QUEENSLAND URBAN UTILITIES

WATER BOOSTER PUMP STATION – WB065
SEIB STREET – KILCOY

WATER BOOSTER PUMP STATION
OPERATION AND MAINTENANCE MANUAL

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Developed by:

J & P RICHARDSON INDUSTRIES
CAMPBELL AVENUE
WACOL QLD 4076

ABN 23 001 952 325
ACN 001 952 325
Ph. (07) 3271 2911
Fax. (07) 3271 3623

WATER BOOSTER PUMP STATION OPERATIONS AND MAINTENANCE MANUAL FOR QUEENSLAND URBAN UTILITIES WATER BOOSTER PUMP STATION – WB065 SEIB STREET, KILCOY

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CONTENTS

1 Electrical Equipment Technical Information
- 1.1. CIRCUIT BREAKERS & ISOLATORS
- 1.2. CONTROL DEVICES
- 1.3. PUSHBUTTONS & SELECTOR SWITCHES
- 1.4. POWER SUPPLIES, GPOs, PLUGS & SOCKETS
- 1.5. SURGE PROTECTION & FUSES
- 1.6. RTU & RADIO
- 1.7. TERMINALS, LINKS & OTHER ACCESSORIES

2 Pumps

3 Valves

4 Flowmeter

5 Generator

6 Test Results

7 “AS INSTALLED” Drawings

8 Service and Maintenance

1 Electrical Equipment Technical Information

1.1 CIRCUIT BREAKERS & ISOLATORS

1.2 CONTROL DEVICES

1.3 PUSHBUTTONS & SELECTOR SWITCHES

1.4 POWER SUPPLIES, GPOs, PLUGS & SOCKETS

1.5 SURGE PROTECTION & FUSES

1.6 RTU & RADIOS

1.7 TERMINALS, LINKS & OTHER ACCESSORIES

1.1. CIRCUIT BREAKERS & ISOLATORS

- TERASAKI – **E125-NJ 63A** – 63A 3P Moulded Case Circuit Breaker
- TERASAKI – **DSRCBH-16-30A** – 10kA 1P 6A 30mA RCD
- TERASAKI – **DTCB10104C** – 10kA 1P 4A "C" curve Circuit Breaker
- TERASAKI – **DTCB10106C** – 10kA 1P 6A "C" curve Circuit Breaker
- TERASAKI – **DTCB15332C+DTLDC** – 10kA 3P 32A "D" curve Circuit Breaker + Captive Lock Dog

TERASAKI Innovators in Protection Technology

TemBreak MCCB's

NHP

Thermal magnetic type

E125NJ



25kA

Current rating: **12.5 – 125A**

Approvals and Tests:
Standards AS/NZS 3947-2, and IEC60947-2

Interrupting capacity:

	Voltage	Icu	Ics
AC use	380/415	25	19
DC use	250V	25	19

Trip unit:
Adjustable thermal (0.63 *Ir* to 100% *Ir*) and adjustable magnetic (6 *Im* to 12 *Im*)

Dimensions (mm)

Poles	3
H	155
W	90
D (less toggle)	68
Toggle cut-out	Standard DIN

Ampere Rating NRC	**Adj. *Ir*** 1) Min - Max.	**Adj. *Im*** 1) Min - Max.	**Cat. No.**
20	12.5 - 20	120 - 240	**E125 NJ 3 20**
32	20 - 32	192 - 384	**E125 NJ 3 32**
50	32 - 50	300 - 600	**E125 NJ 3 50**
63	40 - 63	378 - 756	**E125 NJ 3 63**
100	63 - 100	600 - 1200	**E125 NJ 3 100**
125	80 - 125	750 - 1500	**E125 NJ 3 125**

1) NRC: Nominal rated current
Adj. *Ir*: Adjustable thermal setting
Adj. *Im*: Adjustable magnetic setting

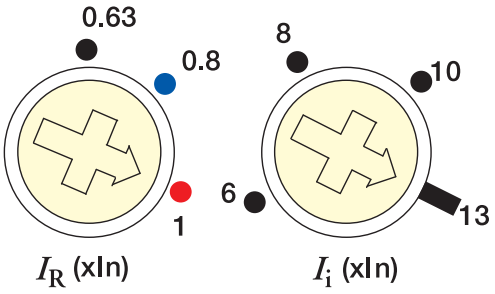
Replaces: XS125CJ, Note: check exact ratings or dimenions to suit your application requirement

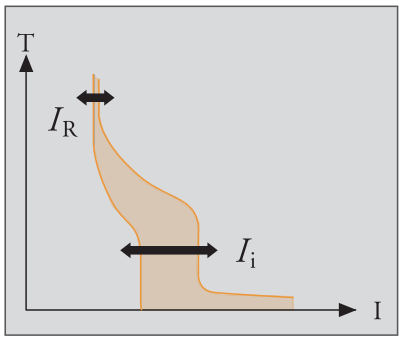
Price Schedule T2

OPERATING CHARACTERISTICS

THERMAL MAGNETIC PROTECTION

Adjustment Dials





1. I_R is the thermal element adjustment dial and is used to set the rated current to match the conductor rating.

   I_R can be set between 0.63 and 1.0 times I_n.

2. I_i is the magnetic element adjustment dial and is used to set the short circuit tripping threshold to suit the application.

   I_i can be set between 6 and 12 times I_n on 125A and 400A frame models.

   I_i can be set between 6 and 13 times I_n on 250A frame models with ratings of 160A, 200A and 250A.

   I_i can be set between 6 and 12 times I_n on 250A frame models with ratings of 125A and less.

Models, Types and Rated Currents of Thermal Elements

Model	Type	Current Rating In (A)
S125	-NF	16, 20, 25, 32, 40, 50, 63, 80, 100, 125
E125	-NJ	20, 32, 50, 63, 100, 125
S125	-NJ	20, 32, 50, 63, 100, 125
S125	-GJ	20, 32, 50, 63, 100, 125
H125	-NJ	20, 32, 50, 63, 100, 125
L125	-NJ	20, 32, 50, 63, 100, 125
S160	-NF	16, 20, 25, 32, 40, 50, 63, 80, 100, 125, 160
S160	-NJ	20, 32, 50, 63, 100, 125, 160
S160	-GJ	50, 63, 100, 125, 160
H160	-NJ	160
L160	-NJ	160
E250	-NJ	20, 32, 50, 63, 100, 125, 160, 200, 250
S250	-NJ	160, 200, 250
S250	-GJ	160, 200, 250
H250	-NJ	160, 250
L250	-NJ	160, 250
E400	-NJ	250, 400
S400	-CJ	250, 400
S400	-NJ	250, 400
S400	-GJ	250, 400
H400	-NJ	250, 400
L400	-NJ	250, 400

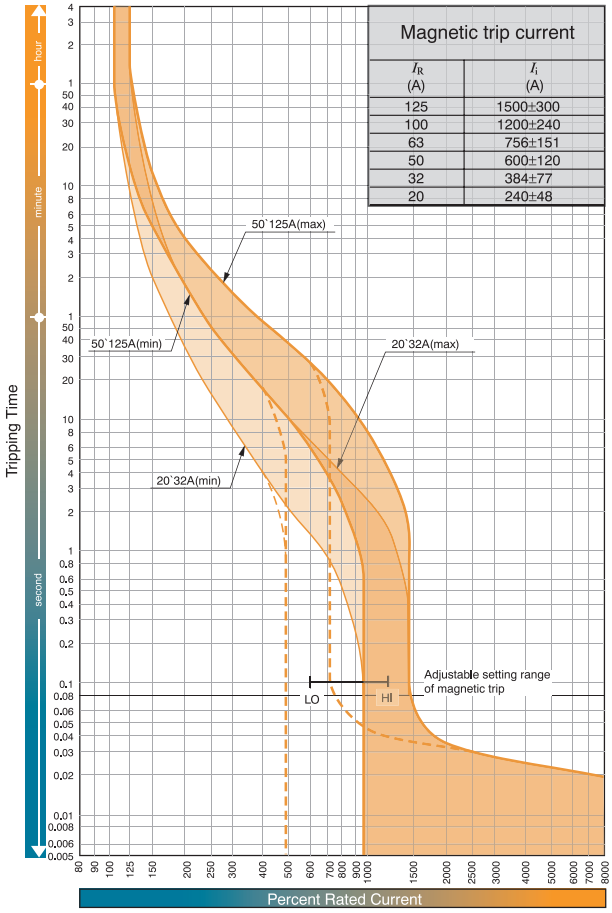
OPERATING CHARACTERISTICS

THERMAL MAGNETIC CHARACTERISTICS

125A Frame MCCBs

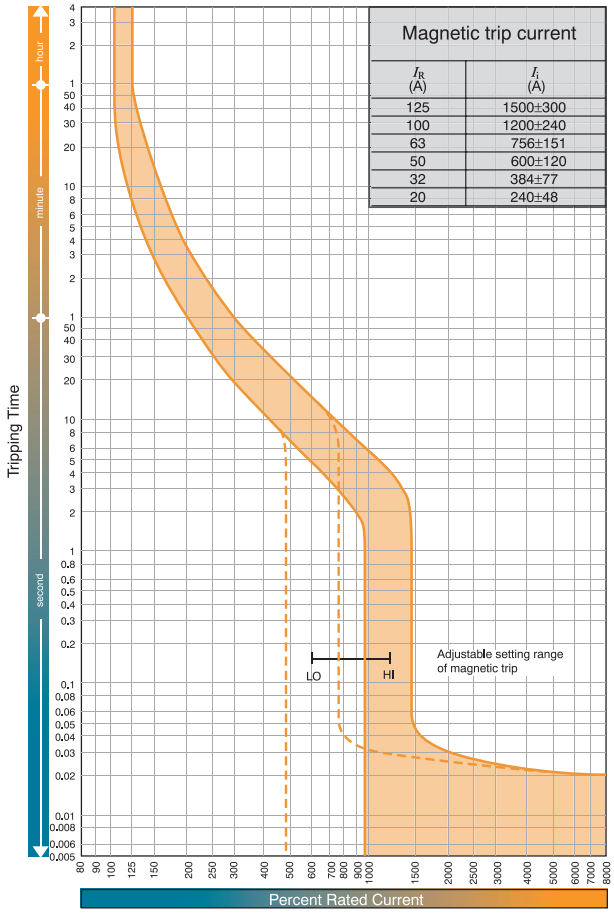
Time/current characteristic curves

E125-NJ, S125-NJ, S125-GJ



Time/current characteristic curves

H125-NJ, L125-NJ



SECTION 3

APPLICATION DATA

SELECTIVITY (DISCRIMINATION) AND CASCADE

Selectivity

The principle of Selectivity (Discrimination) is based upon an analysis of several circuit breaker characteristics. These include time-current (tripping) curves, peak-let-through current (I_{peak}) and energy let-through (I^2t).

The figures stated give the maximum selectivity level with the two nominated breakers in series under short-circuit conditions. For an indication on selectivity under overloads refer to the circuit breaker tripping/characteristic curves, or use the NHP TemCurve selectivity analysis software package.

Selectivity can be enhanced beyond the breaking capacity of the downstream breaker provided it is backed up by an appropriately selected upstream breaker, which should not trip (unlatch) under the stated short circuit current.

Cascade

Cascading is achieved by using an upstream device to assist (back-up) a downstream device in clearing a fault current. This principal is necessary should the downstream device be required to clear a prospective short circuit current greater than the devices' breaking capacity.

In most cascading applications it is generally necessary for the upstream breaker to trip (unlatch), as well as the downstream breaker to give adequate back-up protection. As such, cascade is commonly used in feeding and protecting non-essential loads, such as basic lighting.

For more information on selectivity and cascading please refer to the latest NHP Part C catalogue.

APPLICATION DATA

SELECTIVITY TABLES

Selectivity & Cascade Tables @ 400 / 415 V

Upstream MCCBs kA (RMS) / Downstream MCCBs	S250PE 70	H250NE 125	S400NE 50	S400GE 70	H400NE 125	L400NE 200	E630NE 36	S630CE 50
E125NJ	25/25	25/65	25/36	25/50	25/65	25/85	25/36	25/25
S125NJ	36/36	36/85	36/50	36/65	36/85	36/125	36/36	36/36
S125GJ	65/65	65/125	50/50	65/70	65/125	65/150	36/36	50/50
H125NJ	70/70	125/125	50/50	70/70	125/125	125/200	36/36	50/50
S160NJ			36/50	36/65	36/85	36/125	36/36	36/50
S160GJ			50/50	65/70	65/125	65/150	36/36	50/50
H160NJ					125/125	125/200	36/36	50/50
E250NJ					25/65	25/85	25/36	25/25
S250NJ					36/85	36/125	36/36	36/36
S250GJ					65/125	65/150	36/36	50/50
S250PE					40/125	70/150	36/36	50/50
H250NJ					125/125	125/200	36/36	50/50
H250PE					125/125	125/200	36/36	50/50
E400NJ							10/25	10/25
S400CJ							10/36	10/36
S400NE							10/36	10/50
S400NJ							10/36	10/36
S400GJ							10/36	10/50
H400NJ							10/36	10/50
H400NE							10/36	10/50
E630NE								
E630CE								
S630GE								
XS630CJ								
XS630NJ								
XS630PJ								
XS630SE								
XH630SE								
XH630PE								
XS800NJ								
XS800SE								
XJ800PJ								
XH800SE								
XH800PE								
XS1250SE								
XS1600SE								

XX / YY
Selectivity/ Cascade

Upstream MCCBs kA (RMS) / Downstream MCCBs	S630GE 70	L630NE 125	S800SE 50	H800SE 65	L800NE 125	S1250SE 85	TL1250NE 125	S1600SE 100	XS2000NE 85	XS2500NE 85
E125NJ	25/50	25/25	25/36	25/36	25/65	25/25	25/25	25/25	25/25	25/25
S125NJ	36/65	36/36	36/50	36/36	36/36	36/36	36/36	36/36	36/36	36/36
S125GJ	65/70	65/65	65/50	65/65	65/65	65/65	65/65	65/65	65/65	65/65
H125NJ	70/70	70/70	50/50	65/65	65/65	85/50	85/50	100/100	85/85	85/85
S160NJ	36/50	36/36	36/36	36/65	36/65	36/36	36/36	36/36	36/36	36/36
S160GJ	65/70	65/65	50/50	50/65	50/65	65/65	65/65	65/65	65/65	65/65
H160NJ	70/70	70/70	50/50	50/65	50/65	85/65	85/65	100/100	85/85	85/85
E250NJ	25/50	25/25	25/25	25/50	25/50	25/25	25/25	25/25	25/25	25/25
S250NJ	36/65	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
S250GJ	65/70	65/65	50/50	50/65	50/65	65/65	65/65	65/65	65/65	65/65
S250PE	70/70	70/70	50/50	50/65	50/65	70/70	70/70	70/70	70/70	70/70
H250NJ	70/70	70/70	50/50	50/65	50/65	85/85	85/85	100/100	85/85	85/85
H250PE	70/70	70/70	50/50	50/65	50/65	85/85	85/85	100/100	85/85	85/85
E400NJ	10/50	10/36	25/25	25/25	25/36	25/25	25/25	25/36	25/25	25/25
S400CJ	10/65	10/50	25/36	25/36	25/50	36/36	36/36	36/50	36/36	36/36
S400NE	10/50	10/50	25/50	25/50	25/50	50/50	50/50	50/50	50/50	50/50
S400NJ	10/70	10/65	25/50	25/50	25/65	50/50	50/50	50/65	50/50	50/50
S400GJ	10/70	10/70	25/50	25/50	25/65	70/36	70/36	70/85	70/70	70/70
H400NJ	10/70	10/70	25/50	25/65	25/65	125/85	125/85	125/100	125/85	125/85
H400NE	10/70	10/70	25/50	25/65	25/65	125/85	125/85	125/100	125/85	125/85
E630NE			25/36	25/36	25/36	36/36	36/36	36/36	36/36	36/36
E630CE			25/36	25/50	25/50	50/50	50/50	50/50	50/50	50/50
S630GE						70/36	70/70	70/70	70/70	70/70
XS630CJ						30/45	30/45	30/45	35/45	35/45
XS630NJ						30/65	30/65	30/65	35/65	35/65
XS630PJ						30/85	30/85	30/85	35/85	35/85
XS630SE						30/65	30/65	30/85	30/85	30/85
XH630SE						30/65	30/65	30/85	30/85	30/85
XH630PE						30/65	30/65	30/85	30/85	30/85
XS800NJ						15/65	15/65	20/65	35/65	35/65
XS800SE						15/50	15/50	20/50	35/50	35/50
XJ800PJ						15/85	15/85	20/85	35/85	35/85
XH800SE						15/65	15/65	20/65	35/65	35/65
XH800PE						15/65	15/65	20/65	35/65	35/65
XS1250SE								20/65	35/65	35/65
XS1600SE									35/85	35/85

SECTION 4

APPLICATION DATA

CASCADE TABLES

CASCADE @ 380 – 415 V AC [1]		E125NJ	S125NJ	S125GJ	H125NJ	L125NJ	S160NJ	S160GJ	H160NJ	L160NJ	E250NJ	S250NJ	S250GJ	S250PE	H250NJ	H250NE	L250NJ
Downstream MCCBs	kA (RMS)	25	36	65	125	200	36	65	125	200	25	36	65	70	125	125	200
E125NJ	25	–	36	36	65	85	36	36	65	85	–	36	36	–	65	65	85
S125NJ	36	–	–	50	85	125	–	50	85	125	–	–	–	–	85	85	125
S125GJ	65	–	–	–	125	150	–	–	125	150	–	–	65	–	125	125	150
H125NJ	125	–	–	–	–	200	–	–	-	200	–	–	65	–	–	–	200
S160NJ	36	–	–	65	–	–	–	65	85	125	–	–	65	65	85	85	125
S160GJ	65	–	–	–	–	–	–	–	125	150	–	–	–	70	125	125	150
H160NJ	125	–	–	–	–	–	–	–	–	200	–	–	–	-	–	–	200
S250NJ	36	–	–	–	–	–	–	65	–	–	–	–	–	65	85	85	125
S250GJ	65	–	–	–	–	–	–	–	–	–	–	–	–	70	125	125	150
S250PE	70	–	–	–	–	–	–	–	–	–	–	–	–	–	125	125	150
H250NJ	125	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	200
E400NJ	25	–	–	–	–	–	–	–	–	–	–	–	–	36	65	65	–
S400CJ	36	–	–	–	–	–	–	–	–	–	–	–	–	50	70	70	–
S400NJ	50	–	–	–	–	–	–	–	–	–	–	–	50	65	85	85	–
S400GJ	70	–	–	–	–	–	–	–	–	–	–	–	50	–	125	125	–
H400NJ	125	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Note: [1] Ratings have not been verified where a dash "–" is shown.

All pick-up and time delay settings are to be set at a maximum for upstream MCCB's

Upstream MCCBs

CASCADE @ 380 – 415 V AC [1]		S400CJ	S400NE S400NJ	S400GE S400GJ	H400NJ H400NE	L400NJ	L400NE	E630NE	S630CE	S630GE	TL630NE	XS800SE	XS800NJ	XH800SE	TL800NE	XS1250SE	XS1600SE
Downstream MCCBs	kA (RMS)	36	50	70	125	200	200	36	50	70	125	65	65	65	200	65	85
E125NJ	25	36	36	50	65	85	85	36	-	50	–	36	36	36	–	–	–
S125NJ	36	–	50	65	85	125	125	–	-	65	–	50	50	–	–	–	–
S125GJ	65	–	–	70	125	150	150	–	50	70	–	–	–	65	–	–	–
H125NJ	125	–	–	–	–	200	200	–		-	–	–	–	65	–	50	–
S160NJ	36	–	50	65	85	125	125	–	50	50	–	–	65	65	–	–	–
S160GJ	65	–	–	70	125	150	150	–	–	70	–	–	–	–	–	–	–
H160NJ	125	–	–	–	–	200	200	–	–	–	–	–	–	65	–	65	–
E250NJ	25	36	36	50	65	85	85	36	–	50	–	–	36	50	–	–	–
S250NJ	36	–	50	65	85	125	125	–	–	65	–	–	65	–	–	–	–
S250GJ	65	–	–	70	125	150	150	–	–	70	–	–	–	–	–	–	–
S250PE	70	–	–	–	125	150	150	–	–	–	–	–	–	–	–	–	–
H250NJ	125	–	–	–	–	200	200	–	–-	–	–	–	–	–	–	–	–
E400NJ	25	36	36	50	65	85	85	36	–	50	36	–	–	–	36	–	36
S400CJ	36	–	50	65	70	100	100	–	–	65	50	–	–	–	50	–	50
S400NJ	50	–	–	70	85	125	125	–	36	70	65	–	–	50	65	–	65
S400GJ	70	–	–	–	125	150	150	–	36	–	–	–	–	50	–	36	85
H400NJ	125	–	–	–	–	200	200	–	–	–	–	–	–	–	–	–	–

Note: [1] Ratings have not been verified where a dash "–" is shown.

All pick-up and time delay settings are to be set at a maximum for upstream MCCBs

APPLICATION DATA

SELECTIVITY AND CASCADE TEMBREAK 2 MCCBs AND DIN-T / SAFE-T MCBs

SELECTIVITY / CASCADE @ 415 V AC			Upstream MCCB							
			E125NJ	S125NJ	H125NJ S125GJ	S250NJ	S250GJ	S400CJ	S400GE S400GJ	H400NJ
Downstream MCB	Amp rating	kA (RMS)	25	36	65	36	65	36	70	125
DTCB6	2 – 20	6	18/18	25/25	35/35	35/35	35/35	–	–	–
	25 – 63	6	18/18	20/25	20/25	30/30	30/30	–	–	–
DTCB10	0.5 – 32	10	18/18	30/30	30/50	35/35	40/50	35/35	40/50	40/50
	40 – 63	10	18/18	20/25	25/25	30/30	30/30	30/30	30/30	30/30
DSRCBH /	0.5 – 32	10	18/18	30/30	30/50	35/35	40/50	35/35	40/50	40/50
DSRCD	40	10	18/18	20/25	25/25	30/30	30/30	30/30	30/30	30/30
Din-T10H	80 – 125	10	4/18	4/25	4/25	15/15	15/15	10/10	10/10	–
DTCH15	0.5 – 32	15	18/18	30	30/50	35/35	40/50	35/35	40/50	40/50
	40 – 63	15	18/18	20	25/25	30/30	30/30	30/30	30/30	30/30
Safe-T	16 – 20	6	3/10	3/10	3/10	–	–	–	–	–
SRCB	16 – 20	6	3/10	3/10	3/10	–	–	–	–	–

Guide

XX / YY

Selectivity Cascade

Notes: All figures stated are at 400/415 V AC.

SECTION 4

APPLICATION DATA

MOTOR STARTING TYPE 1 CO-ORDINATION TABLES

Short-Circuit Co-Ordination Motor Starting Table

Type '1'
Terasaki MCCB's & Sprecher + Schuh KT7's
DOL starting 50/65 kA @ 400/415 V to AS/NZS 60947.4.1

TYPE 1 50/65 kA

		Terasaki Combinations	
Motor Size (kW)	Approx. amps @ 400/415 V (A)	MCCB	Contactor
0.37	1.1	XM30PB/1.4	CA7-9
0.55	1.5	XM30PB/2	CA7-9
0.75	1.8	XM30PB/2.6	CA7-9
1.1	2.6	XM30PB/4.0	CA7-9
1.5	3.4	XM30PB/5	CA7-9
2.2	4.8	XM30PB/8	CA7-9
3	6.5	XM30PB/10	CA7-9
4	8.2	XM30PB/12	CA7-9
5.5	11	S125GJ/20	CA7-12
7.5	14	S125GJ/20	CA7-16
11	21	S125GJ/32	CA7-23
15	28	S125GJ/50	CA7-30
18.5	34	S125GJ/50	CA7-37
22	40	S125GJ/63	CA7-43
30	55	S125GJ/100	CA7-60
37	66	S125GJ/100	CA7-72
45	80	S125GJ/125	CA7-85
55	100	S125GJ/125	CA6-110
5	130	S250PE/250	CA6-140
0	155	S250PE/250	CA6-180
10	200	S250PE/250	CA6-210
32	225	S400GE/400	CA6-210
60	270	S400GE/400	CA6-300
00	361	S400GE/400	CA6-420

Terasaki Combinations		Sprecher + Schuh Combinations	
Overload Relay	Thermal Setting (A)	KT7 Circuit Breaker	Contactor
CT 7-24	1.0 - 1.6	KTA7-25S-1.0A	CA7-9
CT 7-24	1.0 - 1.6	KTA7-25S-1.6A	CA7-9
CT 7-24	1.6 - 2.4	KTA7-25S-2.5A	CA7-9
CT 7-24	2.4 - 4.0	KTA7-25S-2.5A	CA7-9
CT 7-24	2.4 - 4.0	KTA7-25S-4.0A	CA7-9
CT 7-24	4.0 - 6.0	KTA7-25S-6.3A	CA7-9
CT 7-24	6.0 - 10	KTA7-25S-6.3A	CA7-9
CT 7-24	6.0 - 10	KTA7-25S-10A	CA7-9
CT 7-24	10 - 16	KTA7-25H-16A	CA7-12
CT 7-24	10 - 16	KTA7-25H-16A	CA7-16
CT 7-24	16 - 24	KTA7-45H-20A	CA7-23
CT 7-45	18 - 30	KTA7-45H-32A	CA7-30
CT 7-45	30 - 45	KTA7-45H-45A	CA7-37
CT 7-45	30 - 45	KTA7-45H-45A	CA7-43
CT 7-75	45 - 60	KTA3-100-63A	CA7-60
CT 7-75	60 - 75	KTA3-100-90A	CA7-72
CT 7-100	70 - 90	KTA3-100-90A	CA7-85
CEF 1-11/12	20 - 180	KTA3-160S-100A	CA6-110
CEF 1-11/12	20 - 180	KTA3-160S-160A	CA6-140
CEF 1-11/12	20 - 180	KTA3-160S-160A	CA6-180
CEF 1-41/42	160 - 400	KTA3-250S-200A	CA6-210
CEF 1-41/42	160 - 400	KTA3-250S-250A	CA6-250
CEF 1-41/42	160 - 400	KTA3-400S-320A	CA6-300
CEF 1-41/42	160 - 400	KTA3-400S-400A	CA6-420

Notes:
- Thermal or electronic overload relays may be used.
- XM30PB MCCB's can be replaced with S125GJ/20 if required.
- Combinations based on the thermal overload relay tripping before the circuit. breaker at overload currents up to the motor locked rotor current.

APPLICATION DATA

MOTOR STARTING TYPE 2 CO-ORDINATION TABLES

Short-Circuit Co-Ordination DOL Motor Starting Table

Type '2'
Terasaki MCCB's & Sprecher + Schuh KT7's
DOL starting 50/65 kA @ 400/415 V to AS/NZS 60947.4.1

TYPE 2 50/65 kA

		Terasaki Combinations	
Motor Size (kW)	Approx. amps @ 400/415 V (A)	MCCB	Contactor
0.37	1.1	XM30PB/1.4	CA7-9
0.55	1.5	XM30PB/2	CA7-9
0.75	1.8	XM30PB/2.6	CA7-9
1.1	2.6	XM30PB/4.0	CA7-16
1.5	3.4	XM30PB/5	CA7-16
2.2	4.8	XM30PB/8	CA7-16
3	6.5	XM30PB/10	CA7-30
4	8.2	XM30PB/12	CA7-30
5.5	11	S125GJ/20	CA7-30
7.5	14	S125GJ/20	CA7-30
11	21	S125GJ/32	CA7-30
15	28	S125GJ/50	CA7-43
18.5	34	S125GJ/50	CA7-43
22	40	S125GJ/63	CA7-43
30	55	S125GJ/100	CA7-72
37	66	S125GJ/100	CA7-72
45	80	S125GJ/125	CA6-105
55	100	S250PE/160	CA6-105
75	130	S250PE/250	CA6-140
90	155	S250PE/250	CA6-170
110	200	S250PE/250	CA6-210
132	225	S400PE/400	CA6-210
160	270	S400PE/400	CA6-300
200	361	S400PE/400	CA6-420

Terasaki Combinations		Sprecher + Schuh Combinations	
Overload Relay	Thermal Setting (A)	KT7 Circuit Breaker	Contactor
CT 7-24	1.0 - 1.6	KTA7-25S-1A	CA7-9
CT 7-24	1.0 - 1.6	KTA7-25S-1.6A	CA7-9
CT 7-24	1.6 - 2.4	KTA7-25S-2.5A	CA7-9
CT 7-24	2.4 - 4.0	KTA7-25S-2.5A	CA7-9
CT 7-24	2.4 - 4.0	KTA7-25S-4A	CA7-9
CT 7-24	4.0 - 6.0	KTA7-25S-6.3A	CA7-9
CT 7-24	6.0 - 10	KTA7-25S-6.3A	CA7-9
CT 7-24	6.0 - 10	KTA7-25S-10A	CA7-9
CT 7-24	10 - 16	KTA7-25H-16A	CA7-12
CT 7-24	10 - 16	KTA7-25H-16A	CA7-16
CT 7-24	16 - 24	KTA7-45H-20A	CA7-23
CT 7-45	18 - 30	KTA7-45H-32A	CA7-30
CT 7-45	30 - 45	KTA7-45H-45A	CA7-37
CT 7-45	30 - 45	KTA7-45H-45A	CA7-43
CT 7-75	45 - 60	KTA3-100-63A	CA7-60
CT 7-75	60 - 75	KTA3-100-90A	CA7-72
CT 7-100	70 - 90	KTA3-100-90A	CA7-85
CEF 1-11/12	20 - 180	KTA3-160S-100A	CA6-110
CEF 1-11/12	20 - 180	KTA3-160S-160A	CA6-140
CEF 1-11/12	20 - 180	KTA3-160S-160A	CA6-180
CEF 1-41/42	160 - 400	KTA3-250S-200A	CA6-210
CEF 1-41/42	160 - 400	KTA3-250S-250A	CA6-250
CEF 1-41/42	160 - 400	KTA3-400S-320A	CA6-300
CEF 1-41/42	160 - 400	KTA3-400S-400A	CA6-420

Notes:
- Thermal or electronic overload relays may be used.
- XM30PB combinations can be replaced with S125GJ/20 and CA7-30 if required.
- Combinations based on the thermal overload relay tripping before the circuit breaker at overload currents up to the motor locked rotor current.

