD-P/P**		**2800017**	50

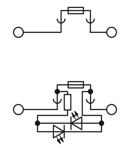
Accessories

Description	No. of pos.	Color	Type	I_{max}	Order No.	Pcs. / Pkt.	Type	I_{max}	Order No.	Pcs. / Pkt.
Cover, width 1.5 mm		gray	**D-UDK 4**		**2775113**	50				
		blue	**D-UDK 4 BU**		**2775197**	50				
Fixed bridge, insulated	10	silver					**FBI 10- 6**	22 A	**0203250**	10
Insertion bridge, insulated	2	gray	**EB 2- 6**	12 A	**0201155**	100				
	3	gray	**EB 3- 6**	12 A	**0201142**	100				
	10	gray	**EB 10- 6**	12 A	**0201139**	10				
Screwdriver			**SF-SL 0,6X3,5-100 S-VDE**		**1212587**	10	**SZG 0,6X3,5 VDE**		**1205121**	10
Lateral groove labeling			**ZB 6 (see Catalog 5)**				**ZB 6 (see Catalog 5)**			

UKK ...-HESI lever-type fuse terminal blocks

- Safety lever locked in end position
- Large area for labeling
- For 5 mm and 6.3 mm cartridge fuse inserts
- Versions with light indicator

Notes:
For further technical notes on power dissipation, see page 724
1) If the fuse is faulty, the downstream circuit is not off load.
2) The current is determined by the fuse used, the voltage by the light indicator. Observe max. power dissipation.



4 (4) mm², 6.3 A, lever-type fuse terminal block for 5 x 20 mm cartridge fuses

Technical data

Dimensions		Width	Length	Height NS 35/7,5	
	[mm]	**8.2**	**72.5**	**56.5**	
Dimensions		Width	Length	Height NS 32	
	[mm]	**8.2**	**72.5**	**61.5**	
Max. electrical data		$I_{max.}$ [A]	$U_{max.}$ [V]	max. Ø [mm²]	AWG
		6.3²)	**500²)**	**0.2 - 4**	**24 - 12**
Rated data		IEC 60947-7-3 IEC	UL/CUL	CSA	IEC/ EN 60079-7
Rated voltage	[V]	500²)	600	600	-
Nominal current / cross section	[A] / [mm²]	6.3²) / 1	12 / -	6.3 / -	-
Rated cross section	[mm²]	4	-	-	-
Cross section range	AWG	24 - 12	26-10	28-10	-
Connection capacity		solid	stranded	Ferrule Without / with plastic sleeve	
1 conductor	[mm²]	0.2 - 4	0.2 - 4	0.25 - 4	0.25 - 4
Two conductors (of the same type)	[mm²]	0.2 - 1.5	0.2 - 1.5	0.25 - 1.5	-
Two stranded conductors with a TWIN ferrule	[mm²]				0.5 - 1.5
Max. cross section with insertion bridge	[mm²]	4	4		
General data					
Fuse type / dimensions	– / [mm]	G / 5 x 20 / 5 x 25 / 5 x 30			
Stripping length	[mm]	8			
Screw thread		M3			
Tightening torque	[Nm]	0.5 - 0.8			
Insulating material		PA			
Inflammability class according to UL 94		V2			

Ordering data

Description	No. of pos.	Color	Type	I_{max}	Order No.	Pcs. / Pkt.
Fuse terminal block, for mounting on NS 32... or NS 35..., for cartridge fuse inserts 5 x 20, 5 x 25 and 5 x 30 mm		black	**UK 5-HESI**		**3004100**	50
With LED for 12-30 V AC/DC		black	**UK 5-HESILED 24**		**3004126**	50
With LED for 110-250 V AC/DC1)		black	**UK 5-HESILA 250**		**3004142**	50
Fuse terminal block, for mounting on NS 32... or NS 35..., for cartridge fuse inserts 6.3 x 32 mm.		black				
With LED for 12-30 V AC/DC1)		black				
With LED for 110-250 V AC/DC1)		black				

Accessories

Description	No. of pos.	Color	Type	I_{max}	Order No.	Pcs. / Pkt.
Insertion bridge, divisible, fully insulated						
	2	gray	**EBS 2- 8**	32 A	**3118151**	100
	3	gray	**EBS 3- 8**	32 A	**3118148**	50
	10	gray	**EBS 10- 8**	32 A	**3118135**	10
Connection pin, for coupling several fuse terminal blocks, made of plastic, 1 m long		gray	**VS**		**3004207**	1
Screwdriver			**SF-SL 0,6X3,5-100 S-VDE**		**1212587**	10
Lateral groove labeling **Lever labeling**			**ZB 8 (see Catalog 5)**			

AC/DC DIN RAIL MOUNTABLE

PBDRN60 Series

60 WATTS - AC/DC DIN RAIL MOUNTABLE - INDUSTRIAL CONTROL

FEATURES

- AC/DC power module
- Universal input 85 - 264VAC
- DC input voltage 90-375Vdc
- Compact and robust design with easy mounting on TS35 Din-Rail
- DC OK relay contact
- High efficiency up to 89%
- Short circuit protection
- Internal input filter
- Operational temperature between to -10 to +61°C
- Local and international Approvals; C-Tick, CE, UL, cUL, TUV

SPECIFICATIONS

INPUT	
Input voltage range	85-264VAC
Input current	Vi: 115 / 230VAC, 1060/590mA
Line frequency	Vi nom, Io nom 47-63Hz
Inrush current	Vi: 115/230VAC, I nom 20/40A
Power disipation	Vi: 230VAc, Io nom 5V 12.5W, 12V 9.06W, 24V 8.8W and 48V 7.8W
Leakage current	Input-Output 0.25mA Input-FG 3.5mA
OUTPUT	
Voltage range	For 5V, up to 110% of Vi nom. Other units, up to 115% ov Vi nom
Hold-up time	Vi: 115/230VAC, 20/30ms
Ripple and noise	BW = 20MHz, 50 mV
Capacitor load	7000µf
ENVIRONMENTAL	
Storage temperature	Non operational -25 to +85°C
Relative humidity	20-95%
Isolation voltage	Input-Output at 3000 VAC Input-FG 1500VAC
Ambient temperature	-10 to +71°C
Derating	From +61°C to +71°C, 2.5% per °C
Temperature coefficient	±0.03%°C
Cooling	Free air convection
Dimensions	90 x 40.5 x 115 mm
GENERAL	
Efficiency	79% - 89% typical, model dependant
Switching frequency	55-90KHz
Weight	340g
STANDARDS	
Safety standards	UL508 Listed, UL60950-1, UL1310 Class 2 Power (5V, 12V models only) Recognised ISA 12.12.01 (Class 1, Division 2, Groups A,B,C and D)
C tick	AS/NZ CISPR11 Group 1, Class A
EMI standards	EN 61000-6-3 EN 55022 Class B EN 61000-3-2, EN 61000-3-3

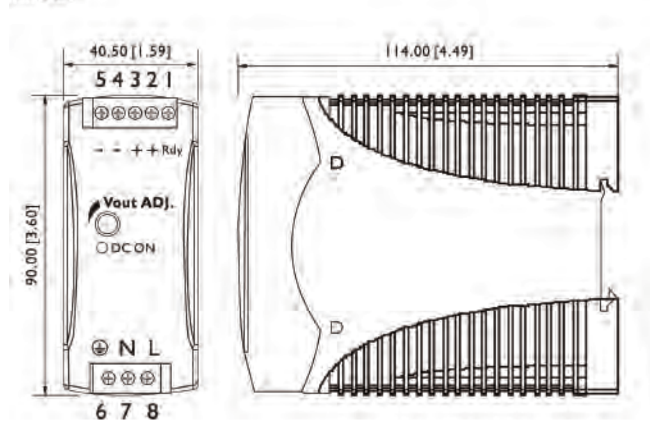
SELECTION TABLE

MODEL NUMBER	OUTPUT		POWER
PBDRN60S05-A*	+ 5 V	10000 mA	50W
PBDRN60S12-A*	+ 12V	5000 mA	60W
PBDRN60S24-A*	+ 24 V	2500 mA	60W
PBDRN60S48-A*	+ 48 V	1250 mA	60W

* Non indent item

MECHANICAL & PIN CONFIGURATION

mm [inch]



CONSTRUCTION
Easy snap-on mounting onto the DIN-Rail (TS35/7.5 or TS35/15), unit sits safely and firmly on the rail.

INSTALLATION
Ventilation / Cooling
Normal convection
All sides 25mm free space
For cooling recommended
Connector size range
Screw terminal:
AWG26-12 (0.2~2.5mm^2) flexible / solid cable, connector can withstand torque at maximum 5 pound-inches.
4~5 m/m stripping at cable end recommends
Use copper conductors only, 60 / 75°C

GENERAL TOLERANCE	
0.00[0.00] - 30.00[1.18]	±0.30[0.01]
30.00[1.18] - 120.00[4.72]	±0.50[0.02]

powerbox

Doc. No. PBC9 Rev.C 28-4-11

PBDRN120 Series

120 WATTS - AC/DC DIN RAIL MOUNTABLE - INDUSTRIAL CONTROL

FEATURES

- Input voltage 115/230VAC auto select
- DC input voltage 210-370Vdc (230V selected)
- Compact and robust design with easy mounting on TS35 Din-Rail
- DC OK relay contact
- High efficiency up to 87%
- Parallel function available (switch)
- Operational temperature between to -10 to +61°C
- Local and international Approvals; C-Tick, CE, UL, cUL, TUV

SPECIFICATIONS

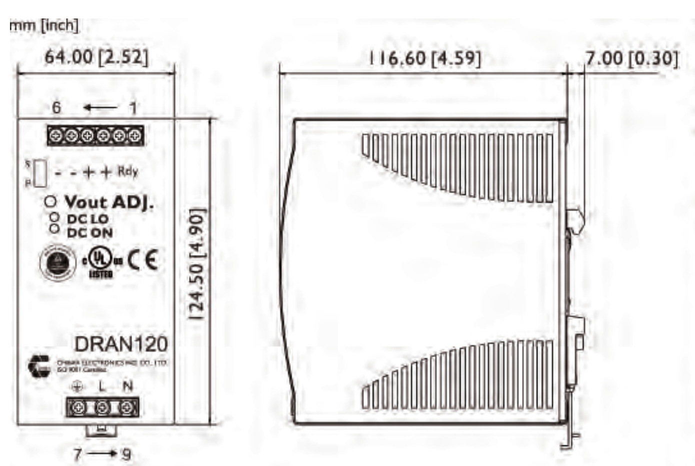
INPUT	
Input voltage	115/230VAC (auto select)
Input voltage range	115V selected 90 - 132VAC 230V selected 180 - 264VAC DC 210 - 375VDC
Input current	Vi: 115/230VAC, 2.2/0.83mA
Line frequency	47-63Hz
Inrush current	Vi: 115/230VAC, 24/48A
Power disipation	Vi: 230VAc, Io nom 12V 24W, 24V 20W, AL/BL 16W and 48V 19W
Leakage current	Input-Output 0.25mA Input-FG 3.5mA
OUTPUT	
Voltage range	95 to 115% of Vi nom
Hold-up time	Vi: 115/230VAC, 25/30ms
Ripple and noise	BW = 20MHz, 50 mV
Capacitor load	12V 7000µf 24V and 48V 3500µf
ENVIRONMENTAL	
Relative humidity	20-95%
Storage temperature	-25 to +85°C
Isolation voltage	Input-Output at 3000 VAC Input-FG 1500VAC
Ambient temperature	-10 to +71°C
Derating	From +61°C to +71°C, 2.5% per °C
Temperature coefficient	±0.03%°C
Cooling	Free air convection
Dimensions	L124.5 x W64 x D123.6mm
GENERAL	
Efficiency	84% - 87% typical, model dependant
Switching frequency	55KHz
Weight	920g
STANDARDS	
Safety standards	UL508 Listed, UL60950-1, UL1310 Class 2 Power (24V AC/DC models only) Recognised ISA 12.12.01 (Class 1, Division 2, Groups A,B,C and D)
C tick	AS/NZ CISPR11 Group 1, Class A
EMI standards	EN 61000-6-3 EN 55022 Class B EN 61000-3-2, EN 61000-3-3

SELECTION TABLE

5MODEL NUMBER	OUTPUT		POWER
PBDRN120S12-A*	+ 12 VDC	10A	120 WATTS
PBDRN120S24-A*	+ 24 VDC	5A	120 WATTS
PBDRN120S48-A*	+ 48 VDC	2.5A	120 WATTS

*Non indent item

MECHANICAL & PIN CONFIGURATION



CONSTRUCTION
Easy snap-on mounting onto the DIN-Rail (TS35/7.5 or TS35/15), unit sits safely and firmly on the rail.

INSTALLATION
Ventilation / Cooling
Normal convection
All sides 25mm free space
For cooling recommended
Connector size range
Screw terminal:
AWG24-10 (0.2~4mm²) flexible / solid cable,
-Input connector can withstand torque at maximum 9 pound-inches.
-Output connector can withstand torque at maximum 5.5 pound-inches.
8 m/m stripping at cable end recommends
Detachable connector:
AWG24-12 (0.2~2.5mm²) flexible / solid cable,
-Input connector can withstand torque at maximum 4.5 pound-inches.
-Output connector can withstand torque at maximum 7 pound-inches.
4~5 m/m stripping at cable end recommends
Use copper conductors only, 60 / 75°C

Bulletin No. PAX2A-C
Drawing No. LP0830
Released 04/13

red lion®
Tel +1 (717) 767-6511
Fax +1 (717) 764-0839
www.redlion.net

MODEL PAX2A – 1/8 DIN ANALOG PANEL METER

- *UNIVERSAL PROCESS, VOLTAGE, CURRENT, RESISTANCE AND TEMPERATURE INPUTS*
- *UNIVERSAL AC/DC POWER SUPPLY*
- *6 / 9 DIGIT DUAL LINE/TRI-COLOR DISPLAY WITH 0.71" & 0.35" DIGITS*
- *PROGRAMMABLE UNITS DISPLAY*
- *VARIABLE CONTRAST AND INTENSITY DISPLAY*
- *UP TO 160 SAMPLES PER SECOND CONVERSION RATE*
- *BUILT-IN USB PROGRAMMING PORT ENABLING UNIT CONFIGURATION WITH CRIMSON PROGRAMMING SOFTWARE*
- *NEMA 4X/IP65 SEALED FRONT BEZEL*

C UL US LISTED
3RSD
PROCESS CONTROL EQUIPMENT

DESCRIPTION

The PAX2A Analog Panel Meter offers many features and performance capabilities to suit a wide range of industrial applications. The PAX2A has a universal input to handle various input signals including DC Voltage/Current, Process, Resistance and Temperature. The optional plug-in output cards allow the opportunity to configure the meter for present applications, while providing easy upgrades for future needs. The PAX2A employs a dual line, tri-color display with a large 0.71", tri-color 6 digit top display line and a 0.35", 9 digit green bottom display line.

The meter provides a MAX and MIN reading memory with programmable capture time. The capture time is used to prevent detection of false max or min readings which may occur during start-up or unusual process events.

The signal totalizer (integrator) can be used to compute a time-input product. This can be used to provide a readout of totalized flow or calculate service intervals of motors, pumps, etc. The meter has up to four setpoint outputs, implemented on plug-in option cards. The plug-in cards provide dual FORM-C relays, quad FORM-A, or either quad sinking or quad sourcing open collector logic outputs. The setpoint alarms can be configured to suit a variety of control and alarm requirements.

Communication and bus capabilities are also available as option cards. These include RS232, RS485, DeviceNet, and Profibus-DP. The PAX2A can be programmed to utilize ModBus protocol. With ModBus, the user has access to most configuration parameters. Readout values and setpoint alarm values can be controlled through the bus. Additionally, the meter has a feature that allows a remote computer to directly control the outputs of the meter.

The PAX2A includes a built-in USB programming port. With a Windows® based program, made available by Red Lion Controls, configuration data can be downloaded to the PAX2A without the need of any additional option cards.

A linear DC output signal is available as an optional plug-in card. The card provides either 20 mA or 10 V signals. The output can be scaled independent of the input range and can track either the input, totalizer, max or min readings.

The meter has been specifically designed for harsh industrial environments. With NEMA 4X/IP65 sealed bezel and extensive testing of noise effects and CE requirements, the meter provides a tough reliable application solution.

SAFETY SUMMARY

All safety related regulations, local codes and instructions that appear in this literature or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

CAUTION: Risk of Danger. Read complete instructions prior to installation and operation of the unit.	**CAUTION:** Risk of electric shock.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 2.1" (53.4) H x 5.5" (140) W.

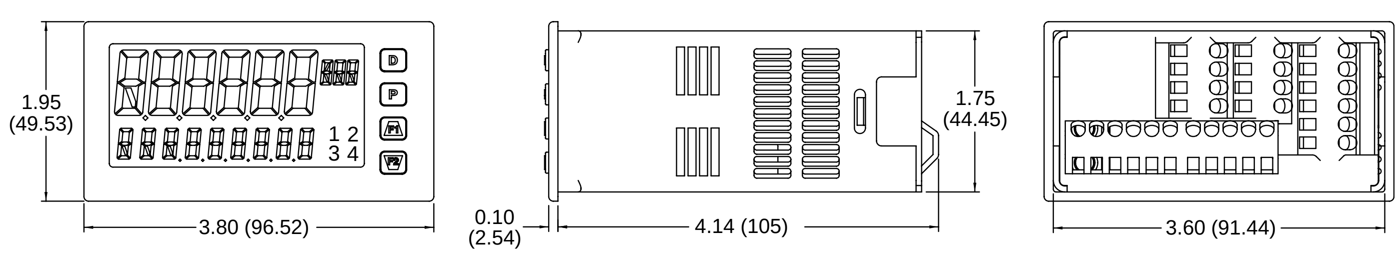


TABLE OF CONTENTS

ORDERING INFORMATION

Meter Part Numbers

MODEL NO.	DESCRIPTION	PART NUMBER
PAX2A	Universal DC Analog Input Panel Meter	PAX2A000

Option Card and Accessories Part Numbers

TYPE	MODEL NO.	DESCRIPTION	PART NUMBER
Optional Plug-In Cards	**PAXCDS**	Dual Setpoint Relay Output Card	PAXCDS10
		Quad Setpoint Relay Output Card	PAXCDS20
		Quad Setpoint Sinking Open Collector Output Card	PAXCDS30
		Quad Setpoint Sourcing Open Collector Output Card	PAXCDS40
	PAXCDC	RS485 Serial Communications Card with Terminal Block	PAXCDC10
		Extended RS485 Serial Communications Card with Dual RJ11 Connector	PAXCDC1C
		RS232 Serial Communications Card with Terminal Block	PAXCDC20
		Extended RS232 Serial Communications Card with 9 Pin D Connector	PAXCDC2C
		DeviceNet Communications Card	PAXCDC30
		Profibus-DP Communications Card	PAXCDC50
	PAXCDL	Analog Output Card	PAXCDL10
Accessories	**SFCRD**[2]	Crimson PC Configuration Software for Windows 2000 and XP	SFCRD200
	CBLUSB	USB Programming Cable Type A-Mini B	CBLUSB01

Notes:
1. For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.
2. Crimson software is available for free download from http://www.redlion.net/

General Meter Specifications

1. **DISPLAY**: Negative image LCD
   Top Line - 6 digit, 0.71" (18 mm), with tri-color backlight (red, green or orange), display range: -199999 to 999999;
   Bottom Line - 9 digit, 0.35" (8.9 mm), with green backlight, display range: - 199,999,999 to 999,999,999
2. **POWER**:
   AC Power: 40 to 250 VAC, 50/60 Hz, 20 VA
   DC Power: 21.6 to 250 VDC, 8 W
   Isolation: 2300 Vrms for 1 min. to all inputs and outputs.
3. **ANNUNCIATORS**: Backlight color: Red
   1 - setpoint alarm 1
   2 - setpoint alarm 2
   3 - setpoint alarm 3
   4 - setpoint alarm 4
   Line 1 Units Display – programmable 3 digit units annunciator with tri-color backlight (red, green or orange)
4. **KEYPAD**: 2 programmable function keys, 4 keys total
5. **A/D CONVERTER**: 24 bit resolution
6. **UPDATE RATES**:
   A/D conversion rate: programmable 5 to 160 readings/sec.
   Step response:

Input Type	Input Update Rate						Readings/ Sec
	5	10	20	40	80	160	
V/I/Resistance	400	200	100	50	30	20	msec response time *
Thermocouple	600	250	100	-	-	-	
RTD	1000	500	250	-	-	-	

   * - max. to within 99% of final readout value (digital filter disabled)
   Display update rate: 1 to 20 updates/sec.
   Setpoint output on/off delay time: 0 to 3275 sec.
   Analog output update rate: 0 to 10 sec
   Max./Min. capture delay time: 0 to 3275 sec.
7. **DISPLAY MESSAGES**:
   "OLOL" - Appears when measurement exceeds + signal range.
   "ULUL" - Appears when measurement exceeds - signal range
   "Short" - Appears when shorted sensor is detected. (RTD range only)
   "OPEN" - Appears when open sensor is detected. (TC/RTD range only)
   ". . . . ." - Appears when display values exceed + display range.
   "- . . . . ." - Appears when display values exceed - display range.
8. **INPUT CAPABILITIES**:

Current Input:

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	IMPEDANCE	‡ RESOLUTION
± 250 µADC	0.03% of rdg + 0.03µA	0.12% of rdg + 0.04µA	1.11 KΩ	10nA
± 2.5 mADC	0.03% of rdg + 0.3µA	0.12% of rdg + 0.4µA	111 Ω	0.1µA
± 25 mADC	0.03% of rdg + 3µA	0.12% of rdg + 4µA	11.1 Ω	1µA
± 250 mADC	0.05% of rdg + 30µA	0.12% of rdg + 40µA	1.1 Ω	10µA
± 2 ADC	0.5% of rdg + 0.3mA	0.7% of rdg + 0.4mA	0.1 Ω	0.1mA

‡ Higher resolution can be achieved via input scaling.

Voltage Input:

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	IMPEDANCE	‡ RESOLUTION
± 250 mVDC	0.03% of rdg + 30µV	0.12% of rdg + 40µV	451 KΩ	10µV
± 2.0 VDC	0.03% of rdg + 0.3mV	0.12% of rdg + 0.4mV	451 KΩ	0.1mV
± 10 VDC	0.03% of rdg + 3mV	0.12% of rdg + 4mV	451 KΩ	1mV
± 25 VDC	0.03% of rdg + 3mV	0.12% of rdg + 4mV	451 KΩ	1mV
± 100 VDC	0.3% of rdg + 30mV	0.12% of rdg + 40mV	451 KΩ	10mV
± 200 VDC	0.3% of rdg + 30mV	0.12% of rdg + 40mV	451 KΩ	10mV

‡ Higher resolution can be achieved via input scaling.

Temperature Inputs:
READOUT:
Scale: F or C
Offset Range: -199,999 to 999,999 display units.

Thermocouple Inputs:
Input Impedance: 20MΩ
Lead Resisitance Effect: 0.03 µV/Ω
Max Continuous Overvoltage: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)	STANDARD	WIRE COLOR	
					ANSI	BS 1843
T	-200 to 400°C	1.2°C	2.1°C	ITS-90	(+) blue (-) red	(+) white (-) blue
E	-200 to 750°C	1.0°C	2.4°C	ITS-90	(+) purple (-) red	(+) brown (-) blue
J	-200 to 760°C	1.1°C	2.3°C	ITS-90	(+) white (-) red	(+) yellow (-) blue
K	-200 to 1250°C	1.3°C	3.4°C	ITS-90	(+) yellow (-) red	(+) brown (-) blue
R	0 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
S	0 to 1768°C	1.9°C	4.0°C	ITS-90	no standard	(+) white (-) blue
B	150 to 300°C 300 to 1820°C	3.9°C 2.8°C	5.7°C 4.4°C	ITS-90	no standard	no standard
N	-200 to 1300°C	1.3°C	3.1°C	ITS-90	(+) orange (-) red	(+) orange (-) blue
C (W5/W26)	0 to 2315°C	1.9°C	6.1°C	ASTM E988-90**	no standard	no standard

RTD Inputs:
Type: 3 or 4 wire, 2 wire can be compensated for lead wire resistance
Excitation current: 100 ohm range: 136.5 µA ±10%
10 ohm range: 2.05 mA ±10%
Lead resistance: 100 ohm range: 10 ohm/lead max.
10 ohm range: 3 ohms/lead max.
Max. continuous overload: 30 V

INPUT TYPE	RANGE	ACCURACY* (18 to 28 °C)	ACCURACY* (0 to 50 °C)	STANDARD **
100 ohm Pt alpha = .00385	-200 to 850°C	0.4°C	1.6°C	IEC 751
100 ohm Pt alpha = .00392	-200 to 850°C	0.4°C	1.6°C	no official standard
120 ohm Nickel alpha = .00672	-80 to 259°C	0.2°C	0.5°C	no official standard
10 ohm Copper alpha = .00427	-110 to 260°C	0.4°C	0.9°C	no official standard

Resistance Inputs:

INPUT RANGE	ACCURACY * (18 to 28°C)	ACCURACY * (0 to 50°C)	COMPLIANCE	MAX CONT. OVERLOAD	‡ RESOLUTION
100 ohm	0.05% of rdg +0.03 ohm	0.2% of rdg +0.04 ohm	0.175 V	30 V	0.01 ohm
1000 ohm	0.05% of rdg +0.3 ohm	0.2% of rdg +0.4 ohm	1.75 V	30 V	0.1 ohm
10 Kohm	0.05% of rdg +1 ohm	0.2% of rdg +1.5 ohm	17.5 V	30 V	0.1 ohm

‡ Higher resolution can be achieved via input scaling.

* After 20 min. warm-up, @ 5 sample per second input rate. Accuracy is specified in two ways: Accuracy over an 18 to 28ºC and 15 to 75% RH environment; and Accuracy over a 0 to 50ºC and 0 to 85% RH (non condensing) environment. The specification includes the A/D conversion errors, linearization conformity, and thermocouple ice point compensation. Total system accuracy is the sum of meter and probe errors. Accuracy may be improved by field calibrating the meter readout at the temperature of interest.

** These curves have been corrected to ITS-90.

9. **EXCITATION POWER**: Jumper selectable
   Transmitter Power: +18 VDC, ± 5% @ 50 mA max.
   Reference Voltage: + 2 VDC, ± 2%
      Compliance: 1KΩ load min (2 mA max)
      Temperature Coefficient: 40 ppm/ºC max.
   Reference Current: 1.05 mADC, ± 2%
      Compliance: 10 KΩ load max.
      Temperature Coefficient: 40 ppm/ºC max.
10. **USER INPUTS**: Two programmable user inputs
   Max. Continuous Input: 30 VDC
   Isolation To Sensor Input Common: Not isolated.
   Response Time: 12 msec. max.
   Logic State: User programmable (USrACt) for sink/source (Lo/Hi)

INPUT STATE (USrACt)	LO/SINK	HI/SOURCE
	20KΩ pull-up to +3.3V	20KΩ pull-down
Active	V_{IN} < 1.1 VDC	V_{IN} > 2.2 VDC
Inactive	V_{IN} > 2.2 VDC	V_{IN} < 1.1 VDC

11. **TOTALIZER**:
   Time Base: second, minute, hour, or day
   Batch: Can accumulate (gate) input display from a user input
   Time Accuracy: 0.01% typical
   Decimal Point: 0 to 0.0000
   Scale Factor: 0.001 to 65.000
   Low Signal Cut-out: -199,999 to 999,999
   Total: 6 digits on Line 1; 9 digits on Line 2
12. **CUSTOM LINEARIZATION**:
   Data Point Pairs: Selectable from 2 to 16
   Display Range: -199,999 to 999,999
   Decimal Point: 0 to 0.0000
13. **MEMORY**: Nonvolatile FRAM memory retains all programmable parameters and display values.
14. **ENVIRONMENTAL CONDITIONS**:
   Operating Temperature Range: 0 to 50 °C
   Storage Temperature Range: -40 to 60 °C
   Vibration to IEC 68-2-6: Operational 5-150 Hz, 2 g
   Shock to IEC 68-2-27: Operational 25 g (10 g relay)
   Operating and Storage Humidity: 0 to 85% max. RH non-condensing
   Altitude: Up to 2000 meters
15. **CERTIFICATIONS AND COMPLIANCES**:
   CE Approved
      EN 61326-1 Immunity to Industrial Locations
      Emission CISPR 11 Class A
      IEC/EN 61010-1
      RoHS Compliant
   UL Listed: File #E179259
   Type 4X Indoor Enclosure rating (Face only)
   IP65 Enclosure rating (Face only)
   IP20 Enclosure rating (Rear of unit)
   Refer to EMC Installation Guidelines section of the bulletin for additional information.
16. **CONNECTIONS**: High compression cage-clamp terminal block
   Wire Strip Length: 0.3" (7.5 mm)
   Wire Gauge Capacity: One 14 AWG (2.55 mm) solid, two 18 AWG (1.02 mm) or four 20 AWG (0.61 mm)
17. **CONSTRUCTION**: This unit is rated NEMA 4X/IP65 for indoor use only. IP20 Touch safe. Installation Category II, Pollution Degree 2. One piece bezel/ case. Flame resistant. Synthetic rubber keypad. Panel gasket and mounting clip included.
18. **WEIGHT**: 8 oz. (226.8 g)

OPTIONAL PLUG-IN OUTPUT CARDS

WARNING: Disconnect all power to the unit before installing plug-in cards.

Adding Option Cards

The PAX2A meters can be fitted with up to three optional plug-in cards. The details for each plug-in card can be reviewed in the specification section below. Only one card from each function type can be installed at a time. The function types include Setpoint Alarms (PAXCDS), Communications (PAXCDC), and Analog Output (PAXCDL). The plug-in cards can be installed initially or at a later date.

COMMUNICATION CARDS (PAXCDC)

A variety of communication protocols are available for the PAX2A meter. Only one PAXCDC card can be installed at a time. *Note: For Modbus communications use RS485 Communications Output Card and configure communication (tYPE) parameter for Modbus.*

PAXCDC10 - RS485 Serial (Terminal)
PAXCDC1C - RS485 Serial (Connector)
PAXCDC20 - RS232 Serial (Terminal)
PAXCDC2C - RS232 Serial (Connector)
PAXCDC30 - DeviceNet
PAXCDC50 - Profibus-DP

SERIAL COMMUNICATIONS CARD

Type: RS485 or RS232
Communication Type: RLC Protocol (ASCII), Modbus RTU, and Modbus ASCII
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Data: 7/8 bits
Baud: 1200 to 38,400
Parity: no, odd or even
Bus Address: Selectable 0 to 99 (RLC Protocol), or 1 to 247 (Modbus Protocol), Max. 32 meters per line (RS485)
Transmit Delay: Selectable for 0 to 0.250 sec (+2 msec min)

DEVICENET™ CARD

Compatibility: Group 2 Server Only, not UCMM capable
Baud Rates: 125 Kbaud, 250 Kbaud, and 500 Kbaud
Bus Interface: Phillips 82C250 or equivalent with MIS wiring protection per DeviceNet™ Volume I Section 10.2.2.
Node Isolation: Bus powered, isolated node
Host Isolation: 500 Vrms for 1 minute (50 V working) between DeviceNet™ and meter input common.

PROFIBUS-DP CARD

Fieldbus Type: Profibus-DP as per EN 50170, implemented with Siemens SPC3 ASIC
Conformance: PNO Certified Profibus-DP Slave Device
Baud Rates: Automatic baud rate detection in the range 9.6 Kbaud to 12 Mbaud
Station Address: 0 to 125, set by rotary switches.
Connection: 9-pin Female D-Sub connector
Network Isolation: 500 Vrms for 1 minute (50 V working) between Profibus network and sensor and user input commons. Not isolated from all other commons.

PROGRAMMING SOFTWARE

Crimson® software is a Windows® based program that allows configuration of the PAX® meter from a PC. Crimson offers standard drop-down menu commands, that make it easy to program the meter. The meter's program can then be saved in a PC file for future use. Crimson can be downloaded at www.redlion.net

SETPOINT CARDS (PAXCDS)

The PAX2A meter has 4 available setpoint alarm output plug-in cards. Only one PAXCDS card can be installed at a time. (Logic state of the outputs can be reversed in the programming.) These plug-in cards include:

PAXCDS10 - Dual Relay, FORM-C, Normally open & closed
PAXCDS20 - Quad Relay, FORM-A, Normally open only
PAXCDS30 - Isolated quad sinking NPN open collector
PAXCDS40 - Isolated quad sourcing PNP open collector

DUAL RELAY CARD

Type: Two FORM-C relays
Isolation To Sensor & User Input Commons: 2000 Vrms for 1 min.
Working Voltage: 240 Vrms
Contact Rating:
One Relay Energized: 5 amps @ 120/240 VAC or 28 VDC (resistive load).
Total current with both relays energized not to exceed 5 amps
Life Expectancy: 100 K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD RELAY CARD

Type: Four FORM-A relays
Isolation To Sensor & User Input Commons: 2300 Vrms for 1 min.
Working Voltage: 250 Vrms
Contact Rating:
One Relay Energized: 3 amps @ 240 VAC or 30 VDC (resistive load).
Total current with all four relays energized not to exceed 4 amps
Life Expectancy: 100K cycles min. at full load rating. External RC snubber extends relay life for operation with inductive loads

QUAD SINKING OPEN COLLECTOR CARD

Type: Four isolated sinking NPN transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: 100 mA max @ V_{SAT} = 0.7 V max. V_{MAX} = 30 V

QUAD SOURCING OPEN COLLECTOR CARD

Type: Four isolated sourcing PNP transistors.
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Rating: Internal supply: 18 VDC unregulated, 30 mA max. total
External supply: 30 VDC max., 100 mA max. each output

ALL FOUR SETPOINT CARDS

Response Time: See Update Rates step response specification on page 3; add 6 msec (typical) for relay card

LINEAR DC OUTPUT (PAXCDL)

Either a 0(4)-20 mA or 0-10 V retransmitted linear DC output is available from the analog output plug-in card. The programmable output low and high scaling can be based on various display values. Reverse slope output is possible by reversing the scaling point positions.

PAXCDL10 - Retransmitted Analog Output Card

ANALOG OUTPUT CARD

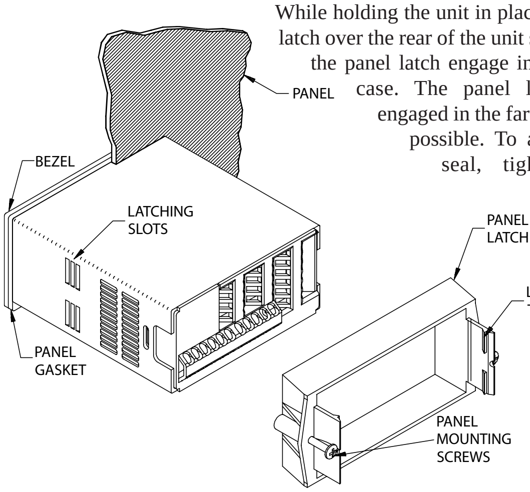
Types: 0 to 20 mA, 4 to 20 mA or 0 to 10 VDC
Isolation To Sensor & User Input Commons: 500 Vrms for 1 min.
Working Voltage: 50 V. Not Isolated from all other commons.
Accuracy: 0.17% of FS (18 to 28 °C); 0.4% of FS (0 to 50 °C)
Resolution: 1/3500
Compliance: 10 VDC: 10 KΩ load min., 20 mA: 500 Ω load max.
Powered: Self-powered
Step Response: See Update Rates step response specification on page 3.
Update time: See ADC Conversion Rate and Update Time parameter

1.0 INSTALLING THE METER

Installation

The PAX2A meets NEMA 4X/IP65 requirements when properly installed. The unit is intended to be mounted into an enclosed panel. Prepare the panel cutout to the dimensions shown. Remove the panel latch from the unit. Slide the panel gasket over the rear of the unit to the back of the bezel. The unit should be installed fully assembled. Insert the unit into the panel cutout.

While holding the unit in place, push the panel latch over the rear of the unit so that the tabs of the panel latch engage in the slots on the case. The panel latch should be engaged in the farthest forward slot possible. To achieve a proper seal, tighten the latch screws evenly until the unit is snug in the panel (Torque to approximately 7 in-lbs [79N-cm]). Do not over-tighten the screws.



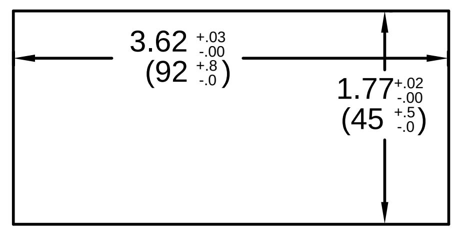
Installation Environment

The unit should be installed in a location that does not exceed the operating temperature and provides good air circulation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should only be cleaned with a soft cloth and neutral soap product. Do NOT use solvents. Continuous exposure to direct sunlight may accelerate the aging process of the bezel.

Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL CUT-OUT

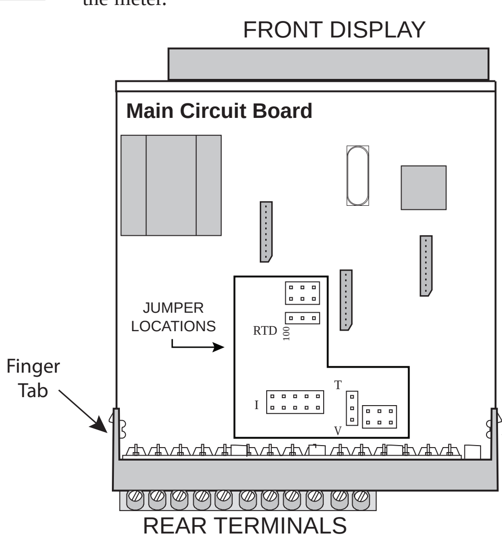


2.0 SETTING THE JUMPERS

The PAX2A meter has four jumpers that must be checked and/or changed prior to applying power. The following Jumper Selection Figures show an enlargement of the jumper area.

To access the jumpers, remove the meter base from the case by firmly squeezing and pulling back on the side rear finger tabs. This should lower the latch below the case slot (which is located just in front of the finger tabs). It is recommended to release the latch on one side, then start the other side latch.

Warning: Exposed line voltage exists on the circuit boards. Remove all power to the meter and load circuits before accessing inside of the meter.



INPUT RANGE JUMPERS

Voltage Input

Two jumpers are used in configuring the meter for voltage/resistance. The first jumper, T/V, must be in the V (voltage) position. The second jumper is used to select the proper voltage input range. (This jumper is also used to select the current input range.) Select a range that is high enough to accommodate the maximum signal input to avoid overloads. For proper operation, the input range selected in programming must match the jumper setting.

Current Input

For current input, only one jumper must be configured to select the current range. This jumper is shared with the voltage input range. To avoid overloads, select the jumper position that is high enough to accommodate the maximum signal input level to be applied.

Note: The position of the T/V jumper does not matter when the meter is in the current input mode.

Temperature Input

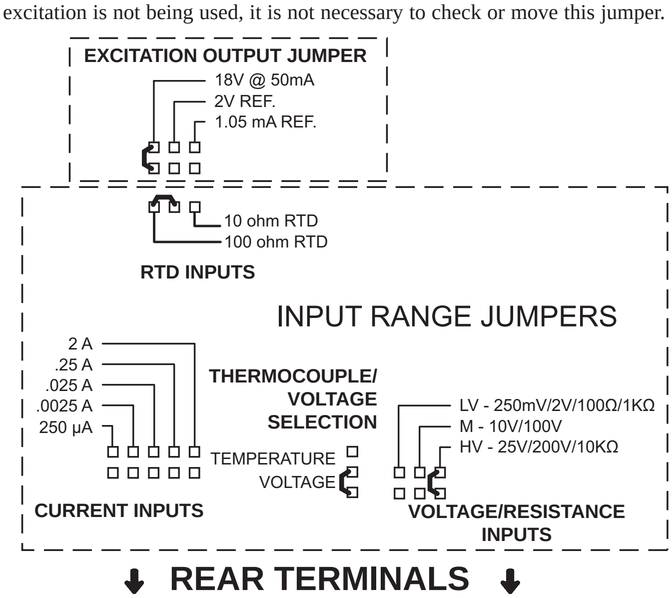
For temperature measurement the T/V jumper must be in the T (temperature) position. For RTD sensors the RTD jumper must also be set.

Resistance Input

Three jumpers are used to configure the resistance input. The T/V jumper must be in the V (voltage) position, and the excitation jumper must be in the 1.05 mA REF position. The voltage/resistance jumper position is determined by the input range.

Excitation Output Jumper

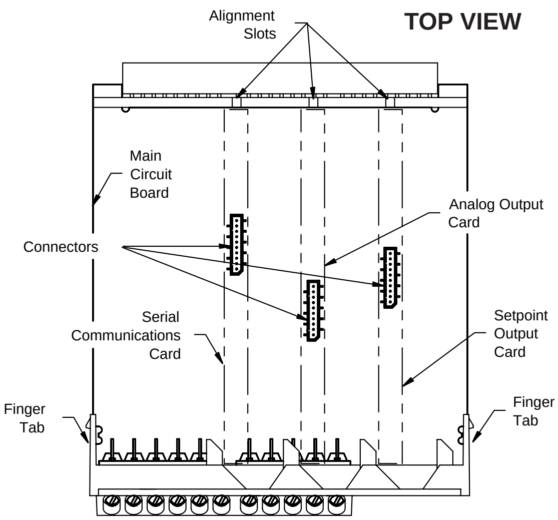
This jumper is used to select the excitation range for the application. If excitation is not being used, it is not necessary to check or move this jumper.



3.0 INSTALLING PLUG-IN CARDS

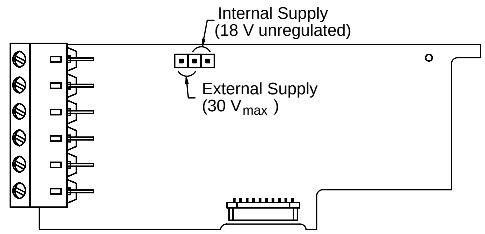
The plug-in cards are separately purchased optional cards that perform specific functions. These cards plug into the main circuit board of the meter. The plug-in cards have many unique functions when used with the PAX2A.

CAUTION: The plug-in card and main circuit board contain static sensitive components. Before handling the cards, discharge static charges from your body by touching a grounded bare metal object. Ideally, handle the cards at a static controlled clean workstation. Also, only handle the cards by the edges. Dirt, oil or other contaminants that may contact the cards can adversely affect circuit operation.



To Install:

1. With the meter removed from the case, locate the plug-in card connector for the card type to be installed. The types are keyed by position with different main circuit board connector locations. When installing the card, hold the meter by the rear terminals and not by the front display board.
   If installing the Quad sourcing Plug-in Card (PAXCDS40), set the jumper for internal or external supply operation before continuing.



2. Install the plug-in card by aligning the card terminals with the slot bay in the rear cover. Be sure the connector is fully engaged and the tab on the plug-in card rests in the alignment slot on the display board.
3. Slide the meter base back into the case. Be sure the rear cover latches fully into the case.
4. Apply the plug-in card label to the bottom side of the meter in the designated area. Do Not Cover the vents on the top surface of the meter. The surface of the case must be clean for the label to adhere properly.

4.0 WIRING THE METER

WIRING OVERVIEW

Electrical connections are made via screw-clamp terminals located on the back of the meter. All conductors should conform to the meter's voltage and current ratings. All cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that the power supplied to the meter (DC or AC) be protected by a fuse or circuit breaker.

When wiring the meter, compare the numbers embossed on the back of the meter case against those shown in wiring drawings for proper wire position. Strip the wire, leaving approximately 0.3" (7.5 mm) bare lead exposed (stranded wires should be tinned with solder). Insert the lead under the correct screw-clamp terminal and tighten until the wire is secure (Pull wire to verify tightness). Each terminal can accept up to one #14 AWG (2.55 mm) wire, two #18 AWG (1.02 mm), or four #20 AWG (0.61 mm).

EMC INSTALLATION GUIDELINES

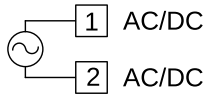
Although Red Lion Controls Products are designed with a high degree of immunity to Electromagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of the electrical noise, source or coupling method into a unit may be different for various installations. Cable length, routing, and shield termination are very important and can mean the difference between a successful or troublesome installation. Listed are some EMI guidelines for a successful installation in an industrial environment.

1. A unit should be mounted in a metal enclosure, which is properly connected to protective earth.
2. Use shielded cables for all Signal and Control inputs. The shield connection should be made as short as possible. The connection point for the shield depends somewhat upon the application. Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield to earth ground (protective earth) at one end where the unit is mounted.
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is over 1 MHz.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors, feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run through metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter. Also, Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
4. Long cable runs are more susceptible to EMI pickup than short cable runs.
5. In extremely high EMI environments, the use of external EMI suppression devices such as Ferrite Suppression Cores for signal and control cables is effective. The following EMI suppression devices (or equivalent) are recommended:
   Fair-Rite part number 0443167251 (RLC part number FCOR0000)
   Line Filters for input power cables:
   Schaffner # FN2010-1/07 (Red Lion Controls # LFIL0000)
6. To protect relay contacts that control inductive loads and to minimize radiated and conducted noise (EMI), some type of contact protection network is normally installed across the load, the contacts or both. The most effective location is across the load.
   a. Using a snubber, which is a resistor-capacitor (RC) network or metal oxide varistor (MOV) across an AC inductive load is very effective at reducing EMI and increasing relay contact life.
   b. If a DC inductive load (such as a DC relay coil) is controlled by a transistor switch, care must be taken not to exceed the breakdown voltage of the transistor when the load is switched. One of the most effective ways is to place a diode across the inductive load. Most RLC products with solid state outputs have internal zener diode protection. However external diode protection at the load is always a good design practice to limit EMI. Although the use of a snubber or varistor could be used.
   RLC part numbers: Snubber: SNUB0000
   Varistor: ILS11500 or ILS23000
7. Care should be taken when connecting input and output devices to the instrument. When a separate input and output common is provided, they should not be mixed. Therefore a sensor common should NOT be connected to an output common. This would cause EMI on the sensitive input common, which could affect the instrument's operation.

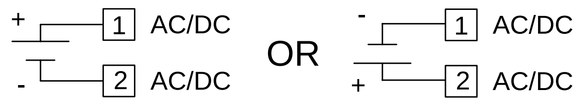
Visit RLC's web site at http://www.redlion.net/Support/InstallationConsiderations.html for more information on EMI guidelines, Safety and CE issues as they relate to Red Lion Controls products.

4.1 POWER WIRING

AC Power



DC Power

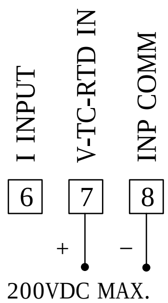


The power supplied to the meter shall employ a 15 Amp UL approved circuit breaker for AC input and a 1 Amp, 250 V UL approved fuse for DC input. It shall be easily accessible and marked as a disconnecting device to the installed unit. This device is not directly intended for connection to the mains without a reliable means to reduce transient over-voltages to 1500 V.

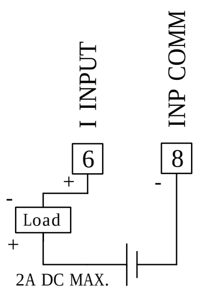
4.2 VOLTAGE/RESISTANCE/CURRENT INPUT SIGNAL WIRING

IMPORTANT: Before connecting signal wires, the Input Range Jumpers and Excitation Jumper should be verified for proper position.

Voltage Signal

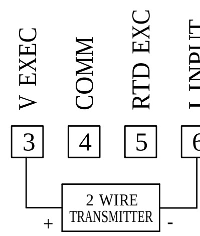


Process/Current Signal (external powered)



Process/Current Signal (2 wire requiring 18V excitation)

Excitation Jumper: 18 V

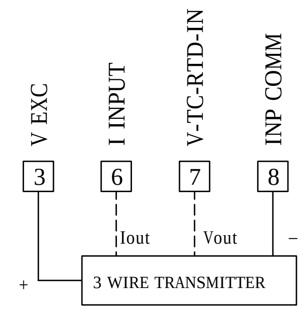


Current Signal (3 wire requiring 18 V excitation)

Terminal 3: +Volt supply
Terminal 6: +ADC (signal)
Terminal 8: -ADC (common)
Excitation Jumper: 18 V

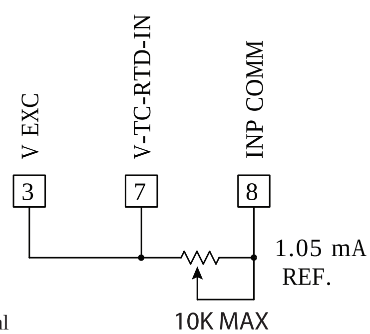
Voltage Signal (3 wire requiring 18 V excitation)

Terminal 3: +Volt supply
Terminal 7: +VDC (signal)
Terminal 8: -VDC (common)
Excitation Jumper: 18 V



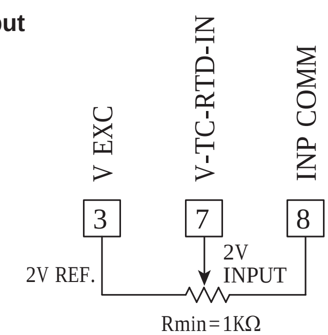
Resistance Signal (2 wire requiring excitation)

Terminal 3: Jumper to terminal 7
Terminal 7: Resistance
Terminal 8: Resistance
Excitation Jumper: 1.05 mA REF.
T/V Jumper: V position
Voltage/Resistance Input Jumper: Set per input signal



Potentiometer Signal as Voltage Input (3 wire requiring excitation)

Terminal 3: High end of pot.
Terminal 7: Wiper
Terminal 8: Low end of pot.
Excitation Jumper: 2 V REF.
T/V Jumper: V
Voltage/Resistance Input Jumper: 2 Volt
Module 1 Input Range: 2 Volt
Note: The Apply signal scaling style should be used because the signal will be in volts.