SECTION 4

APPLICATION DATA

MOTOR STARTING TYPE 2 CO-ORDINATION

Short-Circuit Co-Ordination DOL Motor Starting Table

Type '2'
Terasaki MCCB's & Sprecher + Schuh KT7's
DOL starting 85 kA @ 400/415 V to AS/NZS 60947.4.1

TYPE 2
85 kA

		Terasaki Combinations	
Motor Size (kW)	Approx. amps @ 400/415 V (A)	MCCB	Contactor
0.37	1.1	XM30PB/1.4	CA 7-9
0.55	1.5	XM30PB/2	CA 7-9
0.75	1.8	XM30PB/2.6	CA 7-9
1.1	2.6	XM30PB/4.0	CA 7-16
1.5	3.4	XM30PB/5	CA 7-16
2.2	4.8	XM30PB/8	CA 7-30
3	6.5	XM30PB/10	CA 7-30
4	8.2	XM30PB/12	CA 7-30
5.5	11	H125NJ/20	CA 7-30
7.5	14	H125NJ/20	CA 7-30
11	21	H125NJ/32	CA 7-30
15	28	H125NJ/50	CA 7-43
18.5	34	H125NJ/50	CA 7-43
22	40	H125NJ/63	CA 7-43
30	55	H125NJ/100	CA 7-72
37	66	H125NJ/100	CA 7-72
45	80	H125NJ/160	CA 6-105
55	100	H160NJ/160	CA 6-105
75	130	H250PE/250	CA 6-210
90	155	H250PE/250	CA 6-210
110	200	H250PE/250	CA 6-210
132	225	H400NE/400	CA 6-210
160	270	H400NE/400	CA 6-300
200	361	H400NE/400	CA 6-420

Terasaki Combinations		Sprecher + Schuh Combinations	
Overload Relay	Thermal Setting (A)	KT7 Circuit Breaker	Contactor
CT 7-24	1.0 - 1.6	KTA7-25S-1A	CA 7-9
CT 7-24	1.0 - 1.6	KTA7-25S-1.6A	CA 7-9
CT 7-24	1.6 - 2.4	KTA7-25S-2.5A	CA 7-9
CT 7-24	2.4 - 4.0	KTA7-25H-2.5A	CA 7-9
CT 7-24	2.4 - 4.0	KTA7-25H-4A	CA 7-9
CT 7-24	4.0 - 6.0	KTA7-25H-6.3A	CA 7-9
CT 7-24	6.0 - 10	KTA7-25H-6.3A	CA 7-9
CT 7-24	6.0 - 10	KTA7-25H-10A	CA 7-9
CT 7-24	10 - 16	KTA7-45H-16A	CA 7-12
CT 7-24	10 - 16	KTA7-45H-16A	CA 7-16
CT 7-24	16 - 24	KTA7-45H-20A	CA 7-23
CT 7-45	18 - 30	KTA7-45H-32A	CA 7-30
CT 7-45	30 - 45	KTA7-45H-45A	CA 7-37
CT 7-45	30 - 45	KTA7-45H-45A	CA 7-43
CT 7-75	45 - 60	KTA3-100-63A	CA7-60
CT 7-75	60 - 75	KTA3-100-90A	CA7-72
CT 7-100	70 - 90	KTA3-100-90A	CA7-85
CEF 1-11/12	20 - 180	-	-
CEF 1-11/12	20 - 180	-	-
CEF 1-11/12	20 - 180	-	-
CEF 1-41/42	160 - 400	-	-
CEF 1-41/42	160 - 400	-	-
CEF 1-41/42	160 - 400	-	-
CEF 1-41/42	160 - 400	-	-

Notes:
- Thermal or electronic overload relays may be used.
- XM30PB combinations can be replaced with H125GJ/20 and CA7-30 if required.
- Combinations based on the thermal overload relay tripping before the circuit breaker at overload currents up to the motor locked rotor current.

APPLICATION DATA

MOTOR STARTING TYPE 2 CO-ORDINATION

Short-Circuit Co-Ordination DOL Motor Starting Table

Type '2'
Terasaki MCCB's & Sprecher + Schuh KT7's
DOL starting 100 kA @ 400/415 V to AS/NZS 60947.4.1

TYPE 2
100 kA

		Terasaki Combinations	
Motor Size (kW)	Approx. amps @ 400/415 V (A)	MCCB	Contactor
0.37	1.1	H125NJ/20	CA 7-30
0.55	1.5	H125NJ/20	CA 7-30
0.75	1.8	H125NJ/20	CA 7-30
1.1	2.6	H125NJ/20	CA 7-30
1.5	3.4	H125NJ/20	CA 7-30
2.2	4.8	H125NJ/20	CA 7-30
3	6.5	H125NJ/20	CA 7-30
4	8.2	H125NJ/20	CA 7-30
5.5	11	H125NJ/20	CA 7-30
7.5	14	H125NJ/20	CA 7-30
11	21	H125NJ/32	CA 7-30
15	28	H125NJ/50	CA 7-43
18.5	34	H125NJ/50	CA 7-43
22	40	H125NJ/63	CA 7-43
30	55	H125-NJ/100	CA 7-60
37	66	H125-NJ/100	CA 7-72
45	80	H125-NJ/125	CA 7-85
55	100	H250-NE/160	CA 6-95
75	130	H250-NE/250	CA 6-140
90	155	H250-NE/250	CA 6-140
110	200	H250-NE/250	CA 6-180
132	225	H400-NE/400	CA 6-420
160	270	H400-NE/400	CA 6-420
200	361	H400-NE/400	CA 6-420

Terasaki Combinations		Sprecher + Schuh Combinations	
Overload Relay	Thermal Setting (A)	KT7 Circuit Breaker	Contactor
CT 7-24	1.0 - 1.6	KTA7-25S-1A	CA 7-9
CT 7-24	1.0 - 1.6	KTA7-25S-1.6A	CA 7-9
CT 7-24	1.6 - 2.4	KTA7-25S-2.5A	CA 7-9
CT 7-24	2.4 - 4.0	KTA7-25H-2.5A	CA 7-9
CT 7-24	2.4 - 4.0	KTA7-25H-4A	CA 7-9
CT 7-24	4.0 - 6.0	KTA7-25H-6.3A	CA 7-9
CT 7-24	6.0 - 10	KTA7-25H-6.3A	CA 7-9
CT 7-24	6.0 - 10	KTA7-25H-10A	CA 7-9
CT 7-24	10 - 16	KTA7-45H-16A	CA 7-12
CT 7-24	10 - 16	KTA7-45H-16A	CA 7-16
CT 7-24	16 - 24	KTA7-45H-20A	CA 7-23
CT 7-45	18 - 30	KTA7-45H-32A	CA 7-30
CT 7-45	30 - 45	KTA7-45H-45A	CA 7-37
CT 7-45	30 - 45	KTA7-45H-45A	CA 7-43
CT 7-75	45 - 60	-	-
CT 7-75	60 - 75	-	-
CT 7-100	70 - 90	-	-
CEF 1-11/12	20 - 180	-	-
CEF 1-11/12	20 - 180	-	-
CEF 1-11/12	20 - 180	-	-
CEF 1-41/42	160 - 400	-	-
CEF 1-41/42	160 - 400	-	-
CEF 1-41/42	160 - 400	-	-
CEF 1-41/42	160 - 400	-	-

Notes:
- Thermal or electronic overload relays may be used.
- Combinations based on the thermal overload relay tripping before the circuit breaker at overload currents up to the motor locked rotor current.

SECTION 4

INSTALLATION

INSULATION DISTANCE IN mm (AT 440V AC MAXIMUM)

Model	Type	A	B1	B2	C	D	E
E125	NJ	50	10	10	0	25	*(1)
S125	NF	50	10	10	0	25	*(1)
S125	NJ	50	10	10	0	25	*(1)
S125	GJ	75	45	25	0	25	*(1)
H125	NJ	100	80	60	0	50	*(1)
L125	NJ	100	80	60	0	50	*(1)
S160	NF	50	40	30	0	25	*(1)
S160	NJ	50	40	30	0	25	*(1)
S160	GJ	100	80	60	0	50	*(1)
H160	NJ	100	80	60	0	50	*(1)
L160	NJ	100	80	60	0	50	*(1)
E250	NJ	50	40	30	0	25	*(1)
S250	NJ	50	40	30	0	25	*(1)
S250	GJ	100	80	30	0	25	*(1)
S250	PE	100	80	60	0	50	*(1)
H250	NJ	100	80	60	0	50	*(1)
H250	NE	100	80	60	0	50	*(1)
L250	NJ	100	80	60	0	50	*(1)
E400	NJ	100	80	40	0	30	*(1)
S400	CJ	100	80	40	0	30	*(1)
S400	NJ	100	80	40	0	30	*(1)
S400	GJ	100	80	40	0	30	*(1)
S400	GE	100	80	40	0	30	*(1)
H400	NJ	120	120	80	0	80	*(1)
H400	NE	120	120	80	0	80	*(1)
L400	NJ	120	120	80	0	80	*(1)
L400	NE	120	120	80	0	80	*(1)
E630	NE	120	100	80	0	80	*(1)
S630	CE	120	100	80	0	80	*(1)
S630	GE	120	100	80	0	80	*(1)

***Note:** (1) Insulate the exposed conductor until it overlaps the moulded case at the terminal, or the terminal cover.

INSTALLATION

TEMPERATURE RATINGS & DERATINGS

Calibration Temperature: 45°C

MCCB Type	Connection Type	Rating at calibration temperature (50°C)	Rated Current (A)			
			50°C	55°C	60°C	65°C
E125-NJ S125-NJ S125-GJ	Front Rear Plug-in	20A	19	18.5	18	17.5
		32A	31	30.5	30	29
		50A	48	45	43	41
		63A	60	57	55	52
		100A	97	94	90	87
		125A	121	117	113	109
H125-NJ L125-NJ	Front Rear Plug-in	20A	19	18.5	18	17.5
		32A	31	30	29	28
		50A	48	47	45	44
		63A	61	59	57	55
		100A	97	95	92	89
		125A	121	118	114	111
S160-NJ S160-GJ	Front Rear Plug-in	20A	19	18.5	18	17.5
		32A	31	30	29	28
		50A	48	46	44	42
		63A	61	59	57	55
		100A	97	94	91	88
		125A	121	117	113	109
		160A	156	151	146	141
H160-NJ L160-NJ	Front Rear Plug-in	160A	156	151	147	143
E250-NJ	Front Rear Plug-in	20A	19	18.5	18	17.5
		32A	31	30	29	28
		50A	48	46	44	42
		63A	61	59	57	55
		100A	97	94	91	88
		125A	121	117	113	109
E250-NJ S250-NJ S250-GJ	Front Rear Plug-in	160A	156	151	146	141
		250A	243	235	227	219
H250-NJ L250-NJ	Front Rear Plug-in	160A	156	151	147	143
	Front Rear	250A	244	237	230	223
E400-NJ S400-CJ S400-NJ S400-GJ	Front Rear Plug-in	250A	244	237	230	223
		400A	390	380	369	358
H400-NJ L400-NJ	Front Rear	250A	243	237	230	223
		400A	390	381	371	361
	Plug-in	250A	243	237	231	224
		400A	392	384	376	368

Calibration Temperature: 30°C

MCCB Type	Connection Type	Rating at calibration temperature (30°C)	Rated Current (A)						
			35°C	40°C	45°C	50°C	55°C	60°C	65°C
H250-NJ L250-NJ	Plug-in Conn.	250A	244	236	225	219	209	200	190

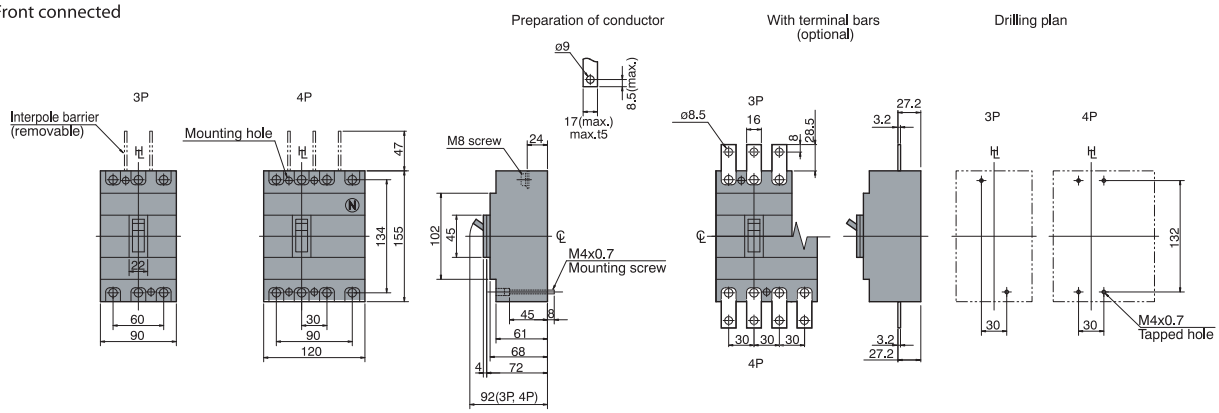
MCCB Type	Connection Type	Rating	Rated Current (A)							
			30°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
S250-PE H250-NE	Front Rear	250A	250	250	250	250	237.5	225	200	200
	Plug-in	250A	250	237.5	225	225	200	200	157.5	157.5
S400-NE S400-GE	Front Rear Plug-in	250A	250	250	250	250	250	250	225	200
		400A	400	400	400	400	400	380	360	320
H400-NE L400-NE	Front Rear	250A	250	250	250	250	250	250	225	200
		400A	400	400	400	400	400	380	360	320
	Plug-in	250A	250	250	250	250	250	250	225	200
		400A	400	400	400	400	400	380	360	320
E630-NE S630-CE S630-GE	Front Rear*	630A	630	630	630	630	598.5	598.5	567	504

DIMENSIONS

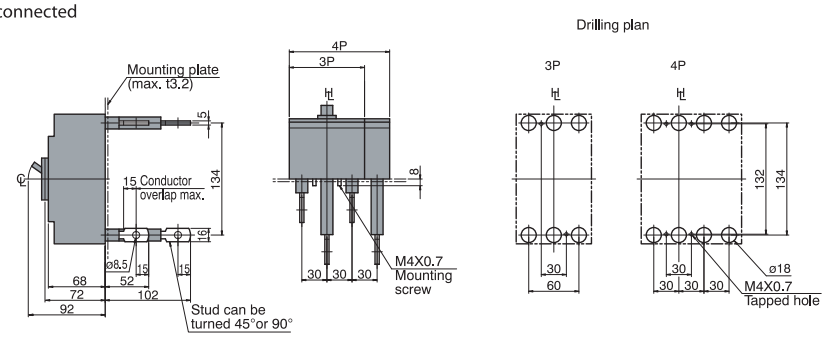
E125-NJ, S125-NJ, S125-GJ

ASL: Arrangement Standard Line
℄ : Handle Frame Centre Line

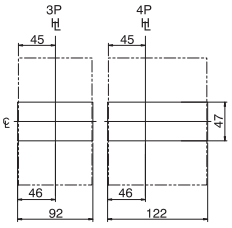
Front connected



Rear connected

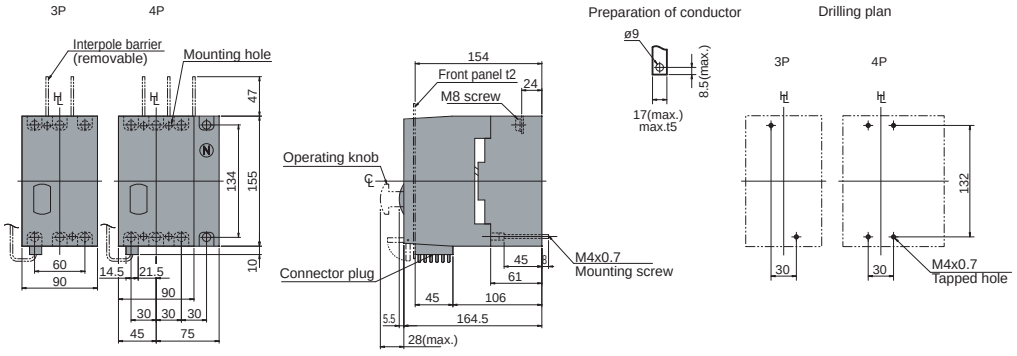


Panel cutout (Front view)

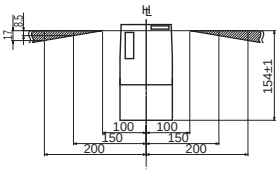


Panel cutout dimensions shown give an allowance of 1.0mm around the handle escutcheon.

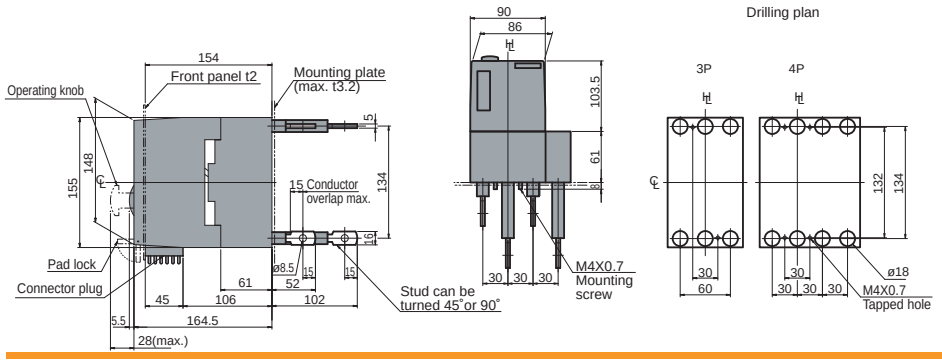
Front connected with Motor Operator



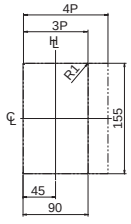
Panel hinge position (hatching area) bottom view



Rear connected with Motor Operator



Panel cutout (Front view)



Panel cutout dimensions shown give an allowance of 1.5mm around the handle escutcheon.

Miniature circuit breakers

Din-Safe single pole width residual current circuit breaker (RCBO)



- Standards AS/NZS 61009
- Approval N17482
- One module wide (18 mm)
- Short circuit, overcurrent and earth leakage protection
- Short circuit protection 10 kA
- Sensitivity 10 and 30 mA
- Din rail mount
- Suits CD chassis
- Type "A" residual current device (AC/DC)

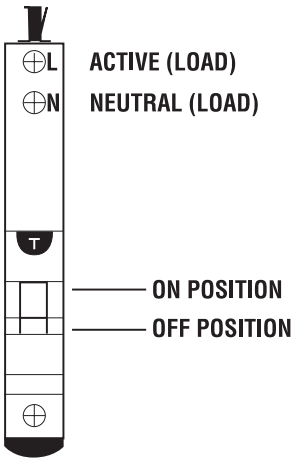
Amp rating (A)	Modules (18mm)	Voltage (AC)	Short circuit (kA)	Trip Sensitivity (mA)	Cat. No [1] [2]
6	1	240	10	30	DSRCBH0630A
10	1	240	10	30	DSRCBH1030A
16	1	240	10	30	DSRCBH1630A
20	1	240	10	30	DSRCBH2030A
25	1	240	10	30	DSRCBH2530A
32	1	240	10	30	DSRCBH3230A
40	1	240	10	30	DSRCBH4030A
6	1	240	10	10	[i] DSRCBH0610A
10	1	240	10	10	DSRCBH1010A
16	1	240	10	10	DSRCBH1610A
20	1	240	10	10	DSRCBH2010A
25	1	240	10	10	[i] DSRCBH2510A
32	1	240	10	10	[i] DSRCBH3210A
40	1	240	10	10	[i] DSRCBH4010A

Note: [1] Neutral not switched.
[2] Will not accept side mounting accessories.
[i] Available on indent only.

Application

The Din-Safe single pole width residual current circuit breaker will fit the standard Din-T chassis for use in NHP panelboards. The design makes it possible to provide an MCB complete with earth leakage protection in an 18 mm wide module, which allows a greater number of devices to be fitted into a distribution board.

Connection diagram



Operation

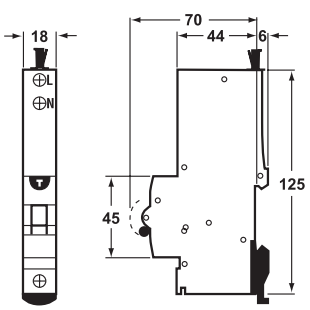
This unit combines the overload and short circuit protection of an MCB with earth leakage protection of an RCD. The unit occupies one, sub- circuit (one pole) of the distribution board and provides single phase protection against overload, short circuit and earth leakage current.

- The MCB element provides thermal and magnetic tripping protection which is rated to 10 kA prospective fault current.
- The RCD element of the device provides core-balance detection of the difference between the active and neutral currents and amplification to provide high sensitivity. The rated residual operating current (IΔn) is 10 mA or 30 mA.
- The green/yellow earth reference cable, in case of loss of supply neutral, ensures the device will continue to provide earth leakage protection and will operate normally upon detection of an earth leakage current.

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

Dimensions (mm)

Note: A 1.2 m long pigtail lead is included as standard.



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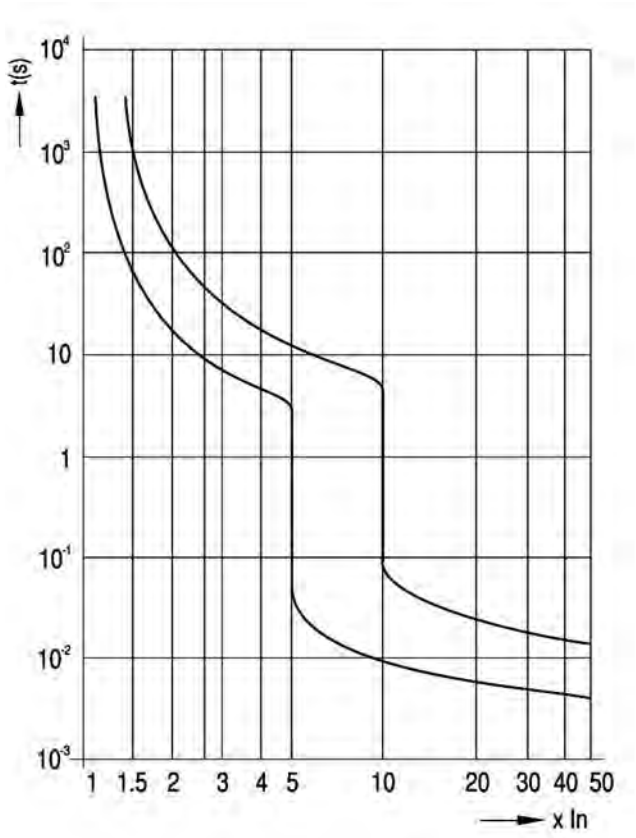
Din-T MCBs + RCDs Technical data

Tripping curves according to EN 60898

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

3

Curve C



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Din-T MCBs + RCDs Technical data

RCDs classification according to EN 61008/61009

RCDs may be classified according to:

The behaviour in the presence of DC current

(types for general use).

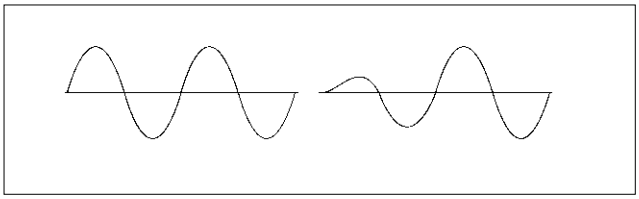
- Type AC
- Type A

The time-delay (in the presence of residual current)

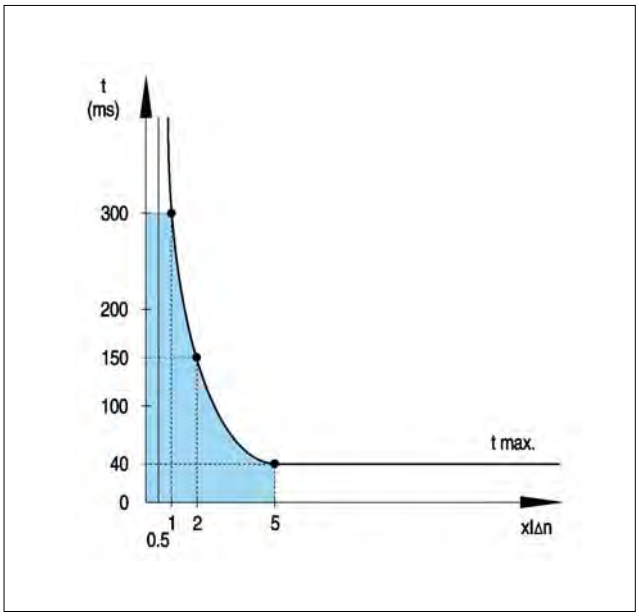
- RCDs without time delay: type for general use
- RCDs with time delay: type S for selectivity

Type AC  [1] [2]

The type AC RCDs are designed to release with sinusoidal residual currents which occur suddenly or slowly rise in magnitude.



Residual current	Tripping time
0.5 x IΔn	t = ∞
1 x IΔn	t = <300 ms
2 x IΔn	t = <150 ms
5 x IΔn	t = ≤40 ms



Tripping curve type AC

[1] Standard in Australia

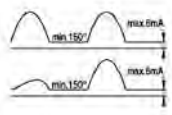
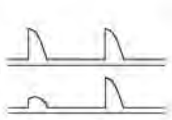
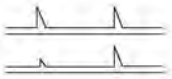
[2] Type A acceptable in Australia

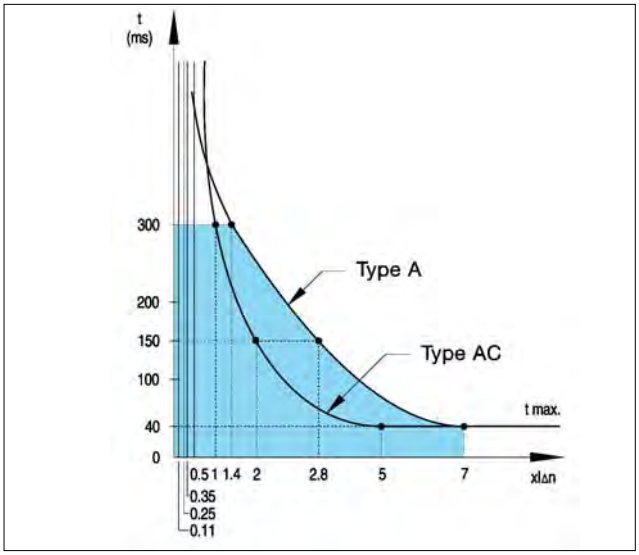
Type A  [3] [4]

Certain devices during faults can be the source of non-sinusoidal earth leakage currents (DC components) due to the electronic components e.g. diodes, thyristors etc.

Type A RCDs are designed to ensure that under these conditions the residual current devices operate on sinusoidal residual current and also with pulsating direct current(*) which occur suddenly or slowly rise in magnitude.

(*) Pulsating direct current: current of pulsating wave form which assumes, in each period of the rated power frequency, the value 0 or a value not exceeding 0.006 A DC during one single interval of time, expressed in angular measure of at least 150°.

	Residual current	Tripping time
1. For sinusoidal residual current		
	0.5 x IΔn	t = ∞
	1 x IΔn	t = <300 ms
	2 x IΔn	t = <150 ms
	5 x IΔn	t = ≤40 ms
2. For residual pulsating direct current		
	At point of wave 0°	
	0.35 x IΔn	t = ∞
	1.4 x IΔn	t = <300 ms
	2.8 x IΔn	t = <150 ms
	7 x IΔn	t = ≤40 ms
	At point of wave 90°	
	0.25 x IΔn	t = ∞
	1.4 x IΔn	t = <300 ms
	2.8 x IΔn	t = <150 ms
	7 x IΔn	t = ≤40 ms
	At point of wave 135°	
	0.11 x IΔn	t = ∞
	1.4 x IΔn	t = <300 ms
	2.8 x IΔn	t = <150 ms
	7 x IΔn	t = ≤40 ms



Tripping curve type A

[3] Standard in New Zealand

[4] DSRCBH is type A.

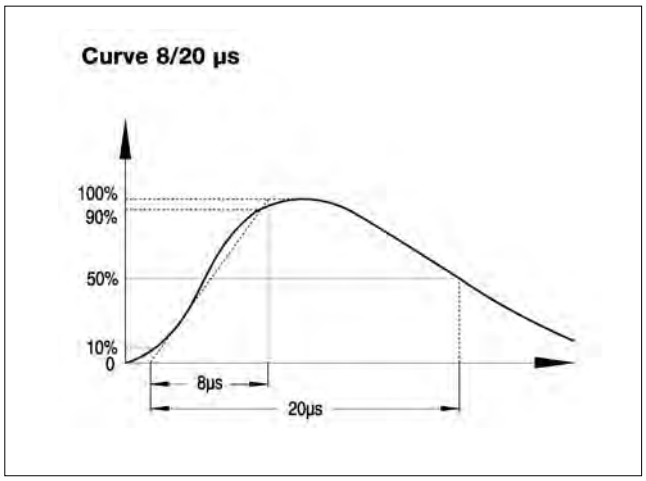
Din-T MCBs + RCDs Technical data

Nuisance tripping

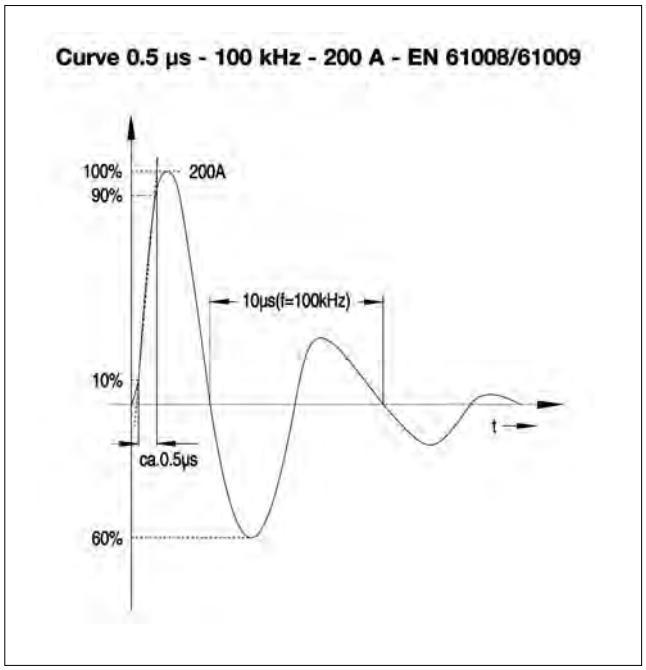
All DinSafe RCDs have a high level of immunity to transient currents, against current impulses of 8/20 µs according to EN 61008/61009 and VDE 0664.T1.

Type A, AC.....250 A 8/20 µs

Type S.....3000 A 8/20 µs



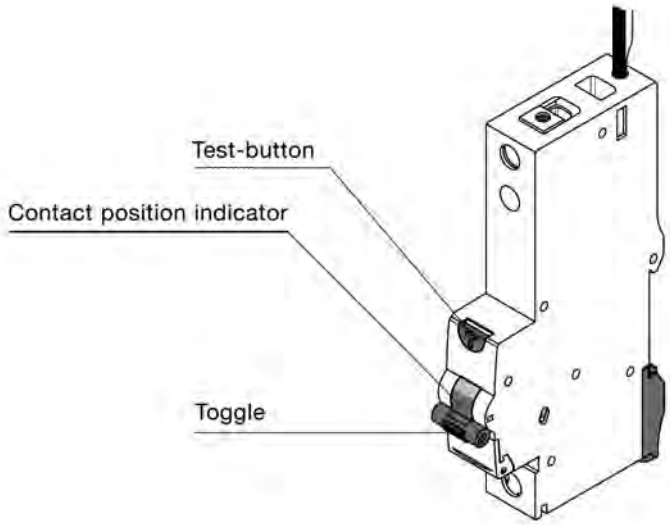
RCDs have a high level of immunity against alternating currents of high frequency according to EN 61008/61009.



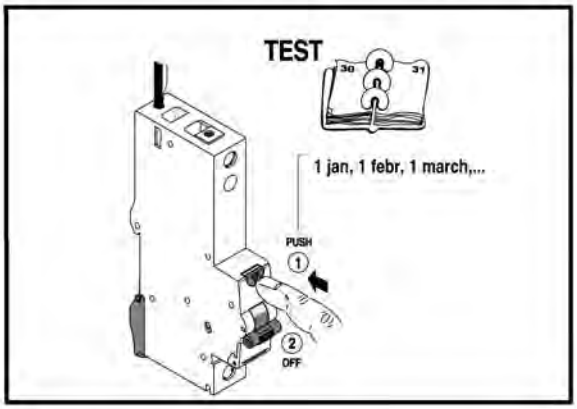
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Din-T MCBs + RCDs Technical data

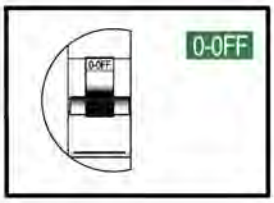
Use of an RCBO (DSRCBH)



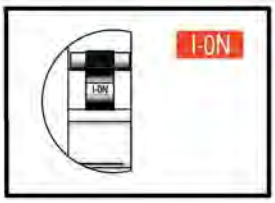
TEST-BUTTON
To ensure the correct functioning of the RCBO, the test-button T shall be pressed frequently. The device must trip when the test-button is pressed.



CONTACT POSITION INDICATOR
Printing on the toggle to provide information of the real contact position.



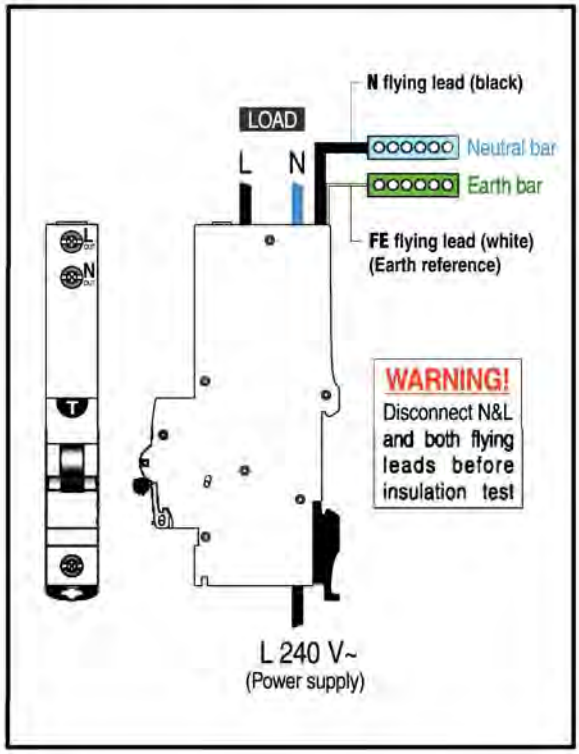
O-OFF
Contacts in open position. Ensure a distance between contacts > 4 mm.



I-ON
Contacts in closed position. Ensure continuity in the main circuit.

TOGGLE
To manually switch the RCBO ON or OFF

CABLE CONNECTION
The power supply (L) must be done at the bottom terminal, and the supply neutral flying cable (black) shall be connected to the neutral bar.
Load connection shall be done in both terminals at the top side (L out / N out).
The earth reference cable (FE white) ensures protection against earth leakage in case of loss of supply neutral.



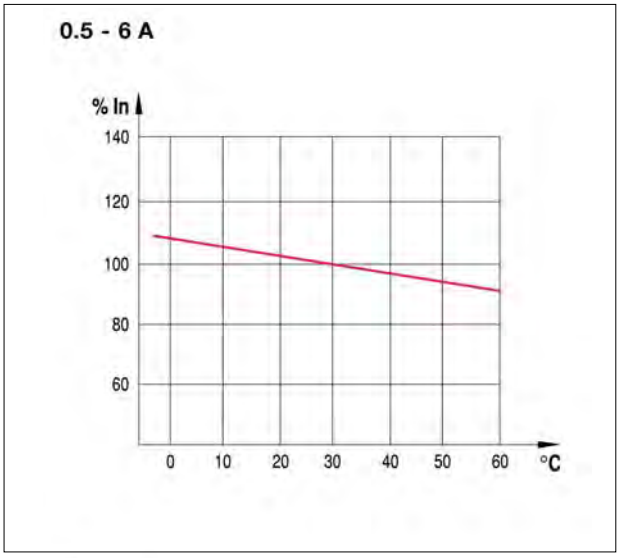
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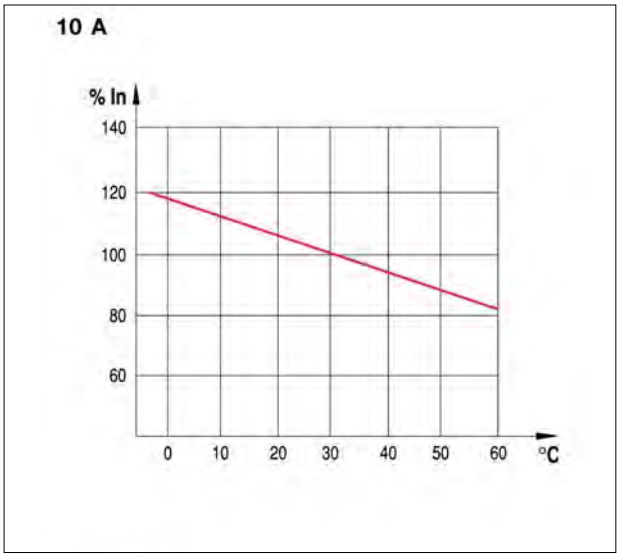
Din-T MCBs + RCDs Technical data

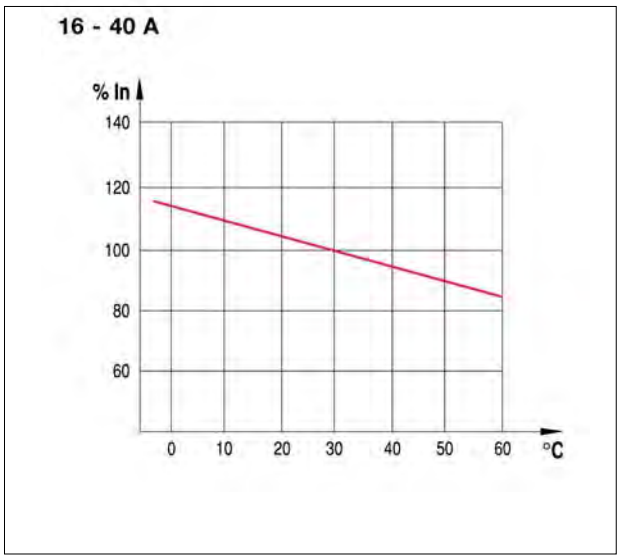
Product related information

Influence of temperature on RCBOs (DinSafe DSRCB)

The thermal calibration of the RCBO was carried out at an ambient temperature of 30 °C. Ambient temperatures different from 30 °C influence the bimetal and this results in earlier or later thermal tripping.







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Din-T MCBs + RCDs Technical data

Tripping current as a function of the frequency

All RCDs are designed to work at frequencies of 50-60 Hz, therefore to work at different values, we must consider the variation of the tripping sensitivity according to the tables below. It should be taken into consideration that there is a no tripping risk when pushing the test-button, due to the fact that such action is made by means of an internal resistor with a fixed value.

RCBO DSRCBH [3])

Type AC [1])	10 Hz	30 Hz	50 Hz	100 Hz	200 Hz	300 Hz	400 Hz
30 mA	0.62	0.65	0.80	0.91	1.24	1.55	1.88
100 mA	0.74	0.71	0.80	0.95	1.16	1.38	1.59
300 mA	0.80	0.74	0.80	0.97	1.19	1.44	1.64
500 mA	1.10	0.81	0.80	0.89	1.18	1.38	1.68
Type A [2])							
30 mA	8.17	3.13	0.75	1.70	3.10	3.52	3.67
100 mA	6.81	2.71	0.75	1.43	2.35	2.58	2.71
300 mA	6.20	2.16	0.75	0.49	0.87	0.74	0.95
500 mA	4.34	1.53	0.75	0.39	0.59	0.62	0.64

Notes: [1]) The standard NHP/Terasaki type is the “type AC” in Australia, Type “A” in New Zealand.
[2]) The standard NHP/Terasaki DSRCBH single pole RCBO is “type A” in Australia and New Zealand.
[3]) The numbers in the table above are multipliers, e.g. A “DSRCD” at 50 hz has an 0.8 multiplier. Therefore a 30 mA, “type AC” RCD will trip at (0.8 x 30 mA) 24 mA.

Power losses

The power losses are calculated by means of measuring the voltage drop between the incoming and the outgoing terminal of the device at rated current. Power loss per pole:

RCBO-Single pole DSRCBH

In (A)	6	10	13	16	20	25	32	40	50	63
Z (mOhm)	45.8	16.4	12.5	10.6	7.3	5.4	3.2	2.6	1.9	1.4
Pw (W)	1.65	1.7	2.1	2.7	2.9	3.3	3.4	4.2	4.8	5.6

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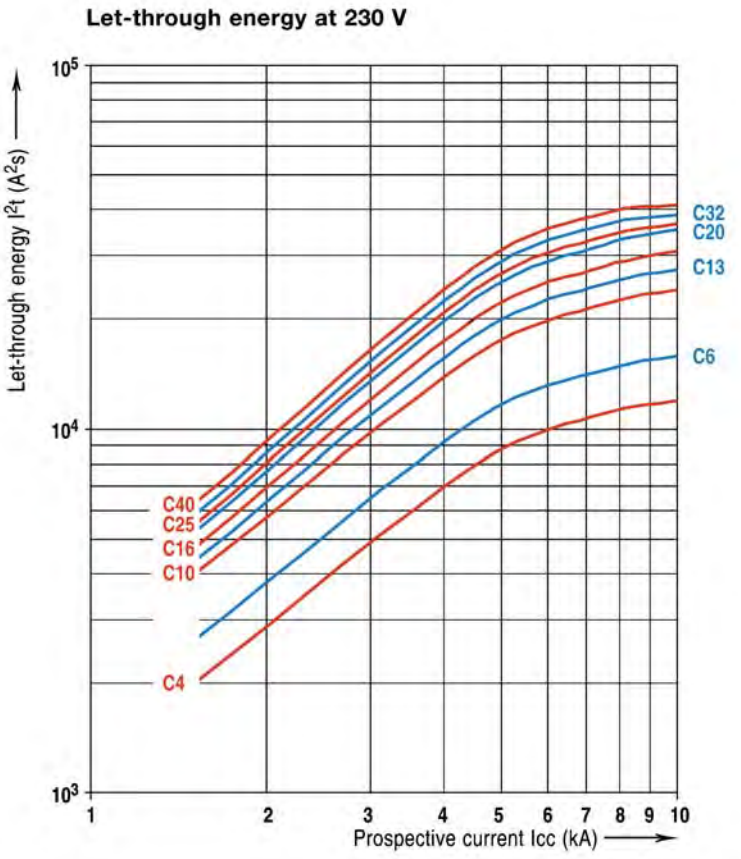
Din-T MCBs + RCDs Technical data

RCBO (DSRCB) let-through energy I^2t

The benefit of an RCBO in short-circuit conditions, is its ability to reduce the value of the let-through energy that the short-circuit would be generating.

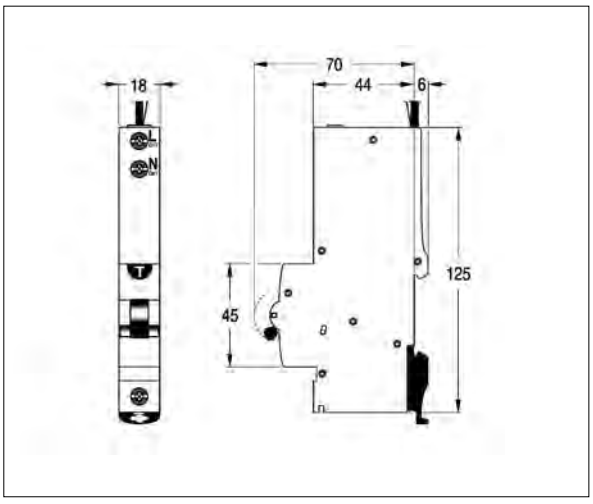
Din-T single pole width RCD (DSRCBH)

Curve C



RCCB - Din-Safe safety switch (DSRCD)

RCBO - Din-Safe (DSRCBH)



Dimensions in mm

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Din-T MCBs + RCDs Technical data

Overview Din-Safe RCDs

Device type definition

Rating/description			Cat. No.	RCBO  DSRCBH
Standards				IEC 61009-1
Magnetic tripping characteristics				C
Residual tripping characteristic [1]				A
Tripping time at IΔn	Instantaneous		ms	<300
	Selective		ms	-
Rated current			A	6, 10, 16, 20, 25, 32, 40
Rated residual current IΔn			mA	10, 30
Calibration temperature			°C	30
Number of poles versus modules				1
Rated voltage Un	2 P AC		V	240 (1 P+N)
	3 P AC		V	-
	4 P AC		V	-
Frequency			Hz	50/60
Maximum service voltage Ubmax			V	255
Minimum service voltage Ubmin			V	100
Power supply				Bottom
Selectivity class				3
Rated making and breaking capacity (Im)			A	10xIn
Residual making and breaking capacity (IΔm)			A	10000
Conditional short-circuit capacity (Inc)			A	-
Conditional residual short-circuit capacity (IΔc)			A	-
Short-circuit capacity (Icn)			A	10000
Grid distance (safety distance between two devices)			mm	-
Isolator application				yes
Insulation degree	Insulation voltage		V (DC)	500 [2]
	Shock voltage (1.2/50 ms)		kV	6 [2]
	Insulation resistance		(mOhm)	1000 [2]
	Dielectric strength		V	2500 [2]
Shock resistance (in x, y, z direction)(IEC 60077/16.3)				40 g, 18 shocks 5 ms
Vibration resistance (in x, y, z direction; IEC 60068-2-6)				2 g, 30 min, 0...80 Hz
Endurance	electrical at Un, In			10000
	mechanical at Un, In			20000
Protection degree (outside/inside electrical enclosure)				IP 20 / IP 40
Self extinguish degree (according to UL 94)				V2
Tropicalisation (according to IEC 60068-2, DIN 40046)			°C/RH	+55/95 %
Pollution degree (acc. IEC 60947-1)				3
Operating temperature			°C	-5..+60
Storage temperature			°C	-25..+70
Terminals capacity	Rigid cable min/max (Top)		mm²	1/25
	Flexible cable min*/max (Top)		mm²	1/16
	Rigid cable min/max (bottom)		mm²	1/35
	Flexible cable min*/max (bottom)		mm²	1/25
	(*Flexible cable 0.75/1/1.5 mm² with cable lug)			
Torque	Top/Bottom		Nm	3
Add-on devices (side add-on)	Auxiliary contacts			-
	UVT			-
	Shunt trip			-
	Motor operator			-
	Panelboard switch			Bottom
Busbars systems	Pin			Bottom
	Fork			yes
Accessories				
Dimensions, weights, packaging			# Poles	1+N
	(HxDxW) 86x68xW		mm	18
	Weight/unit		g	350
	Package/unit			1

Note: [1] Refer catalogue section for types.

[2] Making sure that N-L and both flying leads are disconnected.

Miniature circuit breakers

Din-T15 series 15 kA, 20 kA, 25 kA MCBs

- Standards AS/NZS 3947-2
- Current range 6-63 Amp 1, 2, 3 and 4 pole
- Sealable and lockable handle
- Modular design
- Mounts on CD chassis (250 A and 355 A)
- Industrial applications



DTCB15
1 pole

1 pole 1 module [3])

In (A)	Icu (kA)	C - Curve 5 - 10 In
6	25	DTCB15106C
10	25	DTCB15110C
13	25	[i] DTCB15113C
16	25	DTCB15116C
20	25	DTCB15120C
25	25	DTCB15125C
32	20	DTCB15132C
40	20	DTCB15140C
50	15	DTCB15150C
63	15	DTCB15163C

2 pole 2 modules [3])

In (A)	Icu (kA)	C - Curve 5 - 10 In
6	25	[i] DTCB15206C
10	25	[i] DTCB15210C
13	25	[i] DTCB15213C
16	25	[i] DTCB15216C
20	25	[i] DTCB15220C
25	25	[i] DTCB15225C
32	20	[i] DTCB15232C
40	20	[i] DTCB15240C
50	15	[i] DTCB15250C
63	15	[i] DTCB15263C

3 pole 3 modules [3])

6	25	DTCB15306C
10	25	DTCB15310C
13	25	[i] DTCB15313C
16	25	DTCB15316C
20	25	DTCB15320C
25	25	DTCB15325C
32	20	DTCB15332C
40	20	DTCB15340C
50	15	DTCB15350C
63	15	DTCB15363C

4 pole 4 modules [2]) [3])

6	25	[i] DTCB15406C
10	25	[i] DTCB15410C
13	25	[i] DTCB15413C
16	25	[i] DTCB15416C
20	25	[i] DTCB15420C
25	25	[i] DTCB15425C
32	20	[i] DTCB15432C
40	20	[i] DTCB15440C
50	15	[i] DTCB15450C
63	15	[i] DTCB15463C

In (A)	6 - 63
1 P	240 V AC
2 P	240/415 V AC
3 P	240/415 V AC
4 P	240/415 V AC

Shock resistance (in x, y, z direction)

20 g with shock duration of 10 ms (minimum 18 shocks)
40 g with shock duration of 5 ms (minimum 18 shocks)

Vibration resistance (in x, y, z direction)

3 g in frequency range 10 to 55 Hz (operating time at least 30 mins) according to IEC 60068-2-6

Storage temperature

from -55 °C to +55 °C according to VDE 0664 parts 1 and 2

Operating temperature

from -25 °C to +55 °C according to VDE 0664 Parts 1 and 2.

Use at 400 Hz

At 400 Hz the magnetic tripping current is approximately 50 % higher than at AC 50/60 Hz



DTCB15
2 pole



DTCB15
3 pole

Notes: [1]) 2 P MCB connected in series.
The LINE-side is the OFF or bottom of the MCB and connects to CD chassis tee-offs.
[2]) All poles include overcurrent and short circuit protection.
[3]) Refer Section 3 for kA ratings at 240/415 V. The above ratings are at 415 V AC.
[i] Available on indent only.

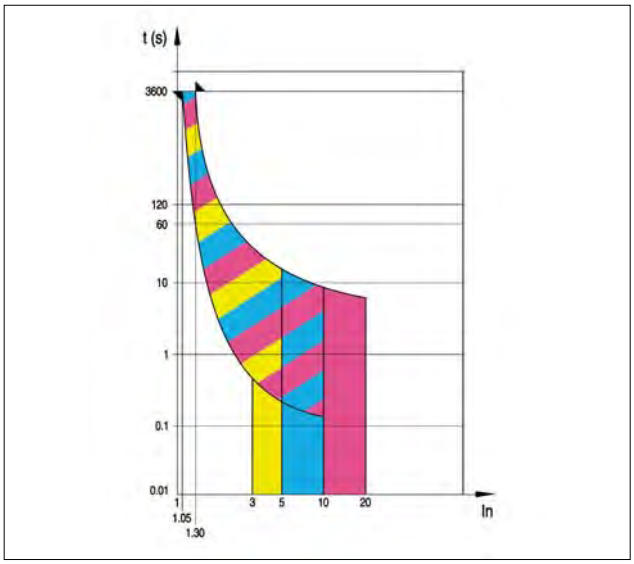
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Din-T MCBs Technical data

Characteristics according to EN 60947-2

Miniature Circuit Breakers are intended for the protection of the lines against both overloads and short-circuits in **industrial** wiring installations where normal operation is done by **instructed** people

Tripping characteristic curves



Magnetic release

An electromagnet with plunger ensures instantaneous tripping in the event of short-circuit. The standard leaves the calibration of magnetic release to the manufacturers discretion.

NHP offers instantaneous tripping ranges:

- release between 5 and 10 In
- release between 10 and 20 In

Thermal release

The release is initiated by a bimetal strip in the event of overload. The standard defines the range of release for two special overload values. Reference ambient temperature is 40 °C.

Test current	Tripping time
1.05 x In	$t \geq 1$ h (In $\leq$ 63 A) $t \geq 2$ h (In > 63 A)
1.30 x In	$t < 1$ h (In $\leq$ 63 A) $t < 2$ h (In > 63 A)

Rated ultimate short-circuit breaking capacity (Icu)

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

After the test the MCB is capable, without maintenance, to withstand a dielectric strength test at a test voltage of 1000 V. Moreover the MCB shall be capable of tripping when loaded with 2.5 In within the time corresponding to 2 In but greater than 0.1 s.

Rated service short-circuit breaking capacity (Ics)

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

After the test the MCB is capable, without maintenance, to withstand a dielectric strength test at a test voltage of twice its rated insulation voltage with a minimum of 1000 V.
A verification of the overload releases on In and moreover the MCB shall trip within 1 h when current is 1.45 In (for In<63 A) and 2 h (for In>63 A).

O - Represents an opening operation

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

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

Category A: Without a short-time withstand current rating.

Utilization category	Application with respect to selectivity
A	Circuit breakers not specifically intended for selectivity under short-circuit conditions with respect to other short-circuit protective devices in series on the load side, i.e. without an intentional short-time delay provided for selectivity under short-circuit conditions, and therefore without a short-time withstand current rating according to 4.3.5.4
B	Circuit breakers specifically intended for selectivity under short-circuit conditions with respect to other short-circuit protective devices in series on the load side, i.e. without an intentional short-time delay (which may be adjustable), provided for selectivity under short-circuit conditions. Such circuit-breakers have a short-time withstand current rating according to 4.3.5.4

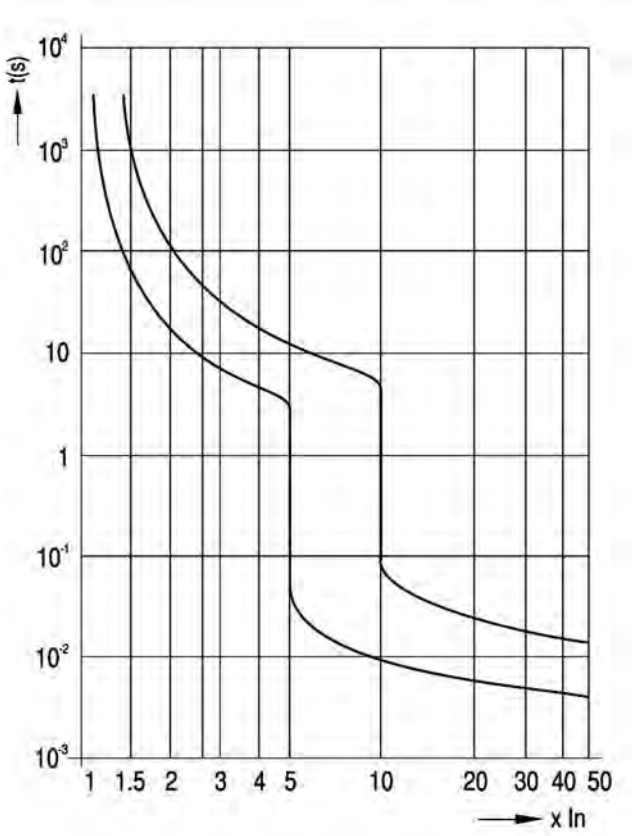
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Din-T MCBs Technical data

Tripping curves according to EN 60898

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

Curve C



Din-T MCBs Technical data

Definitions related to circuit breakers

MCB = Miniature Circuit Breaker

Short-circuit (making and breaking) capacity

Alternating component of the prospective current, expressed by its RMS value, which the circuit breaker is designed to make, to carry for its opening time and to break under specified conditions.

Ultimate or rated short-circuit breaking capacity (Icn - EN 60898)

A breaking capacity for which the prescribed conditions, according to a specified test sequence, do not include the capability of the MCB to carry 0.96 times its rated current for the conventional time.

Ultimate short-circuit breaking capacity (Icu - EN 60947-2)

A breaking capacity for which the prescribed conditions, according to a specified test sequence, do not include the capability of the MCB to carry its rated current for the conventional time.

Service short-circuit breaking capacity (Ics - EN 60898)

A breaking capacity for which the prescribed conditions, according to a specified test sequence, include the capability of the MCB to carry 0.96 times its rated current for the conventional time.

Prospective current

The current that would flow in the circuit, if each main current path of the MCB were replaced by a conductor of negligible impedance.

Conventional non-tripping current (Int)

A specified value of current which the circuit breaker is capable of carrying for a specified time without tripping.

Open position

The position in which the predetermined clearance between open contacts in the main circuit of the MCB is secured.

Closed position

The position in which the predetermined continuity of the main circuit of the MCB is secured.

Maximum prospective peak current (Ip)

The prospective peak current when the initiation of the current takes place at the instant which leads to the highest possible value.

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Din-T MCBs Technical data

Influence of ambient air temperature on the rated current

3

The maximum value of the current which can flow through an MCB depends on the nominal current of the MCB, the conductor cross-section and the ambient air temperature.

The values shown in the table below are for devices in free air. For devices installed with other modular devices in the same switchboard, a correction factor (K) shall be applied relative to the mounting situation of the MCB, the ambient temperature and the number of main circuits in the installation.

No of devices	K [1])
2 or 3	0.9
4 or 5	0.8
6 or 9	0.7
> 10	0.6

Calculation example

Within a distribution board consisting of eight 2 Pole, 16 A, 'C' curve type MCBs, with an operating ambient temperature of 45 °C, which is the highest temperature the MCB can operate at without unwanted tripping?