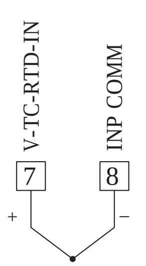


CAUTION: *Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

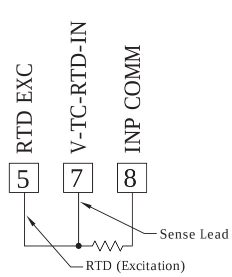
4.3 TEMPERATURE INPUT SIGNAL WIRING

IMPORTANT: Before connecting signal wires, verify the T/V Jumper is in the T position.

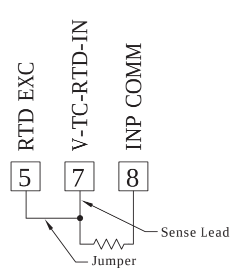
Thermocouple



3-Wire RTD



2-Wire RTD



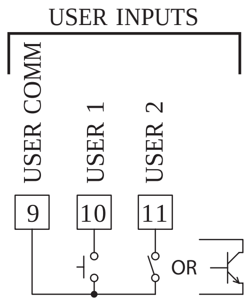
CAUTION*: Sensor input common is NOT isolated from user input common. In order to preserve the safety of the meter application, the sensor input common must be suitably isolated from hazardous live earth referenced voltages; or input common must be at protective earth ground potential. If not, hazardous live voltage may be present at the User Inputs and User Input Common terminals. Appropriate considerations must then be given to the potential of the user input common with respect to earth common; and the common of the isolated plug-in cards with respect to input common.*

4.4 USER INPUT WIRING

If not using User Inputs, then skip this section. Only the appropriate User Input terminal has to be wired.

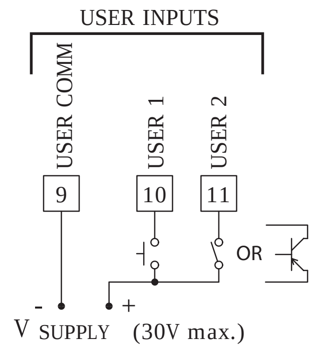
Sinking Logic (USrACt Lo)

When the USrACt parameter is programmed to Lo, the user inputs of the meter are internally pulled up to +3.3 V with 20 KΩ resistance. The input is active when it is pulled low (<1.1 V).



Sourcing Logic (USrACt Hi)

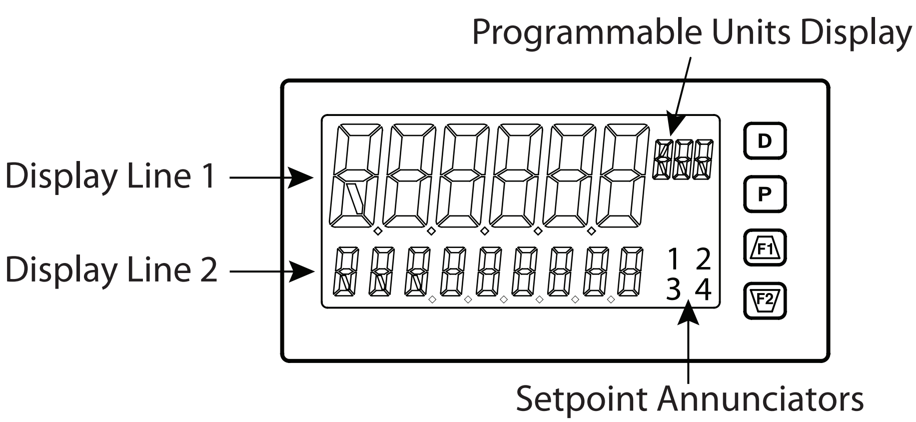
When the USrACt parameter is programmed to Hi, the user inputs of the meter are internally pulled down to 0 V with 20 KΩ resistance. The input is active when a voltage greater than 2.2 VDC is applied.



4.5 SETPOINT (ALARMS) WIRING
4.6 SERIAL COMMUNICATION WIRING
4.7 ANALOG OUTPUT WIRING

See appropriate plug-in card bulletin for wiring details.

5.0 REVIEWING THE FRONT BUTTONS AND DISPLAY

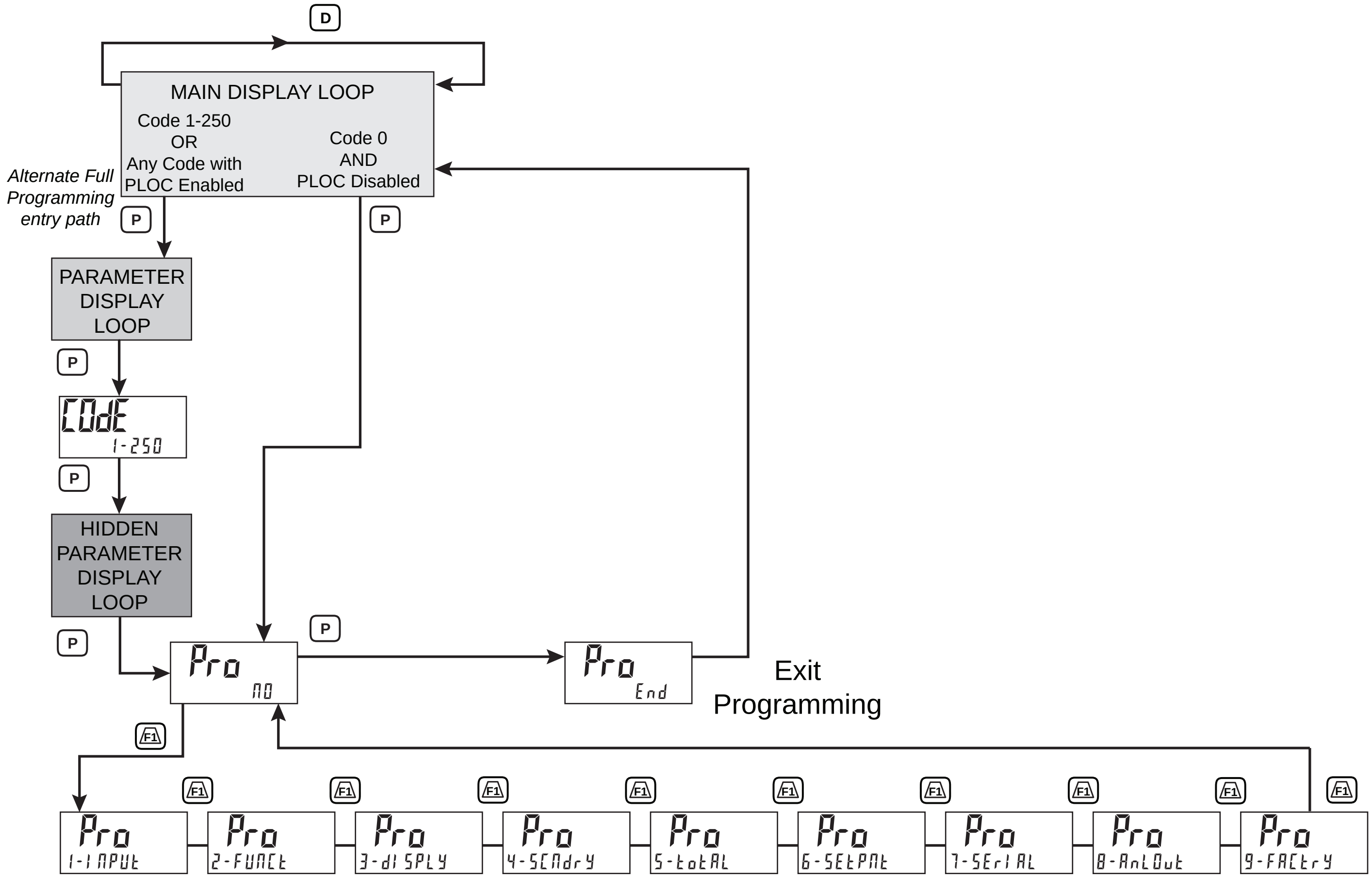


KEY	DISPLAY MODE OPERATION	PROGRAMMING MODE OPERATION
D	Index Line 2 through enabled, max/min/input/total, readouts	Quick exit to display mode
P	Access the parameter and hidden display loops	Access the programming parameter menus, store selected parameter and index to next parameter
F1	Function key 1; hold for 3 seconds for second function 1*	Increment selected parameter value
F2	Function key 2; hold for 3 seconds for second function 2*	Decrement selected parameter value

**Factory setting for F1 and F2 is no mode*

The PAX2A display consists of a large, 6-digit upper display referred to as Line 1 and a smaller 9-digit lower display referred to as Line 2. Line 1 can be configured to show one of several values, including the main input reading, min, max, setpoints or total values. Line 2 can be used to display several selectable values including; input value, min, max, total, list, setpoint values, and other values. For these values the mnemonics is shown in the left most digits of Line 2. To the right of Line 1 is a Programmable Units Display. This display consists of 3 programmable digits that are user defined as mnemonics for Line 1.

PAX2A DISPLAY LOOPS



** Pressing “D” at any time exits back to the Main Display Loop.*

PAX2A DISPLAY LOOPS

The PAX2A offers three display loops to allow users quick access to needed information. These display loops are available when the meter is in the normal display mode. By pressing the **D** key, the user can view parameters such as the Total, Min, Max or the Input in the Main Display Loop. Display selections are fully programmable and are viewed on the 9 digit line of the meter.

Pressing the **P** key with no security code (CODE 0) will put the meter directly into the programming mode. When a security code is programmed (Code 1-250), pressing the **P** key will allow access to the Parameter Display Loop. This loop is where the parameters like setpoint values are normally put for general public access. Parameters in this loop can only be viewed/changed if enabled in the meter programming. After all the parameters in the Parameter Display Loop are viewed, an additional press of the **P** key will bring up the security code (CODE 0). Access the Hidden Parameter Display Loop by entering the selected security code. In this loop displayed parameters can be changed. Combining the two parameter loops provides an area for parameters that require general access and/or protected or secure access depending on your application needs.

During programming of the meter you will need to select if a value is to be displayed or not. If the value is not required, select the lock mode (LOC). If you decide to display the value, you will need to assign it to a loop; **D** for the Main Display Loop, **P** for the Parameter Display Loop, and HIdE for the Hidden Display Loop. In the case of the parameters, such as the setpoint values you will also need to decide if the value can only be read (rEd) or entered (ENt). The F1 and F2 key will increment or decrement the value when the edit mode is active. After the change, press the **P** key to save and move to the next value. Any values placed in the Hidden Parameter Loop can be changed as they are protected by the security code. While in the parameter display and hidden parameter loops, pressing the **D** key will return the meter to the main display.

There are selections in the programming that allow for the values to be reset. When the **P** key is pushed on a resettable display, the unit will display the value mnemonic and “NO” (if Line 2 value was set for “d-ENt” in “3-dISPLY”). Pressing the F1 and F2 keys will toggle between “NO’ and “YES”. Pressing the **P** key with “YES” displayed will cause the reset action to be performed.

The **P**, Parameter key is used to scroll among the programmed Line 2 parameter values when at the main display or to step through the parameter loop and hidden parameter loop. It is used as the enter key when the meter is in the programming mode.

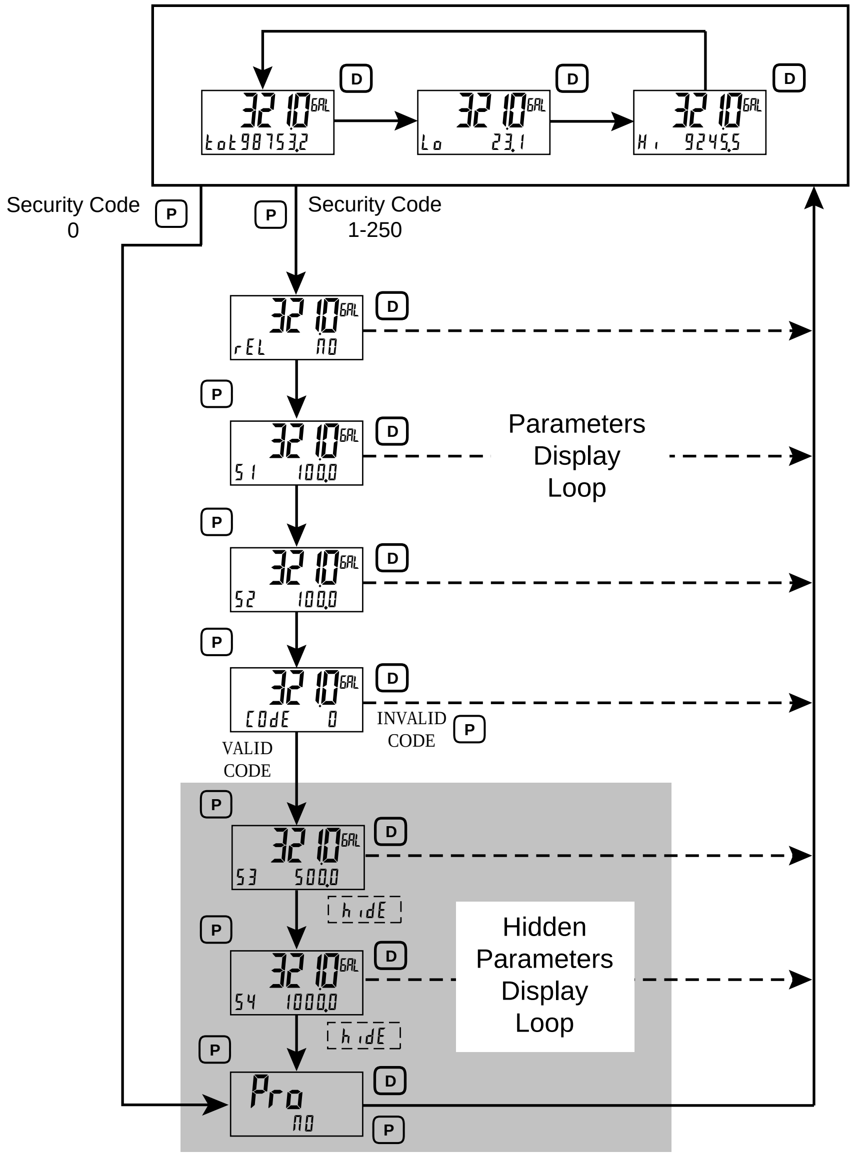
Numerical Value Entry

If the parameter is programmed for enter (ENt), the F1 and F2 keys are used to change the parameter values in any of the display loops.

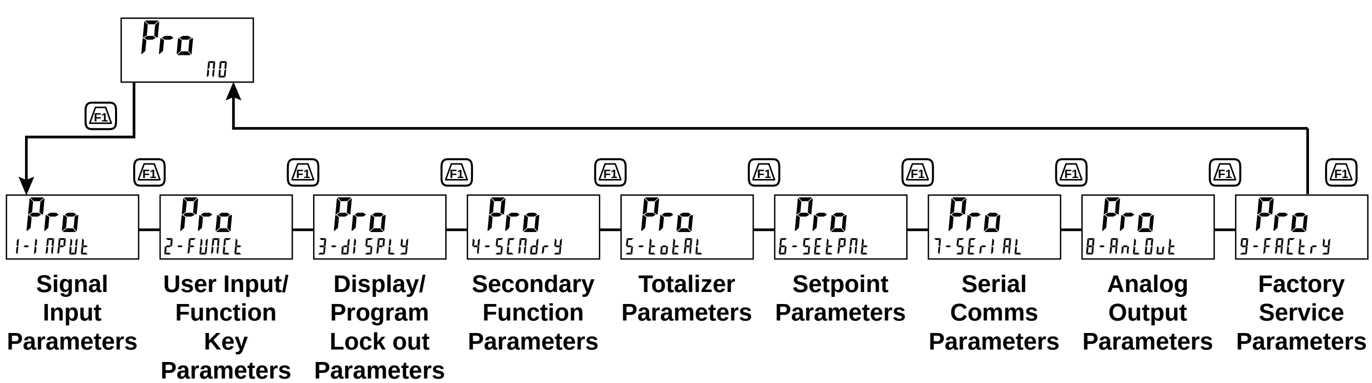
The F1 and F2 keys will increment or decrement the parameter value. When the arrow key is pressed and held, the value automatically scrolls. The longer the arrow key is held the faster the value scrolls.

For large value changes, press and hold the F1 or F2 key. While holding that key, momentarily press the **D** key and the value scrolls by 1000’s as the arrow key is held. Releasing the arrow key removes the 1000’s scroll feature. The arrow keys can then be used to make small value changes as described above.

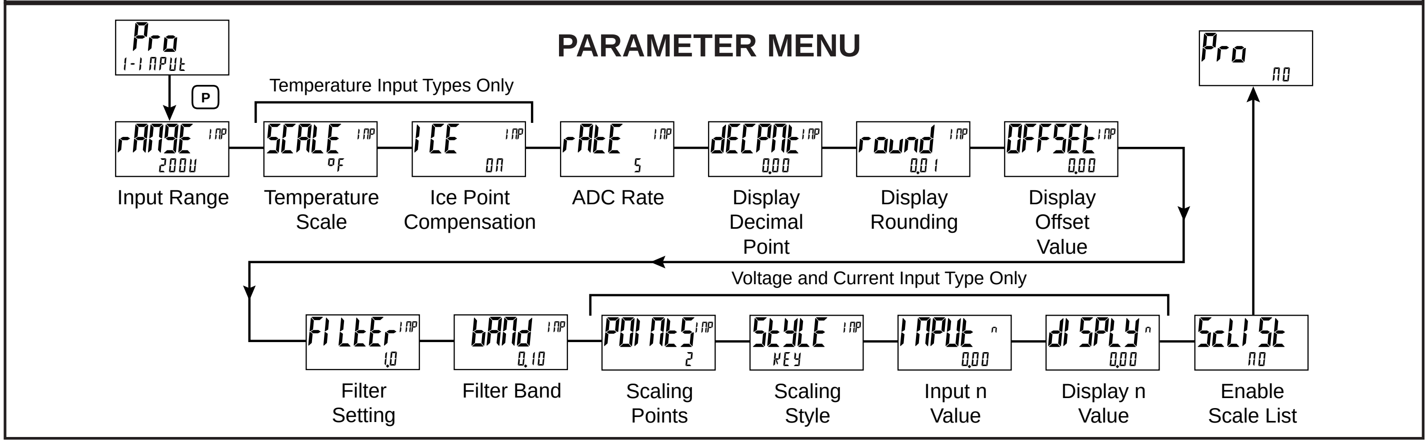
Main Display Loop



6.0 PROGRAMMING THE PAX2A



MODULE 1 - INPUT SETUP PARAMETERS (1-INPUt)



INPUT RANGE

rANGE INP 200U

250uA	2U	1000o	tc-r	r392
0.0025A	10U	10000o	tc-S	r672
0.025A	25U	tc-t	tc-b	r427
0.25A	100U	tc-E	tc-n	
2A	200U	tc-J	tc-C	
0.25U	100o	tc-K	r385	

Select the desired input range.

TEMPERATURE SCALE

For TC and RTD Input Range Selection only.

SCALE INP °F

°F °C

Select the temperature scale. This selection applies for Input, MAX, MIN, and TOT displays. If changed, those parameters that relate to the temperature scale should be checked.

ICE POINT COMPENSATION

For TC Input Range Selection only.

ICE INP ON

ON OFF

This parameter turns the internal ice point compensation on or off. Normally, the ice point compensation is on. If using external compensation, set this parameter to off. In this case, use copper leads from the external compensation point to the meter.

INPUT UPDATE RATE (/SEC)

rAtE INP 5

5 10 20 40 80 160

Select the ADC conversion rate (conversions per second). Temperature inputs can not be set higher than 20 updates per second. The selection does not affect the display update rate, however it does affect setpoint and analog output response time. The default factory setting of 5 is recommended for most applications. Selecting a fast update rate may cause the display to appear very unstable.

DECIMAL RESOLUTION (Display Units)

dECPNt INP 0.00

0 to 0.0000 (curr/volt)
0 to 0.0 (temp)

Select desired display resolution. The available selections are dependent on the Input Range selected (rANGE).

ROUNDING INCREMENT

round INP 0.01

1 2 5
10 20 50 100

Rounding selections other than one, cause the Input Display to 'round' to the nearest rounding increment selected (ie. rounding of '5' causes 122 to round to 120 and 123 to round to 125). Rounding starts at the least significant digit of the Input Display. Remaining parameter entries (scaling point values, setpoint values, etc.) are not automatically adjusted to this display rounding selection.

DISPLAY OFFSET

OFFSEt INP 0.00

-199999 to 999999

The display can be corrected with an offset value. This can be used to compensate for probe errors, errors due to variances in probe placement or adjusting the readout to a reference thermometer. This value is automatically updated after a Zero Display to show how far the display is offset. A value of zero will remove the affects of offset.

DIGITAL FILTERING

FILtEr INP 1.0

0.0 to 25.0 seconds

The input filter setting is a time constant expressed in tenths of a second. The filter settles to 99% of the final display value within approximately 3 time constants. This is an Adaptive Digital Filter which is designed to steady the Input Display reading. A value of '0' disables filtering.

FILTER BAND

bANd INP 0.10

0 to 250 display units

The digital filter will adapt to variations in the input signal. When the variation exceeds the input filter band value, the digital filter disengages. When the variation becomes less than the band value, the filter engages again. This allows for a stable readout, but permits the display to settle rapidly after a large process change. The value of the band is in display units, independent of the Display Decimal Point position. A band setting of '0' keeps the digital filter permanently engaged.

When the meter is programmed for TC or RTD, the following programming steps are not active.

SCALING POINTS

POINtS INP 2

2 to 16

Linear - Scaling Points (2)

For linear processes, only 2 scaling points are necessary. It is recommended that the 2 scaling points be at opposite ends of the input signal being applied. The points do not have to be the signal limits. Display scaling will be linear between and continue past the entered points up to the limits of the Input Signal Jumper position. Each scaling point has a coordinate-pair of Input Value (INPUt n) and an associated desired Display Value (dISPLY n).

Nonlinear - Scaling Points (Greater than 2)

For non-linear processes, up to 16 scaling points may be used to provide a piece-wise linear approximation. (The greater the number of scaling points used, the greater the conformity accuracy.) The Input Display will be linear between scaling points that are sequential in program order. Each scaling point has a coordinate-pair of Input Value (INPUt n) and an associated desired Display Value (dISPLY n). Data from tables or equations, or empirical data could be used to derive the required number of segments and data values for the coordinate pairs. In the Crimson software, several linearization equations are available.

SCALING STYLE

This parameter does not apply for thermocouple or RTD input ranges.

StYLE INP
KEY

KEY key-in data
APPLY apply signal

If Input Values and corresponding Display Values are known, the Key-in (KEY) scaling style can be used. This allows scaling without the presence of the input signal. If Input Values have to be derived from the actual input signal source or simulator, the Apply (APPLY) scaling style must be used.

INPUT VALUE FOR SCALING POINT 1

INPUt 1
0.00

-199999 to 999999

For Key-in (KEY), enter the known first Input Value by using the F1 or F2 arrow keys. (The Input Range selection sets up the decimal location for the Input Value). For Apply (APPLY), the existing programmed value will appear. If this is acceptable, press the **P** key to save and continue to the next parameter. To update/program this value, apply the input signal that corresponds to Scaling Point 1, press F2 key and the actual signal value will be displayed. Then press the **P** key to accept this value and continue to the next parameter.

DISPLAY VALUE FOR SCALING POINT 1

dISPLY 1
0.00

-199999 to 999999

Enter the first coordinating Display Value by using the arrow keys. This is the same for KEY and APPLY scaling styles. The decimal point follows the dECPNt selection.

INPUT VALUE FOR SCALING POINT 2

INPUt 2
100.00

-199999 to 999999

For Key-in (KEY), enter the known second Input Value by using the F1 or F2 arrow keys. For Apply (APPLY), the existing programmed value will appear. If this is acceptable, press the **P** key to save and continue to the next parameter. To update/program this value, apply the input signal that corresponds to Scaling Point 2, press F2 key and the actual signal value will be displayed. Then press the **P** key to accept this value and continue to the next parameter. (Follow the same procedure if using more than 2 scaling points.)

DISPLAY VALUE FOR SCALING POINT 2

dISPLY 2
100.00

-199999 to 999999

Enter the second coordinating Display Value by using the F1 or F2 arrow keys. This is the same for KEY and APPLY scaling styles. (Follow the same procedure if using more than 2 scaling points.)

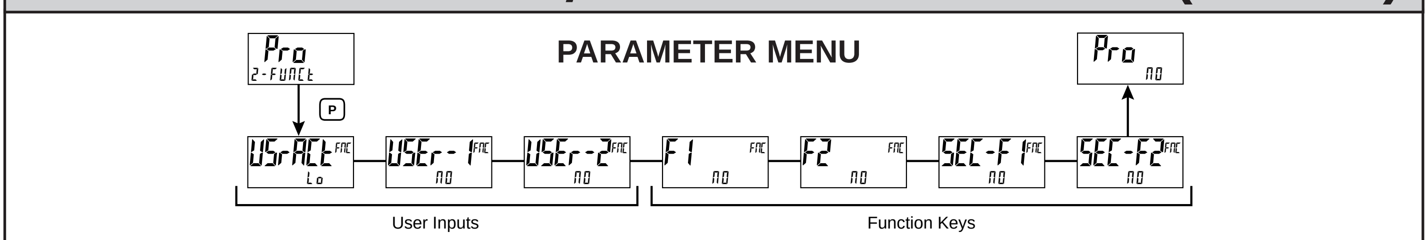
ENABLE SCALE LIST

SCLISt
NO

NO YES

When enabled, a second list of scaling points is active in the selected parameter list for List A and List B.

MODULE 2 - USER INPUT/FUNCTION KEY PARAMETERS (2-FUNCt)



The two user inputs are individually programmable to perform specific meter control functions. While in the Display Mode or Program Mode, the function is executed the instant the user input transitions to the active state. The front panel function keys, F1 and F2, are also individually programmable to perform specific meter control functions. While in the Display Mode, the primary function is executed the instant the key is pressed. Holding the function key for three seconds executes a secondary function. It is possible to program a secondary function without a primary function.

In most cases, if more than one user input and/or function key is programmed for the same function, the maintained (level trigger) actions will be performed while at least one of those user inputs or function keys are activated. The momentary (edge trigger) actions will be performed every time any of those user inputs or function keys transition to the active state.

Note: In the following explanations, not all selections are available for both user inputs and front panel function keys. Displays are shown with each selection. Those selections showing both displays are available for both. If a display is not shown, it is not available for that selection. USEr-n will represent both user inputs. Fn will represent both function keys and second function keys.

USER INPUT ACTIVE STATE

USrACt FNC
Lo

Lo Hi

Select the desired active state for the User Inputs. Select Lo for sink input, active low. Select Hi for source input, active high.

NO FUNCTION

USEr-n FNC
NO

Fn FNC
NO

No function is performed if activated. This is the factory setting for all user inputs and function keys.

PROGRAMMING MODE LOCK-OUT

USEr-n FNC
PLOC

Programming Mode is locked-out, as long as activated (maintained action). A security code can be configured to allow programming access during lock-out.

ZERO (TARE) DISPLAY

USEr-n FNC
rEL

Fn FNC
rEL

The Zero (Tare) Display provides a way to zero the Input Display value at various input levels, causing future Display readings to be offset. This function is useful in weighing applications where the container or material on the scale should not be included in the next measurement value. When activated (momentary action), rESEt flashes and the Display is set to zero. At the same time, the Display value (that was on the display before the Zero Display) is subtracted from the Display Offset Value and is automatically stored as the new Display Offset Value. If another Zero (tare) Display is performed, the display will again change to zero and the Display offset value will shift accordingly.

RELATIVE/ABSOLUTE DISPLAY

USEr-n FNC
d-rEL

Fn FNC
d-rEL

This function will switch the Input Display between Relative and Absolute. The Relative is a net value that includes the Display Offset Value. The Input Display will normally show the Relative unless switched by this function. Regardless of the display selected, all meter functions continue to operate based on relative values. The Absolute is a gross value (based on Module 1 DSP and INP entries) without the Display Offset Value. The Absolute display is selected as long as the user input is activated (maintained action) or at the transition of the function key (momentary action). When the user input is released, or the function key is pressed again, the input display switches back to Relative display. (Abs) or (rEL) is momentarily displayed at transition to indicate which display is active.

HOLD DISPLAY

USEr-n FNC
d-HLd

The active display is held but all other meter functions continue as long as activated (maintained action).

HOLD ALL FUNCTIONS

USEr-n FNC
A-HLd

The meter disables processing the input, holds all display contents, and locks the state of all outputs as long as activated (maintained action). The serial port continues data transfer.

SYNCHRONIZE METER READING

USEr-n FNC
SYNC

The meter suspends all functions as long as activated (maintained action). When the user input is released, the meter synchronizes the restart of the A/D with other processes or timing events.

STORE BATCH READING IN TOTALIZER

USEr-n FNC
bAt

Fn FNC
bAt

The Input Display value is added (batched) to the Totalizer at transition to activate (momentary action) and Line 2 flashes bAtCh. The Totalizer retains a running sum of each batch operation until the Totalizer is reset. When this function is selected, the normal operation of the Totalizer is overridden and only batched Input Display values accumulate in the Totalizer.

SELECT TOTALIZER DISPLAY

USEr-n FNC
d-tot

The Totalizer display appears on Line 2 as long as activated (maintained action). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Totalizer continues to function including associated outputs independent of being displayed.

RESET TOTALIZER

USEr-n FNC
r-tot1

Fn FNC
r-tot

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer then continues to operate as it is configured. This selection functions independent of the selected display.

RESET AND ENABLE TOTALIZER

USEr-n FNC
r-tot2

When activated (momentary action), rESEt flashes and the Totalizer resets to zero. The Totalizer continues to operate while active (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

ENABLE TOTALIZER

USEr-n FNC
E-tot

The Totalizer continues to operate while active (maintained action). When the user input is released, the Totalizer stops and holds its value. This selection functions independent of the selected display.

SELECT MAXIMUM DISPLAY

USEr-n FNC
d-HI

The Maximum display appears on Line 2 as long as activated (maintained). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Maximum continues to function independent of being displayed.

RESET MAXIMUM DISPLAY

USEr-n FNC
r-HI

Fn FNC
r-HI

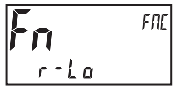
When activated (momentary action), rESEt flashes and the Maximum resets to the present Input Display value. The Maximum function then continues from that value. This selection functions independent of the selected display.

SELECT MINIMUM DISPLAY

USEr-n FNC
d-Lo

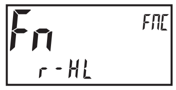
The Minimum display appears on Line 2 as long as activated (maintained). When the user input is released, the previously selected display is returned. The **D** or **P** keys override and disable the active user input. The Minimum continues to function independent of being displayed.

RESET MINIMUM DISPLAY



When activated (momentary action), rESEt flashes and the Minimum resets to the present Input Display value. The Minimum function then continues from that value. This selection functions independent of the selected display.

RESET MAXIMUM AND MINIMUM DISPLAY



When activated (momentary action), rESEt flashes and the Maximum and Minimum readings are set to the present Input Display value. The Maximum and Minimum function then continues from that value. This selection functions independent of the selected display.

DISPLAY SELECT

When activated (momentary action), Line 2 advances to the next display that is not locked out from the Display Mode.

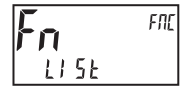
ADJUST DISPLAY INTENSITY

When activated (momentary action), the display intensity changes to the next intensity level.

CHANGE DISPLAY COLOR

When activated (momentary action), Line 1 will change color.

SELECT PARAMETER LIST



Two lists of input scaling points and setpoint values (including band and deviation) are available. The two lists are named LISt-A and LISt-b. If a user input is used to select the list then LISt-A is selected when the user input is not active and LISt-b is selected when the user input is active (maintained action). If a front panel key is used to select the list then the list will toggle for each key press (momentary action). The display will only indicate which list is active when the list is changed. To program the values for LISt-A and LISt-b, first complete the programming of all the parameters. Exit programming and switch to the other list. Re-enter programming and enter the desired values for the input scaling points, setpoints, band, and deviation if used.

SETPOINT SELECTIONS

The following selections are functional only with a Setpoint plug-in card installed.

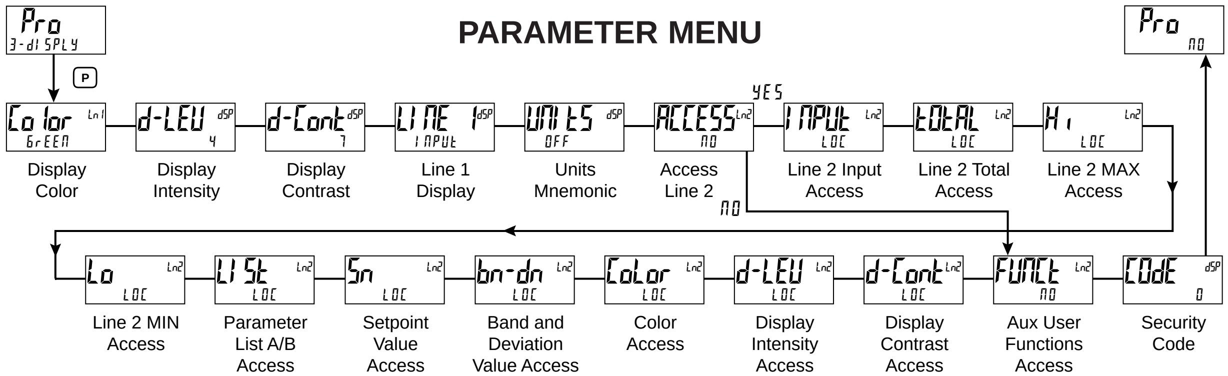
- r-1 - Reset Setpoint 1 (Alarm 1)
- r-2 - Reset Setpoint 2 (Alarm 2)
- r-3 - Reset Setpoint 3 (Alarm 3)
- r-4 - Reset Setpoint 4 (Alarm 4)
- r-34 - Reset Setpoint 3 & 4 (Alarm 3 & 4)
- r-234 - Reset Setpoint 2, 3 & 4 (Alarm 2, 3 & 4)
- r-ALL - Reset All Setpoints (Alarms 1-4)

PRINT REQUEST

The meter issues a block print through the serial port when activated, and the serial type is set to rLC. The data transmitted during a print request and the serial type is programmed in Module 7. If the user input is still active after the transmission is complete (about 100 msec), an additional transmission occurs. As long as the user input is held active, continuous transmissions occur.

MODULE 3 - DISPLAY PARAMETERS (3-dISPLY)

PARAMETER MENU



Module 3 is the programming of the Main Display Loop, Parameter Display Loop, Hidden Parameter Loop, and Full Programming lock-out. The large upper display line value is configured by the "LINE 1" parameter. The Units mnemonic can be used to assign a custom display mnemonic to the upper display value. When in the Main Display Loop, the available Line 2 displays (items configured for d-rEd or d-EnT) can be consecutively read on lower display by repeatedly pressing the **D** key. A left justified 3 character mnemonic indicates which parameter value is being shown on the lower display. When in the Main Display Loop the User keys F1 and F2 function as programmed in Module 2.

The Parameter display loop items can be accessed by pressing the **P** key. To edit a main display line item, that is configured as d-EnT, the **P** key is pushed and the unit enters a parameter edit mode in which the F1 and F2 key increments or decrements the value.

Full Programming Mode permits all parameters to be viewed and modified. This Programming Mode can be locked with a security code and/or user input.

LINE 1 DISPLAY COLOR

Color Ln1 / GrEEN — GrEEN rEd OrANGE

Enter the desired Display Line 1 and programmable Units Display color.

DISPLAY INTENSITY LEVEL

d-LEU dSP / 4 — 0 to 4

Enter the desired Display Intensity Level (0-4) by using the arrow keys. The display will actively dim or brighten as the levels are changed. This parameter also appears in the Parameter Display Loop when enabled.

DISPLAY CONTRAST LEVEL

d-Cont dSP / 7 — 0 to 15

Enter the desired Display Contrast Level (0-15) by using the arrow keys. The display contrast / viewing angle will actively move up or down as the levels are changed. This parameter also appears in the Parameter Display Loop when enabled.

LINE 1 DISPLAY

LINE 1 dSP / INPUT — INPUT TOTAL Hi Lo S1 S2 S3 S4 NONE

Select the value to be assigned to the primary or top line of the meter display.

UNITS MNEMONIC

UNITS dSP / OFF — OFF LISt

This parameter allows programming of the display mnemonics characters. Three individual characters may be selected from a preprogrammed list. The list includes:

_ A b C d E F G H I J K L N O P Q R S t U V Y Z 0 1 2 3 4 5 6 7 8 9 c e g h i n o q r u - ° blank

LINE 2 MAIN, SECONDARY & HIDDEN DISPLAY LOOP ACCESSIBLE ITEMS

ACCESS Ln2 / NO — NO YES

Select YES to program the display Line 2 accessible values. The default setting of NO bypasses the programming of these values to shorten the module.

All of the individual Line 2 settings are retained.

The following values can be made accessible on Line 2 of the Main (**D** key), Parameter (**P** key) and Hidden (**P** key following code entry) Display Loops.

Each of the following parameters can be configured for one of the following settings. Not all selections are available for each parameter.

SELECTION	DESCRIPTION
LOC	Not viewed on display line
d-rEd	View in Main Display Loop. Cannot change or reset.
d-EnT	View and change (reset) in Main Display Loop
P-rEd	View in Parameter Display Loop. Cannot change or reset.
P-EnT	View and change (reset) in Parameter Display Loop
HidE	View and change in Hidden Parameter Display Loop

LINE 2 INPUT ACCESS

INPUT Ln2 / LOC — LOC d-rEd d-EnT

When configured for d-EnT, the Input value can be reset (tare) using a front keypad sequence. To reset (tare), push the **P** key while viewing the Input value on Line 2. The display will show rEL NO. Press the F1 key to select YES and then press **P** key. The display will indicate rESEt and then advance to Parameter Display.

LINE 2 TOTAL ACCESS

TOTAL Ln2 / LOC — LOC d-rEd d-EnT

When configured for d-EnT, the Total value can be reset using a front keypad sequence. To reset, push the **P** key while viewing the Total value on Line 2. The display will show r-tot NO. Press the F1 key to select YES and then press **P** key. The display will indicate rESEt and then advance to Parameter Display.

LINE 2 MAX ACCESS

Hi Ln2 LOC — LOC d-rEd d-Ent

When configured for d-Ent, the Max Display value can be reset using a front keypad sequence. To reset, push the **P** key while viewing the Hi value on Line 2. The display will show r-Hi nO. Press the F1 key to select YES and then press **P** key. The display will indicate rESEt and then advance to Parameter Display.

LINE 2 MIN ACCESS

Lo Ln2 LOC — LOC d-rEd d-Ent

When configured for d-Ent, the Min Display value can be reset using a front keypad sequence. To reset, push the **P** key while viewing the Lo value on Line 2. The display will show r-Lo nO. Press the F1 key to select YES and then press **P** key. The display will indicate rESEt and then advance to Parameter Display.

LINE 2 PARAMETER LIST A/B ACCESS

LISt Ln2 LOC — LOC d-rEd d-Ent P-rEd P-Ent HidE

When configured for d-Ent, the Parameter list can be selected using a front keypad sequence. To select, push the **P** key while viewing LISt x". "x" will begin to flash, press the F1 key to select "A" or "B" and then press **P** key. The selected Parameter List will become active and the display will advance to Parameter Display. See User Functions "Select Parameter List" for a description of the list function. The Line 2 Parameter List provides a means of setting or viewing the active parameter list.

LINE 2 SETPOINTS ACCESS

Sn Ln2 LOC — LOC d-rEd d-Ent P-rEd P-Ent HidE

When configured for d-Ent, the **P** key must be pressed to select the item for change before the F1 and F2 keys will increment or decrement the value.

LINE 2 BAND/DEVIATION ACCESS

bn-dn Ln2 LOC — LOC d-rEd d-Ent P-rEd P-Ent HidE

When configured for d-Ent, the **P** key must be pressed to select the item for change before the F1 and F2 keys will increment or decrement the value.

LINE 1 DISPLAY COLOR ACCESS

Color Ln2 LOC — LOC P-rEd P-Ent HidE

When configured for P-Ent, Line 1 Color can be selected in the Parameter Display by using the F1 and F2 keys while viewing Color.

DISPLAY INTENSITY ACCESS

d-LEU Ln2 LOC — LOC P-rEd P-Ent HidE

When configured for P-Ent, the display intensity can be selected in the Parameter Display by using the F1 and F2 keys while viewing d-LEU.

DISPLAY CONTRAST ACCESS

d-Cont Ln2 LOC — LOC P-rEd P-Ent HidE

When configured for P-Ent, the display contrast can be selected in the Parameter Display by using the F1 and F2 keys while viewing d-Cont.

LINE 2 USER FUNCTIONS ACCESSIBLE ITEMS

FUNCt Ln2 nO — YES nO

Select YES to display the following list of User functions that can be made available at the end of the Parameter (P-Ent) or Hidden (HidE) display loops. The more critical and frequently used Functions should be first assigned to the User Inputs and User Function keys. If more functions are needed than what can be obtained with User Inputs, this feature will provide a means to provide that access. Refer to module 2, 2-FUNCt for a description of the function.

rEL	bAt	r-tot	r-HI	r-Lo
r-HL	r-1	r-2	r-3	r-4
r-34	r-234	r-ALL	Print	

PROGRAMMING SECURITY CODE

COdE dSP 0 — 000 to 250

To activate either the Parameter or Hidden Parameter Display Loops, a security code (1-250) must be entered. If a "0" security code is programmed, pressing the **P** key takes you directly to the Full Programming Mode.

The Security Code determines the programming mode and the accessibility of programming parameters. This code can be used along with the Program Mode Lock-out (PLOC) in the User Input Function parameter (Module 2).

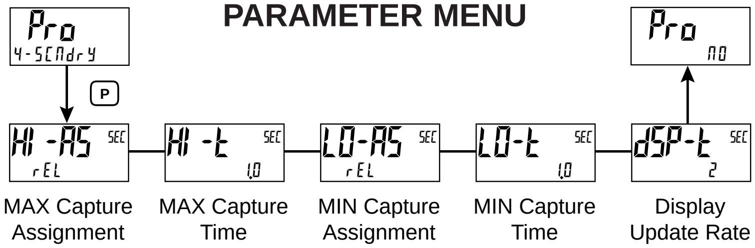
Two programming modes are available. Full Programming Mode allows all parameters to be viewed and modified. Parameter Display Loop mode provides access to those selected parameters, that can be viewed and/or modified without entering the Full programming mode.

The following chart indicates the levels of access based on various CodE and User Input PLOC settings.

SECURITY CODE	USER INPUT CONFIGURED	USER INPUT STATE	WHEN P KEY IS PRESSED	FULL PROGRAMMING MODE ACCESS
0	not PLOC	————	Full Programming	Immediate Access
>0	not PLOC	————	Enter Parameter Display Loop	After Parameter Display Loop with correct code # at COdE prompt.
>0	PLOC	Active	Enter Parameter Display Loop	After Parameter Display Loop with correct code # at COdE prompt.
>0	PLOC	Not Active	Full Programming	Immediate Access
0	PLOC	Active	Enter Parameter Display Loop	No Access
0	PLOC	Not Active	Full Programming	Immediate Access

MODULE 4 - SECONDARY FUNCTION PARAMETERS (4-SECndrY)

PARAMETER MENU



MAX CAPTURE ASSIGNMENT

HI-AS SEC rEL

rEL AbS

Select the desired parameter that will be assigned to the Max Capture.

MAX CAPTURE DELAY TIME

HI-t SEC 1.0

0.0 to 3275.0 seconds

When the Input Display is above the present MAX value for the entered delay time, the meter will capture that display value as the new MAX reading. A delay time helps to avoid false captures of sudden short spikes.

MIN CAPTURE ASSIGNMENT

LO-AS SEC rEL

rEL AbS

Select the desired parameter that will be assigned to the Min Capture.

MIN CAPTURE TIME

LO-t SEC 1.0

0.0 to 3275.0 seconds

When the Input Display is below the present MIN value for the entered delay time, the meter will capture that display value as the new MIN reading. A delay time helps to avoid false captures of sudden short spikes.

DISPLAY UPDATE RATE

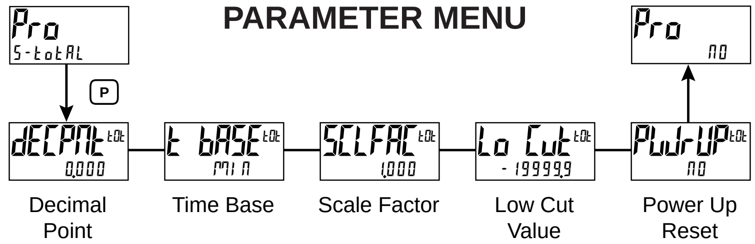
dSP-t SEC 2

1 2 5 10 20 updates/second

This parameter configures the display update rate. It does not affect the response time of the setpoint output or analog output option cards.

MODULE 5 - TOTALIZER (INTEGRATOR) PARAMETERS (5-totAL)

PARAMETER MENU



The totalizer accumulates (integrates) the Input Display value using one of two modes. The first is using a time base. This can be used to compute a time temperature product. The second is through a user input or function key programmed for Batch (one time add on demand). This can be used to provide a readout of temperature integration, useful in curing and sterilization applications. If the Totalizer is not needed, its display can be locked-out and this module can be skipped during programming.

TOTALIZER DECIMAL POINT

dECPNt tot 0.000   0   0.0   0.00   0.000   0.0000

For most applications, this matches the Input Display Decimal Point (dECPNt). If a different location is desired, refer to Totalizer Scale Factor.

TOTALIZER TIME BASE

t bASE tot min

SEC -seconds (/1)   min -minutes (/60)

hour -hours (/3600)   dAY -days (/86400)

This is the time base used in Totalizer accumulations. If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER SCALE FACTOR

SCLFAC tot 1.000   0.001 to 65.000

For most applications, the Totalizer reflects the same decimal point location and engineering units as the Input Display. In this case, the Totalizer Scale Factor is 1.000. The Totalizer Scale Factor can be used to scale the Totalizer to a value that is different than the Input Display. Common possibilities are:

1. Changing decimal point location (example tenths to whole)
2. Average over a controlled time frame.

Details on calculating the scale factor are shown later.

If the Totalizer is being accumulated through a user input programmed for Batch, then this parameter does not apply.

TOTALIZER LOW CUT VALUE

Lo Cut tot -1999.99   -199999 to 999999

A low cut value disables Totalizer when the Input Display value falls below the value programmed.

TOTALIZER POWER UP RESET

PWrUP tot NO

NO - do not reset buffer

YES - reset buffer

The Totalizer can be reset to zero on each meter power-up by setting this parameter to YES.

TOTALIZER BATCHING

The Totalizer Time Base and scale factor are overridden when a user input or function key is programmed for store batch (bAt). In this mode, when the user input or function key is activated, the Input Display reading is one time added to the Totalizer (batch). The Totalizer retains a running sum of each batch operation until the Totalizer is reset. This is useful in weighing operations, when the value to be added is not based on time but after a filling event.

TOTALIZER USING TIME BASE

Totalizer accumulates as defined by:

$$\frac{\text{Input Display x Totalizer Scale Factor}}{\text{Totalizer Time Base}}$$

Where:

Input Display - the present input reading
Totalizer Scale Factor - 0.001 to 65.000
Totalizer Time Base - (the division factor of tbASE)

Example: The input reading is at a constant rate of 10.0 gallons per minute. The Totalizer is used to determine how many gallons in tenths has flowed. Because the Input Display and Totalizer are both in tenths of gallons, the Totalizer Scale Factor is 1. With gallons per minute, the Totalizer Time Base is minutes (60). By placing these values in the equation, the Totalizer will accumulate every second as follows:

$$\frac{10.0 \text{ x } 1.000}{60} = 0.1667 \text{ gallon accumulates each second}$$

This results in:
10.0 gallons accumulates each minute
600.0 gallons accumulates each hour

TOTALIZER SCALE FACTOR CALCULATION EXAMPLES

1. When changing the Totalizer Decimal Point (dECPNt) location from the Input Display Decimal Point (dECPNt), the required Totalizer Scale Factor is multiplied by a power of ten.