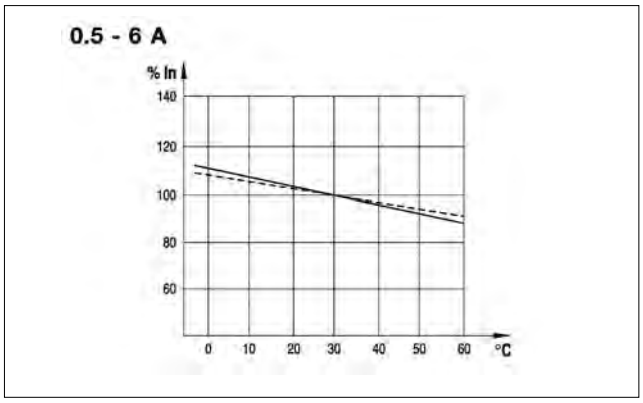
Calculation

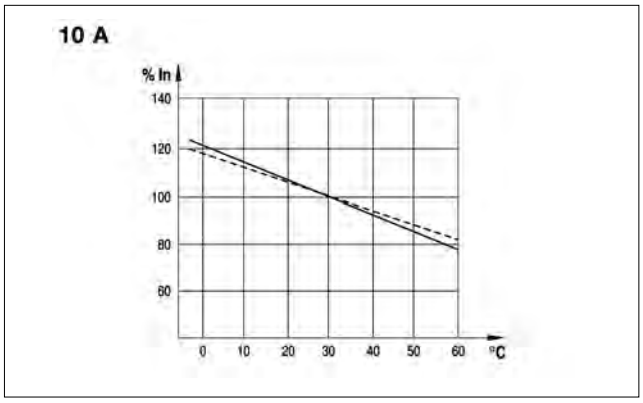
The correction factor K = 0.7, for use in an eight circuit installation: 16 A x 0.7 = 11.2 A

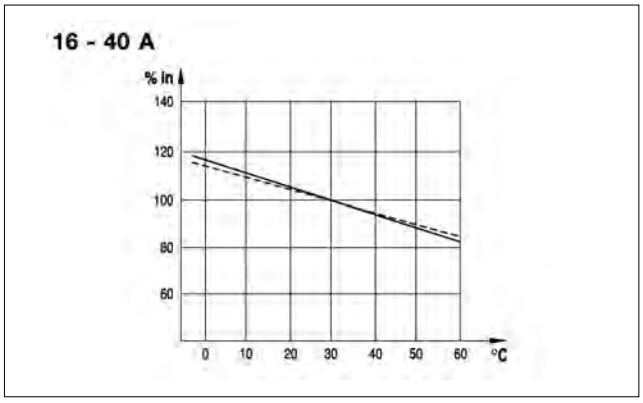
As the MCB is working at 45 °C it shall be given another factor (90 % = 0.9):
In at 45 °C = In at 30 °C x 0.9 = 11.2 A x 0.9 = 10.1 A.

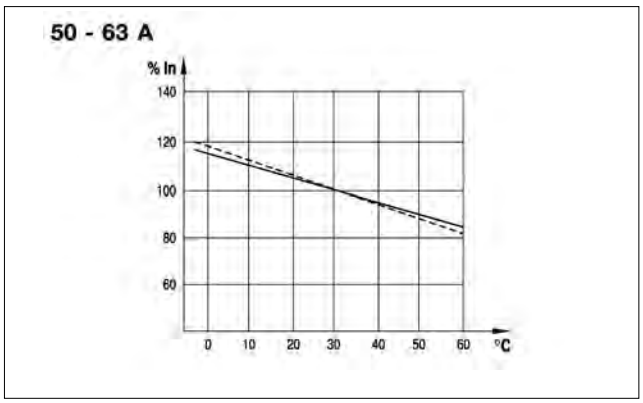
Note: [1]) Applicable for MCBs working at maximum rated currents.

The thermal calibration of the MCBs was carried out at an ambient temperature of 30 °C. Ambient temperatures different from 30 °C influence the bimetal and this results in earlier or later thermal tripping.









——— : 1P (single pole)

- - - - - - - - : mP (multi-pole)

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Din-T MCBs Technical data

Effects of frequency on the tripping characteristic

All the MCBs are designed to work at frequencies of 50-60 Hz, therefore to work at different values, consideration must be given to the variation of the tripping characteristics. The thermal tripping does not change with variation of the frequency but the magnetic tripping values can be up to 50 % higher than the ones at 50-60 Hz.

Tripping current variation

60 Hz	100 Hz	200 Hz	300 Hz	400 Hz
1	1.1	1.2	1.4	1.5

Power losses

The power losses are calculated by measuring the voltage drop between the incoming and the outgoing terminals of the device at rated current.

Power loss per pole

In (A)	Voltage drop (V)	Energy loss (W)	Resistance (mOhm)
0.5	2.230	1.115	4458.00
1	1.270	1.272	1272.00
2	0.620	1.240	310.00
3	0.520	1.557	173.00
4	0.370	1.488	93.00
6	0.260	1.570	43.60
8	0.160	1.242	19.40
10	0.160	1.560	15.60
13	0.155	2.011	11.90
16	0.162	2.586	10.10
20	0.138	2.760	6.90
25	0.128	3.188	5.10
32	0.096	3.072	3.00
40	0.100	4.000	2.50
50	0.090	4.500	1.80
63	0.082	5.160	1.30

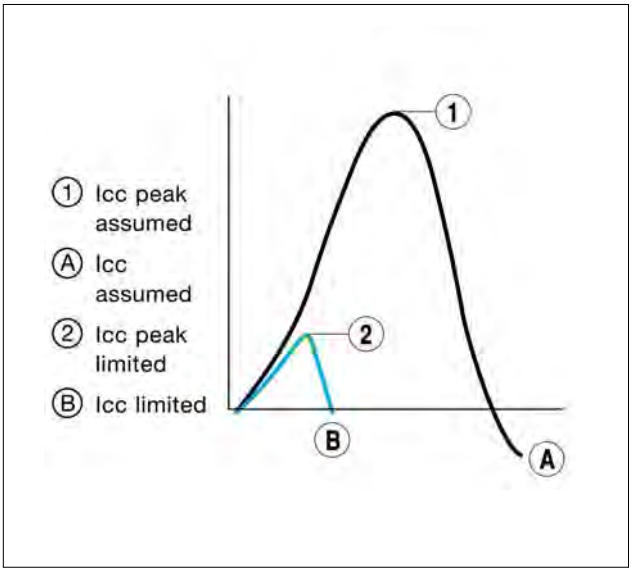
Limitation curves

Let-through energy I^2t

The limitation capacity of an MCB in short-circuit conditions, is its capacity to reduce the value of the let-through energy that the short-circuit would be generating.

Peak current Ip

Is the value of the maximum peak of the short-circuit current limited by the MCB.



See following pages

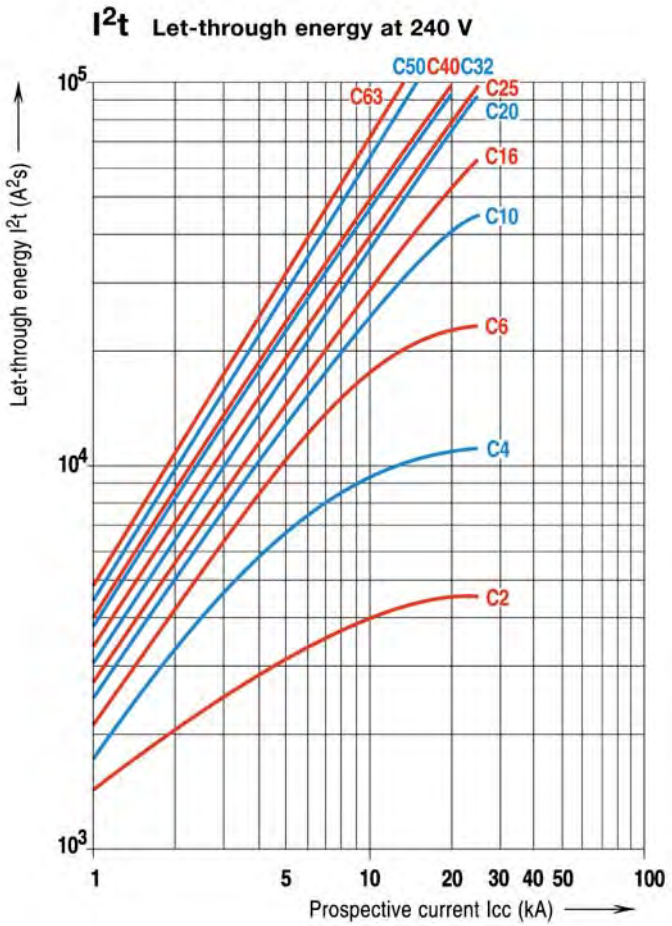
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Din-T MCBs Technical data

Din-T 15

15 kA

C curve



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Din-T MCBs Technical data

Use of standard MCB for DC use

For MCBs designed to be used in alternating current but used in installations in direct current, the following should be taken into consideration:

- For protection against overloads it is necessary to connect the two poles to the MCB. In these conditions the tripping characteristic of the MCB in direct current is similar to alternating current.
- For protection against short-circuits it is necessary to connect the two poles to the MCB. In these conditions the tripping characteristic of the MCB in direct current is 40% higher than the one in alternating current.

Use in DC selection table

Series	Rated current (A)	48 V 1 pole Icu (kA)	110 V 2 poles in series Icu (kA)	250 V 1 pole Icu (kA)	440 V 2 poles in series Icu (kA)
Din-T 15	6....25 A	10	10	-	-

Installation of Din-T DC MCBs in direct current

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Din-T MCBs Technical data

Series					Din-T15 AS/NZS 3947-2
Standards (Aust / NZ / International)					IEC 60947-2
Tripping characteristics					C
Nominal current				A	0.5-63
Calibration temperature				°C	40
Number of poles (# mod)					1/2/3/4
Neutral pole protected					-
Nominal voltage Un	AC	1 P		V	240/415
		3 P/4 P		V	415
	DC	1 P [1]		V DC	48
		2 P (in series) [1]		V DC	110
Frequency				Hz	50/60
				Hz	DC: magn.trip +40%
				Hz	400: magn.trip +50%
Maximum service voltage Ubmax between two wires				V	250/440; 53/120
Minimum service voltage Ubmin				V	12; 12
Selectivity class (IEC 60898)					3
Isolator application		IEC 60947-2			yes
Rated insulation voltage		Pollution degree 2		V	500
		Pollution degree 3		V	440
Impulse withstand test voltage				kV	6
Insulation resistance				mOhm	10,000
Dielectric rigidity				kV	2.5
Vibration resistance (in x, y, z direction) (IEC 77/16.3)					3 g
Endurance		Electrical at Un, In			4000
		mechanical			20,000
Utilisation category (IEC 60947-2)					A
Protection degree (outside / inside, in enclosure with door)					IP 20/IP 40
Self-extinguish degree (according to UL94)					V2
Tropicalisation (according to IEC 60068-2 / DIN 40046)				°C/RH	+55 °C/95 % RH
Operating temperature				°C	-25/+55
Storage temperature				°C	-55/+55
Terminal capacity Rigid cable min/max (top)				mm²	1/35
		Flexible cable min*/max (top)		mm²	0.75/25
		Rigid cable min/max (bottom)		mm²	1/35
		Flexible cable min*/max (bottom)		mm²	0.75/25
		(* Flexible cable 0.75/1/1.5 mm² with cable lug)			
		Torque		Nm	4.5
Add-on devices (side add-on)		Auxiliary contacts			yes
		UVT			yes
		Shunt trip			yes
		Motor operator			yes
		Panelboard switch			yes
Busbar systems		Pin (top/bottom)			yes/yes
		Fork (top/bottom)			-/yes
Accessories					yes
Dimensions, weights, packaging					
		(HxDxW) 86x68xW		mm/mod.	18
		Weight/mod.		g	120
		Package		mod.	12
Short-circuit capacity AC			**(kA)**		**AS/NZS 3947-2**
IEC 60898	Icn		1 P	230/400 V	-
			2 P	230/400 V	-
			3 P/4 P	230/400 V	-
	Ics (service)				-
IEC 60947-2	Icu (ultimate)		1 P	127 V	50
				240 V	50/25/20/15 [2]
				415 V	-
			2 P	127 V	-
				240 V	50/50/40/30 [2]
				415 V	50/25/20/15 [2]
			3 P, 4 P	240 V	50/50/40/30 [2]
				415 V	50/25/20/15 [2]
				440 V	50/20/15/10 [2]
	Ics (service)				75 % Icu
	NEMA AB1 (120/240V)				-
Short-circuit capacity DC			**(kA)**		
IEC 60947-2	Icu (ultimate)		1 P	≤60 V	25
				≤220 V	-
			2 P	≤125 V	30
				≤440 V	-
	Ics (service)				100 % Icu

Notes Refer pages 3 - 23, 24 for information on SAFE-T MCBs.

[1]) Preferred values of rated control supply voltage (IEC 60947 - 2): 24 V, 48 V, 110 V, 125 V, 250 V

[2]) 0.5-4 A/6-25 A/32-40 A/50-63 A

[3]) 10 (125 V DC)

[4]) 10 (250 V DC)

[5]) On request.

Miniature circuit breakers

Din-T10 series 10 kA MCB

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



DTCB10
1 pole

1 pole 1 module

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

2 pole 2 modules

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

Short circuit capacity 10 kA

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

Use at DC

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

Notes: [1]) A range of UL standard MCBs is available on indent. (ref DTCBUL10___C).
[2]) 2 pole MCB connected in series.
The line side is the "OFF" (bottom) side of the MCB, and connects to CD chassis tee-offs.
i Available on indent only.

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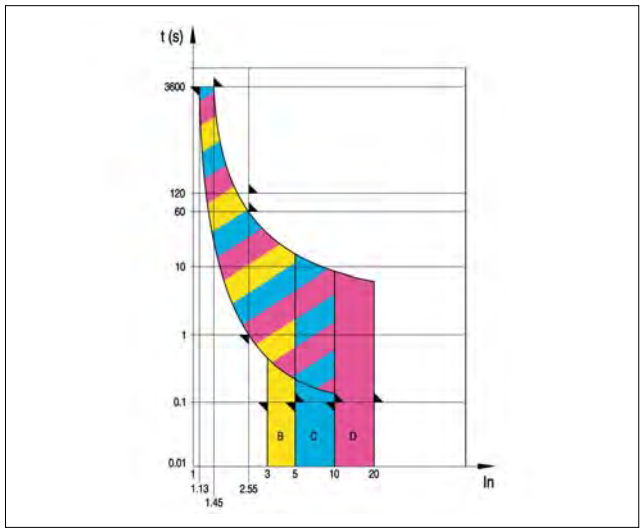
Din-T MCBs Technical data

Characteristics according to BS EN 60898

3

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

Tripping characteristic curves



Magnetic release

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

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

Thermal release

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

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

Rated short-circuit breaking capacity (Icn)

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

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

Service short-circuit breaking capacity (Ics)

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

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

O - Represents an opening operation

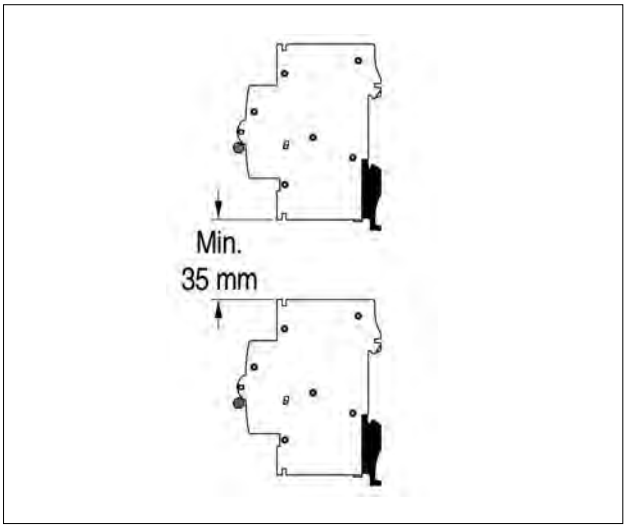
C - Represents a closing operation followed by an automatic opening.

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

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

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

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



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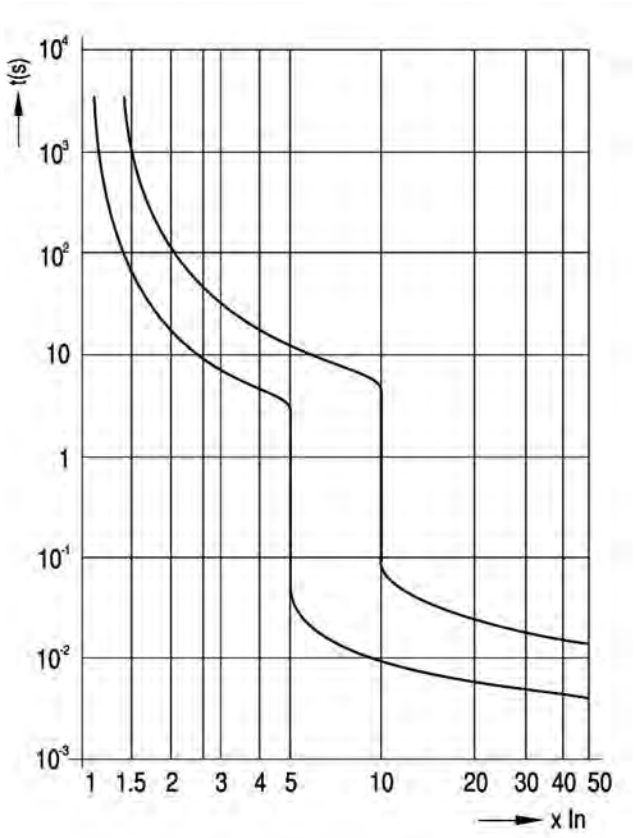
Din-T MCBs Technical data

Tripping curves according to EN 60898

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

3

Curve C



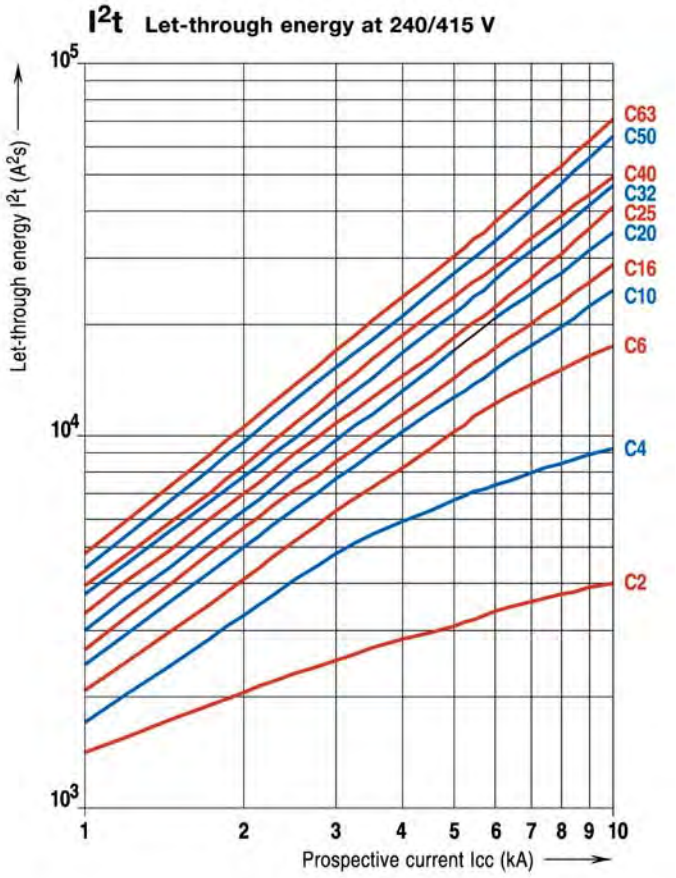
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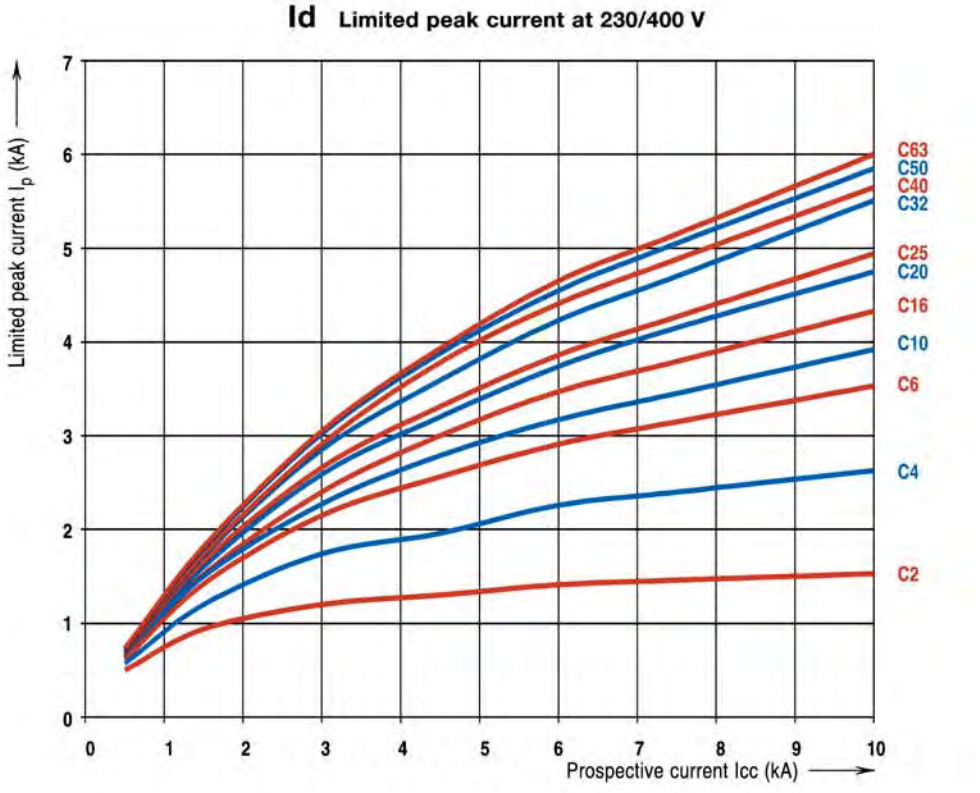
Din-T MCBs Technical data

Din-T 10

10 kA

C curve





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Din-T MCBs Technical data

Influence of ambient air temperature on the rated current

3

The maximum value of the current which can flow through an MCB depends on the nominal current of the MCB, the conductor cross-section and the ambient air temperature.

The values shown in the table below are for devices in free air. For devices installed with other modular devices in the same switchboard, a correction factor (K) shall be applied relative to the mounting situation of the MCB, the ambient temperature and the number of main circuits in the installation.

No of devices	K [1])
2 or 3	0.9
4 or 5	0.8
6 or 9	0.7
> 10	0.6

Calculation example

Within a distribution board consisting of eight 2 Pole, 16 A, 'C' curve type MCBs, with an operating ambient temperature of 45 °C, which is the highest temperature the MCB can operate at without unwanted tripping?

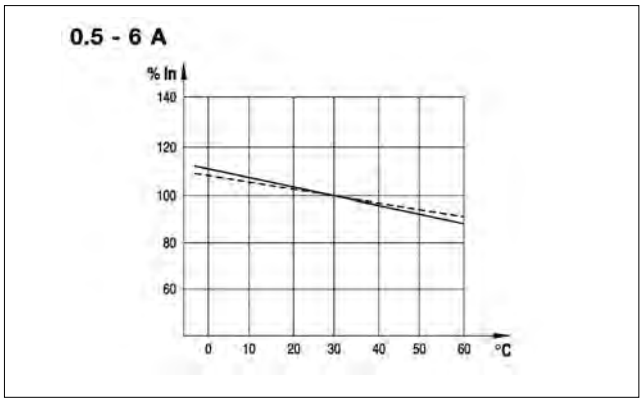
Calculation

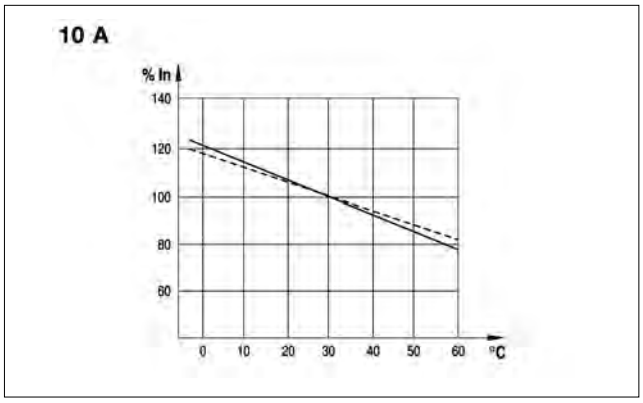
The correction factor K = 0.7, for use in an eight circuit installation: 16 A x 0.7 = 11.2 A

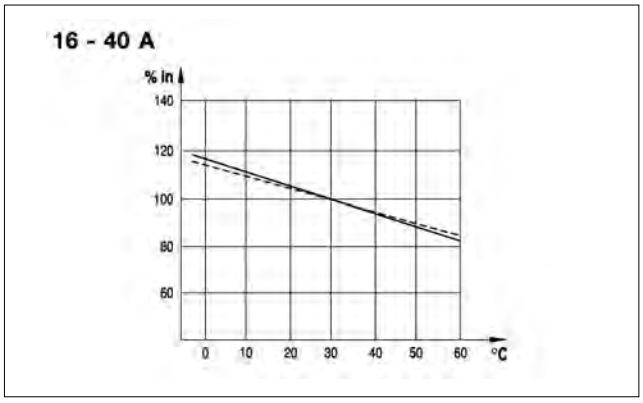
As the MCB is working at 45 °C it shall be given another factor (90 % = 0.9):
In at 45 °C = In at 30 °C x 0.9 = 11.2 A x 0.9 = 10.1 A.

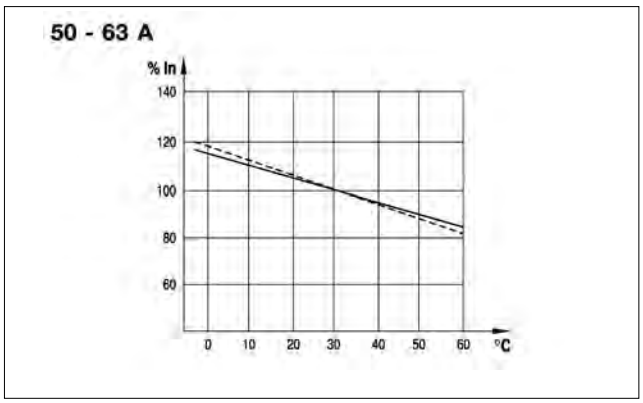
Note: [1]) Applicable for MCBs working at maximum rated currents.

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Din-T MCBs Technical data

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Tripping current variation

60 Hz	100 Hz	200 Hz	300 Hz	400 Hz
1	1.1	1.2	1.4	1.5

Power losses

The power losses are calculated by measuring the voltage drop between the incoming and the outgoing terminals of the device at rated current.

Power loss per pole

In (A)	Voltage drop (V)	Energy loss (W)	Resistance (mOhm)
0.5	2.230	1.115	4458.00
1	1.270	1.272	1272.00
2	0.620	1.240	310.00
3	0.520	1.557	173.00
4	0.370	1.488	93.00
6	0.260	1.570	43.60
8	0.160	1.242	19.40
10	0.160	1.560	15.60
13	0.155	2.011	11.90
16	0.162	2.586	10.10
20	0.138	2.760	6.90
25	0.128	3.188	5.10
32	0.096	3.072	3.00
40	0.100	4.000	2.50
50	0.090	4.500	1.80
63	0.082	5.160	1.30
80	0.075	6.000	0.90
100	0.075	7.500	0.75
125	0.076	9.500	0.60

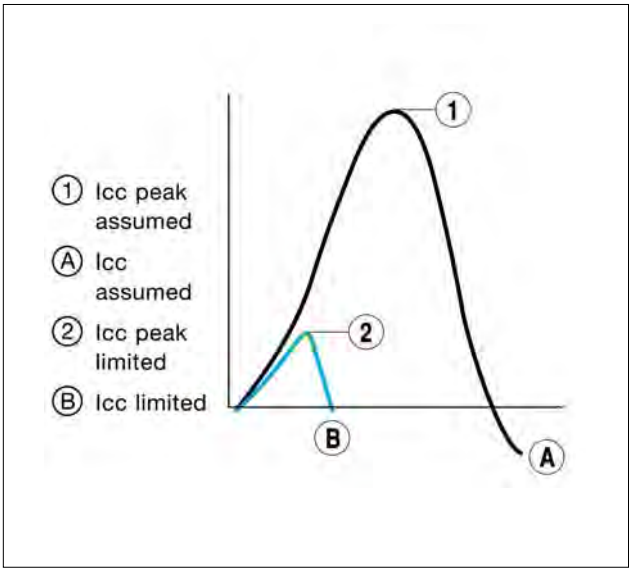
Limitation curves

Let-through energy I^2t

The limitation capacity of an MCB in short-circuit conditions, is its capacity to reduce the value of the let-through energy that the short-circuit would be generating.

Peak current Ip

Is the value of the maximum peak of the short-circuit current limited by the MCB.



See following pages

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Din-T MCBs Technical data

3

Use of standard MCB for DC use

For MCBs designed to be used in alternating current but used in installations in direct current, the following should be taken into consideration:

- For protection against overloads it is necessary to connect the two poles to the MCB. In these conditions the tripping characteristic of the MCB in direct current is similar to alternating current.
- For protection against short-circuits it is necessary to connect the two poles to the MCB. In these conditions the tripping characteristic of the MCB in direct current is 40% higher than the one in alternating current.

Use of special MCB Din-T DC for DC use.