Example:

Input (dECPNt) = 0

Totalizer dECPNt	Scale Factor
0.0	10
0	1
x10	0.1
x100	0.01
x1000	0.001

Input (dECPNt) = 0.0

Totalizer dECPNt	Scale Factor
0.00	10
0.0	1
0	0.1
x10	0.01
x100	0.001

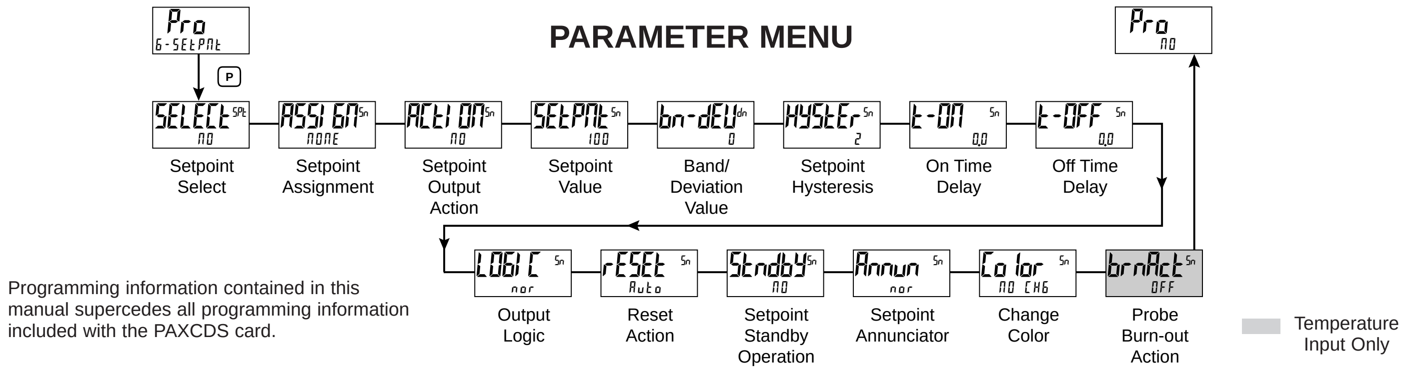
Input (dECPNt) = 0.00

Totalizer dECPNt	Scale Factor
0.000	10
0.00	1
0.0	0.1
0	0.01
x10	0.001

2. To obtain an average reading within a controlled time frame, the selected Totalizer Time Base is divided by the given time period expressed in the same timing units.

Example: Average temperature per hour in a 4 hour period, the scale factor would be 0.250. To achieve a controlled time frame, connect an external timer to a user input programmed for r-tot. The timer will control the start (reset) and the stopping (hold) of the totalizer.

MODULE 6 - SETPOINT OUTPUT PARAMETERS (6-SETPNT)



Programming information contained in this manual supercedes all programming information included with the PAXCDS card.

SETPOINT SELECT

SELECT SPt NO

NO S1 S2 S3 S4

Enter the setpoint (alarm output) to be programmed. The "n" in the following parameters will reflect the chosen setpoint number. After the chosen setpoint is completely programmed, the display will return to NO. Repeat step for each setpoint to be programmed. The NO chosen at SELECT SPt, will return to Pro NO. The number of setpoints available is setpoint output card dependent.

SETPOINT ASSIGNMENT

ASSIGN Sn NONE

NONE rEL AbS totAL

Selects the meter value to be used to trigger the Setpoint Alarm. The rEL setting will cause the setpoint to trigger off of the relative (net) input value. The relative input value is the absolute input value that includes the Display Offset Value. The AbS setting will cause the setpoint to trigger off of the absolute (gross) input value. The absolute input value is based on Module 1 dISPLY and INPUt entries.

SETPOINT ACTION

ACTION Sn NO

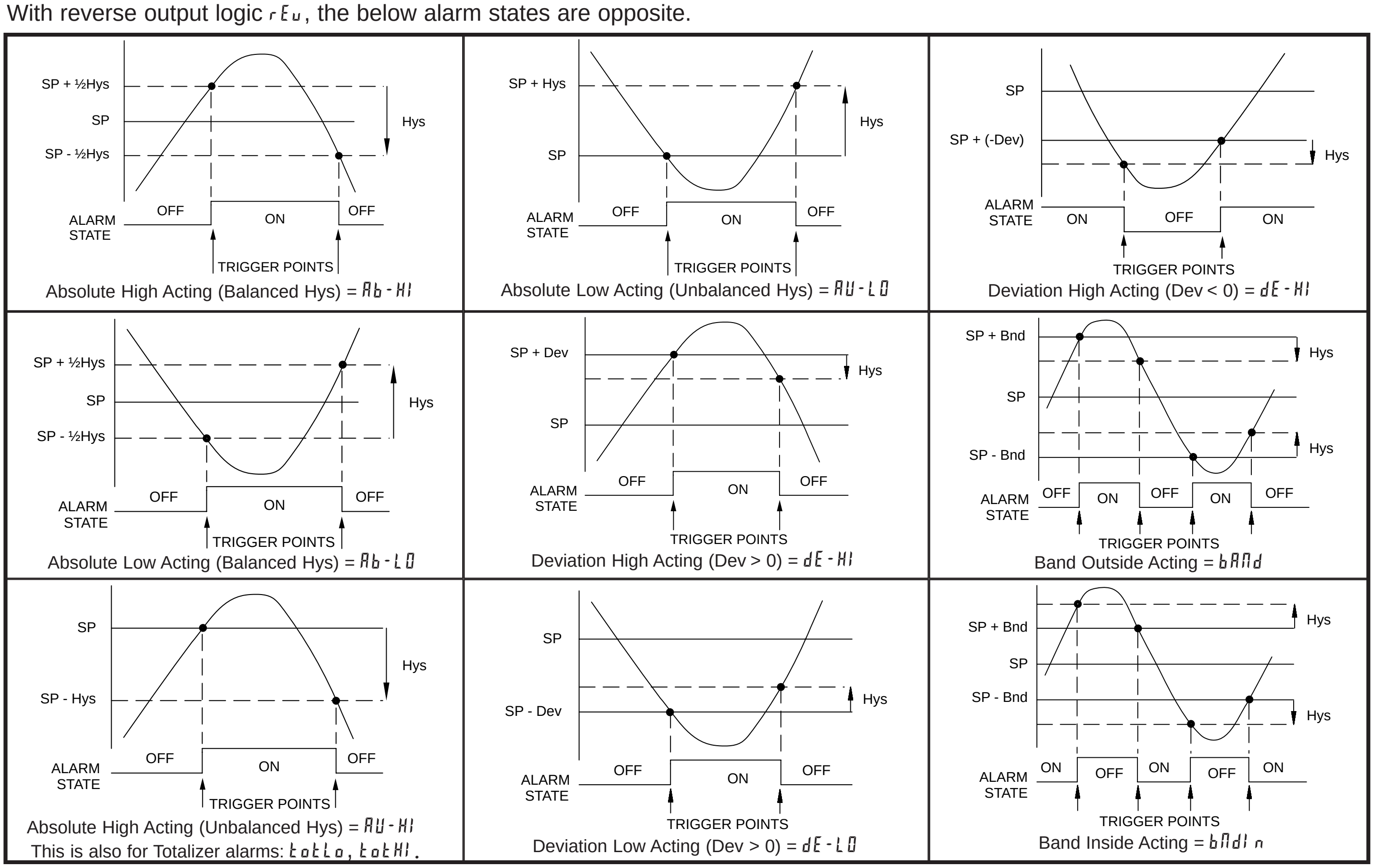
NO Ab-HI Ab-LO AU-HI AU-LO dE-HI dE-LO bAND bNdIn totLo totHI

Enter the action for the selected setpoint (alarm output). See Setpoint Alarm Figures for a visual detail of each action. The Setpoint Actions that pertains to the total is only active when the Setpoint Assignment is set to totAL.

- NO = No Setpoint Action
- Ab-HI = Absolute high, with balanced hysteresis
- Ab-LO = Absolute low, with balanced hysteresis
- AU-HI = Absolute high, with unbalanced hysteresis
- AU-LO = Absolute low, with unbalanced hysteresis
- dE-HI = deviation high, with unbalanced hysteresis
- dE-LO = deviation low, with unbalanced hysteresis
- bAND = Outside band, with unbalanced hysteresis
- bNdIn = Inside band, with unbalanced hysteresis
- totLo = Lower 6 digits of 9 digit Totalizer, with unbalanced hysteresis
- totHI = Upper 6 digits of 9 digit Totalizer, with unbalanced hysteresis

Setpoint Alarm Figures

With reverse output logic rEv, the below alarm states are opposite.



Absolute High Acting (Balanced Hys) = Ab-HI
Absolute Low Acting (Unbalanced Hys) = AU-LO
Deviation High Acting (Dev < 0) = dE-HI
Absolute Low Acting (Balanced Hys) = Ab-LO
Deviation High Acting (Dev > 0) = dE-HI
Band Outside Acting = bAND
Absolute High Acting (Unbalanced Hys) = AU-HI
This is also for Totalizer alarms: totLo, totHI.
Deviation Low Acting (Dev > 0) = dE-LO
Band Inside Acting = bNdIn

SETPOINT VALUE

SEtPNt Sn
100

-199999 to 999999

Enter desired setpoint alarm value. Setpoint values can also be entered in the Display Mode during Program Lockout when the setpoint is programmed as Ent in Parameter Module 3. The decimal point position is determined by the Setpoint Assignment value.

BAND/DEVIATION VALUE

bn-dEV dn
0

-199999 to 999999

This parameter is only available in band and deviation setpoint actions. Enter desired setpoint band or deviation value. When the Setpoint Action is programmed for Band, this value can only be a positive value.

HYSTERESIS VALUE

HYStEr Sn
2

1 to 65000

Enter desired hysteresis value. See Setpoint Alarm Figures for visual explanation of how setpoint alarm actions (balanced and unbalanced) are affected by the hysteresis. When the setpoint is a control output, usually balanced hysteresis is used. For alarm applications, usually unbalanced hysteresis is used. For unbalanced hysteresis modes, the hysteresis functions on the low side for high acting setpoints and functions on the high side for low acting setpoints. Note: Hysteresis eliminates output chatter at the switch point, while time delay can be used to prevent false triggering during process transient events.

ON TIME DELAY

t-ON Sn
0.0

0.0 to 3275.0 seconds

Enter the time value in seconds that the alarm is delayed from turning on after the trigger point is reached. A value of 0.0 allows the meter to update the alarm status per the response time listed in the Specifications. When the output logic is rEv, this becomes off time delay. Any time accumulated at power-off resets during power-up.

OFF TIME DELAY

t-OFF Sn
0.0

0.0 to 3275.0 seconds

Enter the time value in seconds that the alarm is delayed from turning off after the trigger point is reached. A value of 0.0 allows the meter to update the alarm status per the response time listed in the Specifications. When the output logic is rEv, this becomes on time delay. Any time accumulated at power-off resets during power-up.

OUTPUT LOGIC

LOGIC Sn
nor

nor rEv

Enter the output logic of the alarm output. The nor logic leaves the output operation as normal. The rEv logic reverses the output logic. In rEv, the alarm states in the Setpoint Alarm Figures are reversed.

RESET ACTION

rESEt Sn
Auto

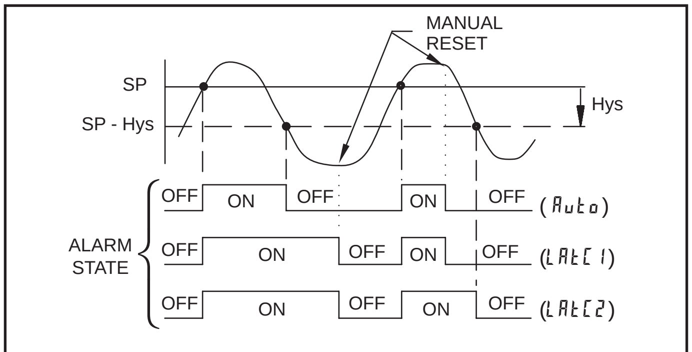
Auto LAtCh1 LAtCh2

Enter the reset action of the alarm output.

Auto = Automatic action; This action allows the alarm output to automatically reset off at the trigger points per the Setpoint Action shown in Setpoint Alarm Figures. The "on" alarm may be manually reset (off) immediately by a front panel function key or user input.The alarm remains reset off until the trigger point is crossed again.

LAtCh1 = Latch with immediate reset action; This action latches the alarm output on at the trigger point per the Setpoint Action shown in Setpoint Alarm Figures. Latch means that the alarm output can only be turned off by front panel function key or user input manual reset, serial reset command or meter power cycle. When the user input or function key is activated (momentary or maintained), the corresponding "on" alarm output is reset immediately and remains off until the trigger point is crossed again. (Previously latched alarms will be off if power up Display Value is lower than setpoint value.)

LAtCh2 = Latch with delay reset action; This action latches the alarm output on at the trigger point per the Setpoint Action shown in Setpoint Alarm Figures. Latch means that the alarm output can only be turned off by front panel function key or user input manual reset, serial reset command or meter power cycle. When the user input or function key is activated (momentary or maintained), the meter delays the event until the corresponding "on" alarm output crosses the trigger off point. (Previously latched alarms are off if power up Display Value is lower than setpoint value. During a power cycle, the meter erases a previous Latch 2 reset if it is not activated at power up.)



Setpoint Alarm Reset Actions

SETPOINT STANDBY OPERATION

Stndby Sn
NO

NO YES

When YES, the alarm is disabled (after a power up) until the trigger point is crossed. Once the alarm is on, the alarm operates normally per the Setpoint Action and Reset Mode.

SETPOINT ANNUNCIATOR

Annun Sn
nor

nor rEv FLASh OFF

The OFF mode disables display setpoint annunciators. The nor mode displays the corresponding setpoint annunciators of "on" alarm outputs. The rEv mode displays the corresponding setpoint annunciators of "off" alarms outputs. The FLASh mode flashes the corresponding setpoint annunciators of "on" alarm outputs.

LINE 1 CHANGE COLOR

Color Sn
NO CHG

NO CHG GrEEN OrANGE rEd
GrnOrG rEdOrG rEdGrn LINE 1

This parameter allows the Line 1 Display to change color, or alternate between two colors, when the alarm is activated. When multiple alarms are programmed to change color, the highest numbered active alarm (S4-S1) determines the display color.

The NO CHG selection will maintain the color displayed prior to the alarm activation. The LINE 1 selection sets the display to the Line 1 Display Color (Color), programmed in Module 3.

The following programming step is only available when Input Range in Module 1 is set for a temperature input (TC/RTD).

PROBE BURN-OUT ACTION

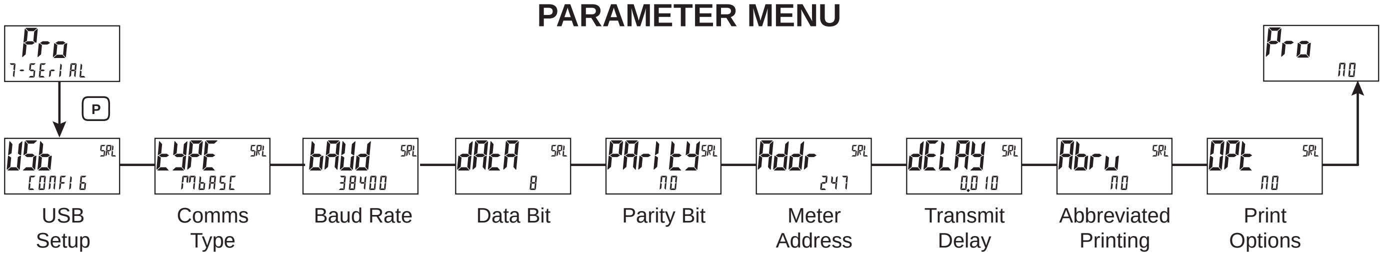
brnAct Sn
OFF

OFF ON

Enter the probe burn-out action. In the event of a temperature probe failure (TC open; RTD open or short), the output can be programmed to be on or off.

MODULE 7 - SERIAL COMMUNICATIONS PARAMETERS (7-SErIAL)

PARAMETER MENU



Programming information contained in this manual supercedes all programming information included with the PAXCDC card.

USB SETUP

USb — CONFIG — Port

CONFIG – Configures USB with settings required to operate with Crimson configuration software. This will automatically internally configure the PAX2A to use ModBus RTU protocol, 38400 baud, 8 bits, and unit address of 247 when a USB cable is attached to PAX2A and PC. The serial port settings shown in 7- SErIAL (this module) will not change, or show this.

Port – Configures USB to utilize serial settings and protocol as configured in "7- SErIAL" (this module).

COMMUNICATIONS TYPE

tYPE

- MbASC - ModBus ASCII
- rLC - RLC Protocol (ASCII)
- Mbrtu - ModBus RTU

Select the desired communications protocol. Modbus is preferred as it provides access to all meter values and parameters. Since the Modbus protocol is included within the PAX2A, the PAX Modbus option card, PAXCDC4, should not be used. The PAXCDC1 (RS485), or PAXCDC2 (RS232) card should be used instead.

BAUD RATE

bAUd

1200 4800 19200
2400 9600 38400

Set the baud rate to match the other serial communications equipment on the serial link. Normally, the baud rate is set to the highest value that all the serial equipment are capable of transmitting and receiving.

DATA BIT

dAtA

7 8

Select either 7 or 8 bit data word lengths. Set the word length to match the other serial communications equipment on the serial link.

PARITY BIT

PArItY

NO EVEN Odd

Set the parity bit to match that of the other serial communications equipment on the serial link. The meter ignores the parity when receiving data and sets the parity bit for outgoing data. If no parity is selected with 7 bit word length, an additional stop bit is used to force the frame size to 10 bits.

METER UNIT ADDRESS

Addr

- 0 to 99 - RLC Protocol
- 1 to 247 - ModBus

Select a Unit Address that does not match an address number of any other equipment on the serial link.

TRANSMIT DELAY

dELAY

0.000 to 0.250 seconds

Following a transmit value ("*" terminator) or Modbus command, the PAX2A will wait this minimum amount of time in seconds before issuing a serial response

---

The following programming steps are only available when Communications Type (tYPE) is programmed for rLC.

ABBREVIATED PRINTING

Abrv

NO YES

Select YES for full print or Command T transmissions (meter address, mnemonics and parameter data) or NO for abbreviated print transmissions (parameter data only). This will affect all the parameters selected in the print options. If the meter address is 00, it will not be sent during a full transmission.

PRINT OPTIONS

OPt

NO YES

YES - Enters the sub-menu to select the meter parameters to appear during a print request. For each parameter in the sub-menu, select YES for that parameter information to be sent during a print request or NO for that parameter information not to be sent. A print request is sometimes referred to as a block print because more than one parameter information (meter address, mnemonics and parameter data) can be sent to a printer or computer as a block.

DISPLAY	DESCRIPTION	FACTORY SETTING	MNEMONIC
INPUt	Signal Input	YES	INP
totAL	Total Value	NO	TOT
HI LO	Max & Min	NO	MAX, MIN
SPNt	Setpoint Values	NO	SP1-SP4

SERIAL COMMUNICATIONS

The PAX2A supports serial communications using the optional serial communication cards or via the USB programming port located on the side of the unit. When USB is being used (connected), the serial communication card is disabled. When using the standard RS232 and RS485 Pax option cards, the PAX2A supports both the RLC protocol and also supports ModBus communications. The Pax ModBus option card should not be used with the PAX2A, as the PAX2A internal ModBus protocol supports complete unit configuration, and is much more responsive.

USB

The USB programming port is primarily intended to be used to configure the PAX2A with the Crimson programming software. It can also, be used as a virtual serial communications port following installation of the PAX2A USB drivers that are supplied with the Crimson software. When the USB port is being used, i.e. the USB cable is connected between PAX2A and PC, all serial communications with the serial option card (if used) is disabled.

USB Cable type required: USB A to Mini-B (not supplied)

PAX2A CONFIGURATION USING CRIMSON AND USB

1. Install Crimson software.
2. Supply power to PAX2A
3. Insure "USB" parameter in module 7-SERIAL, is set to "CONFIG" (factory default setting).
4. Attach USB A – MiniB cable between PC and PAX2A
5. Create a new (File, New) or open an existing PAX2A database within Crimson.
6. Configure Crimson 2 Link, Options to the serial port the communication cable is attached (in Step 4).

SERIAL MODBUS COMMUNICATIONS

Modbus Communications requires that the Serial Communication Type Parameter (tYPE) be set to "MbrtU" or "MbASC".

PAX2A CONFIGURATION USING CRIMSON AND SERIAL COMMUNICATIONS CARD

1. Install Crimson software.
2. Install RS232 or RS485 card and connect communications cable from PAX2A to PC.
3. Supply power to PAX2A
4. Configure serial parameters in 7-SERIAL to MbrtU, 38,400 baud, address 247.
5. Create a new (File, New) or open an existing PAX2A database within Crimson.
6. Configure Crimson 2 Link, Options to the serial port the comunication cable is attached (in step 2).

SUPPORTED FUNCTION CODES

FC03: Read Holding Registers

1. Up to 32 registers can be requested at one time.
2. HEX <8000> is returned for non-used registers.

FC04: Read Input Registers

1. Up to 32 registers can be requested at one time.
2. Block starting point can not exceed register boundaries.
3. HEX <8000> is returned in registers beyond the boundaries.
4. Input registers are a mirror of Holding registers.

FC06: Preset Single Register

1. HEX <8001> is echoed back when attempting to write to a read only register.
2. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit. It is also returned in the response.

FC16: Preset Multiple Registers

1. No response is given with an attempt to write to more than 32 registers at a time.
2. Block starting point cannot exceed the read and write boundaries (40001-41280).
3. If a multiple write includes read only registers, then only the write registers will change.
4. If the write value exceeds the register limit (see Register Table), then that register value changes to its high or low limit.

FC08: Diagnostics

The following is sent upon FC08 request:

Module Address, 08 (FC code), 04 (byte count), "Total Comms" 2 byte count, "Total Good Comms" 2 byte count, checksum of the string

"Total Comms" is the total number of messages received that were addressed to the PAX2. "Total Good Comms" is the total messages received by the PAX2A with good address, parity and checksum. Both counters are reset to 0 upon response to FC08 and at power-up.

FC17: Report Slave ID

The following is sent upon FC17 request:

RLC-PAX2A ab<0100h><20h><20h><10h>
a = SP Card, "0"-No SP, "2" or "4" SP
b = Linear Card "0" = None, "1" = Yes
<0100> Software Version Number (1.00)
<20h>Max Register Reads (32)
<20h>Max Register Writes (32)
<10h> Number Guid/Scratch Pad Regs (16)

SUPPORTED EXCEPTION CODES

01: Illegal Function

Issued whenever the requested function is not implemented in the meter.

02: Illegal Data Address

Issued whenever an attempt is made to access a single register that does not exist (outside the implemented space) or to access a block of registers that falls completely outside the implemented space.

03: Illegal Data Value

Issued when an attempt is made to read or write more registers than the meter can handle in one request.

07: Negative Acknowledge

Issued when a write to a register is attempted with an invalid string length.

PAX2A MODBUS REGISTER TABLE

The below limits are shown as Integers or HEX < > values. Read and write functions can be performed in either Integers or Hex as long as the conversion was done correctly. Negative numbers are represented by two's complement.

Note 1: The PAX2A should not be powered down while parameters are being changed. Doing so may corrupt the non-volatile memory resulting in checksum errors.

REGISTER ADDRESS		REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
		FREQUENTLY USED REGISTERS					
40001		Input Relative Value (Hi word)	N/A	N/A	N/A	Read Only	Process value of present input level. This value is affected by Input Type, Resolution, Scaling, & Offset Value. (Relative Value = Absolute Input Value + Offset Value)
40002		Input Relative Value (Lo word)					
40003		Maximum Value (Hi word)	-199999	999999	N/A	Read/Write	
40004		Maximum Value (Lo word)					
40005		Minimum Value (Hi word)	-199999	999999	N/A	Read/Write	
40006		Minimum Value (Lo word)					
40007		Total Value (Hi word)	-199999999	999999999	N/A	Read/Write	
40008		Total Value (Lo word)					
40009		Setpoint 1 Value (Hi word)	-199999	999999	100	Read/Write	Active List (A or B)
40010		Setpoint 1 Value (Lo word)					
40011		Setpoint 2 Value (Hi word)	-199999	999999	200	Read/Write	Active List (A or B)
40012		Setpoint 2 Value (Lo word)					
40013		Setpoint 3 Value (Hi word)	-199999	999999	300	Read/Write	Active List (A or B)
40014		Setpoint 3 Value (Lo word)					
40015		Setpoint 4 Value (Hi word)	-199999	999999	400	Read/Write	Active List (A or B)
40016		Setpoint 4 Value (Lo word)					
40017		Setpoint 1 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Active List (A or B). Applicable only for Band or Deviation Setpoint Action.
40018		Setpoint 1 Band/Dev. Value (Lo word)					
40019		Setpoint 2 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Active List (A or B). Applicable only for Band or Deviation Setpoint Action.
40020		Setpoint 2 Band/Dev. Value (Lo word)					
40021		Setpoint 3 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Active List (A or B). Applicable only for Band or Deviation Setpoint Action.
40022		Setpoint 3 Band/Dev. Value (Lo word)					
40023		Setpoint 4 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Active List (A or B). Applicable only for Band or Deviation Setpoint Action.
40024		Setpoint 4 Band/Dev. Value (Lo word)					
40025		Setpoint Output Register (SOR)	0	15	N/A	Read/Write	Status of Setpoint Outputs. Bit State: 0 = Off, 1 = On. Bit 3 = S1, Bit 2 = S2, Bit 1 = S3, Bit 0 = S4. Outputs can only be activated/reset with this register when the respective bits in the Manual Mode Register (MMR) are set.
40026		Manual Mode Register (MMR)	0	31	0	Read/Write	Bit State: 0 = Auto Mode, 1 = Manual Mode Bit 4 = S1, Bit 3 = S2, Bit 2 = S3, Bit 1 = S4, Bit 0 = Linear Output
40027		Reset Output Register	0	15	0	Read/Write	Bit State: 1 = Reset Output, bit is returned to zero following reset processing; Bit 3 = S1, Bit 2 = S2, Bit 1 = S3, Bit 0 = S4
40028		Analog Output Register (AOR)	0	4095	0	Read/Write	Linear Output Card written to only if Linear Output is in Manual Mode.(MMR bit 0 = 1)
40029		Input Absolute Value (Hi word)	N/A	N/A	N/A	Read Only	Gross value of present Input level. This value is affected by Input Type, Resolution, Scaling, but not affected by Offset Value
40030		Input Absolute Value (Lo word)					
40031		Input Offset Value (Hi word)	-199999	999999	0	Read/Write	Input Offset Value plus the Input Absolute Value equals the Relative Input Value (standard meter value).
40032		Input Offset Value (Lo word)					
		INPUT PARAMETERS					**SEE MODULE 1 FOR PARAMETER DESCRIPTIONS**
40081		Input Range	0	26	10	Read/Write	0 = 250µA 5 = 250mV 11 = 100Ω 17 = TC-K 23 = RTD 385 1 = 2.5mA 6 = 2V 12 = 1KΩ 18 = TC-R 24 = RTD 392 2 = 25mA 7 = 10V 13 = 10KΩ 19 = TC-S 25 = RTD 672 3 = 250mA 8 = 25V 14 = TC-T 20 = TC-B 26 = RTD 427 4 = 2A 9 = 100V 15 = TC-E 21 = TC-N 10 = 200V 16 = TC-J 22 = TC-C
40082		Temperature Scale (TC or RTD only)	0	1	1	Read/Write	0 = °C, 1 = °F
40083		Ice Point Compensation (TC only)	0	1	1	Read/Write	0 = Off, 1 = On
40084		ADC Conversion Rate (samples/sec)	0	5	0	Read/Write	0 = 5, 1 = 10, 2 = 20, 3 = 40, 4 = 80, 5 = 160
40085		Decimal Point	0	4	2	Read/Write	0 = 0, 1 = 0.0, 2 = 0.00, 3 = 0.000, 4 = 0.0000
40086		Rounding Factor	0	6	0	Read/Write	0 = 1, 1 = 2, 2 = 5, 3 = 10, 4 = 20, 5 = 50, 6 = 100
40087		Digital Input Filter	0	250	10	Read/Write	1 = 0.1 Second
40088		Filter Band	0	250	10	Read/Write	1 = 1 display unit
40089		Input Scaling Points in List Function	0	1	0	Read/Write	0 = No, 1 = Yes
List A	List B	**Input Scaling Points Parameters**					
40101	40201	Number of Scaling Points	2	16	2	Read/Write	Number of Linearization Scaling Points
40102	40202	Reserved	N/A	N/A	N/A	N/A	
40103	40203	Scaling Pt.1 Input Value (Hi word)	-199999	999999	0	Read/Write	1 = 1 in least significant digit (Input Range dependant)
40104	40204	Scaling Pt.1 Input Value (Lo word)					

REGISTER ADDRESS		REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
40105	40205	Scaling Pt.1 Display Value (Hi word)	-199999	999999	0	Read/Write	1 = 1 display unit (disregard decimal point)
40106	40206	Scaling Pt.1 Display Value (Lo word)					
thru	thru	Scaling Pts. 2 thru 15 Values	…	…	…	…	Registers 40107-40162 and 40207-40262 hold values for Scaling Points 2 thru 15, and follow the same ordering as Scaling Point 1.
40163	40263	Scaling Pt.16 Input Value (Hi word)	-199999	999999	0	Read/Write	1 = 1 in least significant digit (Input Range dependant)
40164	40264	Scaling Pt.16 Input Value (Lo word)					
40165	40265	Scaling Pt.16 Display Value (Hi word)	-199999	999999	0	Read/Write	1 = 1 display unit (disregard decimal point)
40166	40266	Scaling Pt.16 Display Value (Lo word)					
List A	List B	**Setpoint Values**					
40167	40267	Setpoint 1 Value (Hi word)	-199999	999999	100	Read/Write	1 = 1 display unit (disregard decimal point)
40168	40268	Setpoint 1 Value (Lo word)					
40169	40269	Setpoint 2 Value (Hi word)	-199999	999999	200	Read/Write	1 = 1 display unit (disregard decimal point)
40170	40270	Setpoint 2 Value (Lo word)					
40171	40271	Setpoint 3 Value (Hi word)	-199999	999999	300	Read/Write	1 = 1 display unit (disregard decimal point)
40172	40272	Setpoint 3 Value (Lo word)					
40173	40273	Setpoint 4 Value (Hi word)	-199999	999999	400	Read/Write	1 = 1 display unit (disregard decimal point)
40174	40274	Setpoint 4 Value (Lo word)					
40175	40275	Setpoint 1 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Applicable only for Band or Deviation Setpoint Action.
40176	40276	Setpoint 1 Band/Dev. Value (Lo word)					
40177	40277	Setpoint 2 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Applicable only for Band or Deviation Setpoint Action.
40178	40278	Setpoint 2 Band/Dev. Value (Lo word)					
40179	40279	Setpoint 3 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Applicable only for Band or Deviation Setpoint Action.
40180	40280	Setpoint 3 Band/Dev. Value (Lo word)					
40181	40281	Setpoint 4 Band/Dev. Value (Hi word)	-199999	999999	0	Read/Write	Applicable only for Band or Deviation Setpoint Action.
40182	40282	Setpoint 4 Band/Dev. Value (Lo word)					
		USER INPUT / FUNCTION KEYS					SEE MODULE 2 FOR PARAMETER DESCRIPTIONS
40301		User Input Active State	0	1	0	Read/Write	0 = Active Low, 1 = Active High
40302		User Input 1 Action	0	28	0	Read/Write	0 = NO 8 = d-tot 16 = r-HL 24 = r-4 1 = PLOC 9 = r-tot1 17 = dISP 25 = r-34 2 = rEL 10 = r-tot2 18 = d-LEV 26 = r-234 3 = d-rEL 11 = E-tot 19 = Color 27 = r-ALL 4 = d-HLd 12 = d-HI 20 = LISt 28 = Print 5 = A-HLd 13 = r-HI 21 = r-1 6 = SYNC 14 = d-Lo 22 = r-2 7 = bAt 15 = r-Lo 23 = r-3
40303		User Input 2 Action	0	28	0	Read/Write	Same as User Input 1 Action
40304		User F1 Key Action	0	17	0	Read/Write	0 = NO 5 = r-HI 10 = r-1 15 = r-234 1 = rEL 6 = r-Lo 11 = r-2 16 = r-ALL 2 = d-rEL 7 = r-HL 12 = r-3 17 = Print 3 = bAt 8 = d-LEV 13 = r-4 4 = r-tot 9 = LISt 14 = r-34
40305		User F2 Key Action	0	17	0	Read/Write	Same as User F1 Key Action
40306		User F1 Second Action	0	17	0	Read/Write	Same as User F1 Key Action
40307		User F2 Second Action	0	17	0	Read/Write	Same as User F1 Key Action
		DISPLAY PARAMETERS					SEE MODULE 3 FOR PARAMETER DESCRIPTIONS
40331		Line 1 Display Color	0	2	0	Read/Write	0 = Green, 1 = Red, 2 = Orange
40332		Display Intensity Level	0	4	4	Read/Write	0 = Min.(off), 4 = Max.
40333		Display Contrast Level	0	15	7	Read/Write	
40334		Line 1 Display	0	8	1	Read/Write	0 = None, 1 = Input, 2 = Total, 3 = Hi, 4 = Lo, 5 = S1, 6 = S2, 7 = S3, 8 = S4
40335		Units Mnemonic	0	1	0	Read/Write	0 = Off, 1 = List
40336		Units Digit 1 (Left)	0	46	0	Read/Write	0 = _ 7 = G 14 = O 21 = V 28 = 4 35 = e 42 = r 1 = A 8 = H 15 = P 22 = Y 29 = 5 36 = g 43 = u 2 = b 9 = I 16 = Q 23 = Z 30 = 6 37 = h 44 = - 3 = C 10 = J 17 = R 24 = 0 31 = 7 38 = i 45 = ° 4 = d 11 = K 18 = S 25 = 1 32 = 8 39 = n 46 = 5 = E 12 = L 19 = t 26 = 2 33 = 9 40 = o 6 = F 13 = M 20 = U 27 = 3 34 = c 41 = q
40337		Units Digit 2 (Center)	0	46	0	Read/Write	Same selections as Digit 1
40338		Units Digit 3 (Right)	0	46	0	Read/Write	Same selections as Digit 1
40339		Line 2 Input Display Access	0	2	0	Read/Write	0=LOC, 1=d-rEd, 2=d-Ent
40340		Line 2 Totalizer Display Access	0	2	0	Read/Write	0=LOC, 1=d-rEd, 2=d-Ent
40341		Line 2 Maximum (Hi) Value Access	0	2	0	Read/Write	0=LOC, 1=d-rEd, 2=d-Ent
40342		Line 2 Minimum (Lo) Value Access	0	2	0	Read/Write	0=LOC, 1=d-rEd, 2=d-Ent
40343		Line 2 List Selection Access	0	5	0	Read/Write	0=LOC, 1=d-rEd, 2=d-ENt, 3=P-rEd, 4=P-ENt, 5=HidE
40344		Line 2 Setpoint 1 Value Access	0	5	0	Read/Write	0=LOC, 1=d-rEd, 2=d-ENt, 3=P-rEd, 4=P-ENt, 5=HidE
40345		Line 2 S1 Band/Dev. Value Access	0	5	0	Read/Write	0=LOC, 1=d-rEd, 2=d-ENt, 3=P-rEd, 4=P-ENt, 5=HidE
40346		Line 2 Setpoint 2 Value Access	0	5	0	Read/Write	0=LOC, 1=d-rEd, 2=d-ENt, 3=P-rEd, 4=P-ENt, 5=HidE
40347		Line 2 S2 Band/Dev.Value Access	0	5	0	Read/Write	0=LOC, 1=d-rEd, 2=d-ENt, 3=P-rEd, 4=P-ENt, 5=HidE

REGISTER ADDRESS	REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
40348	Line 2 Setpoint 3 Value Access	0	5	0	Read/Write	0=LOC, 1=d-rEd, 2=d-ENt, 3=P-rEd, 4=P-ENt, 5=HidE
40349	Line 2 S3 Band/Dev.Value Access	0	5	0	Read/Write	0=LOC, 1=d-rEd, 2=d-ENt, 3=P-rEd, 4=P-ENt, 5=HidE
40350	Line 2 Setpoint 4 Value Access	0	5	0	Read/Write	0=LOC, 1=d-rEd, 2=d-ENt, 3=P-rEd, 4=P-ENt, 5=HidE
40351	Line 2 S4 Band/Dev.Value Access	0	5	0	Read/Write	0=LOC, 1=d-rEd, 2=d-ENt, 3=P-rEd, 4=P-ENt, 5=HidE
40352	Reserved	N/A	N/A	N/A	N/A	
40353	Reserved	N/A	N/A	N/A	N/A	
40354	Reserved	N/A	N/A	N/A	N/A	
40355	Reserved	N/A	N/A	N/A	N/A	
40356	Line 2 Display Color Access	0	3	0	Read/Write	0=LOC, 1=P-rEd, 2=P-ENt, 3=HidE
40357	Line 2 Display Intensity Level Access	0	3	0	Read/Write	0=LOC, 1=P-rEd, 2=P-ENt, 3=HidE
40358	Line 2 Display Contrast Level Access	0	3	0	Read/Write	0=LOC, 1=P-rEd, 2=P-ENt, 3=HidE
40359	Line 2 Zero (Tare) Display Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40360	Line 2 Batch Input to Totalizer Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40361	Line 2 Reset Totalizer Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40362	Line 2 Reset Max (Hi) Display Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40363	Line 2 Reset Min (Lo) Display Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40364	Line 2 Reset Max and Min Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40365	Line 2 Reset Alarm 1 Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40366	Line 2 Reset Alarm 2 Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40367	Line 2 Reset Alarm 3 Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40368	Line 2 Reset Alarm 4 Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40369	Line 2 Reset Alarm 3 and 4 Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40370	Line 2 Reset Alarm 2, 3 and 4 Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40371	Line 2 Reset All Alarms (1-4) Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40372	Line 2 Print Request Access	0	2	0	Read/Write	0=LOC, 1=P-ENt, 2=HidE
40373	Line 2 Security Code Value	0	250	0	Read/Write	
	SECONDARY PARAMETERS					SEE MODULE 4 FOR PARAMETER DESCRIPTIONS
40381	Max (Hi) Capture Value Assignment	0	1	0	Read/Write	0 = Relative, 1 = Absolute
40382	Max (Hi) Capture Delay Time	0	32750	10	Read/Write	0 = Max Update Rate, 1 = 0.1Sec
40383	Min (Lo) Capture Value Assignment	0	1	0	Read/Write	0 = Relative, 1 = Absolute
40384	Min (Lo) Capture Delay Time	0	32750	10	Read/Write	0 = Max Update Rate, 1 = 0.1Sec
40385	Display Update (readings per second)	0	4	0	Read/Write	0 = 1, 1 = 2, 2 = 5, 3 = 10, 4 = 20
	TOTALIZER PARAMETERS					SEE MODULE 5 FOR PARAMETER DESCRIPTIONS
40391	Totalizer Decimal Point	0	4	3	Read/Write	0 = 0, 1 = 0.0, 2 = 0.00, 3 = 0.000, 4 = 0.0000
40392	Totalizer Time Base	0	3	1	Read/Write	0 = Second, 1 = Minute, 2 = Hour, 3 = Day
40393	Totalizer Scale Factor	1	65000	1000	Read/Write	1 = 0.001
40394	Totalizer Reset at Power Up	0	1	0	Read/Write	0 = No, 1 = Yes
40395	Totalizer Low Cut Value (Hi word)	-199999	999999	-199999	Read/Write	
40396	Totalizer Low Cut Value (Lo word)					
	SETPOINT PARAMETERS					SEE MODULE 6 FOR PARAMETER DESCRIPTIONS
	Setpoint 1					
40401	Assignment	0	3	0	Read/Write	0 = None, 1 = Rel, 2 = Abs, 3 = Total
40402	Action	0	10	0	Read/Write	0=No, 1=Ab-HI, 2=Ab-LO, 3=AU-HI, 4=AU-LO, 5=dE-HI, 6=dE-LO, 7=bANd, 8=bNdIn, 9=totLo, 10=totHI
40403	Hysteresis Value	1	65000	2	Read/Write	1 = 1 Display Unit
40404	On Time Delay	0	32750	0	Read/Write	1 = 0.1 Second
40405	Off Time Delay	0	32750	0	Read/Write	1 = 0.1 Second
40406	Output Logic	0	1	0	Read/Write	0 = Normal, 1 = Reverse
40407	Reset Action	0	2	0	Read/Write	0 = Auto, 1 = Latch1, 2 = Latch2
40408	Standby Operation	0	1	0	Read/Write	0 = No, 1 = Yes
40409	Annunciator	0	3	1	Read/Write	0 = Off, 1 = Normal, 2 = Reverse, 3 = Flash
40410	Color	0	7	0	Read/Write	0 = No Change, 1 = Green, 2 = Orange, 3 = Red, 4 = Grn/Org, 5 = Red/Org, 6 = Red/Grn, 7 = Line 1 Color
40411	Probe Failure Action (TC or RTD only)	0	1	0	Read/Write	0 = Off, 1 = On (only applies for TC or RTD input)
	Setpoint 2					
40421	Assignment	0	3	0	Read/Write	0 = None, 1 = Rel, 2 = Abs, 3 = Total
40422	Action	0	10	0	Read/Write	0=No, 1=Ab-HI, 2=Ab-LO, 3=AU-HI, 4=AU-LO, 5=dE-HI, 6=dE-LO, 7=bANd, 8=bNdIn, 9=totLo, 10=totHI
40423	Hysteresis Value	1	65000	2	Read/Write	1 = 1 Display Unit
40424	On Time Delay	0	32750	0	Read/Write	1 = 0.1 Second
40425	Off Time Delay	0	32750	0	Read/Write	1 = 0.1 Second
40426	Output Logic	0	1	0	Read/Write	0 = Normal, 1 = Reverse
40427	Reset Action	0	2	0	Read/Write	0 = Auto, 1 = Latch1, 2 = Latch2

REGISTER ADDRESS	REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
40428	Standby Operation	0	1	0	Read/Write	0 = No, 1 = Yes
40429	Annunciator	0	3	1	Read/Write	0 = Off, 1 = Normal, 2 = Reverse, 3 = Flash
40430	Color	0	7	0	Read/Write	0 = No Change, 1 = Green, 2 = Orange, 3 = Red, 4 = Grn/Org, 5 = Red/Org, 6 = Red/Grn, 7 = Line 1 Color
40431	Probe Failure Action (TC or RTD only)	0	1	0	Read/Write	0 = Off, 1 = On (only applies for TC or RTD input)
	Setpoint 3					
40441	Assignment	0	3	0	Read/Write	0 = None, 1 = Rel, 2 = Abs, 3 = Total
40442	Action	0	10	0	Read/Write	0=No, 1=Ab-HI, 2=Ab-LO, 3=AU-HI, 4=AU-LO, 5=dE-HI, 6=dE-LO, 7=bANd, 8=bNdIn, 9=totLo, 10=totHI
40443	Hysteresis Value	1	65000	2	Read/Write	1 = 1 Display Unit
40444	On Time Delay	0	32750	0	Read/Write	1 = 0.1 Second
40445	Off Time Delay	0	32750	0	Read/Write	1 = 0.1 Second
40446	Output Logic	0	1	0	Read/Write	0 = Normal, 1 = Reverse
40447	Reset Action	0	2	0	Read/Write	0 = Auto, 1 = Latch1, 2 = Latch2
40448	Standby Operation	0	1	0	Read/Write	0 = No, 1 = Yes
40449	Annunciator	0	3	1	Read/Write	0 = Off, 1 = Normal, 2 = Reverse, 3 = Flash
40450	Color	0	7	0	Read/Write	0 = No Change, 1 = Green, 2 = Orange, 3 = Red, 4 = Grn/Org, 5 = Red/Org, 6 = Red/Grn, 7 = Line 1 Color
40451	Probe Failure Action (TC or RTD only)	0	1	0	Read/Write	0 = Off, 1 = On (only applies for TC or RTD input)
	Setpoint 4					
40461	Assignment	0	3	0	Read/Write	0 = None, 1 = Rel, 2 = Abs, 3 = Total
40462	Action	0	10	0	Read/Write	0=No, 1=Ab-HI, 2=Ab-LO, 3=AU-HI, 4=AU-LO, 5=dE-HI, 6=dE-LO, 7=bANd, 8=bNdIn, 9=totLo, 10=totHI
40463	Hysteresis Value	1	65000	2	Read/Write	1 = 1 Display Unit
40464	On Time Delay	0	32750	0	Read/Write	1 = 0.1 Second
40465	Off Time Delay	0	32750	0	Read/Write	1 = 0.1 Second
40466	Output Logic	0	1	0	Read/Write	0 = Normal, 1 = Reverse
40467	Reset Action	0	2	0	Read/Write	0 = Auto, 1 = Latch1, 2 = Latch2
40468	Standby Operation	0	1	0	Read/Write	0 = No, 1 = Yes
40469	Annunciator	0	3	1	Read/Write	0 = Off, 1 = Normal, 2 = Reverse, 3 = Flash
40470	Color	0	7	0	Read/Write	0 = No Change, 1 = Green, 2 = Orange, 3 = Red, 4 = Grn/Org, 5 = Red/Org, 6 = Red/Grn, 7 = Line 1 Color
40471	Probe Failure Action (TC or RTD only)	0	1	0	Read/Write	0 = Off, 1 = On (only applies for TC or RTD input)
	SERIAL COMMUNICATIONS PARAMETERS					SEE MODULE 7 FOR PARAMETER DESCRIPTIONS
40481	USB Mode	0	1	0	Read/Write	0 = Configuration, 1 = Port
40482	Type	0	2	2	Read/Write	0 = RLC Protocol (ASCII), 1 = Modbus RTU, 2 = Modbus ASCII
40483	Baud Rate	0	5	5	Read/Write	0=1200, 1=2400, 2=4800, 3=9600, 4=19200, 5=38400
40484	Data Bits	0	1	1	Read/Write	0 = 7 Bits, 1 = 8 Bits
40485	Parity	0	2	0	Read/Write	0 = None, 1 = Even, 2 = Odd
40486	Address	0	99	247	Read/Write	RLC Protocol: 0-99
		1	247			Modbus: 1-247
40487	Transmit Delay	0	250	10	Read/Write	1 = 0.001 Second
40488	Abbreviated Transmission (RLC only)	0	1	0	Read/Write	0 = No, 1 = Yes (Not used when communications type is Modbus)
40489	Print Options (RLC only)	0	15	1	Read/Write	0 = No, 1 = Yes (Not used when communications type is Modbus) Bit 0 – Print Input Value, Bit 1 – Print Total Value, Bit 2 – Print Max & Min Values, Bit 3 – Print Setpoint Values
40490	Load Serial Settings	0	1	0	Read/Write	Changing 40481-40487 will not update the PAX2A until this register is written with a 1. After the write, the communicating device must be changed to new PAX2A settings and this register returns to 0.
	ANALOG OUTPUT PARAMETERS					SEE MODULE 8 FOR PARAMETER DESCRIPTIONS
40491	Type	0	2	1	Read/Write	0 = 0-20 mA, 1 = 4-20 mA, 2 = 0-10 V
40492	Assignment	0	9	0	Read/Write	0=NONE, 1=rEL, 2=AbS, 3=tOtAL, 4=HI, 5=LO, 6=S1, 7=S2, 8=S3, 9=S4
40493	Analog Low Scale Value (Hi word)	-199999	999999	0	Read/Write	Display value that corresponds with 0 V, 0 mA or 4 mA output
40494	Analog Low Scale Value (Lo word)					
40495	Analog High Scale Value (Hi word)	-199999	999999	10000	Read/Write	Display value that corresponds with 10 V or 20 mA output
40496	Analog High Scale Value (Lo word)					
40497	Update time	0	100	0	Read/Write	0 = Max update rate, 1 = 0.1 Second
40498	Probe Failure Action (TC or RTD only)	0	1	0	Read/Write	0 = Low Scale, 1 = High Scale (only applies for TC or RTD input)

REGISTER ADDRESS	REGISTER NAME	LOW LIMIT	HIGH LIMIT	FACTORY SETTING	ACCESS	COMMENTS
	FACTORY SERVICE					
40501-40506	Factory Service Registers	N/A	N/A	N/A	Read/Write	Factory Use Only - Do Not Modify
41001-41010	Slave ID	N/A	N/A	N/A	Read Only	RLC-PAX2A <a><b><0100h><0020h><0020h><0010h> <a> = SP Card Status. "0"-No Card, "2"-Dual SP, "4"-Quad SP <b> = Linear Card Status. "0"-Not Installled, "1"-Installed <0100h> = Version Number (1.00 or higher) <0020h><0020h> = 32 Register Writes, 32 Register Reads (Max.) <0010h> = 16 Register GUID/Scratch
41101-41116	GUID/Scratch	N/A	N/A	N/A	Read/Write	Reserved (may be used in future RLC software)

SERIAL RLC PROTOCOL COMMUNICATIONS

RLC Communications requires the Serial Communications Type Parameter (tYPE) be set to "rLC".