(UC = Universal current)

For MCBs designed to work in both alternating and direct current, it is necessary to respect the polarity of the terminals since the device is equipped with a permanent magnet.

Use in DC selection table

Series	Rated current (A)	48 V 1 pole Icu (kA)	110 V 2 poles in series Icu (kA)	250 V 1 pole Icu (kA)	440 V 2 poles in series Icu (kA)
Din-T 10	0.5....63 A	25	30	-	-

Installation of Din-T DC MCBs in direct current

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Din-T MCBs Technical data

Series					Din-T10 AS/NZS 4898
Standards (Aust / NZ / International)					IEC 60898
Tripping characteristics					B, C, D
Nominal current				A	B(6-63), C/D(0.5-63)
Calibration temperature				°C	30
Number of poles (# mod)					1/2/3/4
Neutral pole protected					yes
Nominal voltage Un	AC	1 P		V	240/415
		3 P/4 P		V	415
	DC	1 P [1]		V DC	48
		2 P (in series) [1]		V DC	110
Frequency				Hz	50/60
				Hz	DC: magn.trip +40%
				Hz	400: magn.trip +50%
Maximum service voltage Ubmax between two wires				V	250/440; 53/120
Minimum service voltage Ubmin				V	12; 12
Selectivity class (IEC 60898)					3
Isolator application		IEC 60947-2			yes
Rated insulation voltage		Pollution degree 2		V	500
		Pollution degree 3		V	440
Impulse withstand test voltage				kV	6
Insulation resistance				mOhm	10,000
Dielectric rigidity				kV	2.5
Vibration resistance (in x, y, z direction) (IEC 77/16.3)					3 g
Endurance		Electrical at Un, In			10,000
		mechanical			20,000
Utilisation category (IEC 60947-2)					A
Protection degree (outside / inside, in enclosure with door)					IP 20/IP 40
Self-extinguish degree (according to UL94)					V2
Tropicalisation (according to IEC 60068-2 / DIN 40046)				°C/RH	+55 °C/95 % RH
Operating temperature				°C	-25/+55
Storage temperature				°C	-55/+55
Terminal capacity Rigid cable min/max (top)				mm²	1/35
		Flexible cable min*/max (top)		mm²	0.75/25
		Rigid cable min/max (bottom)		mm²	1/35
		Flexible cable min*/max (bottom) (* Flexible cable 0.75/1/1.5 mm² with cable lug)		mm²	0.75/25
		Torque		Nm	4.5
Add-on devices (side add-on)		Auxiliary contacts			yes
		UVT			yes
		Shunt trip			yes
		Motor operator			yes
		Panelboard switch			yes
Busbar systems		Pin (top/bottom)			yes/yes
		Fork (top/bottom)			-/yes
Accessories					yes
Dimensions, weights, packaging					
		(HxDxW) 86x68xW		mm/mod.	18
		Weight/mod.		g	120
		Package		mod.	12
Short-circuit capacity AC				**(kA)**	**AS/NZS 4898**
IEC 60898	Icn		1 P	230/400 V	10
			2 P	230/400 V	10
			3 P/4 P	230/400 V	10
	Ics (service)				75 % Icn
IEC 60947-2	Icu (ultimate)		1 P	127 V	30
				240 V	15
				415 V	4
			2 P	127 V	40
				240 V	30
				415 V	15
			3 P, 4 P	240 V	30
				415 V	15
				440 V	10
	Ics (service)				50 % Icu
	NEMA AB1 (120/240V)				30
Short-circuit capacity DC				**(kA)**	
IEC 60947-2	Icu (ultimate)		1 P	≤60 V	25
				≤220 V	-
			2 P	≤125 V	30
				≤440 V	-
	Ics (service)				100 % Icu

Notes Refer pages 3 - 23, 24 for information on SAFE-T MCBs.
[1]) Preferred values of rated control supply voltage (IEC 60947 - 2): 24 V, 48 V, 110 V, 125 V, 250 V
[2]) 0.5-4 A/6-25 A/32-40 A/50-63 A
[3]) 10 (125 V DC)
[4]) 10 (250 V DC)
[5]) On request.

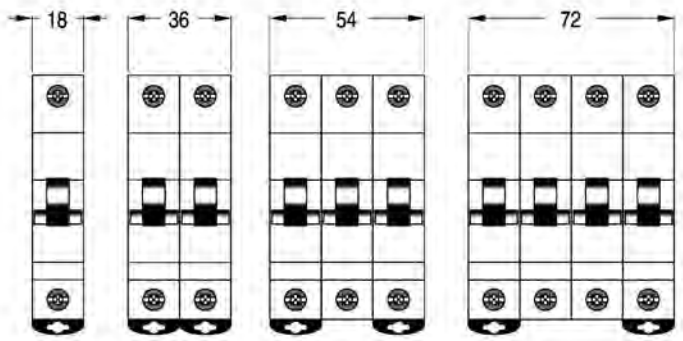
TERASAKI
Innovators in Protection Technology

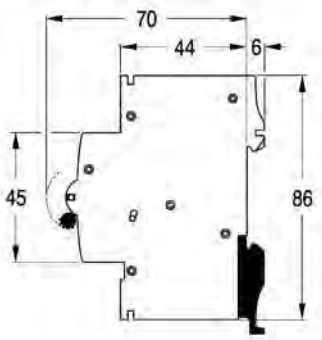
Din-T MCBs + RCDs Technical data

Miniature circuit breakers - Din-T 10

Dimensions in mm.

3





1.2. CONTROL DEVICES

- CARLO GAVAZZI – **DPB-01-C-M48W** – Phase Failure Relay
- MULTITRODE – **MTR** – 24VDC Sump Pump Level Relay
- SPRECHER & SCHUH – **CS 7C-40E24V –** Pumps Stop Relay
- SPRECHER & SCHUH – **CS 7-PV-22 –** Pumps Stop Relay Aux Contact
- SPRECHER & SCHUH – **CS 7C-22E24V** – 24VDC Relay
- IDEC – **RH2B-ULD-D24VDC + SH2B-05** – Run Relay + Base
- SPRECHER & SCHUH – **CA7-9C-01 24VDC** – Contactor
- COSMOTEC – **KTS01141** - Thermostat

Monitoring Relays
True RMS 3-Phase, 3-Phase+N, Multi-function
Types DPB01, PPB01


DPB01


PPB01

- **TRMS 3-phase over and under voltage, phase sequence and phase loss monitoring relays**
- **Detect when all 3 phases are present and have the correct phase sequence (except for N versions)**
- **Available versions (W4) supplied between phase and neutral**
- **Detect if all the 3-phase-phase or phase-neutral voltages are within the set limits**
- **Upper and lower limits separately adjustable**
- **Measure on own power supply**
- **Selection of measuring range by DIP-switches**
- **Adjustable voltage on relative scale**
- **Adjustable delay function (0.1 to 30 s)**
- **Output: 8 A SPDT relay N.E.**
- **For mounting on DIN-rail in accordance with DIN/EN 50 022 (DPB01) or plug-in module (PPB01)**
- **22.5 mm Euronorm housing (DPB01) or 36 mm plug-in module (PPB01)**
- **LED indication for relay, alarm and power supply ON**

Product Description

3-phase or 3-phase+neutral line voltage monitoring relay for phase sequence, phase loss, over and under voltage (separately adjustable set points) with built-in time delay function.
Supply ranges from 208 to 480 VAC covered by two multivoltage relays.

Ordering Key

DPB 01 C M23

Housing
Function
Type
Item number
Output
Power supply

Type Selection

Mounting	Phase sequence detection	Output	Supply: 208 to 240 VAC	Supply: 380 to 415 VAC	Supply: 380 to 480 VAC
DIN-rail	yes	SPDT	**DPB 01 C M23**	**DPB 01 C M48 W4**	**DPB 01 C M48**
Plug-in	yes	SPDT	**PPB 01 C M23**	**PPB 01 C M48 W4**	
Plug-in	yes	SPDT		**PPB 01 C M48**	
DIN-rail	no	SPDT	**DPB 01 C M23 N**	**DPB 01 C M48 N W4**	**DPB 01 C M48 N**
Plug-in	no	SPDT	**PPB 01 C M23 N**	**PPB 01 C M48 N W4**	
Plug-in	no	SPDT		**PPB 01 C M48 N**	

Input Specifications

Input
L1, L2, L3, N — DPB01: Terminals L1, L2, L3, N; PPB01: Terminals 5, 6, 7, 11; Measure on own supply

Note: Connect the neutral only if it is intrinsically at the star centre

Measuring ranges
208 to 240 VAC — 177 to 275 V_{L-L} AC; M23 versions
380 to 415 VAC — 323 to 475 V_{L-L} AC; PPB01CM48; PPB01CM48N; D/P PB01CM48W4; D/P PB01CM48NW4
380 to 480 VAC — 323 to 550 V_{L-L} AC; DPB01CM48; DPB01CM48N

Ranges
Upper level — +2 to +22% of the nominal voltage
Lower level — -22 to -2% of the nominal voltage

Note: The input voltage must not exceed the maximum rated voltage or drop below the minumum rated voltage reported above.

Hysteresis
Set points from 2 to 5% — 1%
Set points from 5 to 22% — 2%

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Output Specifications

Output		SPDT relay
Rated insulation voltage		250 VAC
Contact ratings ($AgSnO_2$)		µ
Resistive loads	AC 1	8 A @ 250 VAC
	DC 12	5 A @ 24 VDC
Small inductive loads	AC 15	2.5 A @ 250 VAC
	DC 13	2.5 A @ 24 VDC
Mechanical life		≥ 30 x 10^6 operations
Electrical life		≥ 10^5 operations (at 8 A, 250 V, cos φ = 1)
Operating frequency		≤ 7200 operations/h
Dielectric strength		
Dielectric voltage		2 kVAC (rms)
Rated impulse withstand volt.		4 kV (1.2/50 µs)

Supply Specifications

Power supply	Overvoltage cat. III (IEC 60664, IEC 60038)
Rated operational voltage through terminals:	
L1, L2, L3, N (DPB01)	
5, 6, 7, 11 (PPB01)	
D/P PB01CM23, D/P PB01CM23N	208 to 240 V_{L-L} AC ±15%, 45 to 65 Hz
D/P PB01CM48W4, D/P PB01CM48NW4, PPB01CM48, PPB01CM48N	380 to 415 V_{L-L} AC ±15% (220 to 240 V_{L-N} AC ±15%), 45 to 65 Hz
DPB01CM48, DPB01CM48N	380 to 480 V_{L-L} AC ±15% (220 to 277 V_{L-N} AC ±15%), 45 to 65 Hz
Rated operational power	
DPB01CM23x, PPB01CM23x	13 VA @ 230 ΔVAC, 50 Hz
DPB01CM48x, PPB01CM48x	13 VA @ 400 ΔVAC, 50 Hz Supplied by L1 and L2
DPB01CM48xW4 DPB01CM48xW4	13 VA @ 400 ΔVAC, 50 Hz Supplied by L1 and N

General Specifications

Power ON delay		1 s ± 0.5 s or 6 s ± 0.5 s
Reaction time		
Incorrect phase sequence or total phase loss		< 200 ms
Voltage level		(input signal variation from -20% to +20% or from +20% to -20% of set value)
Alarm ON delay		< 200 ms (delay < 0.1 s)
Alarm OFF delay		< 200 ms (delay < 0.1 s)
Accuracy		(15 min warm-up time)
Temperature drift		± 1000 ppm/°C
Delay ON alarm		± 10% on set value ± 50 ms
Repeatability		± 0.5% on full-scale
Indication for		
Power supply ON		LED, green
Alarm ON		LED, red (flashing 2 Hz during delay time)
Output relay ON		LED, yellow
Environment		
Degree of protection		IP 20
Pollution degree		3 (DPB01), 2 (PPB01)
Operating temperature		
@ Max. voltage, 50 Hz		-20 to 60°C, R.H. < 95%
@ Max. voltage, 60 Hz		-20 to 50°C, R.H. < 95%
Storage temperature		-30 to 80°C, R.H. < 95%
Housing		
Dimensions	DPB01	22.5 x 80 x 99.5 mm
	PPB01	36 x 80 x 94 mm
Weight		Approx. 120 g
Screw terminals		
Tightening torque		Max. 0.5 Nm according to IEC 60947
Approvals		UL, CSA (except for W4 versions)
CE Marking		Yes
EMC		Electromagnetic Compatibility
Immunity		According to EN 61000-6-2
Emissions		According to EN 61000-6-3

Mode of Operation

Connected to the 3 phases (and neutral) DPB01 and PPB01 operate when all 3 phases are present at the same time, the phase sequence is correct (not N versions) and the phase-phase (or phase-neutral) voltage levels are within set limits.

If one or more phase-phase or phase-neutral voltages exceeds the upper set level or drops below the lower set level, the red LED starts flashing 2 Hz and the output relay releases after the set time period. In any case if phase-neutral measurement is selected both phase-phase and phase-neutral voltages are monitored. If the phase sequence is wrong or one phase is lost, the output relay releases immediately.
Only 200 ms delay occurs. The failure is indicated by the red LED flashing 5 Hz during the alarm condition.

Example 1
(mains network monitoring)

The relay monitors over and under voltage, phase loss and correct phase sequence.
In case of N versions, the relay monitors over and under voltage.

Example 2
(load monitoring)

The relay releases in case of interruption of one or more phases, when one or more voltages drop below the lower set level or exceed the upper set level.

Specifications are subject to change without notice (10.04.07)

DPB01, PPB01

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Function/Range/Level and Time Delay Setting

Adjust the input range setting the DIP switches 3 and 4 as shown below.

Select the desired function setting the DIP switches 1 and 2 as shown below.

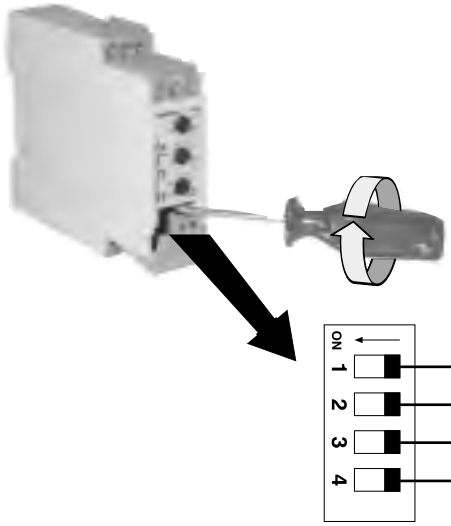
To access the DIP swiches open the grey plastic cover as shown below

Selection of level and time delay:

Upper knob:
Setting of lower level on relative scale.

Centre knob:
Setting of upper level on relative scale.

Lower knob:
Setting of delay on alarm time on absolute scale (0.1 to 30 s).



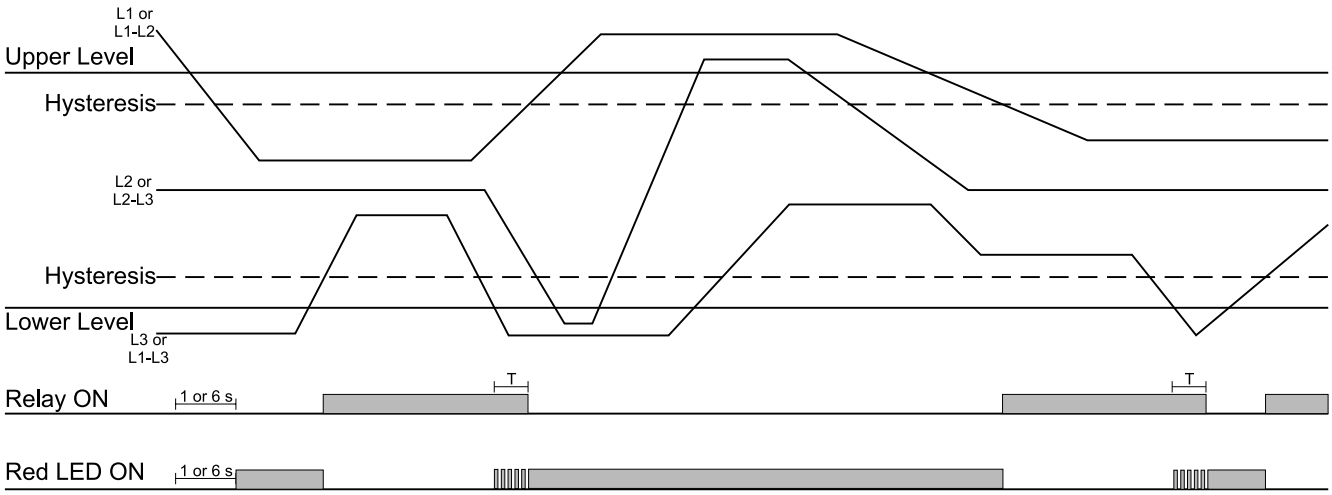
Power ON delay
ON: 6 s ± 0.5 s
OFF: 1 s ± 0.5 s

Monitored voltage
ON: Phase-Neutral
OFF: Phase-Phase

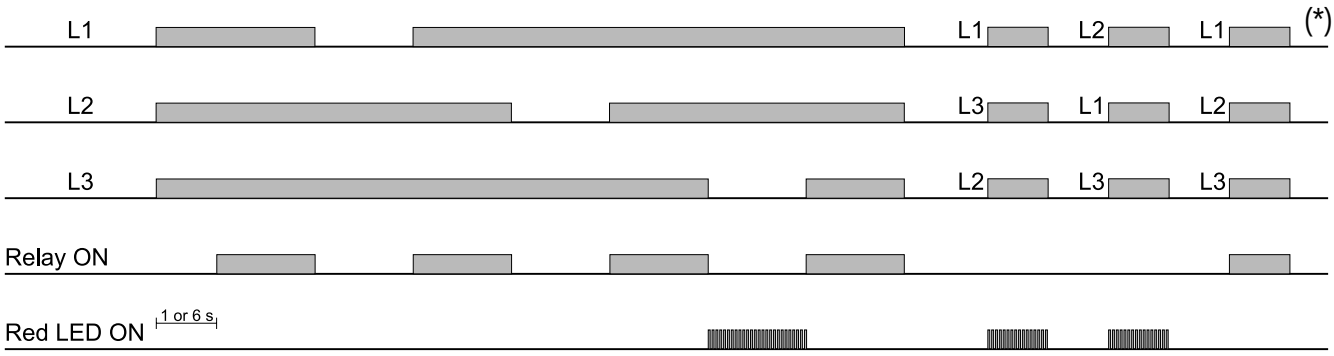
Measuring range

SW3	ON	ON	OFF	OFF
SW4	ON	OFF	ON	OFF
M23 Ph-Ph Voltage	208 VAC	220 VAC	230 VAC	240 VAC
M48 Ph-Ph Voltage	380 VAC	400 VAC	415 VAC	480 VAC DPB01CM48, DPB01CM48N only
M48 Ph-N Voltage	220 VAC	230 VAC	240 VAC	277 VAC DPB01CM48, DPB01CM48N only

Operation Diagrams



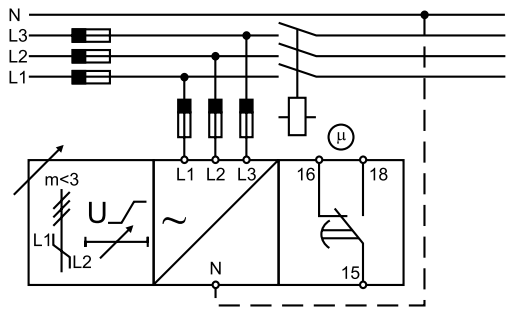
Operation Diagrams (cont.)



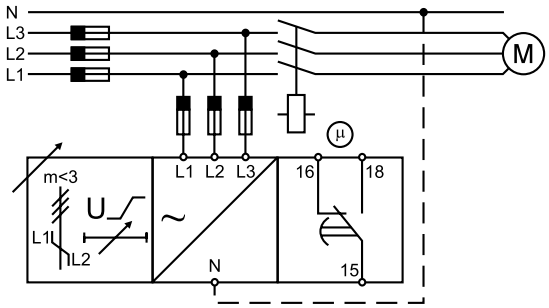
(*) N versions don't detect incorrect phase sequence.

Wiring Diagrams

Example 1

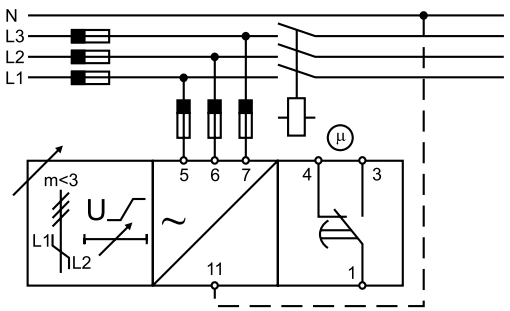


Example 2

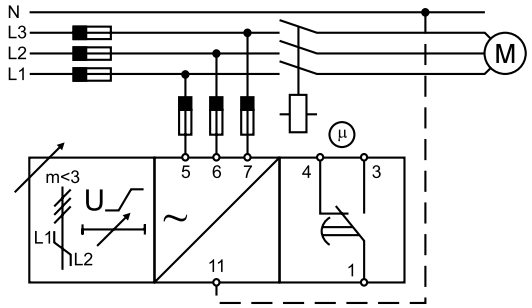


DPB01

Example 1



Example 2



PPB01

DPB01, PPB01

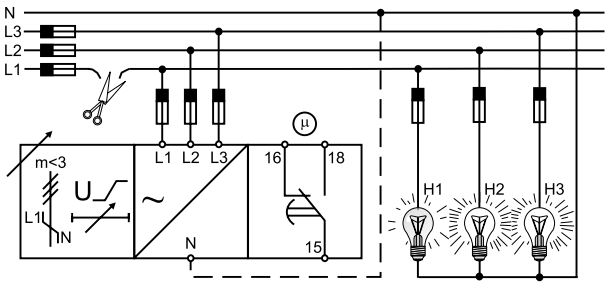
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Note

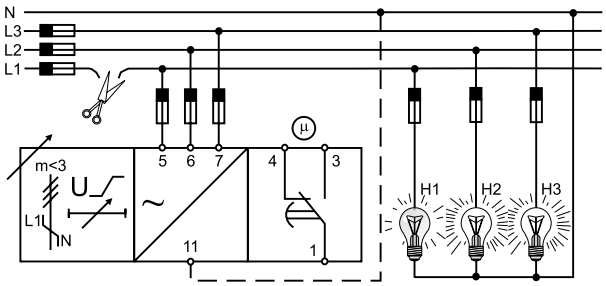
When DPB01 or PPB01 is used with phase indicator lamps (see examples in the following diagrams), the lamp H1 or H2 might be dimly lit when there is a phase loss in L1 or L2. This might happen if the lamps used are the typical low power indicator lamps, and there are no other loads present.

This fact can be avoided by using W4 models. Note that the neutral must be always connected to the device.

DPB01

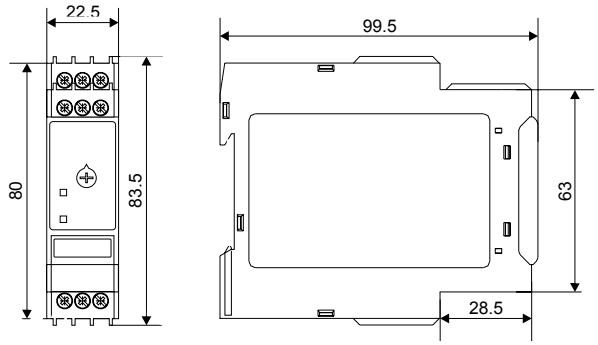


PPB01

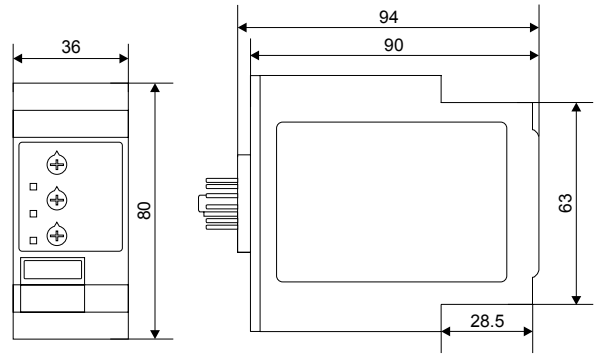


Dimensions

DIN-rail



Plug-in



finder

38 Series - Relay interface modules 0.1 - 2 - 3 - 5 - 6 - 8 A

Common features

- Instant ejection of relay by plastic retaining clip
- Integral coil indication and protection circuit
- 35 mm rail (EN 60715) mounting

	EMR Electromechanical Relays	SSR Solid State Relays
6.2 mm wide • **EMR - DC, AC or AC/DC coil versions** • **SSR - DC or AC/DC input versions** • Screw and Screwless terminal options	**38.51/38.61**  • **1 CO - 6 A 250VAC** **Page 1**	**38.81/38.91**  • Single solid state output: Options **0.1A 48VDC, 2A 24VDC, 2A 240VAC** • Silent, high speed switching • Long electrical life **Page 2**
6.2 mm wide • **Special coil / input leakage current suppression types** • **EMR - AC or AC/DC coil versions** • **SSR - AC or AC/DC input versions** • Screw and Screwless terminal options	**38.51.3... - 38.61.3...**  • **1 CO - 6 A 250VAC** **Page 1**	**38.81.3... - 38.91.3...**  • Single solid state output: Options **0.1A 48VDC, 2A 24VDC, 2A 240VAC** • Silent, high speed switching • Long electrical life **Page 2**
6.2 mm wide • **Timed Interface module** • **4 functions & 4 time scales 0.1s ... 6h** • **EMR - AC/DC (12 or 24V) supply versions** • **SSR - AC/DC (24V) supply** • Screw terminals	**38.21**  • **1 CO - 6 A 250VAC** **Page 3**	**38.21...9024-8240**  • Single solid state output: Options **2A 24VDC, 2A 240VAC** • Silent, high speed switching • Long electrical life **Page 3**
14 mm wide • **2 pole 8 A or 1 pole 16 A** • **EMR - DC or AC/DC coil versions** • **SSR - DC input versions** • Screw and Screwless terminal options	**38.01/38.52/38.11/38.62**  • **1 CO - 16 A 250VAC** • **2 CO - 8 A 250VAC** **Page 4**	**38.31/38.41**  • Single solid state output: Options **5A 24VDC, 3A 240VAC** • Silent, high speed switching • Long electrical life **Page 5**

finder

38 Series - Relay interface modules - 1 Pole 6 A EMR

Features

1 Pole - 6 A electromechanical relay interface modules, 6.2 mm wide.

Ideal interface for PLC and electronic systems

- Sensitive DC coil or AC/DC coil versions
- Integral coil indication and protection circuit
- Instant ejection of relay using plastic retaining clip
- UL Listing (certain relay/socket combinations)
- 35 mm rail (EN 60715) mounting

38.51 / 38.51.3
Screw terminal



38.61 / 38.61.3
Screwless terminal



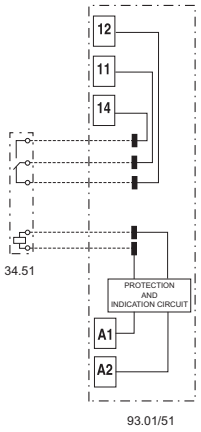
* Special version for max ambient temperature +70°C.

For outline drawing see page 12

38.51/61



- 1 pole electromechanical relay
- Screw terminal and screwless terminal
- 35 mm rail (EN 60715) mounting

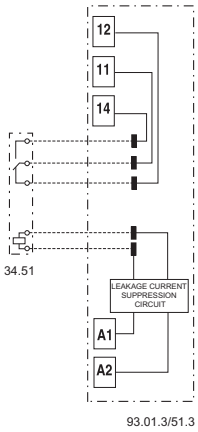


93.01/51

38.51.3 / 38.61.3



- Leakage current suppression
- 1 pole electromechanical relay
- Screw terminal and screwless terminal
- 35 mm rail (EN 60715) mounting



93.01.3/51.3

Contact specification				
Contact configuration		1 CO (SPDT)	1 CO (SPDT)	
Rated current/Maximum peak current	A	6/10	6/10	
Rated voltage/Maximum switching voltage	V AC	250/400	250/400	
Rated load AC1	VA	1,500	1,500	
Rated load AC15 (230 V AC)	VA	300	300	
Single phase motor rating (230 V AC)	kW	0.185	0.185	
Breaking capacity DC1: 30/110/220 V	A	6/0.2/0.12	6/0.2/0.12	
Minimum switching load	mW (V/mA)	500 (12/10)	500 (12/10)	
Standard contact material		AgNi	AgNi	
Coil specification				
Nominal voltage (U_N)	V AC/DC	12 - 24 - 48 - 60 - (110...125) - (220...240)	(110...125)	—
	V AC	(230...240)*	—	(230...240)
	V DC	6 - 12 - 24 - 48 - 60 (non polarized)	—	—
Rated power AC/DC	VA (50 Hz)/W	See page 9	1/1	0.5/—
Operating range	AC/DC	(0.8...1.1)U_N	(94...138)V	—
	AC	(184...264)V	—	(184...264)V
	DC	(0.8...1.2)U_N	—	
Holding voltage	AC/DC	0.6 U_N / 0.6 U_N	0.6 U_N / 0.6 U_N	
Must drop-out voltage	AC/DC	0.1 U_N / 0.05 U_N	44 V	72 V
Technical data				
Mechanical life AC/DC	cycles	$10 \cdot 10^6$	$10 \cdot 10^6$	
Electrical life at rated load AC1	cycles	$60 \cdot 10^3$	$60 \cdot 10^3$	
Operate/release time	ms	5/6	5/6	
Insulation between coil and contacts (1.2/50 µs)	kV	6 (8 mm)	6 (8 mm)	
Dielectric strength between open contacts	V AC	1,000	1,000	
Ambient temperature range ($U_N \leq$ 60 V/>60V)	°C	–40...+70/–40...+55	—/–40...+55	
Protection category		IP 20	IP 20	
Approvals relay (according to type)		CE SP PG RINA cULus		

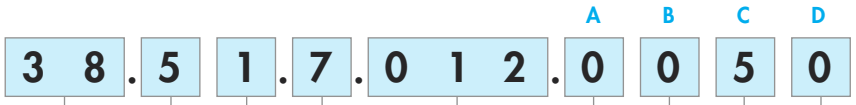
finder

38 Series - Relay interface modules - Ordering information

Ordering information

Electromechanical relay - 1 or 2 Pole

Example: 38 series screw terminal relay interface module, 1 CO (SPDT), sensitive 12 V DC coil.



Series

Type
0 = Electromechanical 16 A relay, with screw terminal
1 = Electromechanical 16 A relay, with screwless terminal
2 = Timer multifunction (AI, DI, GI, SW), with screw terminal
5 = Electromechanical relay, with screw terminal
6 = Electromechanical relay, with screwless terminal

No. of poles
1 = 1 pole, 6 or 16 A
2 = 2 pole, 8 A

Coil version
0 = AC (50/60 Hz)/ DC
3 = Leakage current suppression for (110...125)V AC/DC - (230...240)V AC
7 = Sensitive DC, (6, 12, 24, 48, 60)V only
8 = AC (50/60 Hz)

Coil voltage
See coil specifications

D: Special versions
0 = Standard

C: Options
5 = Standard DC
6 = Standard AC/DC

B: Contact circuit
0 = CO (nPDT)

A: Contact material
0 = AgNi Standard
4 = $AgSnO_2$
5 = AgNi + Au (5 µm)

Selecting features and options: only combinations in the same row are possible.

Type	Coil version	A	B	C	D
38.01/11	7	0 - 4	0	5	0
38.01/11	0	0 - 4	0	6	0
38.51/61	7	0 - 4 - 5	0	5	0
38.51/61	0 - 3 - 8	0 - 4 - 5	0	6	0
38.52/62	7	0 - 5	0	5	0
38.52/62	0	0 - 5	0	6	0
38.21	0	0	0	6	0

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38 Series - Relay interface modules - Ordering information

Ordering information

Solid state relay - Single output - 6.2 & 14 mm wide

Example: 38 series screw terminal SSR relay interface module, 6.2 mm wide, 2 A output, 24 V DC input.

3 8 . 8 1 . 7 . 0 2 4 . 9 0 2 4

Series

Type
21 = Timer SSR 6.2mm wide, with screw terminal
31 = SSR 14mm wide, with screw terminal
41 = SSR 14mm wide, with screwless terminal
81 = SSR 6.2mm wide, with screw terminal
91 = SSR 6.2mm wide, with screwless terminal

Input version
0 = AC/DC for 24V Timer SSR and (110...125)V and (220...240)V SSR only
3 = Leakage current suppression for (110...125)V AC/DC and (230...240)V AC SSR only
7 = DC, (6, 24, 60)V SSR only

Input voltage
See input specifications

Output version
9024 = 2 A - 24 V DC (38.81 & 38.91)
9024 = 5 A - 24 V DC (38.31 & 38.41)
7048 = 0.1 A - 48 V DC (38.81 & 38.91)
8240 = 2 A - 240 V AC (38.81 & 38.91)
8240 = 3 A - 240 V AC (38.31 & 38.41)

Selecting features and options: only combinations in the same row are possible.

Type	Input version	Output version
38.81/91	7	9024 - 7048 - 8240
38.81/91	0 - 3	9024 - 7048 - 8240
38.31/41	7	9024 - 8240
38.21	0	9024 - 8240

finder

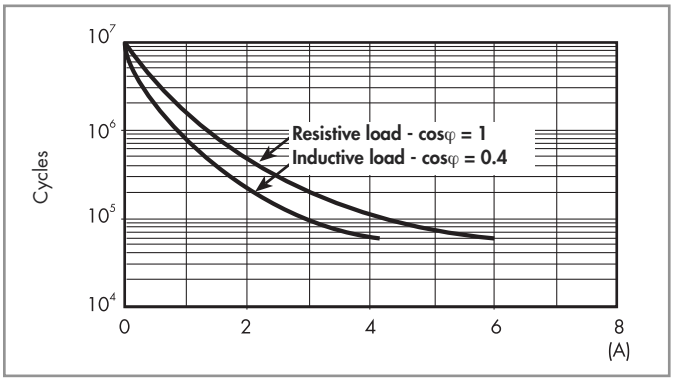
38 Series - Relay interface modules - Technical data

Technical data - 1 & 2 Pole Electromechanical Relays

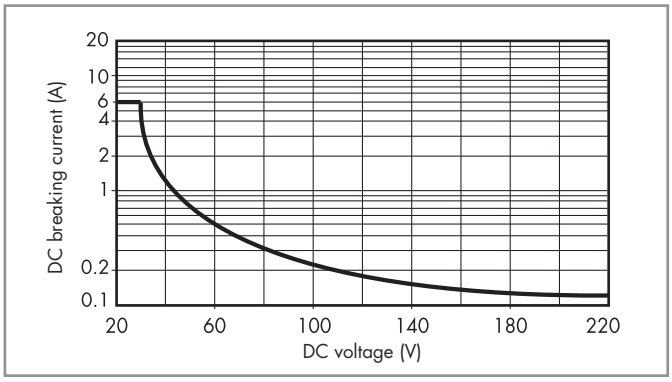
Insulation						
Insulation according to EN 61810-1	insulation rated voltage	V	250		400	
	rated impulse withstand voltage	kV	4		4	
	pollution degree		3		2	
	overvoltage category		III		III	
Insulation between coil and contacts (1.2/50 µs)		kV	6 (8 mm)			
Dielectric strength between open contacts		V AC	1,000			
Conducted disturbance immunity						
Burst (5...50)ns, 5 kHz, on A1 - A2			EN 61000-4-4		level 4 (4 kV)	
Surge (1.2/50 µs) on A1 - A2 (differential mode)			EN 61000-4-5		level 3 (2 kV)	
Other data			**1 Pole 6 A**		**1 Pole 16 A - 2 Pole 8 A**	
Bounce time: NO/NC		ms	1/6		2/5	
Vibration resistance (10...55)Hz: NO/NC		g	10/5		15/2	
Power lost to the environment	without contact current	W	0.2 (12 V) - 0.9 (240 V)		0.5 (24 V) - 0.9 (240 V)	
	with rated current	W	0.5 (12 V) - 1.5 (240 V)		1.3 (24 V) - 1.7 (240 V)	
Terminals			**38.21 / 38.51**		**38.61**	
Wire strip length		mm	10		10	
⏀ Screw torque		Nm	0.5		—	
Max. wire size			solid cable	stranded cable	solid cable	stranded cable
		mm^2	1x2.5/2x1.5	1x2.5/2x1.5	1x2.5	1x2.5
		AWG	1x14/2x16	1x14/2x16	1x14	1x14
			38.01 / 38.52		**38.11 / 38.62**	
Wire strip length		mm	10		10	
⏀ Screw torque		Nm	0.5		—	
Max. wire size			solid cable	stranded cable	solid cable	stranded cable
		mm^2	1x2.5/2x1.5	1x2.5/2x1.5	1x2.5	1x2.5
		AWG	1x14/2x16	1x14/2x16	1x14	1x14

Contact specification - 1 & 2 Pole Electromagnetic Relays

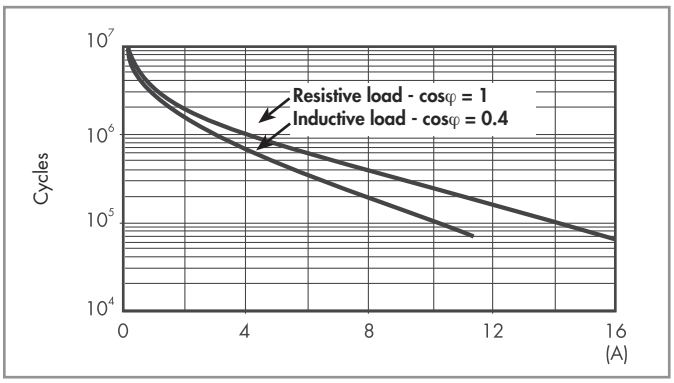
F 38 - Electrical life (AC) v contact current, 1 Pole 6 A



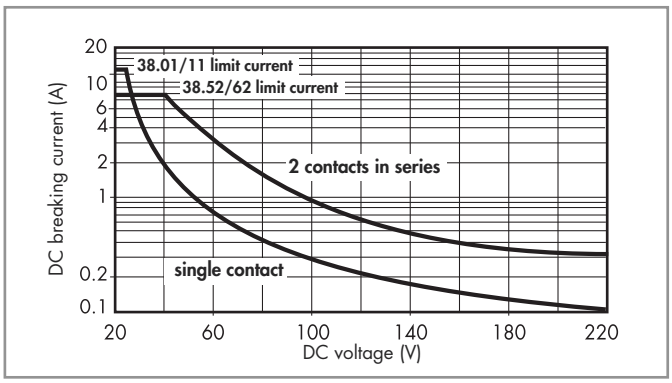
H 38 - Maximum DC1 breaking capacity, 1 Pole 6 A



F 38 - Electrical life (AC) v contact current, 1 Pole 16 A and 2 Pole 8 A



H 38 - Maximum DC1 breaking capacity, 1 Pole 16 A and 2 Pole 8 A



- When switching a resistive load (DC1) having voltage and current values under the curve, an electrical life of ≥ $60 \cdot 10^3$ (1 Pole) or ≥ $80 \cdot 10^3$ (2 Pole) can be expected.
- In the case of DC13 loads, the connection of a diode in parallel with the load will permit a similar electrical life as for a DC1 load. Note: the release time for the load will be increased.

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38 Series - Relay interface modules - Technical data

Coil specifications - 1 Pole 6 A Electromechnical Relay

Coil data sensitive DC, 1 Pole

Nominal voltage U_N	Coil code	Operating range U_{min}	Operating range U_{max}	Rated coil consumption I at U_N	Power consumption P at U_N
V		V	V	mA	W
6	**7**.006	4.8	7.2	35	0.2
12	**7**.012	9.6	14.4	15.2	0.2
24	**7**.024	19.2	28.8	10.4	0.3
48	**7**.048	38.4	57.6	6.3	0.3
60	**7**.060	48	72	7	0.4

Coil data AC/DC, 1 Pole

Nominal voltage U_N	Coil code	Operating range U_{min}	Operating range U_{max}	Rated coil consumption I at U_N	Power consumption P at U_N
V		V	V	mA	VA/W
12	**0**.012	9.6	13.2	16	0.2/0.2
24	**0**.024	19.2	26.4	12	0.3/0.2
48	**0**.048	38.4	52.8	6.9	0.3/0.3
60	**0**.060	48	66	7	0.5/0.5
110...125	**0**.125	88	138	5(*)	0.6/0.6(*)
220...240	**0**.240	176	264	4(*)	1/0.9(*)

(*) Rated coil consumption and power consumption values relate to U_N = 125 and 240 V.

Coil data AC, 1 Pole (indicated for max ambient temperature +70°C)

Nominal voltage U_N	Coil code	Operating range U_{min}	Operating range U_{max}	Rated coil consumption I at U_N	Power consumption P at U_N
V		V	V	mA	VA/W
(230...240) AC	**8**.240	184	264	3	0.7/0.3

Coil data, leakage current suppression types, 1 Pole

Nominal voltage U_N	Coil code	Operating range U_{min}	Operating range U_{max}	Rated coil consumption I at U_N	Power consumption P at U_N
V		V	V	mA	VA/W
(110...125) AC/DC	**3**.125	94	138	8(*)	1/1(*)
(230...240) AC	**3**.240	184	264	7(*)	1.7/0.5(*)

(*) Rated coil consumption and power consumption values relate to U_N = 125 and 240 V.

The 38 Series interface modules (supply version 3) have built-in leakage current suppression to address industry concerns of the contacts not dropping-out when there is residual current in the circuit; at (110...125)V AC and (230...240)V AC.

This problem can occur, for example, when connecting the interface modules to PLC,s with triac outputs or when connecting via relatively long cables.

Coil specifications - 1 Pole 16 A and 2 Pole 8 A Electromechanical Relay

Coil data sensitive DC, 1 Pole 16 A and 2 Pole 8 A

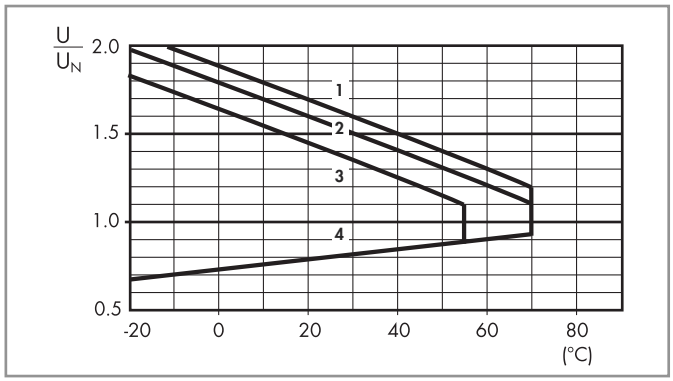
Nominal voltage U_N	Coil code	Operating range U_{min}	Operating range U_{max}	Rated coil consumption I at U_N	Power consumption P at U_N
V		V	V	mA	W
12	**7**.012	9.6	14.4	41	0.5
24	**7**.024	19.2	28.8	19.5	0.5
60	**7**.060	48	72	8	0.5

Coil data AC/DC, 1 Pole 16 A and 2 Pole 8 A

Nominal voltage U_N	Coil code	Operating range U_{min}	Operating range U_{max}	Rated coil consumption I at U_N	Power consumption P at U_N
V		V	V	mA	VA/W
24	**0**.024	19.2	26.4	20	0.5/0.5
60	**0**.060	48	66	7.1	0.5/0.5
110...125	**0**.125	88	138	4.6	0.6/0.6
220...240	**0**.240	184	264	3.8	0.9/0.9

Coil specification - 1 & 2 Pole Electromagnetic Relays

R 38 - DC coil operating range v ambient temperature
1 Pole and 2 Pole



1 - Max. permitted coil voltage at nominal load (DC coil).
2 - Max. permitted coil voltage at nominal load (AC/DC coils U ≤ 60 V).
3 - Max. permitted coil voltage at nominal load (AC/DC coils U > 60 V).
4 - Min pick-up voltage with coil at ambient temperature.

Technical data - Solid State Relays

Other data			38.81/38.91		38.31/38.41	
Power lost to the environment	without output current	W	0.25 (24 V DC)		0.5	
	with rated current	W	0.4		2.2 (DC output) / 3 (AC output)	
Terminals			**38.81**		**38.91**	
Wire strip length		mm	10		10	
⊖ Screw torque		Nm	0.5		—	
Max. wire size			solid cable	stranded cable	solid cable	stranded cable
		mm^2	1x2.5 / 2x1.5	1x2.5 / 2x1.5	1x2.5	1x2.5
		AWG	1x14 / 2x16	1x14 / 2x16	1x14	1x14
			38.31		**38.41**	
Wire strip length		mm	10		10	
⊖ Screw torque		Nm	0.5		—	
Max. wire size			solid cable	stranded cable	solid cable	stranded cable
		mm^2	1x2.5 / 2x1.5	1x2.5 / 2x1.5	1x2.5	1x2.5
		AWG	1x14 / 2x16	1x14 / 2x16	1x14	1x14

Input specifications - Solid State Relays type 38.81 and 38.91 - 6.2 mm wide

Input data DC

Nominal voltage U_N	Supply code	Operating range U_{min}	Operating range U_{max}	Release voltage U	Rated coil consumption I at U_N	Power consumption P
V		V	V	V	mA	W
6	**7**.006	5	7.2	2.4	7	0.2
24	**7**.024	16.8	30	10	10.5	0.3
60	**7**.060	35.6	72	20	6.5	0.4

Input data AC/DC

Nominal voltage U_N	Supply code	Operating range U_{min}	Operating range U_{max}	Release voltage U	Rated coil consumption I at U_N	Power consumption P
V		V	V	V	mA	VA/W
110...125	**0**.125	88	138	22	5.5*	0.7/0.7
220...240	**0**.240	184	264	44	3.5*	1/0.9

(*) Rated coil consumption and power consumption values relate to U_N = 125 and 240 V.

Input data - Leakage current suppression types

Nominal voltage U_N	Supply code	Operating range U_{min}	Operating range U_{max}	Release voltage U	Rated coil consumption I at U_N	Power consumption P at U_N
V		V	V		mA	W
110...125 AC/DC	**3**.125	94	138	44	8(*)	1/1(*)
230...240 AC	**3**.240	184	264	72	6.5(*)	1.6/0.6(*)

(*) Rated coil consumption and power consumption values relate to U_N = 125 and 240 V.

The 38 Series interface modules (supply version 3) have built-in leakage current suppression to address industry concerns of the contacts not dropping-out when there is residual current in the circuit; at (110...125)V AC and (230...240)V AC.

This problem can occur, for example, when connecting the interface modules to PLC,s with triac outputs or when connecting via relatively long cables.

Input specification - Solid State Relay types 38.31 and 38.41 - 14 mm wide

Input data DC

Nominal voltage U_N	Supply code	Operating range U_{min}	Operating range U_{max}	Release voltage U	Rated coil consumption I at U_N	Power consumption P
V		V	V	V	mA	W
24	**7**.024	16.8	30	5	12	0.3

Additional technical data - Timed Interface Module

EMC specifications				
Type of test			**Reference standard**	
Electrostatic discharge	contact discharge		EN 61000-4-2	4 kV
	air discharge		EN 61000-4-2	8 kV
Radio-frequency electromagnetic field (80 ÷ 1000 MHz)			EN 61000-4-3	10 V/m
Fast transients (burst) (5-50 ns, 5 kHz) on Supply terminals			EN 61000-4-4	4 kV
Surges (1.2/50 µs) on Supply terminals	common mode		EN 61000-4-5	4 kV
	differential mode		EN 61000-4-5	4 kV
Radio-frequency common mode (0.15 ÷ 80 MHz) on Supply terminals			EN 61000-4-6	10 V
Radiated and conducted emission			EN 55022	class B
Other data			**EMR**	**SSR**
Power lost to the environment	without contact current	W	0.1	0.1
	with rated current	W	0.6	0.5
Terminals			**38.21**	
Wire strip length		mm	10	
Screw torque		Nm	0.5	
Max. wire size			solid cable	stranded cable
		mm^2	1x2.5 / 2x1.5	1x2.5 / 2x1.5
		AWG	1x14 / 2x16	1x14 / 2x16

Times scales



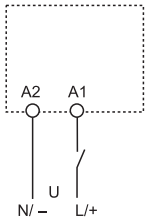
(0.1...3)s (3...60)s (1...20)min (0.3...6)h

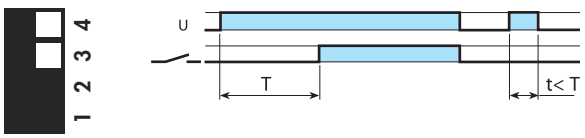
Functions

LED	Supply voltage	NO contact/output
———	OFF	Open
———	ON	Open (time in progress)
▬▬▬	ON	Closed

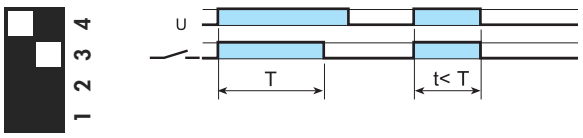
Wiring diagram

U = Supply voltage = Output contact

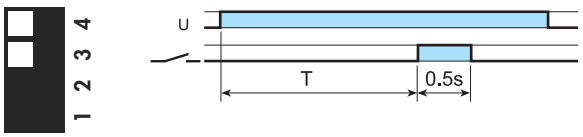




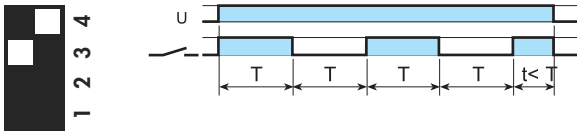
(AI) ON delay.
Apply power to timer.
Output contacts transfer after preset time has elapsed.
Reset occurs when power is removed.



(DI) ON pulse.
Apply power to timer.
Output contacts transfer immediately.
After the preset time has elapsed, contacts reset.



(GI) Fixed pulse (0.5s) delayed.
Apply power to timer. Output contacts transfer after preset time has elapsed. Reset occurs after a fixed time of 0.5s.



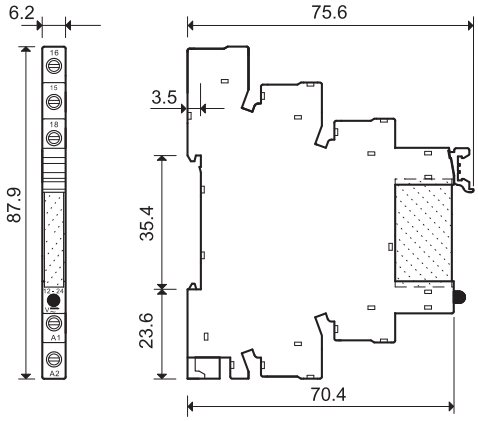
(SW) Symmetrical recycling: ON start.
Apply power to timer.
Output contacts transfer immediately and cycle between ON and OFF for as long as power is applied.
The ratio is 1:1 (time on = time off).

38 Series - Relay interface modules - Dimensional data

Outline drawings

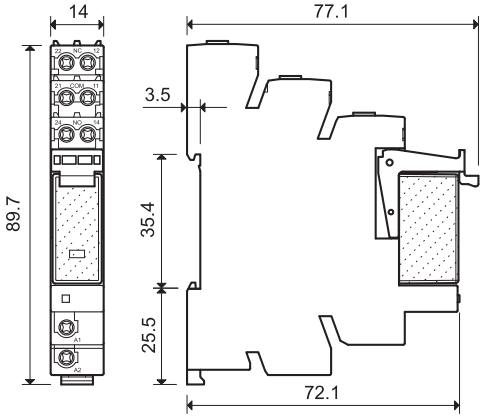
38.21
38.51 / 38.51.3
38.81 / 38.81.3
Screw terminal





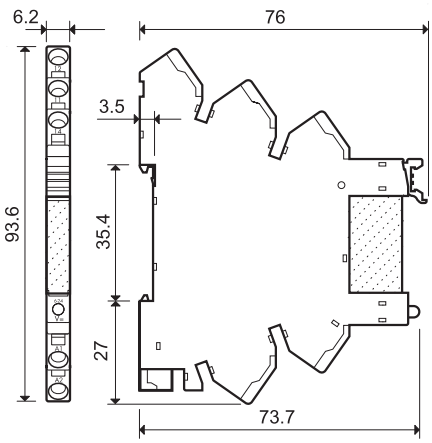
38.01
38.31
38.52
Screw terminal





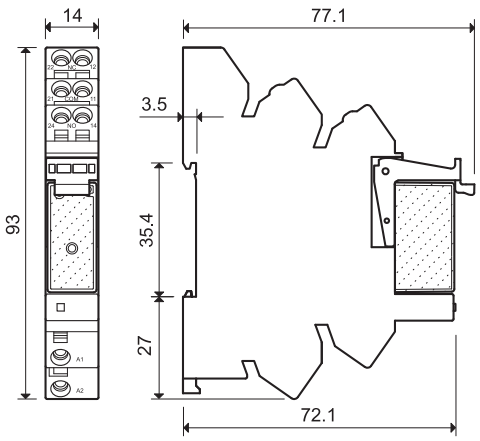
38.61 / 38.61.3
38.91 / 38.91.3
Screwless terminal





38.11
38.41
38.62
Screwless terminal



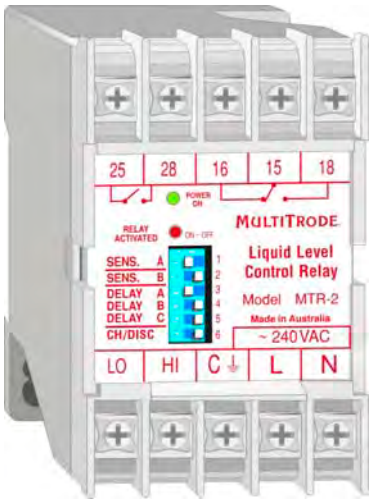


1 Introduction

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

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

2 Electrical Overview



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

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

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

3 DIP Switches

3.1 DIP Switches

(See Wiring Diagram for full program functions.)

3.1.1 DIP 1 & 2

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

3.1.2 DIP 3, 4 & 5

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

3.1.3 DIP 6

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

3.2 Relay Contacts & their Applications

3.2.1 Contacts 15, 16 & 18

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

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

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

3.2.2 Contacts 25 & 28

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

4 Practical Overview

4.1 Discharge Mode – DIP switch 6 set to “OFF”

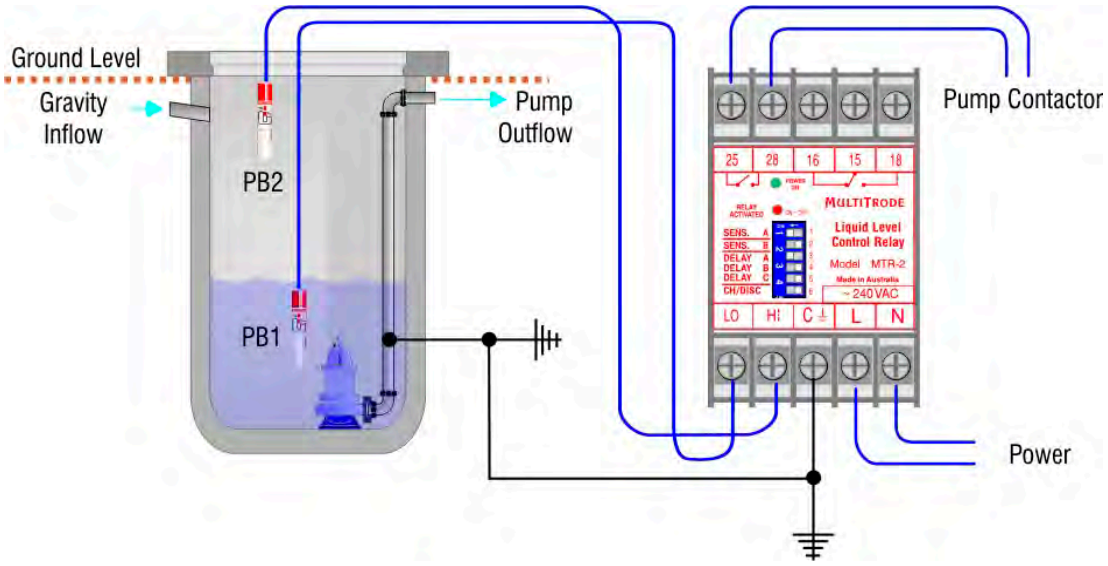
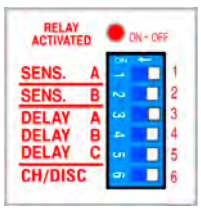


Figure 1 – Discharge Mode

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



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

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

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

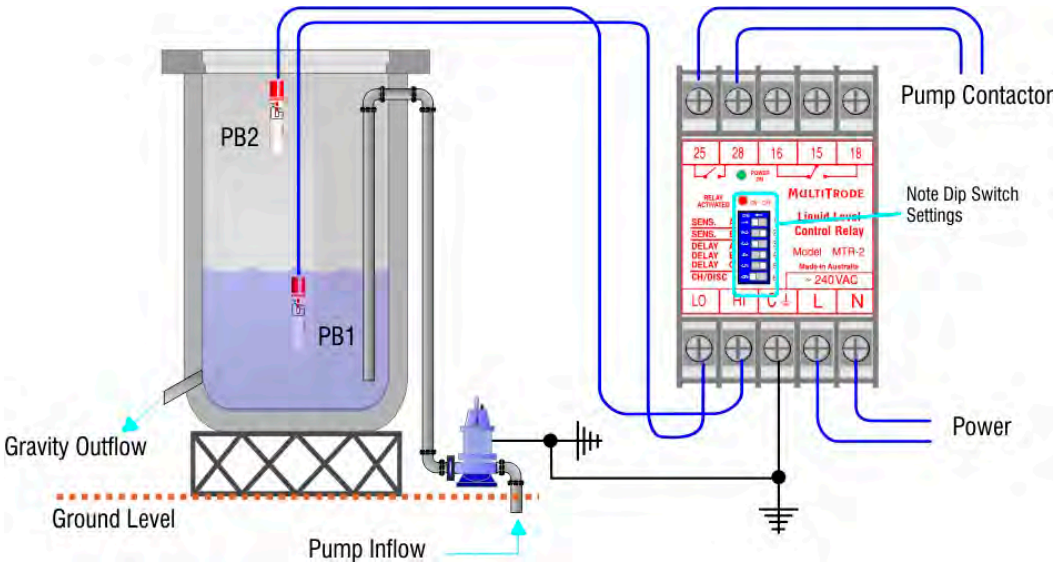


Figure 2 – Charge Mode

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



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

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

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

4.3 MTRA Relay with Alarm (Discharge Applications Only)

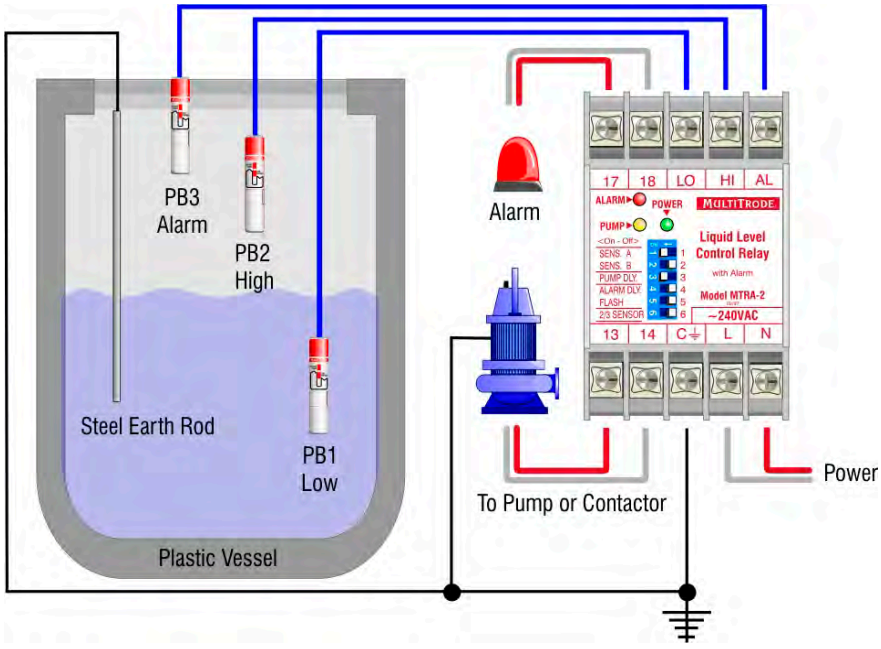


Figure 3 - MTRA Operation

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

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

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

5 Most Common Installation Problems

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

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

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

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

6 Troubleshooting

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

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

MultiTrode Pty Ltd—Australia
Ph: +61 7 3340 7000
Fx: +61 7 3340 7077
E-mail: sales@multitrode.com.au

Sydney—Australia
Ph: +61 2 9533 7735
Fx: +61 2 9533 7790
Visit www.multitrode.com.au **for the latest information**

MultiTrode Inc—USA
Ph: +1 561 994 8090
Fx: +1 561 994 6282
E-mail: sales@multitrode.net

Electrical Data

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

❶ Approved by Lloyd's register of shipping.