SENDING SERIAL COMMANDS AND DATA TO THE METER

When sending commands to the meter, a string containing at least one command character must be constructed. A command string consists of a command character, a value identifier, numerical data (if writing data to the meter) followed by a command terminator character * or $.

Command Chart

COMMAND	DESCRIPTION	NOTES
N	Node Address Specifier	Address a specific meter. Must be followed by a one or two digit node address. Not required when address = 0.
T	Transmit Value (read)	Read a register from the meter. Must be followed by register ID character
V	Value Change (write)	Write to register or output. Must be followed by register ID character and numeric data.
R	Reset	Reset a register or output. Must be followed by register ID character.
P	Block Print Request	Initiates a block print output. Registers are defined in programming.

Command String Construction

The command string must be constructed in a specific sequence. The meter does not respond with an error message to invalid commands. The following procedure details construction of a command string:

1. The first characters consist of the Node Address Specifier (N) followed by a 1 or 2 character address number. The address number of the meter is programmable. If the node address is 0, this command and the node address itself may be omitted. This is the only command that may be used in conjunction with other commands.
2. After the address specifier, the next character is the command character.
3. The next character is the Register ID. This identifies the register that the command affects. The P command does not require a Register ID character. It prints according to the selections made in print options.
4. If constructing a value change command (writing data), the numeric data is sent next.
5. All command strings must be terminated with the string termination characters * or $. The meter does not begin processing the command string until this character is received. See Timing Diagram figure for differences between terminating characters.

Register Identification Chart

ID	VALUE DESCRIPTION	MNEMONIC	APPLICABLE COMMANDS/COMMENTS
A	Input (relative value)	INP	T, P, R (Reset command resets input to zero; tares)
B	Total	TOT	T, P, R (Reset command resets total to zero)
C	Max Input	MAX	T, P, R (Reset command resets Max to current reading)
D	Min Input	MIN	T, P, R (Reset command resets Min to current reading)
E	Setpoint 1	SP1	T, P, V, R (Reset command resets the setpoint output)
F	Setpoint 2	SP2	
G	Setpoint 3	SP3	
H	Setpoint 4	SP4	
I	Band/Deviation 1	BD1	T, V
J	Band/Deviation 2	BD2	T, V
K	Band/Deviation 3	BD3	T, V
L	Band/Deviation 4	BD4	T, V
M	Absolute Input value	ABS	T
O	Offset	OFS	T, V
U	Auto/Manual Register	MMR	T, V
W	Analog Output Register	AOR	T, V
X	Setpoint Register	SOR	T, V

Command String Examples:

1. Node address = 17, Write 350 to Setpoint 1.
   String: N17VE350$
2. Node address = 5, Read Input value.
   String: N5TA*
3. Node address = 0, Reset Setpoint 4 output.
   String: RH*

Sending Numeric Data

Numeric data sent to the meter must be limited to 6 digits (-199999 to 999999). Leading zeros are ignored. Negative numbers must have a minus sign. The meter ignores any decimal point and conforms the number to the scaled resolution. (For example: the meter's scaled decimal point position = 0.0 and 25 is written to a register. The value of the register is now 2.5.

Note: Since the meter does not issue a reply to value change commands, follow with a transmit value command for readback verification.

RECEIVING DATA FROM THE METER

Data is transmitted by the meter in response to either a transmit command (T), a print block command (P) or User Function print request. The response from the meter is either a full field transmission or an abbreviated transmission. The meter response mode is selected in program Module 7 (Abru).

Full Field Transmission (Address, Mnemonic, Numeric data)

Byte	Description
1, 2	2 byte Node Address field [00-99]
3	<SP> (Space)
4-6	3 byte Register Mnemonic field
7-18	2 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
19	<CR> carriage return
20	<LF> line feed
21	<SP>* (Space)
22	<CR>* carriage return
23	<LF>* line feed

** These characters only appear in the last line of a block print.*

The first two characters transmitted are the node address, unless the node address assigned = 0, in which case spaces are substituted. A space follows the node address field. The next three characters are the register mnemonic.

The numeric data is transmitted next. The numeric field is 12 characters long (to accommodate the 10 digit totalizer), with the decimal point position floating within the data field. Negative values have a leading minus sign. The data field is right justified with leading spaces.

The end of the response string is terminated with a carriage return <CR> and <LF>. When block print is finished, an extra <SP><CR> <LF> is used to provide separation between the blocks.

Abbreviated Transmission (Numeric data only)

Byte	Description
1-12	12 byte data field, 10 bytes for number, one byte for sign, one byte for decimal point
13	<CR> carriage return
14	<LF> line feed
15	<SP>* (Space)
16	<CR>* carriage return
17	<LF>* line feed

** These characters only appear in the last line of a block print.*

Meter Response Examples:

1. Node address = 17, full field response, Input = 875
   17 INP 875 <CR><LF>
2. Node address = 0, full field response, Setpoint 2 = -250.5
   SP2 -250.5<CR><LF>
3. Node address = 0, abbreviated response, Setpoint 2 = 250, last line of block print
   250<CR><LF><SP><CR><LF>

Auto/Manual Mode Register (MMR) ID: U

This register sets the controlling mode for the outputs. In Auto Mode (0) the meter controls the setpoint and analog output. In Manual Mode (1) the outputs are defined by the registers SOR and AOR. When transferring from auto mode to manual mode, the meter holds the last output value (until the register is changed by a write). Each output may be independently changed to auto or manual. In a write command string (VU), any character besides 0 or 1 in a field will not change the corresponding output mode.

U abcde
e = Analog Output
d = SP4
c = SP3
b = SP2
a = SP1

Example: VU00011 places SP4 and Analog in manual.

Analog Output Register (AOR) ID: W

This register stores the present signal value of the analog output. The range of values of this register is 0 to 4095, which corresponds to the analog output range per the following chart:

Register Value	Output Signal*		
	0-20 mA	4-20 mA	0-10 V
0	0.00	4.00	0.000
1	0.005	4.004	0.0025
2047	10.000	12.000	5.000
4094	19.995	19.996	9.9975
4095	20.000	20.000	10.000

**Due to the absolute accuracy rating and resolution of the output card, the actual output signal may differ 0.15% FS from the table values. The output signal corresponds to the range selected (0-20 mA, 4-20 mA or 0-10 V).*

Writing to this register (VW) while the analog output is in the Manual Mode causes the output signal level to update immediately to the value sent. While in the Automatic Mode, this register may be written to, but it has no effect until the analog output is placed in the manual mode. When in the Automatic Mode, the meter controls the analog output signal level. Reading from this register (TW) will show the present value of the analog output signal.

Example: VW2047 will result in an output of 10.000 mA, 12.000 mA or 5.000V depending on the range selected.

Setpoint Output Register (SOR) ID: X

This register stores the states of the setpoint outputs. Reading from this register (TX) will show the present state of all the setpoint outputs. A “0” in the setpoint location means the output is off and a “1” means the output is on.

X abcd
d = SP4
c = SP3
b = SP2
a = SP1

In Automatic Mode, the meter controls the setpoint output state. In Manual Mode, writing to this register (VX) will change the output state. Sending any character besides 0 or 1 in a field or if the corresponding output was not first in manual mode, the corresponding output value will not change. (It is not necessary to send least significant 0s.)

Example: VX10 will result in output 1 on and output 2 off.

COMMAND RESPONSE TIME

The meter can only receive data or transmit data at any one time (half-duplex operation). When sending commands and data to the meter, a delay must be imposed before sending another command. This allows enough time for the meter to process the command and prepare for the next command.

At the start of the time interval t_1, the computer program prints or writes the string to the com port, thus initiating a transmission. During t_1, the command characters are under transmission and at the end of this period, the command terminating character (*) is received by the meter. The time duration of t_1 is dependent on the number of characters and baud rate of the channel.

$$t_1 = (10 * \# \text{ of characters}) / \text{baud rate}$$

At the start of time interval t_2, the meter starts the interpretation of the command and when complete, performs the command function. This time interval t_2 varies from 2 msec to 15 msec. If no response from the meter is expected, the meter is ready to accept another command.

If the meter is to reply with data, the time interval t_2 is controlled by the use of the command terminating character and the (Serial Transmit Delay parameter (dELAY)). The standard command line terminating character is "*". This terminating character results in a response time window of the Serial Transmit Delay time (dELAY) plus 15 msec. maximum. The dELAY parameter should be programmed to a value that allows sufficient time for the release of the sending driver on the RS485 bus. Terminating the command line with "$" results in a response time window (t_2) of 2 msec minimum and 15 msec maximum. The response time of this terminating character requires that sending drivers release within 2 msec after the terminating character is received.

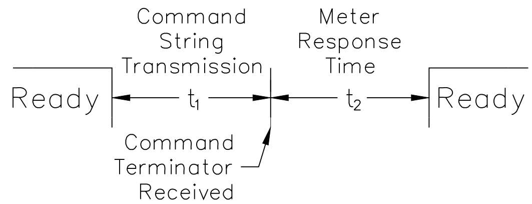
At the beginning of time interval t_3, the meter responds with the first character of the reply. As with t_1, the time duration of t_3 is dependent on the number of characters and baud rate of the channel.

$$t_3 = (10 * \# \text{ of characters}) / \text{baud rate}.$$

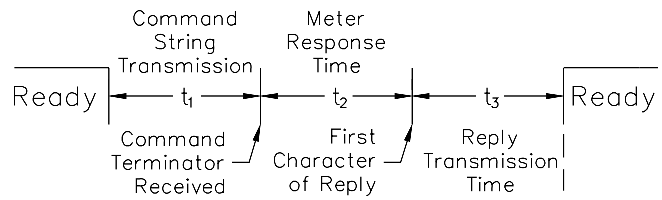
At the end of t_3, the meter is ready to receive the next command. The maximum serial throughput of the meter is limited to the sum of the times t_1, t_2 and t_3.

Timing Diagrams

NO REPLY FROM METER



RESPONSE FROM METER



COMMUNICATION FORMAT

Data is transferred from the meter through a serial communication channel. In serial communications, the voltage is switched between a high and low level at a predetermined rate (baud rate) using ASCII encoding. The receiving device reads the voltage levels at the same intervals and then translates the switched levels back to a character.

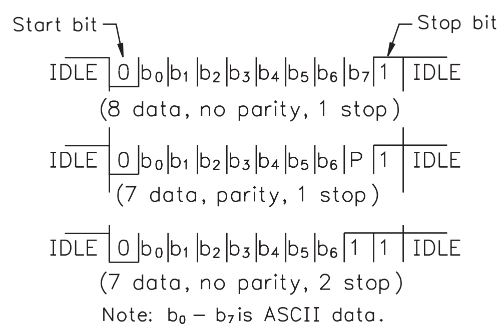
The voltage level conventions depend on the interface standard. The table lists the voltage levels for each standard.

LOGIC	INTERFACE STATE	RS232*	RS485*
1	mark (idle)	TXD,RXD; -3 to -15 V	a-b < -200 mV
0	space (active)	TXD,RXD; +3 to +15 V	a-b > +200 mV
* Voltage levels at the Receiver			

Data is transmitted one byte at a time with a variable idle period between characters (0 to ∞). Each ASCII character is "framed" with a beginning start bit, an optional parity bit and one or more ending stop bits. The data format and baud rate must match that of other equipment in order for communication to take place. The figures list the data formats employed by the meter.

Start bit and Data bits

Data transmission always begins with the start bit. The start bit signals the receiving device to prepare for reception of data. One bit period later, the least significant bit of the ASCII encoded character is transmitted, followed by the remaining data bits. The receiving device then reads each bit position as they are transmitted. Since the sending and receiving devices operate at the same transmission speed (baud rate), the data is read without timing errors.



Character Frame Figure

Parity bit

After the data bits, the parity bit is sent. The transmitter sets the parity bit to a zero or a one, so that the total number of ones contained in the transmission (including the parity bit) is either even or odd. This bit is used by the receiver to detect errors that may occur to an odd number of bits in the transmission. However, a single parity bit cannot detect errors that may occur to an even number of bits. Given this limitation, the parity bit is often ignored by the receiving device. The PAX meter ignores the parity bit of incoming data and sets the parity bit to odd, even or none (mark parity) for outgoing data.

Stop bit

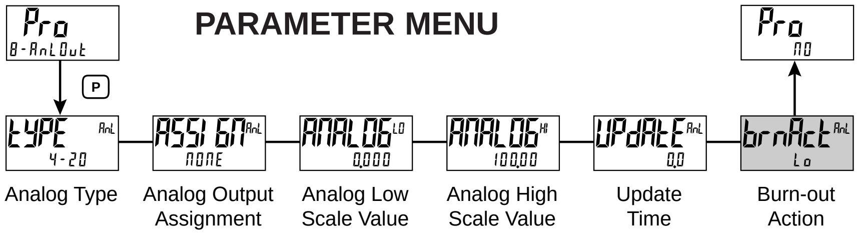
The last character transmitted is the stop bit. The stop bit provides a single bit period pause to allow the receiver to prepare to re-synchronize to the start of a new transmission (start bit of next byte). The receiver then continuously looks for the occurrence of the start bit. If 7 data bits and no parity is selected, then 2 stop bits are sent from the PAX meter.

MODULE 8 - ANALOG OUTPUT PARAMETERS (8-AnLOut)

This module is only accessible with the optional PAXCDL Analog card installed.

Programming information contained in this manual supercedes all programming information included with the PAXCDL card.

PARAMETER MENU



ANALOG OUTPUT TYPE

tYPE AnL 4-20 — 4-20 0-10 0-20

Enter the analog output type. For 0-20 mA or 4-20 mA use terminals 18 and 19. For 0-10 V use terminals 16 and 17. Only one range can be used at a time.

ANALOG OUTPUT ASSIGNMENT

ASSIGN AnL NONE — NONE rEL AbS totAL Hi Lo S1 S2 S3 S4

Enter the source for the analog output to retransmit:

NONE = Manual Mode operation. (See Module 7, Serial RLC Protocol).
rEL = Relative (net) Input Value. The Relative Input Value is the Absolute Input Value including the Display Offset Value.
AbS = Absolute (gross) Input Value. The Absolute Input Value is the scaled input value. It does not include the Display Offset Value.
totAL = Totalizer Value
Hi = Maximum Display Value
Lo = Minimum Display Value
S1-S4 = Setpoint Values

ANALOG LOW SCALE VALUE

ANALOG LO 0 — -199999 to 999999

Enter the Display Value that corresponds to 0 mA (0-20 mA) , 4 mA (4-20 mA) or 0 VDC (0-10 VDC).

ANALOG HIGH SCALE VALUE

ANALOG HI 10000 — -199999 to 999999

Enter the Display Value that corresponds to 20 mA (0-20 mA) , 20 mA (4-20 mA) or 10 VDC (0-10 VDC).

ANALOG UPDATE TIME

UPdAtE AnL 0.0 — 0.0 to 10.0

Enter the analog output update rate in seconds. A value of 0.0 allows the meter to update the analog output at the ADC Conversion Rate.

The following programming step is only available when Input Range in Module 1 is set for a temperature input (TC/RTD).

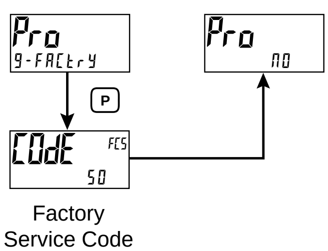
PROBE BURN-OUT ACTION

brnAct AnL Lo — Hi Lo

Enter the probe burn-out action. In the event of a temperature probe failure, the analog output can be programmed for low or high scale.

MODULE 9 - FACTORY SERVICE OPERATIONS (9-FACtrY)

PARAMETER MENU



RESTORE FACTORY DEFAULTS

COdE FCS 66 — P — rESEt — COdE FCS 50

Use the F1 and F2 keys to display COdE 66 and press **P**. The meter will flash rESEt and then return to COdE 50. Press the **P** key to return to Display Mode. This will overwrite all user settings with the factory settings.

MODEL AND CODE VERSION

COdE FCS 51 — P — P2A FCS VEr x.xx — COdE FCS 50

The meter will briefly display the model (P2A) on Line 1, and the current firmware version (VEr x.xx) on Line 2, and then return to COdE 50.

CALIBRATION

COdE FCS 48 — P — CAL FCS NO — NO Curr VoLt OhMS tc ICE rtd AnLOut

The meter has been fully calibrated at the factory. Scaling to convert the input signal to a desired display value is performed in Module 1. If the meter appears to be indicating incorrectly or inaccurately, refer to Troubleshooting before attempting to calibrate the meter. When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment. Calibration does not change any user programmed parameters. However, it will affect the accuracy of the input signal and the values previously stored using the Apply (APPLY) Scaling Style.

Preparation for Current, Volt, and Ohm Input Calibration

Warning: Input Calibration of this meter requires a signal source capable of producing a signal greater than or equal to the range being calibrated with an accuracy of 0.01% or better.

Before starting, verify that the Input Range, T/V, and Excitation Jumper is set for the range to be calibrated. Verify that the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter. Selecting nO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing the **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

Current, Volt and Ohm Calibration Procedure

1. After entering CodE 48, in Module 9, select the input signal type (Curr, VoLt, OhMS) to be calibrated.
2. Press the **P** key until the desired range along with ZEr is indicated on Line 1 of the meter.
3. Apply the zero input limit of the range indicated on Line 1 of the meter.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate the desired range along with FUL on Line 1 of the meter.
7. Apply the signal level indicated on Line 1 of the meter.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. Repeat Preparation and Calibration Procedure for each Input Range to be calibrated.

Preparation for TC calibration

TC calibration parameters will affect RTD calibration. If using an RTD, it is recommended that the RTD calibration be performed after completing the TC calibration.

Warning: TC Input Calibration of this meter requires a signal source capable of producing a 60 mV signal with an accuracy of 0.01% or better.

Before starting, verify the T/V jumper is in the T position. Verify the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter. Selecting nO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

TC Calibration Procedure

1. After entering CodE 48, in Module 9, select the tc.
2. Press the **P** key. Display will indicate 0.060V with ZEr in upper right.
3. Apply 0 mV to input.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate 0.060V with FUL in upper right.
7. Apply 60 mV to input.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. TC Calibration complete.

Preparation for RTD Input Calibration

RTD calibration is dependent on TC calibration parameters. Therefore, the TC calibration should be performed prior to attempting the RTD calibration.

Warning: RTD Input Calibration of this meter requires a signal source capable of producing a 300 ohm resistance with an accuracy of 0.01% or better.

Before starting, verify that the T/V Jumper is in the T position. Verify the RTD jumper is in the proper range. Verify the precision signal source is connected and ready. Allow a 30 minute warm-up period before calibrating the meter. Selecting nO at any calibration step, will cause the unit to maintain the existing calibration parameters for that step. Selecting YES and pressing **P** key will cause the unit to store new calibration settings for the range selected. Pressing **D** at any time will exit programming mode, but any range that has been calibrated will maintain the new settings.

RTD Calibration Procedure

1. After entering Code 48, in Module 9, select rtd.
2. Press the **P** key until the desired range along with 0 in upper right corner is indicated on Line 1 of the meter.
3. Apply zero ohms to the input of the meter.
4. Press F1 to select YES.
5. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
6. Display will indicate the desired range along with a value in the upper right corner, in ohms, to be applied in the next step on Line 1 of the meter.
7. Apply the signal level, in ohms, indicated in the upper right corner of Line 1 on the meter.
8. Press F1 to select YES.
9. Press **P**. Display will indicate ---- on Line 2 as the unit reads and stores the new calibration parameter.
10. Repeat Preparation and Calibration Procedure for each Input Range to be calibrated.

Ice Point Calibration Procedure

1. Remove all option cards.
2. Verify ambient temperature of meter environment is between 20°C and 30°C.
3. Set T/V jumper in the T position.
4. Connect a thermocouple with an accuracy of 1°C or better to the meter.
5. In Module 1 of unit programming, verify Input Range (rAnGE) is set to the type thermocouple connected in step 4, Temperature Scale (SCALE) is °C, Ice Point Compensation (ICE) is turned ON, Decimal Resolution (dECPNt) is 0.0, Rounding Increment (round) is 0.1 and Display Offset (OFFSEt) is set to 0.
6. Place the thermocouple in close thermal contact to a reference thermometer probe. (Use a reference thermometer with an accuracy of 0.25% °C or better.) The two probes should be shielded from air movement and allowed sufficient time to equalize in temperature. (A calibration bath could be used in place of the thermometer.)
7. If a difference exits between PAX2A display and reference thermometer, continue calibration.
8. Note the PAX2A display reading as the "Display Mode" reading to be used in Step 12.
9. Enter Module 9, select CodE 48 and press **P**.
10. Select ICE and press **P**.
11. Display will indicate the Existing ICE Point Value.
12. Calculate a new ICE Point Value using: Existing ICE Point Value + (reference temperature – Display Mode reading). All values are in °C.
13. Using F1 and F2 change Existing ICE Point Value to indicate the new ICE Point Value calculated in Step 12.
14. Press **P** and return to Display Mode. Verify the Display Mode reading (with 0 Display Offset) matches the reference temperature. If not, repeat steps 8 thru 14.

Preparation for Analog Output Card Calibration

Warning: Calibration of this meter requires an external meter with an accuracy of 0.005% or better.

Before starting, verify that the precision voltmeter (voltage output) or current meter (current output) is connected and ready. Perform the following procedure.

1. After entering CodE 48, in Module 9, select AnLOut.
2. Using the chart below, step through the five selections to be calibrated. At each prompt, use the PAX2A F1 and F2 keys to adjust the external meter display to match the selection being calibrated. When the external reading matches, or if the particular range is not in need of calibration, press the **P** key to advance to the next range.

PAX2A DISPLAY	EXTERNAL METER	ACTION
0.000A	0.00 mA	F1 and F2 to adjust External Meter
0.004A	4.00 mA	F1 and F2 to adjust External Meter
0.020A	20.00 mA	F1 and F2 to adjust External Meter
0.0v	0.00 V	F1 and F2 to adjust External Meter
10.0v	10.00 V	F1 and F2 to adjust External Meter

3. Calibration Complete.

TROUBLESHOOTING

PROBLEM	REMEDIES
No Display At Power-Up	Check power level and power connections
No Display After Power-Up	Check Module 3: d-LEV, d-Cont, and LINE 1 program settings.
Program Locked-Out	Check for Active User Input, programmed for PLOC. Deactivate User Input.
	Enter proper access code at CODE 0 prompt.
No Line 1 Display	Check Module 3: LINE 1 program setting.
No Line 2 Display	Check Module 3: ACCESS program settings.
No Programmable Units Display	Check Module 3: UNItS Mnemonic program settings.
Incorrect Input Display Value	Check Input Jumper Setting, Input Level, and Input Connections.
	Verify Module 1 program settings.
	Contact factory
Display of OLOL, ULUL, Short, OPEN, or ". . . ."	See General Meter Specifications, Display Messages.
Modules or Parameters Not Accessible	Check for corresponding plug-in option card.
	Verify parameter is valid in regard to previous program settings.
Error Code: ErrKEY	Keypad is active at power up. Check for depressed or stuck keypad. Press any key to clear Error Code.
Error Code: EE PAr Error Code: EE Pdn	Parameter Data Checksum Error. Press any key to clear Error Code, verify all program settings and cycle power. Contact factory if Error Code returns at next power-up.
Error Code: ErrPro	Parameter Data Validation Error. Press any key to clear Error Code, verify all program settings and cycle power. Contact factory if Error Code returns at next power-up.
Error Code: EE CAL	Calibration Data Validation Error. Contact factory.
Error Code: EE Lin	Linear Output Card Data Validation Error. Press any key to clear Error Code and cycle power. If Error Code returns at next power-up, replace Linear Option Card or contact factory.