Electrical Data

				CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
Switching Motor Loads *(continued)*													
AC-4		230V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
200,000 Op. Cycles		240V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
50Hz		400V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		415V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		500V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		690V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		230V	[kW]	0.75	1.5	2.2	2.2	3	3.7	4	6.3	7.5	11
		240V	[kW]	0.75	1.5	2.2	2.2	3	4	4	7.5	7.5	11
		400V	[kW]	1.8	3	4	4	5.5	6.3	7.5	13	15	20
		415V	[kW]	1.8	3	4	4	5.5	6.3	7.5	13	17	20
		500V	[kW]	2.2	3.7	5.5	5.5	7.5	7.5	10	15	20	25
		690V	[kW]	3	5.5	7.5	7.5	10	11	15	22	25	32
60Hz	1Ø	115V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		230V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		115V	[HP]	1/8	1/4	1/3	1/2	1/2	3/4	1	2	2	3
		230V	[HP]	1/3	1/2	1	1-1/2	2	2	2	3	5	5
		200V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
	3Ø	230V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		460V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		575V	[A]	4.3	6.6	9	10	12	14	16.5	25.5	31	38
		200V	[HP]	3/4	1	2	2	3	3	3	7-1/2	7-1/2	10
		230V	[HP]	1	1-1/2	2	3	3	3	5	7-1/2	10	10
		460V	[HP]	2	3	5	5	7-1/2	10	10	15	20	25
		575V	[HP]	3	5	7-1/2	7-1/2	10	10	10	20	25	30
Maximum Operating Rate			[	250	250	220	200	200	200	200	120	120	120
Wye-Delta (Star Delta)		230V	[kW]	5.5	7.5	10	13	17	20	22	32	37	45
50 Hz		240V	[kW]	5.5	7.5	10	13	18.5	20	22	32	40	50
		400V	[kW]	7.5	10	13	20	25	32	40	55	63	80
		415V	[kW]	7.5	11	15	22	25	37	40	55	63	80
		500V	[kW]	7.5	11	15	22	25	32	45	63	80	90
		690V	[kW]	7.5	10	13	18.5	25	32	40	55	63	80
		200V	[HP]	5	5	7-1/2	7-1/2	10	15	20	30	40	50
60 Hz		230V	[HP]	5	7-1/2	10	10	15	20	25	40	50	60
		460V	[HP]	10	15	20	25	30	40	50	75	100	125
		575V	[HP]	10	15	20	25	30	40	50	75	100	125
AC Elevator Control Ratings													
UL / CSA		Max FLC	[A]	8.0	11.0	16.0	21.0	27.0	31.0	37.0	43.0	54.0	62.0
500,000 operations		200V	[A]	7.8	11.0	11.0	17.5	25.3	25.3	32.2	32.2	48.3	62.1
		230V	[A]	6.8	9.6	15.2	15.2	22.0	28.0	28.0	42.0	54.0	68.0
		460V	[A]	7.6	11.0	14.0	21.0	27.0	27.0	34.0	40.0	52.0	65.0
		575V	[A]	6.1	9.0	11.0	17.0	22.0	27.0	32.0	41.0	52.0	62.0
		200V	[HP]	2	3	3	5	7-1/2	7-1/2	10	10	15	20
		230V	[HP]	2	3	5	5	7-1/2	10	10	15	20	25
		460V	[HP]	5	7-1/2	10	15	20	20	25	30	40	50
		575V	[HP]	5	7-1/2	1 0	15	20	25	30	40	50	60

Electrical Data

			CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
AC-1 Load, 30 Switching	I_{th}	[A]	32	32	32	32	65	65	85	100	100	100
Ambient Temperature 40° C	230V	[kW]	13	13	13	13	26	26	34	40	40	40
	240V	[kW]	13	13	13	13	27	27	35	42	42	42
	400V	[kW]	22	22	22	22	45	45	59	69	69	69
	415V	[kW]	23	23	23	23	47	47	61	72	72	72
	500V	[kW]	28	28	28	28	56	56	74	87	87	87
	690V	[kW]	38	38	38	38	78	78	102	120	120	120
Ambient Temperature 60° C	I_{th}	[A]	32	32	32	32	65	65	80	100	100	100
	230V	[kW]	13	13	13	13	26	26	32	40	40	40
	240V	[kW]	13	13	13	13	27	27	33	42	42	42
	400V	[kW]	22	22	22	22	45	45	55	69	69	69
	415V	[kW]	23	23	23	23	47	47	57	72	72	72
	500V	[kW]	28	28	28	28	56	56	69	87	87	87
	690V	[kW]	38	38	38	38	78	78	95	120	120	120
Maximum Operating Rate		[	1,000	1,000	1,000	1,000	1,000	1,000	300	600	600	600
Continuous Current (UL/CSA)												
General Purpose Rating (40°)	Open	[A]	25	25	30	30	45	55	60	90	90	100
	Enclosed	[A]	25	25	30	30	55	60	75	90	90	100
Maximum Operating Rate		[	1,400	1,400	1,200	1,200	1,200	1,000	1000	700	700	600
Lighting Loads ❶												
Elec.Dischrg.Lamps-AC-5a,	Open	[A]	22.5	25	28	29	40.5	45	77	81	85	90
single compensated	Enclosed	[A]	22.5	25	28	29	37	41	57	57	81	90
Max. capacitance at prospective	10kA	[µf]	1,000	1,000	1,000	1,000	2,700	2,700	3,200	4,000	4,000	4,700
short circuit current available at	20kA	[µf]	500	500	500	500	1,350	1,350	1,600	2,000	2,000	2,350
the contactor	50kA	[µf]	200	200	200	200	540	540	640	800	800	940
Incandescent Lamps - AC -5b												
Electrical endurance ~ 100,000 operations		[A]	12	16	18	22	30	37	43	60	70	76
Switching power transformers AC-6a 50Hz												
Inrush	= n											
Rated transformer current												
		[A]	10.9	10.9	10.9	10.9	20	20	23	40.8	40.8	40.8
n=30	230 VAC	[kVA]	4.3	4.3	4.3	4.3	8	8	9.2	16	16	16
	240 VAC	[kVA]	4.5	4.5	4.5	4.5	8.3	8.3	10	17	17	17
	400 VAC	[kVA]	7.5	7.5	7.5	7.5	14	14	16	28	28	28
	415 VAC	[kVA]	7.8	7.8	7.8	7.8	14	14	17`	29	29	29
	500 VAC	[kVA]	9.4	9.4	9.4	9.4	17	17	20	35	35	35
	690 VAC	[kVA]	13	13	13	13	24	24	27	49	49	49
		[A]	16.3	16.3	16.3	16.3	30	30	34.5	61.3	61.3	61.3
n=20	230 VAC	[kVA]	6.5	6.5	6.5	6.5	12	12	13.7	24.4	24.4	24.4
	240 VAC	[kVA]	6.8	6.8	6.8	6.8	12.5	12.5	14.3	25.5	25.5	25.5
	400 VAC	[kVA]	11.3	11.3	11.3	11.3	20.8	20.8	23.9	42.5	42.5	42.5
	415 VAC	[kVA]	11.7	11.7	11.7	11.7	21.6	21.6	24.8	44.1	44.1	44.1
	500 VAC	[kVA]	14.1	14.1	14.1	14.1	26	26	29.9	53.1	53.1	53.1
	690 VAC	[kVA]	19.5	19.5	19.5	19.5	35.9	35.9	41.2	73.3	73.3	73.3
		[A]	22	22	22	22	40	40	46	82	82	82
n=15	230 VAC	[kVA]	2.3	2.3	2.3	2.3	4.3	4.3	5.0	8.8	8.8	8.8
	240 VAC	[kVA]	2.4	2.4	2.4	2.4	4.5	4.5	5.2	9.2	9.2	9.2
	400 VAC	[kVA]	4.1	4.1	4.1	4.1	7.5	7.5	8.6	15.3	15.3	15.3
	415 VAC	[kVA]	4.2	4.2	4.2	4.2	7.8	7.8	8.9	15.9	15.9	15.9
	500 VAC	[kVA]	5.1	5.1	5.1	5.1	9.4	9.4	10.8	19.1	19.1	19.1
	690 VAC	[kVA]	7.0	7.0	7.0	7.0	12.9	12.9	14.9	26.4	26.4	26.4

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

Electrical Data

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

Electrical Data

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

❶ CA7 capacitor ratings are provided for technical reference. For cUL rated and labeled devices, see CAQ7 contactors listed in this section.

❷ CA7-9…CA7-30 = L min. 30 µH; CA7-37…CA7-85 = L min. 6 µH

Electrical Data

			CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
Resistance and Watt Loss I_e AC3												
Resistance per power pole		[mΩ]	2.7	2.7	2.7	2.0	2.0	2.0	1.5	0.9	0.9	0.9
Watt Loss - 3 power poles		[W]	0.66	1.2	2.1	3.2	5.4	8.2	8.3	9.7	14.0	19.5
Coil and 3 power poles	AC	[W]	3.3	3.8	4.7	6.2	8.4	11.2	11.5	11	13.8	17.5
	DC	[W]	6.7	7.2	8.1	12.4	14.6	17.4	18.4	11	13.8	17.5
Coil only	AC	[W]	2.6	2.6	2.6	3.0	3.0	3.0	3.2	4.5	4.5	4.5
	DC	[W]	6.0	6.0	6.0	9.2	9.2	9.2	10.0	4.9	4.9	4.9
Short-Circuit Coordination												
Max. Fuse or circuit breaker ratings												
DIN Fuses -gG, gL												
Available Fault Current		[A]	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA
Type “1” (690V) ❸		[A]	50	50	50	80	125	125	160	250	250	250
Type “2” (690V) ❸		[A]	25	35	35	40	80	80	100	160	160	160
BS 88 Fuses												
Available Fault Current		[A]	80 KA	80 KA	80 KA	80 KA	80 KA	80 KA	80 KA	80 KA	80 KA	80 KA
Type “1” (690V) ❸		[A]	25	32	35	50	63	80	100	100	125	160
Type “2” (690V) ❸		[A]	25	32	35	50	63	80	100	100	125	160
Class K1, RK1 Fuses												
Available Fault Current		[A]	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA
Type “2” (600V) ❸		[A]	15	20	20	30	40	50	50	80	100	100
cUL Short-Circuit Ratings												
Class K1, RK1, K5, and RK5 Fuses												
Available Fault Current		[A]	5 KA	5 KA	5 KA	5 KA	5 KA	5 KA	5 KA	5 KA	5 KA	5 KA
cUL Max. Rating (600V) ❷ Type 1		[A]	35	40	70	90	110	125	150	200	250	300
Class CC & CSA HRCI Fuses												
Available Fault Current		[A]	100 KA	100 KA	100 KA	100 KA	~	~	~	~	~	~
cUL Max. Rating (600V) ❷ Type 2		[A]	15	20	30	30	~	~	~	~	~	~
Class J CSA & HRCI-J Fuses												
Available Fault Current		[A]	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA
cUL Max. Rating (600V) ❷ Type 2		[A]	15	20	30	30	50	50	70	80	100	150
Inverse-Time Circuit Breaker ❶												
Available Fault Current		[A]	5 KA	5 KA	5 KA	5 KA	5 KA	5 KA	5 KA	5 KA	10 KA	10 KA
cUL Max. Rating 480V ❷ Type 1		[A]	30	30	50	50	125	125	125	250	250	250
cUL Max. Rating 600V ❷ Type 1		[A]	~	~	~	~	125	125	125	250	250	250
Short Time Current Withstand Ratings												
I_{cw} 60° C	10 s	[A]	170	170	170	215	300	304	375	700	700	700
Off Time Between Operations		[Min.]	20	20	20	20	20	20	20	20	20	20

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

❷ UL Listed Combination. (UL File E41850) Per UL508A, NEC409 abd CSA 22.2 No.14 for contactor and fuses or circuit breaker only.

❸ Per IEC 60947-1 for contactor and fuses only.

Electrical Data

Short Circuit Coordination I_e AC3

Type 2 Coordination Combinations (contactor, overload and fuses) — Per UL 508 and IEC 60947-4-1

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

CEP7 First Generation Scheduled for Obsolesence 2006

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

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

Short Circuit Ratings

Standard Fault Short Circuit Ratings per UL508 and CSA 22.2 No.14

CEP7 Second Generation Cat. No.		Max. available fault current (kA)	Conditional S.C. current, Iq (kA)	S.C.P.D.
CEP7	ED1AB, EEAB ED1BB, EEBB	1	600	Suitable for use with fuses only
	ED1CB, ED1DB, ED1EB, EECB, EEDB, EEEB, EEED, EEFD, EEPB, EERB, EESB, EETD	5		Not restricted to
	EEEE, EEFE, EEGE, EEUE	10		

IEC Short Circuit Ratings per EN60947-4-1

CEP7 Second Generation Cat. No.		Prospective S.C. current, Ir (kA)	Conditional S.C. current, Iq (kA)	Max. voltage (V)	S.C.P.D.
CEP7	ED1AB, EEAB ED1BB, EEAB	1	100	690	Suitable for use with fuses only
	ED1CB, ED1DB, EECB, EEDB, EEPB, EERB	1			Not restricted to
	ED1EB, EEEB, EEED, EEFD, EEEE, EEFE, EESB, EETD	3			
	EEGE, EEUE	5			

High Fault Short Circuit Ratings per UL508 and CSA 22.2 No.14

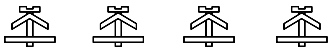
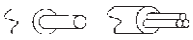
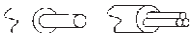
CEP7 Second Generation Cat. No.		Contactor Cat. No.	Max. starter FLC (A)	Max. available fault current (kA)	Max. voltage (V)	UL Class J and CSA HRCI-J fuse (A)
CEP7	ED1AB, EEAB	CA7-09	0.5	100	600	3
	ED1BB, EEBB		1			6
	ED1CB, ED1DB, ED1EB, EEEB, EECB, EEDB	CA7-09	09			20
		CA7-12	12			20
		CA7-16	16			30
		CA7-23	23			30
	EEED, EEFD	CA7-30	30			50
		CA7-37	37			50
		CA7-43	43			70
	EEEE, EEFE EEGE	CA7-60	60			80
		CA7-72	72			100
		CA7-85	85			150

IEC Type 1 and Type II Fuse Coordination with CA7 Series contactors per EN60947-4-1

CEP7 Second Generation Cat. No.		Contactor Cat. No.	Max. starter FLC (A)	Prospective S.C. current, Ir (kA)	Conditional S.C. current, Iq (kA)	Max. voltage (V)	Type I with Class J fuse (A)	Type II with Class J fuse (A)
CEP7	ED1AB, EEAB	CA7-09	0.5	1	100	600	3	3
	ED1BB, EEBB		1				6	6
	ED1CB, ED1DB, EECB, EEDB	CA7-09	09	1			20	15
		CA7-12	12				20	20
		CA7-16	16				30	30
		CA7-23	23				30	30
	ED1EB, EEEB	CA7-09	09	3			20	15
		CA7-12	12				20	20
		CA7-16	16				30	30
		CA7-23	23				30	30
	EEED, EEFD	CA7-30	30	3			50	50
		CA7-37	37				50	50
		CA7-43	43				70	70
	EEEE, EEFE	CA7-60	60	3			80	80
		CA7-72	72				100	100
		CA7-85	85				150	150
	EEGE	CA7-60	60	5			80	80
		CA7-72	72				100	100
		CA7-85	85				150	150

sprecher+schuh

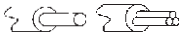
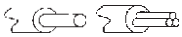
Electro-Mechanical Data

			CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
Service Life												
Mechanical	AC	[Mil.]	13	13	13	13	13	13	12	10	10	10
	DC	[Mil.]	13	13	13	13	13	13	13	10	10	10
Electrical AC-3 (400V)	AC	[Mil.]	1.3	1.3	1.3	1.3	1.3	1.3	1.0	1.0	1.0	1.0
Shipping Weights												
AC - CA7		[kg]	0.39	0.39	0.39	0.39	0.48	0.49	0.51	1.45	1.45	1.45
		[Lbs.]	0.86	0.86	0.86	0.86	1.06	1.08	1.12	3.20	3.20	3.20
AC -CAU7		[kg]	0.85	0.85	0.85	0.85	1.08	1.08	1.15	3.14	3.14	3.14
		[Lbs.]	1.89	1.89	1.89	1.89	2.39	2.39	2.54	6.92	6.92	6.92
DC - CA7		[kg]	0.60	0.60	0.60	0.73	0.85	0.85	1.00	1.47	1.47	1.47
		[Lbs.]	1.32	1.32	1.32	1.61	1.87	1.87	2.20	3.24	3.24	3.24
DC - CAU7		[kg]	1.27	1.27	1.27	1.53	1.81	1.81	2.13	3.22	3.22	3.22
		[Lbs.]	2.81	2.81	2.81	3.39	4.00	4.00	4.70	7.10	7.10	7.10
Terminations - Power												
Description												
			One saddleclamp per pole: cross, slotted or Pozidrive No. 2/blade No. 3 screw				Dual connection; one saddleclamp and one box lug per pole; cross, slotted or Pozidrive No. 2/blade No. 4 screw			Dual connection; two box lugs per pole Allen Head: 4mm, 5/32		
	1 Wire	[mm²]	1...4	1...4	1...4	1...4	2.5...10	2.5...10	2.5...16	2.5...35	2.5...35	2.5...35
	2 Wires	[mm²]	1...4	1...4	1...4	1...4	2.5...10	2.5...10	2.5...10	2.5...25	2.5...25	2.5...25
	1 Wire	[mm²]	1.5...6	1.5...6	1.5...6	1.5...6	2.5...16	2.5...16	2.5...25	2.5...50	2.5...50	2.5...50
	2 Wires	[mm²]	1.5...6	1.5...6	1.5...6	1.5...6	2.5...16	2.5...16	2.5...16	2.5...35	2.5...35	2.5...35
	1 Wire	[AWG]	16...10	16...10	16...10	16...10	14...4	14..4	14...4	14...1	14...1	14...1
	2 Wires	[AWG]	16...10	16...10	16...10	16...10	14...4	14..4	14...4	14...1	14...1	14...1
Torque Requirement		[Nm]	1.0...2.5	1.0...2.5	1.0...2.5	1.0...2.5	2.5...3.5	2.5...4	2.5...4	3.5...6	3.5...6	3.5...6
		[Lb-in]	9...22	9...22	9...22	9...22	22...31	22...35	22...35	31...53	31...53	31...53
Terminations - Control												
Description												
			Combination Screw Head: Cross, Slotted, Pozidrive									
Coils	1 or 2	[mm²]	1.5...6									
Wires		[AWG]	16...12									
Control Modules	1or 2	[mm²]	1.5...6									
Wires		[AWG]	16...12									
Torque Requirement		[Nm]	1...2.5									
		[Lb-in]	9...13									
Degree of Protection - contactor			IP 2LX per IEC 529 and DIN 40 050 (with wires installed)									
Protection Against Accidental Contact			Safe from touch by fingers and back-of-hand per VDE 0106; Part 100									

Environmental and General Specifications

Ambient Temperature	
Storage	-55...+80˚ C (-67...176˚ F) - [CRI7E Electronic Interface -50...+80˚ C (-58...176˚ F)]
Operation	-25...+60˚ C (-13...140˚ F)
Conditioned 15% current reduction after AC-1 at >60˚ C	-25...+70˚ C (-13...158˚ F)
Altitude at installed site	2000 meters above sea level per IEC 947-4
Resistance to Corrosion/Humidity	Damp-alternating climate: cyclic to IEC 68-2, 56 cycles Dry heat: IEC 68-2, +100˚C (212˚ F), relative humidity <50%, 7 days. Damp tropical: IEC 68-2, +40˚C (104˚F), relative humidity <92%, 56 days.
Shock Resistance	IEC 68-2: Half sinusoidal shock 11ms, 30g (in all three directions)
Vibration Resistance	IEC 68-2: Static > 2g, in normal position no malfunction <5g
Pollution Degree	3
Operating Position	Refer to Dimension Pages
Standards	IEC947-1/4, EN 60947; UL 508; CSA 22.2, No. 14
Approvals	CE, UL, CSA

Lug Kit and Paralleling Link Specifications

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

Coil Data

			CA7-9	CA7-12	CA7-16	CA7-23	CA7-30	CA7-37	CA7-43	CA7-60	CA7-72	CA7-85
Voltage Range												
AC: 50Hz, 60Hz, 50/60 Hz	Pickup	[xU_s]	0.85...1.1									
	Dropout	[xU_s]	0.3...0.6									
DC	Pickup	[xU_s]	0.8...1.1 (9V coils = 0.65...1.3; 24V coils = 0.7...1.25)									
	Dropout	[xU_s]	0.1...0.6									
Coil Consumption												
AC: 50Hz, 60Hz, 50/60 Hz	Pickup	[VA/W]	70/50	70/50	70/50	70/50	80/60	80/60	130/90	200/110	200/110	200/110
	Hold-in	[VA/W]	8/2.6	8/2.6	8/2.6	9/3	9/3	9/3	10/3.2	16/4.5	16/4.5	16/4.5
True DC Coils (CA7C)	Pickup	[W]	6.5	6.5	6.5	9.2	9.2	9.2	10.1	~	~	~
	Hold-in	[W]	6.5	6.5	6.5	9.2	9.2	9.2	10.1	~	~	~
Two Winding DC Coils	Pickup	[W]	120	120	120	200	200	200	200	200	200	200
CA7Y & CA7D	Hold-in	[W]	1.1	1.1	1.1	1.2	1.2	1.2	1.3	4.5	4.5	4.5
Operating Times												
AC: 50Hz, 60Hz, 50/60 Hz	Pickup	[ms]	15...30	15...30	15...30	15...30	15...30	15...30	15...30	20...40	20...40	20...40
	Dropout	[ms]	10...60	10...60	10...60	10...60	10...60	10...60	10...60	10...60	10...60	10...60
with RC Suppressor	Dropout	[ms]	10...60	10...60	10...60	10...60	10...60	10...60	10...60	10...60	10...60	10...60
True DC Coils (CA7C)	Pickup	[ms]	40...70	40...70	40...70	40...70	50...80	50...80	50...80	~	~	~
without Suppression	Dropout	[ms]	7...15	7...15	7...15	7...15	7...15	7...15	7...15	~	~	~
with Integrated Suppression	Dropout	[ms]	14...20	14...20	14...20	17...23	17...23	17...23	17...23	~	~	~
with External Suppression	Dropout	[ms]	70...95	70...95	70...95	80...125	80...125	80...125	80...125	~	~	~
Two Winding DC Coils (CA7Y/D)	Pickup	[ms]	17...26	17...26	15...27	15...27	15...27	15...27	15...27	20...40	20...40	20...40
with Internal Suppression	Dropout	[ms]	9...20	9...20	14...24	14...24	14...24	14...24	14...24	20...35 ❶	20...35 ❶	20...35 ❶

❶ ≤ 220V.

Electrical Data

			CA7-9-M40(31; 22)	CA7-12-M40(31; 22)	CA7-16-M40(31; 22)	CA7-23-M40(31; 22)	CA7-40-M22	CA7-40-M40	CA7-90-M22	CA7-90-M40
Rated Insulation Voltage U_i										
IEC, AS, BS, SEV, VDE 0660						690V				
UL; CSA						600V				
Rated Impulse Voltage U_{imp}						8 kV				
Rated Voltage U_e - Main Contacts										
AC 50/60Hz					115, 200, 208, 230, 240, 380, 400, 415, 460, 500, 575, 690V					
DC					24, 48, 110, 115, 220, 230, 300, 440V					
Operating Frequency for AC Loads						50...60Hz				
Switching Motor Loads										
Standard IEC Ratings										
AC-2, AC-3, AC-4	230V	[A]	12	15	20	26.5	38	38	85	85
DOL & Reversing	240v	[A]	12	15	20	26.5	38	38	85	85
50Hz/60ºC	400V	[A]	9	12	16	23.	37	37	85	85
	415V	[A]	9	12	16	23	37	37	85	85
	500V	[A]	7	10	14	20	29	30	80	80
	690V	[A]	5	7	9	12	9	21	22	49
	230V	[kW]	3	4	5.5	7.5	11	11	25	25
	240V	[kW]	3	4	5.5	7.5	11	11	25	25
	400V	[kW]	4	5.5	7.5	11	18.5	18.5	45	45
	415V	[kW]	4	5.5	7.5	11	18.5	18.5	45	45
	500V	[kW]	4	5.5	7.5	13	18.5	20	55	55
	690V	[kW]	4	5.5	7.5	10	7.5	18.5	18.5	45
UL/CSA/IEC										
DOL & Reversing	115V	[A]	7.2	9.8	16	24	34	34	80	80
60Hz/60ºC 1Ø	230V	[A]	18	12	17	17	28	28	68	68
	115V	[HP]	1/2	1/2	1	2	3	3	7-1/2	7-1/2
	230V	[HP]	1-1/2	2	3	3	5	5	15	15
	200V	[A]	7.8	11	17.5	17.5	32.2	32.2	78.2	78.2
	230V	[A]	6.8	9.6	15.2	22	28	28	80	80
	460V	[A]	7.6	11	14	21	34	34	65	77
	575V	[A]	9	11	17	17	17	32	22	52
	200V	[HP]	2	3	5	5	10	10	25	25
	230V	[HP]	2	3	5	7-1/2	10	10	30	30
	460V	[HP]	5	7-1/2	10	15	25	25	50	60
	575V	[HP]	7-1/2	10	15	15	15	30	20	50
Maximum Operating Rate	AC2	[ops/hr]	450	450	450	400	400	400	200	200
(at max. amps)	AC3	[ops/hr]	700	700	700	600	600	600	500	500
	AC4	[ops/hr]	200	150	120	80	70	70	50	50

Electrical Data

			CA7-9-M40(31; 22)	CA7-12-M40(31; 22)	CA7-16-M40(31; 22)	CA7-23-M40(31; 22)	CA7-40-M22	CA7-40-M40	CA7-90-M22	CA7-90-M40
AC-1 Load, 3Ø Switching		[A]								
Ambient Temperature 40ºC	I_{th}	[kW]	32	32	32	32	75	75	130	130
	230V	[kW]	13	13	13	13	30	30	52	52
	240V	[kW]	13	13	13	13	31	31	54	54
	400V	[kW]	22	22	22	22	52	52	90	90
	415V	[kW]	23	23	23	23	54	54	93	93
	500V	[kW]	28	28	28	28	65	65	113	113
	690V	[kW]	38	38	38	38	90	90	155	155
	I_{th}	[kW]	32	32	32	32	60	60	110	110
	230V	[kW]	13	13	13	13	24	24	44	44
Ambient Temperature 60º	240V	[kW]	13	13	13	13	25	25	46	46
	400V	[kW]	22	22	22	22	42	42	76	76
	415V	[kW]	23	23	23	23	43	43	79	79
	500V	[kW]	28	28	28	28	52	52	95	95
	690V	[kW]	38	38	38	38	72	72	131	131
Max Operating Rate		[ops/hour]	1,000	1,000,	1,000,	1,000	300	300	600	600
Continuous Current (UL/CSA)										
General Purpose Rating (40º)	Open	[A]	25	25	30	30	60	60	125	130
	Enclosed	[A]	25	25	30	30	60	60	125	130
Max. Operating Rate		[ops/hour]	1,400	1,400	1,200	1,200	1,000	1,000	600	600
Lighting Loads ❶										
Elec. Dischrg.Lamps-AC-5a,	Open	[A]	22.5	25	28	29	65	65	115	115
single compensated	Enclosed	[A]	22.5	25	28	29	54	54	95	95
Incandescent Lamps AC-5b, Electrical endurance~100,000 operations			12	16	18	22	18	25	60	75
DC-1 Switching - 60ºC	24VDC	[A]	25	25	32	32	45	45	80	80
	48VDC	[A]	20	20	20	20	25	25	40	40
1 Pole	60VDC	[A]	20	20	20	20	25	30	40	40
	110VDC	[A]	6	6	6	6	10	10	11	11
	220VDC	[A]	1.5	1.5	1.5	1.5	1.5	1.5	1.8	1.8
	440VDC	[A]	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5
	24VDC	[A]	25	25	32	32	45	45	80	80
	48VDC	[A]	25	25	32	32	45	45	80	80
2 Pole in Series	60VDC	[A]	25	25	32	32	45	45	80	80
	110VDC	[A]	25	25	32	32	45	45	80	80
	220VDC	[A]	8	8	8	8	10	10	15	15
	440VDC	[A]	1	1	1	1	1	1	1.5	1.5
	24VDC	[A]	25	25	32	32	~	48	~	100
	48VDC	[A]	25	25	32	32	~	48	~	100
3 Poles in Series	60VDC	[A]	25	25	32	32	~	48	~	100
	110VDC	[A]	25	25	32	32	~	48	~	100
	220VDC	[A]	25	25	32	32	~	48	~	80
	440VDC	[A]	3	3	3	3	~	3.5	~	5
	24VDC	[A]	25	25	32	32	~	60	~	110
	48VDC	[A]	25	25	32	32	~	60	~	110
4 Poles in Series	60VDC	[A]	25	25	32	32	~	60	~	110
	110VDC	[A]	25	25	32	32	~	60	~	110
	220VDC	[A]	25	25	32	32	~	60	~	100
	440VDC	[A]	8	8	8	8	~	10	~	15

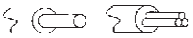
❶ CA7 ratings for lighting loads are provided for technical reference. For cUL rated and labeled devices, see CAL7 contactors listed in this section.