PARAMETER VALUE CHART PAX2A

Programmer ________________ Date ________
Meter# ______________ Security Code ________

1-INPUt INPUT SETUP PARAMETERS

DISPLAY	PARAMETER	USER SETTING
rAnGE	INPUT RANGE	
SCALE	TEMPERATURE SCALE	
ICE	ICE POINT CONPENSATION	
rAtE	ADC CONVERSION RATE	
dECPNt	SCALING DECIMAL POINT	
round	DISPLAY ROUNDING	
OFFSEt	DISPLAY OFFSET	
FILtEr	DIGITAL FILTER	
bAnd	DIGITAL FILTER BAND	
POINtS	SCALING POINTS	
StYLE	SCALING STYLE	
INPUt 1	INPUT 1 SCALING VALUE	
dISPLY 1	DISPLAY 1 VALUE	
INPUt 2	INPUT 2 SCALING VALUE	
dISPLY 2	DISPLAY 2 VALUE	
INPUt 3	INPUT 3 SCALING VALUE	
dISPLY 3	DISPLAY 3 VALUE	
INPUt 4	INPUT 4 SCALING VALUE	
dISPLY 4	DISPLAY 4 VALUE	
INPUt 5	INPUT 5 SCALING VALUE	
dISPLY 5	DISPLAY 5 VALUE	
INPUt 6	INPUT 6 SCALING VALUE	
dISPLY 6	DISPLAY 6 VALUE	

DISPLAY	PARAMETER	USER SETTING
INPUt 7	INPUT 7 SCALING VALUE	
dISPLY 7	DISPLAY 7 VALUE	
INPUt 8	INPUT 8 SCALING VALUE	
dISPLY 8	DISPLAY 8 VALUE	
INPUt 9	INPUT 9 SCALING VALUE	
dISPLY 9	DISPLAY 9 VALUE	
INPUt 10	INPUT 10 SCALING VALUE	
dISPLY 10	DISPLAY 10 VALUE	
INPUt 11	INPUT 11 SCALING VALUE	
dISPLY 11	DISPLAY 11 VALUE	
INPUt 12	INPUT 12 SCALING VALUE	
dISPLY 12	DISPLAY 12 VALUE	
INPUt 13	INPUT 13 SCALING VALUE	
dISPLY 13	DISPLAY 13 VALUE	
INPUt 14	INPUT 14 SCALING VALUE	
dISPLY 14	DISPLAY 14 VALUE	
INPUt 15	INPUT 15 SCALING VALUE	
dISPLY 15	DISPLAY 15 VALUE	
INPUt 16	INPUT 16 SCALING VALUE	
dISPLY 16	DISPLAY 16 VALUE	
ScLISt	ENABLE SCALE LIST	

2-FUNCt USER INPUT/FUNCTION KEY PARAMETERS

DISPLAY	PARAMETER	USER SETTING
USrACt	USER ACTIVE STATE	
USEr-1	USER INPUT 1	
USEr-2	USER INPUT 2	
F1	FUNCTION KEY 1	
F2	FUNCTION KEY 2	
SEC-F1	2nd FUNCTION KEY 1	
SEC-F2	2nd FUNCTION KEY 2	

3-dISPLY DISPLAY PARAMETERS

DISPLAY	PARAMETER	USER SETTING
CoLor	LINE 1 DISPLAY COLOR	
d-LEU	DISPLAY LEVEL	
d-Cont	DISPLAY CONTRAST LEVEL	
LInE 1	LINE 1 DISPLAY	
UnItS	UNITS MNEMONIC	OFF LISt
UnItS1	SEGMENT 1	
UnItS2	SEGMENT 2	
UnItS3	SEGMENT 3	
ACCESS	LINE 2 LOOP ACCESSIBILE ITEMS	nO YES

InPUt		b2-d2	
totAL		S3	
Hi		b3-d3	
Lo		S4	
LISt		b4-d4	
S1		CoLor	
b1-d1		d-LEU	
S2		d-Cont	

DISPLAY	PARAMETER	USER SETTING
FUnCt	LINE 2 USER FUNC. ACCESS. ITEMS	nO YES

rEL		r-2	
bAt		r-3	
r-tot		r-4	
r-HI		r-34	
r-Lo		r-234	
r-HL		r-ALL	
r-1		Print	

DISPLAY	PARAMETER	USER SETTING
COdE	SECURITY CODE	

4-SCndrY SECONDARY FUNCTION PARAMETERS

DISPLAY	PARAMETER	USER SETTING
HI-AS	MAX ASSIGNMENT	
HI-t	MAX CAPTURE DELAY TIME	
LO-AS	MIN ASSIGNMENT	
LO-t	MIN CAPTURE DELAY TIME	
dSP-t	DISPLAY UPDATE TIME	

5-totAL TOTALIZER PARAMETERS

DISPLAY	PARAMETER	USER SETTING
dECPnt	TOTALIZER DECIMAL POINT	
t bASE	TOTALIZER TIME BASE	
SCLFAC	TOTALIZER SCALE FACTOR	
Lo Cut	TOTALIZER LOW CUT VALUE	
PwrUP	TOTALIZER POWER-UP RESET	

7-SErIAL SERIAL COMMUNICATIONS PARAMETERS

DISPLAY	PARAMETER	USER SETTING
USb	USB PORT	
tYPE	TYPE	
bAUd	BAUD RATE	
dAtA	WORD LENGTH	
PArItY	PARITY	
Addr	ADDRESS	
dELAY	TRANSMIT DELAY	
Abru	ABBREVIATED	
OPt	PRINT OPTION	nO YES
InPUt	Signal Input	
totAL	Total Value	
HILO	Max & Min	
SPnt	Setpoint Values	

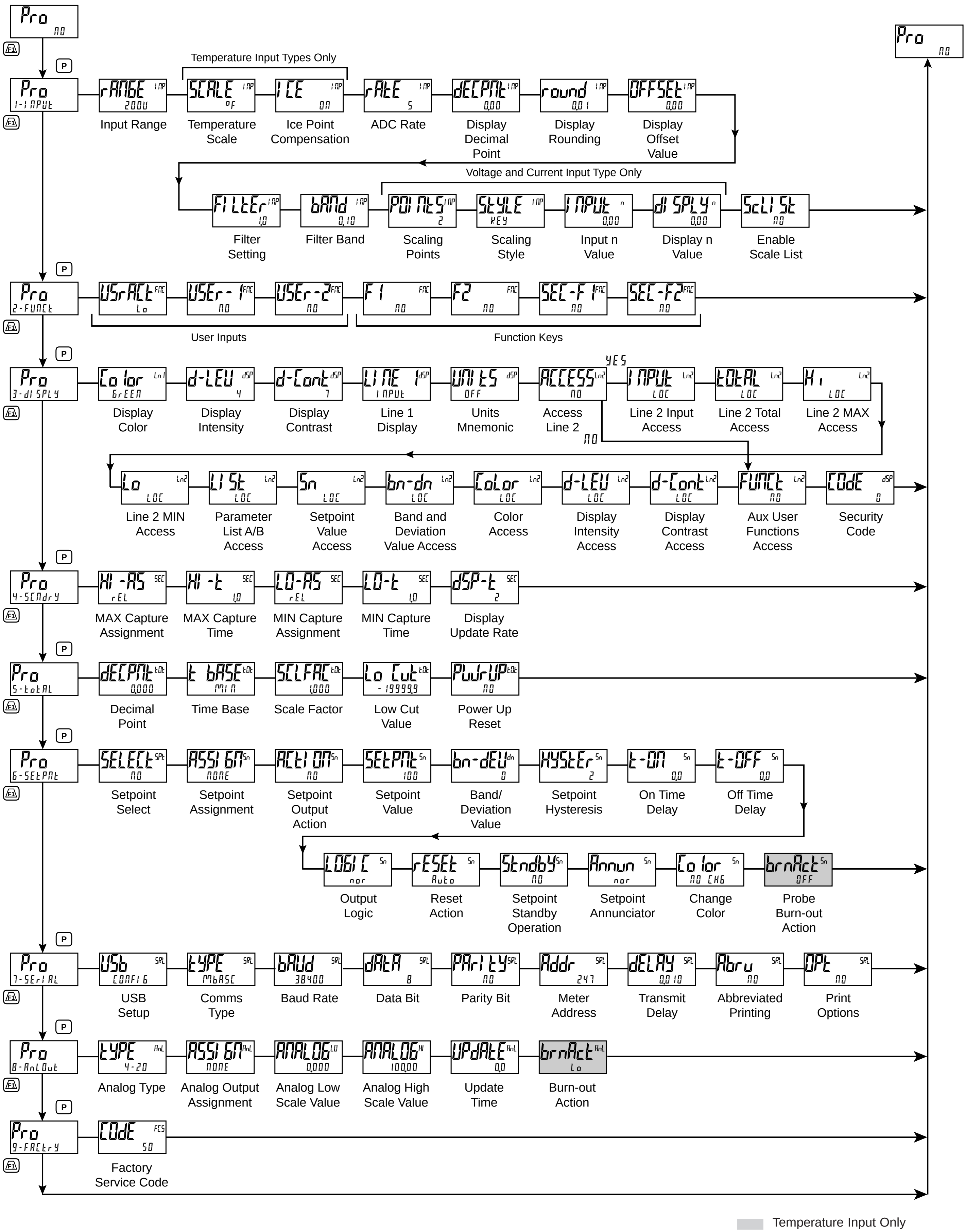
8-AnLOut ANALOG OUTPUT PARAMETERS

DISPLAY	PARAMETER	USER SETTING
tYPE	ANALOG TYPE	
ASSIGn	ANALOG ASSIGNMENT	
AnALOG LO	ANALOG LOW	
AnALOG HI	ANALOG HIGH	
UPdAtE	ANALOG UPDATE TIME	
brnAct	PROBE BURN-OUT ACTION	

6-SEtPnt SETPOINT OUTPUT PARAMETERS

DISPLAY	PARAMETER	USER SETTING S1	USER SETTING S2	USER SETTING S3	USER SETTING S4
SELECt	SETPOINT SELECTION				
ASSIGn	SETPOINT SOURCE				
ACtIOn	ACTION FOR SETPOINT				
SEtPnt	SETPOINT VALUE				
bn-dEU	SETPOINT BAND/DEVIATION VALUE				
HYStEr	HYSTERESIS FOR SETPOINT				
t-On	ON TIME DELAY SETPOINT				
t-OFF	OFF TIME DELAY SETPOINT				
LOGIC	OUTPUT LOGIC				
rESEt	RESET ACTION				
StndbY	STANDYBY OPERATION				
Annun	OUTPUT ANNUNCIATOR LIGHT				
CoLor	CHANGE COLOR				
brnAct	PROBE BURN-OUT ACTION				

PAX2A PROGRAMMING QUICK OVERVIEW



LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company's liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company's option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company's products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained herein and relies on no other warranties or affirmations.

Red Lion Controls
Headquarters
20 Willow Springs Circle
York PA 17406
Tel +1 (717) 767-6511
Fax +1 (717) 764-0839

Red Lion Controls
Europe
Printerweg 10
NL - 3821 AD Amersfoort
Tel +31 (0) 334 723 225
Fax +31 (0) 334 893 793

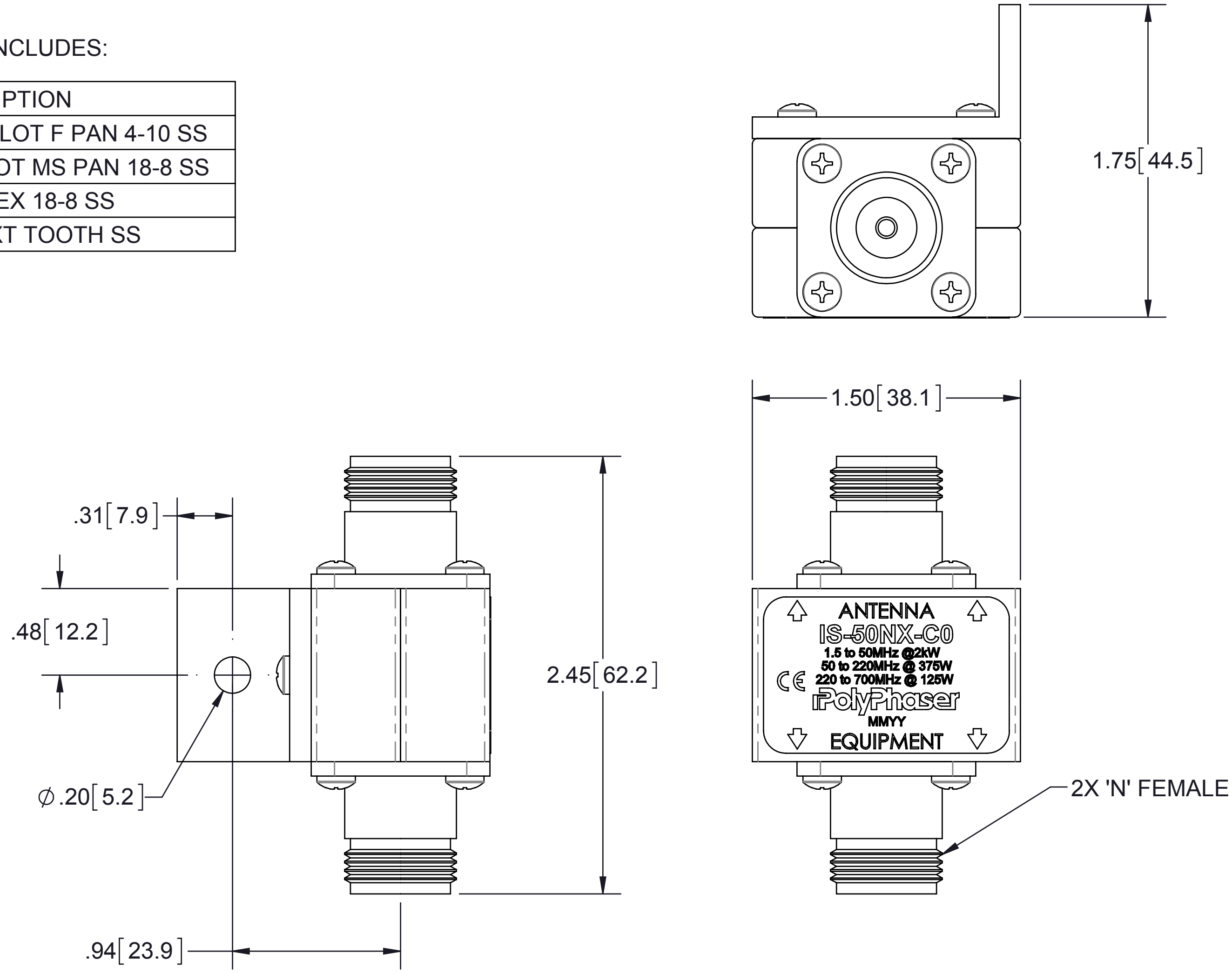
Red Lion Controls
India
54, Vishvas Tenement
GST Road, New Ranip,
Ahmedabad-382480 Gujarat, India
Tel +91 987 954 0503
Fax +91 79 275 31 350

Red Lion Controls
China
Unit 101, XinAn Plaza
Building 13, No.99 Tianzhou Road
ShangHai, P.R. China 200223
Tel +86 21 6113-3688
Fax +86 21 6113-3683

REVISIONS				
REV.	DESCRIPTION	ECN	DATE	APPROVED
G	REFER TO ECN	11976	8/29/13	KCB

HARDWARE KIT INCLUDES:

QTY	DESCRIPTION
1	SCREW 10-32 X .50 SLOT F PAN 4-10 SS
1	SCREW 10-32x.50 SLOT MS PAN 18-8 SS
1	NUT 10-32 HEX 18-8 SS
2	WASHER 10 EXT TOOTH SS



MAXIMUM CHARACTERISTICS

APPLICATION:
For two way radio and SCADA applications.
Non-weatherized, Flange mount
SURGE:
50kA IEC 61000-4-5 8/20μs waveform 500J
TURN ON:
600Vdc ± 20%
TURN ON TIME:
2.5ns for 2kV/ns
FREQUENCY RANGE:
1.5MHz to 700MHz
VSWR:
≤1.1 to 1 over frequency range
INSERTION LOSS:
≤0.1dB over frequency range
MAX POWER:
2kW @ 1.5 to 50MHz
375W @ 50 to 220MHz
125W @ 220 to 700MHz
THROUGHPUT ENERGY:
≤10mJ 3kA 8/20μs waveform
TEMPERATURE:
Storage: -55°C to +85°C
Operating: -50°C to +50°C
VIBRATION:
1G at 5Hz to 100Hz
CE COMPLIANT
RoHS COMPLIANT

CUSTOMER APPROVAL: ______________________ DATE: ____________

ALL DIMENSIONS SHOWN ARE FOR REFERENCE ONLY.

UNLESS OTHERWISE SPECIFIED
LEADING DIMENSIONS ARE INCHES
DIMENSIONS IN [ ] ARE MILLIMETERS

TOLERANCES:
FRACTIONS=± 1/32 .XX=± .03
ANGLES=± 1° .XXX=± .010

THIRD-ANGLE PROJECTION

DRAWN	J. CALLISTER	2/24/98
ENG APPD	O. AKDAG	3/20/98
PRODUCT MGR	K. BARTEL	3/16/98
MARKETING APPD	R. MATHEUS	3/20/98
PROJECT NO.		

PolyPhaser®

SHEET 1 OF 1
SCALE 1:1

TITLE: BROADBAND 1.5-700MHz R50 T.O. 600Vdc N FEM
CUSTOMER SPECIFICATION

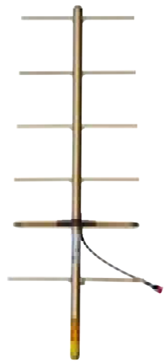
DOCUMENT NAME	SIZE	CAGE	PROD CAT	PART NUMBER	REV
IS-50NX-C0-C	A	61114	RFP	IS-50NX-C0	G

UHF Directional Yagi Antennas

400-600 MHz

YB6 Series

The YB Series are high gain yagi antennas which will provide excellent point to point communication in RF control, short or long haul link and other applications calling for highly directional antennas. YB Series antennas exhibit narrow beamwidths and high front to back ratios to help minimise potential interference to and from other systems.



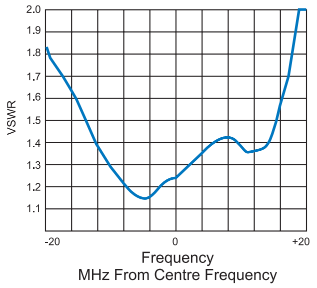
The feed element of each antenna is of full folded dipole construction thus offering maximum bandwidth and reliability. The dipole element is welded to the boom to ensure low intermodulation performance and maximum durability. The passive elements are through mounted to the circular boom section and welded at each side to further minimise the potential for both corrosion and generation of intermodulation products.

For extreme climatic or corrosive applications, the stainless steel YBSS Series or black ruggedised RDA Series yagis should be considered.

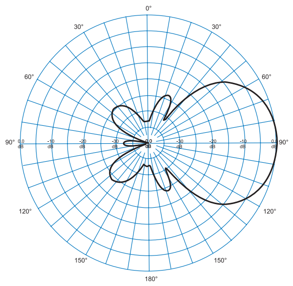
Features:

- All welded construction for maximum and reliable performance
- Narrow beamwidths & high front to back ratios effective in reducing interference
- Alodine finish provides an excellent conductive surface for earthing
- Can be configured in stacks or bays for higher gain applications using PH and PHE series phasing harnesses
- DC grounding on all elements for the ultimate in lightning protection and dissipation of static noise

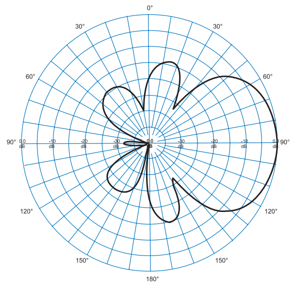
Typical VSWR response (YB6-61)



YB6-61 - E Plane



YB6-61 - H Plane



Electrical

Model Number	YB6-65	YB6-61	YB6-62	YB6-75	YB6-99
Nominal Gain *dBi (dBd)*			11 (9)		
Frequency *MHz*	400 - 420	450 - 480	480 - 520	580 - 600	350 - 600
Tuned Bandwidth		Full band			5%
VSWR (Return Loss)			<1.5 :1 (14dB)		
Nominal Impedance Ω			50		
Vertical Beamwidth°			47		
Horizontal Beamwidth°			56		
Front / Back Ratio *dB*			18 (Typical)		
Input Power *W*			100		

Mechanical

Model Number		YB6-65	YB6-61	YB6-62	YB6-75	YB6-99
Construction				All welded aluminium with alodined finish		
Length *m*		0.9	1.0	0.8	0.8	1.3
Weight *kg*		0.7	0.7	0.6	0.6	0.8
Termination				N female with short 9008 cable tail		
Mounting Area				100mm x 25mm diam. alodined aluminium		
Suggested Clamps				1 X UNV		
Projected Area *cm²*	No ice	485	477	394	349	600
	With ice	1169	1099	967	857	1367
Wind Load (Thrust) @ 160km/h *N*		57	56	47	41	71
Wind Gust Rating *km/h*				>240		
Torque @160 km/h *Nm*		22	24	16	13	42

Treo S

A functional Metal Halide highbay luminaire suitable for indoor mounting applications above 6m.

Description	Ilcos Code	Socket	Wt (kgs)	Cat. No.	SAP Code
TREO S 1X250W HIE	ME	E39/40	4.3	TREOS250MH	96064933
TREO S 1X400W HIE	ME	E39/40	5.3	TREOS400MH	96064934
Attachment					
TREO S WIRE GUARD	-	-	-	TREOSWG	96064935

Indoor Decorative

D-CO LED

Lighting for everyday indoor and accent tasks.

Description	Wt (kgs)	Cat. No.	SAP Code
D-CO LED DL 6x1.2W 3K 35° WHI F/P	0.4	96536894	96536894
D-CO LED DL 6x1.2W 4K 35° WHI F/P	0.4	96536895	96536895
D-CO LED DL 6X1.2W GYRO 3K 35° WHI F/P	0.4	96536896	96536896
D-CO LED DL 6X1.2W GYRO 4K 35° WHI F/P	0.4	96536897	96536897
D-CO LED MINI DL 5/1x1.2W 3K20° KIT	0.4	96107429	96107429
D-CO LED WALL ASYM 1.6W 3K 24V (less driver)	0.1	96107419	96107419
Accessory			
D-CO LED WALL CONCRETE MTG BOX	0.1	96107421	96107421
Driver (D-CO LED WALL ASYM)			
D-CO LED Driver 24V 25VA	0.2	96537360	96537360

LV Halogen Downlight

LV Halogen electronic kit complete with lamp, transformer and gimble.

Description	Ilcos Code	Socket	Wt (kgs)	Cat. No.	SAP Code
THORN ELEC ADJ LV DL KIT WHITE FLEX FNV	HMG/ HRG	GU5.3	0.3	LVAW50EFP	96034207
THORN ELEC FIXED DL KIT WHITE FLEX FNV	HMG/ HRG	GU5.3	0.3	LVFW50EFP	96039276

Leopard

A low energy bulkhead featuring a twist and lock diffuser.

Description	Ilcos Code	Socket	Wt (kgs)	Cat. No.	SAP Code
LEOPARD 1X16W TC-DD NC OP RD WHI LI830	FSS	GR8	1.0	LERO2D16W	96230478
LEOPARD 1X28W TC-DDEL CP OP RD WHI LI840	FSS	GR10Q	1.8	LERO2D28W	96233792

Brighton Oyster

A decorative clipper gloss white glass oyster with white metal finish.

Description	Ilcos Code	Socket	Wt (kgs)	Cat. No.	SAP Code
BRIGHTON OYSTER 100W BC - WHITE L/L	IA	B22	1.0	BRO100	96016377

Rectangular Downlight (Shoplighter)

Rectangular shoplighter suitable for a wide range of display applications.

Description	Ilcos Code	Socket	Wt (kgs)	Cat. No.	SAP Code
THORN RECT 70MH CWL & GEAR CLEAR	MD	Rx7s	NA	KRCMH70	96017544

Indoor Commercial

Bikini

A compact miniature fluorescent batten.

Description	Ilcos Code	Socket	Wt (kgs)	Cat. No.	SAP Code
Bikini Bare					
BIKINI BATTEN 1X8W C/W LAMP LPF	FD	G5	0.6	BB108	96028477
BIKINI BATTEN 1X13W C/W LAMP LPF	FD	G5	0.7	BB113	96028479
Bikini Diffused					
BIKINI ENCLOSED 1X8W CWL	FD	G5	0.7	BBO108	96028481
BIKINI ENCLOSED 1X8W SW CWL	FD	G5	0.7	BBO108SW	96028484
BIKINI ENCLOSED 1X13W CWL	FD	G5	0.7	BBO113	96028485
BIKINI ENCLOSED 13W SW CWL	FD	G5	0.7	BBO113SW	96028488