Electrical Data

			CA7-9-M40(31; 22)	CA7-12-M40(31; 22)	CA7-16-M40(31; 22)	CA7-23-M40(31;22)	CA7-40-M22	CA7-40-M40	CA7-90-M22	CA7-90-M40
Resistance and Watt Loss I_e AC3										
Resistance per power pole		[mΩ]	2.7	2.7	2.7	2.0	2.0	1.5	0.8	0.7
Watt Loss - 4 power poles		[W]	2.8	2.8	2.8	2.0	11.3	8.4	13.5	11.8
Coil and 4 power poles	AC	[W]	13.7	13.7	13.7	10.8	26.1	37.4	36.0	56.3
	DC (true)	[W]	17.6	17.6	17.6	17.4	32.6	43.9	~	~
	DC (2 winding)	[W]	~	~	~	~	~	~	32.5	52.8
Short Circuit Coordination										
DIN Fuses -gG, gL										
Available Fault Current		[A]	100 KA	100 KA	100 KA	100 KA	50 KA	50 KA	50 KA	50 KA
Type "1" (690V) ❸		[A]	50	50	50	80	160	160	250	250
Type "2" (690V) ❸		[A]	25	35	35	40	100	100	160	160
BS 88 Fuses										
Available Fault Current		[A]	80 KA	80 KA	80 KA	80 KA	~	~	~	~
Type "1" (690V) ❸		[A]	25	32	35	50	~	~	~	~
Type "2" (690V) ❸		[A]	25	32	35	50	~	~	~	~
Class K1, RK1 Fuses										
Available Fault Current		[A]	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA
Type "2" (600V) ❸		[A]	15	20	20	30	70	70	100	100
cUL Short-Circuit Ratings										
Class K1, RK1, K5, and RK5 Fuses										
Available Fault Current		[A]	5 KA	5 KA	5 KA	5 KA	5 KA	5 KA	10 KA	10 KA
cUL Max. Rating (600V) ❷ Type 1		[A]	35	40	70	90	125	125	300	300
Class CC & CSA HRCI Fuses										
Available Fault Current		[A]	100 KA	100 KA	100 KA	100 KA	~	~	~	~
cUL Max. Rating (600V) ❷ Type 2		[A]	15	20	30	30	~	~	~	~
Class J CSA & HRCI-J Fuses										
Available Fault Current		[A]	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA	100 KA
cUL Max. Rating (600V) ❷ Type 2		[A]	15	20	30	30	70 ❹	70 ❹	150 ❹	150 ❹
Inverse-Time Circuit Breaker ❶										
Available Fault Current		[A]	5 KA	5 KA	5 KA	5 KA	5 KA	5 KA	10 KA	10 KA
cUL Max. Rating 480V ❷ Type 1		[A]	30	30	50	50	125	125	250	250
cUL Max. Rating 600V ❷ Type 1		[A]	~	~	~	~	125	125	250	250
Short Time Current Withstand Ratings										
I_{cw} 60° C		[A]	170	170	170	215	304	304	700	700
Off Time Between Operations		[Min.]	20	20	20	20	5	5	5	5

❶ When used as a Branch Circuit Protection device, NEC 430-152 defines the maximum rating of an Inverse-time circuit breaker to be sized at 250% of the motor nameplate FLA for most applications.
❷ UL Listed Combination. (UL File E41850) Per UL508A, NEC409 abd CSA 22.2 No.14 for contactor and fuses or circuit breaker only.
❸ Per IEC 60947-1 for contactor and fuses only.
❹ UL Testing not complete a the time of printing this catalog.

Mechanical Data

			CA7-9- M40(31; 22)	CA7-12- M40(31; 22)	CA7-16- M40(31; 22)	CA7-23- M40(31; 22)	CA7-40-M22	CA7-40-M40	CA7-90- M22	CA7-90- M40
Service Life										
Mechanical	AC	[Mil.]	13	13	13	13	10	10	10	10
	DC	[Mil.]	13	13	13	13	10	10	10	10
Shipping Weights										
AC - CA7		[kg]	0.39	0.39	0.39	0.39	0.51	0.51	1.45	1.45
		[Lbs.]	0.86	0.86	0.86	0.86	1.12	1.12	3.20	3.20
DC - CA7		[kg]	0.60	0.60	0.60	0.73	1.00	1.00	1.47	1.47
		[Lbs.]	1.32	1.32	1.32	1.61	2.20	2.20	3.24	3.24
Terminations - Power										
Description										
			One saddleclamp per pole: cross, slotted or Pozidrive No. 2/blade No. 3 screw				Dual connection; one saddleclamp and one box lug per pole; cross, slotted or Pozidrive No. 2/blade No. 4 screw		Dual connection; two box lugs per pole Allen Head: 4mm, 5/32	
	1 Wire	[mm²]	1...4	1...4	1...4	1...4	2.5...10	2.5...10	2.5...16	2.5...35
	2 Wires	[mm²]	1...4	1...4	1...4	1...4	2.5...10	2.5...10	2.5...10	2.5...25
	1 Wire	[mm²]	1.5...6	1.5...6	1.5...6	1.5...6	2.5...16	2.5...16	2.5...25	2.5...50
	2 Wires	[mm²]	1.5...6	1.5...6	1.5...6	1.5...6	2.5...16	2.5...16	2.5...16	2.5...35
	1 Wire	[AWG]	16...10	16...10	16...10	16...10	14...6	14..6	14...4	14...1
	2 Wires	[AWG]	16...10	16...10	16...10	16...10	14...6	14..6	14...4	14...1
Torque Requirement		[Nm]	1.0...2.5	1.0...2.5	1.0...2.5	1.0...2.5	2.5...4	2.5...4	2.5...4	3.5...6
		[Lb-in]	9...22	9...22	9...22	9...22	22...35	22...35	22...35	31...53
Terminations - Control										
Description										
			Combination Screw Head: Cross, Slotted, Pozidrive							
Coils	1 or 2	[mm²]	1.5...6							
Wires		[AWG]	16...12							
Control Modules	1or 2	[mm²]	1.5...6							
Wires		[AWG]	16...12							
Torque Requirement		[Nm]	1...2.5							
		[Lb-in]	9...13							
Degree of Protection - contactor			IP 2LX per IEC 529 and DIN 40 050 (with wires installed)							
Protection Against Accidental Contact			Safe from touch by fingers and back-of-hand per VDE 0106; Part 100							

Environmental and General Specifications

Ambient Temperature	
Storage	-55...+80˚ C (-67...176˚ F) - [CRI7E Electronic Interface -50...+80˚ C (-58...176˚ F)]
Operation	-25...+60˚ C (-13...140˚ F)
Conditioned 15% current reduction after AC-1 at >60˚ C	-25...+70˚ C (-13...158˚ F)
Altitude at installed site	2000 meters above sea level per IEC 947-4
Resistance to Corrosion/Humidity	Damp-alternating climate: cyclic to IEC 68-2, 56 cycles Dry heat: IEC 68-2, +100˚C (212˚ F), relative humidity <50%, 7 days. Damp tropical: IEC 68-2, +40˚C (104˚F), relative humidity <92%, 56 days.
Shock Resistance	IEC 68-2: Half sinusoidal shock 11ms, 30g (in all three directions)
Vibration Resistance	IEC 68-2: Static > 2g, in normal position no malfunction <5g
Pollution Degree	3
Operating Position	Refer to Dimension Pages
Standards	IEC947-1/4, EN 60947; UL 508; CSA 22.2, No. 14
Approvals	CE, UL, CSA

Coil Data (CA7 4-Pole)

			CA7-9-M40(31; 22)	CA7-12-M40(31; 22)	CA7-16-M40(31; 22)	CA7-23-M40(31; 22)	CA7-40-M22	CA7-40-M40	CA7-90-M22	CA7-90-M40
Voltage Range										
AC: 50Hz, 60Hz, 50/60 Hz	Pickup	[xU_s]					0.85...1.1			
	Dropout	[xU_s]					0.3...0.6			
DC	Pickup	[xU_s]					0.8...1.1 (9V coils = 0.65...1.3; 24V coils = 0.7...1.25)			
	Dropout	[xU_s]					0.1...0.6			
Coil Consumption										
AC: 50Hz, 60Hz, 50/60 Hz	Pickup	[VA/W]	70/50	70/50	70/50	70/50	130/90	130/90	400/240	400/240
	Hold-in	[VA/W]	8/2.6	8/2.6	8/2.6	9/3	12/3.6	12/3.6	24/9	24/9
True DC Coils (CA7C)	Pickup	[W]	6.5	6.5	6.5	9.2	10.1	10.1	~	~
	Hold-in	[W]	6.5	6.5	6.5	9.2	10.1	10.1	~	~
Two Winding DC Coils	Pickup	[W]	~	~	~	~	~	~	325	325
CA7Y & CA7D	Hold-in	[W]	~	~	~	~	~	~	5.5	5.5
Operating Times										
AC: 50Hz, 60Hz, 50/60 Hz	Pickup	[ms]	15...30	15...30	15...30	15...30	15...30	15...30	20...30	20...30
	Dropout	[ms]	10...60	10...60	10...60	10...60	10...60	10...60	20...40	20...40
with RC Suppressor	Dropout	[ms]	10...60	10...60	10...60	10...60	10...60	10...60	20...40	20...40
True DC Coils (CA7C)	Pickup	[ms]	40...70	40...70	40...70	40...70	50...80	50...80	~	~
without Suppression	Dropout	[ms]	7...15	7...15	7...15	7...15	7...15	7...15	~	~
with Integrated Suppression	Dropout	[ms]	14...20	14...20	14...20	17...23	~	~	~	~
with External Suppression	Dropout	[ms]	70...95	70...95	70...95	80...125	~	~	~	~
Two Winding DC Coils	Pickup	[ms]	~	~	~	~	~	~	15...20	20...25
with Internal Suppression	Dropout	[ms]	~	~	~	~	~	~	20...25	20...25

Technical Information – Auxiliary Contact Data

		Mounted Standard Auxiliary	Built-in Auxiliary Contacts in Contactor CA7-9...CA7-23	Front Mounted Auxiliary Contacts CA7-PV, CS7-PV, CZE/A7, CV7	Front Mounted Bifurcated Auxiliary Contacts	Side Mounted Auxiliary Contacts CA-PA, CM7
Electrical Contact Ratings - NEMA			A600, P600	A600, Q600		A600, Q600
Min. Contact Rating			17V, 10 mA	17V, 5 mA	5V, 3 mA	17V, 10 mA
Contact Ratings - IEC AC-15 (solenoids, contactors) rated voltage IEC 60947-5-1		24V	10 A	6 A	3 A	6 A
		48V	10 A	6 A	3 A	6 A
		120V	10 A	6 A	3 A	6 A
		240V	10 A	5 A	3 A	5 A
		400V	6 A	3 A	2 A	3 A
		480V/500V	2.5 A	1.6 A	1.2 A	1.6 A
		600V	1 A	1 A	0.7 A	1 A
		690V	1 A	1 A	0.7 A	1 A
AC-12 (Control of resistive loads) IEC 60947-5-1	**40 °C**	I_{th}	20 A	10 A	10 A	10 A
		230V	8 kW			
		400V	14 kW			
		690V	24 kW			
	60 °C	I_{th}	20 A	6 A	6 A	6 A
		230V	8 kW			
		400V	14 kW			
		690V	24 kW			
DC-12 Switching DC Loads $L/R < 1$ ms, Resistive Loads IEC 60947-5-1		24V	12 A	12 A	6 A	6 A
		48V	9 A	9 A	3.2 A	3.2 A
		110V	3.5 A	3.5 A	0.45 A	0.45 A
		220V	0.55 A	0.55 A	0.18 A	0.18 A
		440V	0.2 A	0.2 A	0.1 A	0.1 A
DC-13 IEC 60947-5-1, Solenoids and contactors		24V	5 A	5 A	2.5 A	5 A
		48V	3 A	3 A	1.5 A	3 A
		110V	1.2 A	1.2 A	0.6 A	1.2 A
		220V	0.6 A	0.6 A	0.3 A	0.6 A
		440V	0.3 A	0.15 A	0.15 A	0.15 A

Auxiliary Contacts

			Built-in Auxiliary Contacts in Contactor CA7-9...CA7-23	Front Mounted Auxiliary Contacts CA7-PV, CS7-PV, CZE/A7, CV7	Side Mounted Auxiliary Contacts CA-PA, CM7
Continuous Current Rating per UL/CSA					
Rated Voltage	AC	[V]	600 max.	600 max.	600 max.
Continuous Rating	40°C	[A]	10 A general purpose Heavy pilot duty (A600)	10 A general purpose Heavy pilot duty (A600)	10 A general purpose Heavy pilot duty (A600)
Continuous Rating	DC	[A]	5A, 600 max. Standard pilot duty (P600)	2.5A, 600 max. Standard pilot duty (Q600)	2.5A, 600 max. Standard pilot duty (Q600)
Short-Circuit Protection -gGFuse Type 2 Coordination		[A]	20	10	10
Rated Impulse Voltage U_{imp}		[kV]	8	8	6
Insulation Voltage (between control and load circuit) per DIN< VDE 0103, Part 101 (NAMUR recommendation)		[V]	380	440	440
Mechanically Linked Contacts (per IEC60947-5-1 ❶Annex L (SUVA Third-party certified)			Mutually unrestricted between all NO and NC contacts	Mutually unrestricted between all NO & NC contacts. CZE & CV7 not mechanically linked with contactor main contacts	Mutually unrestricted between all NO and NC contacts
Terminals					
Terminal Type					
Maximum Wire Size per IEC 947-1			2xA4	2xA4	2xA4
 Flexible with Wire-End Ferrule	1 conductor	[mm²]	1...4	0.5...2.5	0.5...2.5
	2 conductor	[mm²]	1...4	0.75...2.6	0.75...2.6
 Solid/Stranded-Conductor	1 conductor	[mm²]	1.5...6	0.5...2.5	0.5...2.5
	2 conductor	[mm²]	1.5...6	0.75...2.6	0.75...2.6
Recommended Tightening Torque		[Nm]	1...2.5	1...15	1...15
Max. Wire Size per UL/CSA		[AWG]	16...10	18...14	18...14
Recommended Tightening Torque		[lb-in]	9...22	9...13	9...13

Accessories

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

Positively-Guided Contacts (Mechanically-linked)
SUVA Certified

- Restricted guidance guarantees without restrictions from contactor to auxiliary contact and auxiliary contact to contactor.❶

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

Standard	Circuit Voltage	Make (Amps/VA)	Break (Amps/VA	Continuous Amps
A600	120AC 240AC 480AC 600AC	60A/7200VA 30A/7200VA 15A/7200VA 12A/7200VA	6A/720VA 3A/720VA 1.5A/720VA 1.2A/720VA	10
Q600	125DC 250DC 301-600DC	0.55A/69VA 0.27A/69VA 0.1A/69VA	0.55A/69VA 0.27A/69VA 0.1A/69VA	25

❶ See Section G for additional details.

Determining Contact Life

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

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

Table A – IEC Special Utilization Categories, AC Ratings ❶

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

Legend

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

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

Determining Contact Life

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

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

Table A – IEC Special Utilization Categories, DC Ratings ❶

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

Legend

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

❶ Utilization categories and test conditions for AC & DC. For contactors according to IEC 158-1, starters according to IEC 292-1 ... 4 and control switches according to IEC 337-1 and IEC 337-1A.
❷ Only according to VDE.
❸ *P = Ue x Ie* rated power [W]. The value "6 x P" has been derived from an empiric relationship which covers most magnetic loads for DC up to an upper limit of P = 50W.

Predicting Electrical Life

Sprecher + Schuh contactors are designed for superior performance in a wide variety of applications, by giving consideration to the specific load, utilization category and required electrical life, you can purchase exactly the type and size of contactor required. This assures reliable operation and high value the ability to very closely match the contactor to the application.

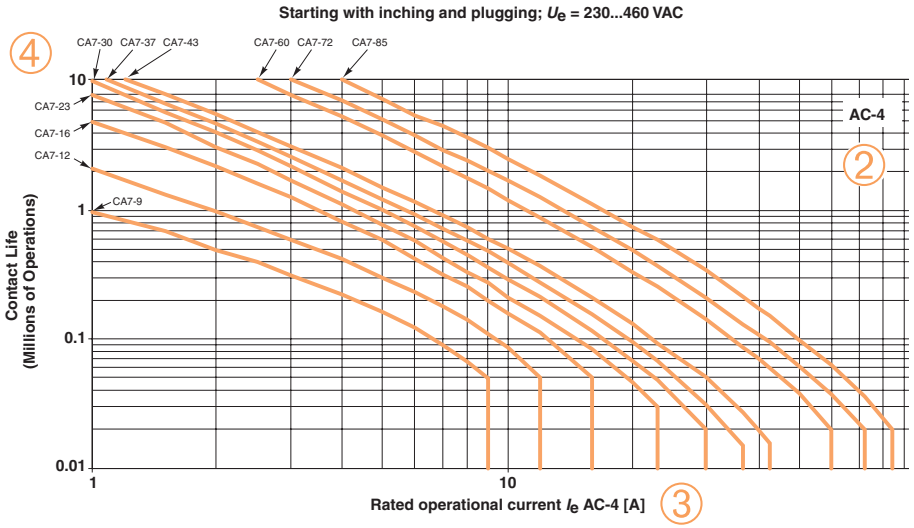
① Identify they appropriate utilization category. For this example, we will determine CA7 contact life for inching and plugging squirrel-cage motors. ❶

Utilization Category	Definition	
AC-1	Resistance Furnaces	Non inductive or slightly inductive loads, Resistive Furnaces
AC-2	Slip-ring motors	Starting and stopping of running motors
AC-3	Squirrel-cage motors	Starting and stopping of running motors
AC-4 ①	Squirrel-cage motors	Starting, plugging, and inching (Plugging is understood as stopping or reversing the motor rapidly by reversing the motor primary connections while the motor is running. Inching [or jogging] is understood as energizing a motor once or repeatedly for short periods to obtain small movements of the driven mechanism.)
AC-15	Electromagnets	Electromagnets for contactors, valves, solenoid actuators

② Choose the graph for the utilization category selected. (a graph pertaining to most Utilization Categories can be found in each contactor section.)

③ Locate the Rated Operational Current (Ie) along the bottom of the chart and follow the graph lines up to the intersection of the appropriate contactor's life-load curve.

④ Read the estimated contact life along the vertical axis. ❷



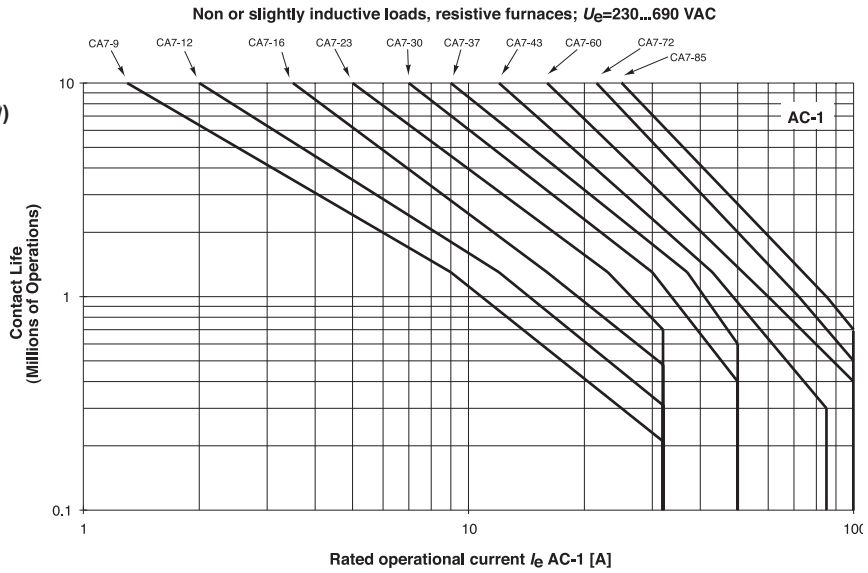
❶ A comprehensive list of Utilization Categories can be found in each contactor section, however, these are the primary categories used in most industrial motor applications.

❷ The life-load curves shown here are based on Sprecher+Schuh tests according to the requirements defined in IEC 60947-4-1. Since contact life in a given application is dependent on environmental conditions and duty cycle, actual application contact life may vary from that indicated by the curves shown here.

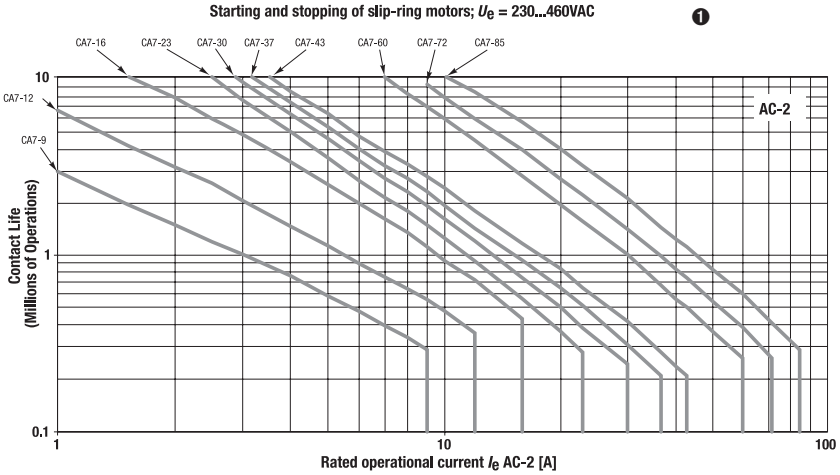
Life-Load Curves

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

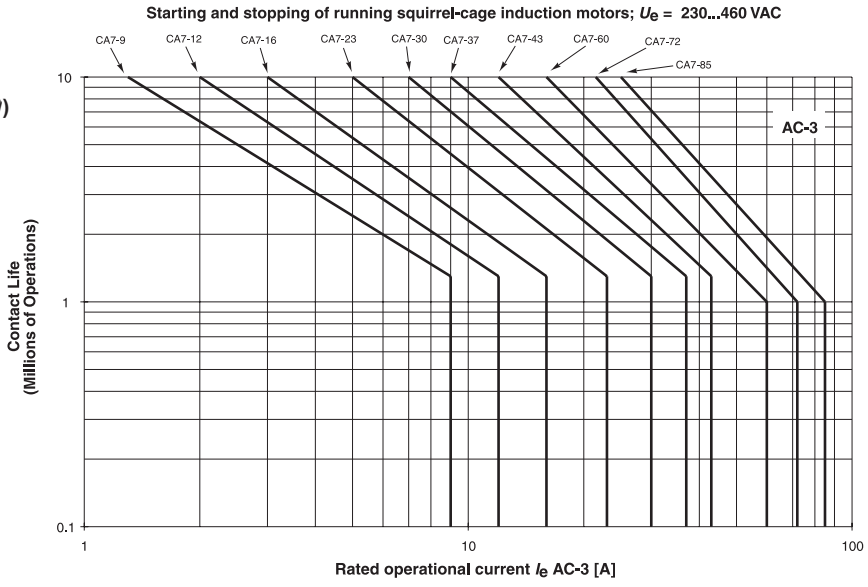
AC-1
(to 690V)



AC-2
(to 460V)



AC-3
(to 460V)



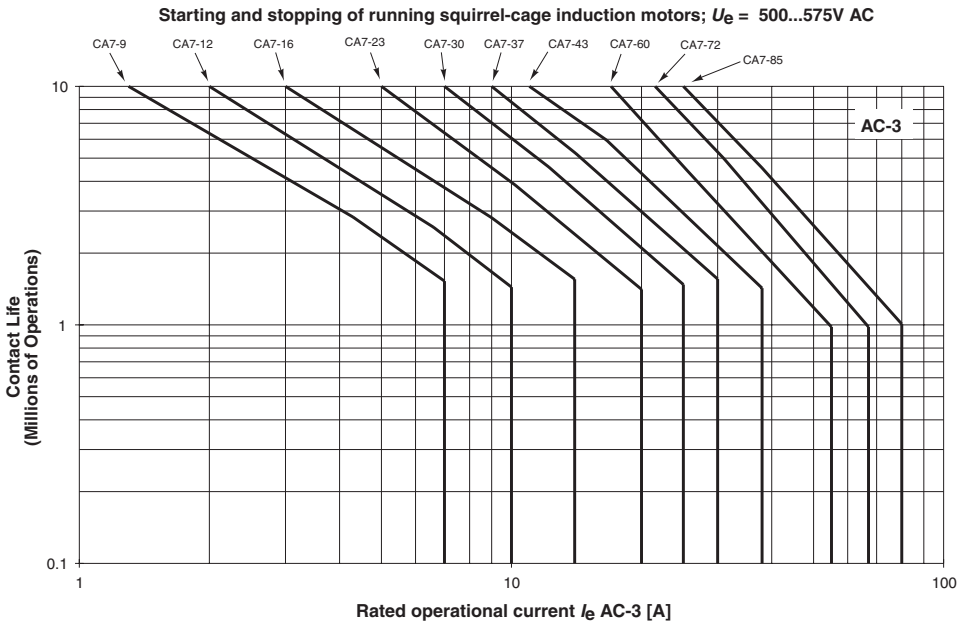
NOTE: The life-load curves shown here are based on Sprecher+Schuh tests according to the requirements defined in IEC 60947-4-1. Since contact life in any given application is dependent on environmental conditions and duty cycle, actual application contact life may vary from that indicated by the curves shown here.

❶ 575V applications use 90% of curve value.

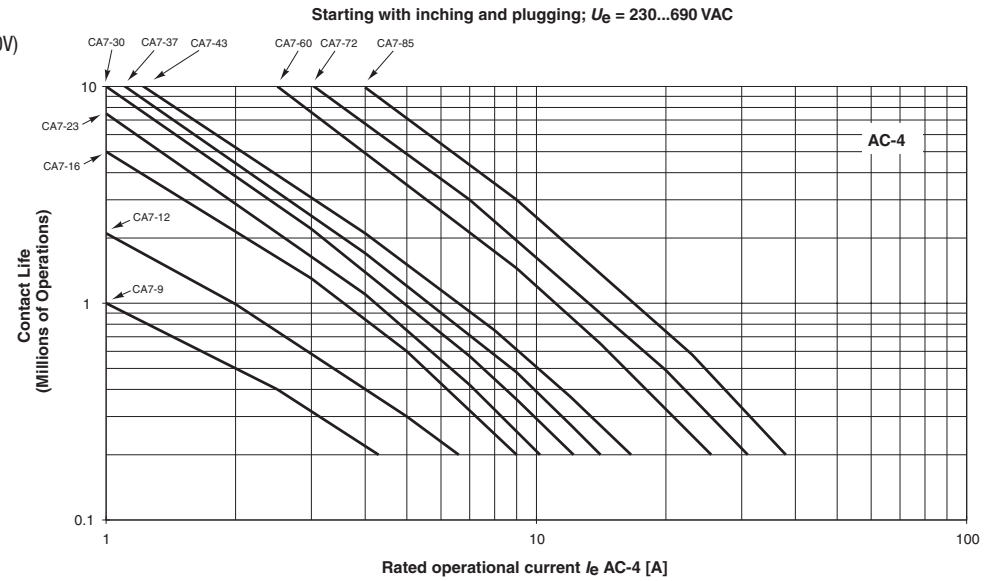
Life-Load Curves

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

AC-3
(to 575)



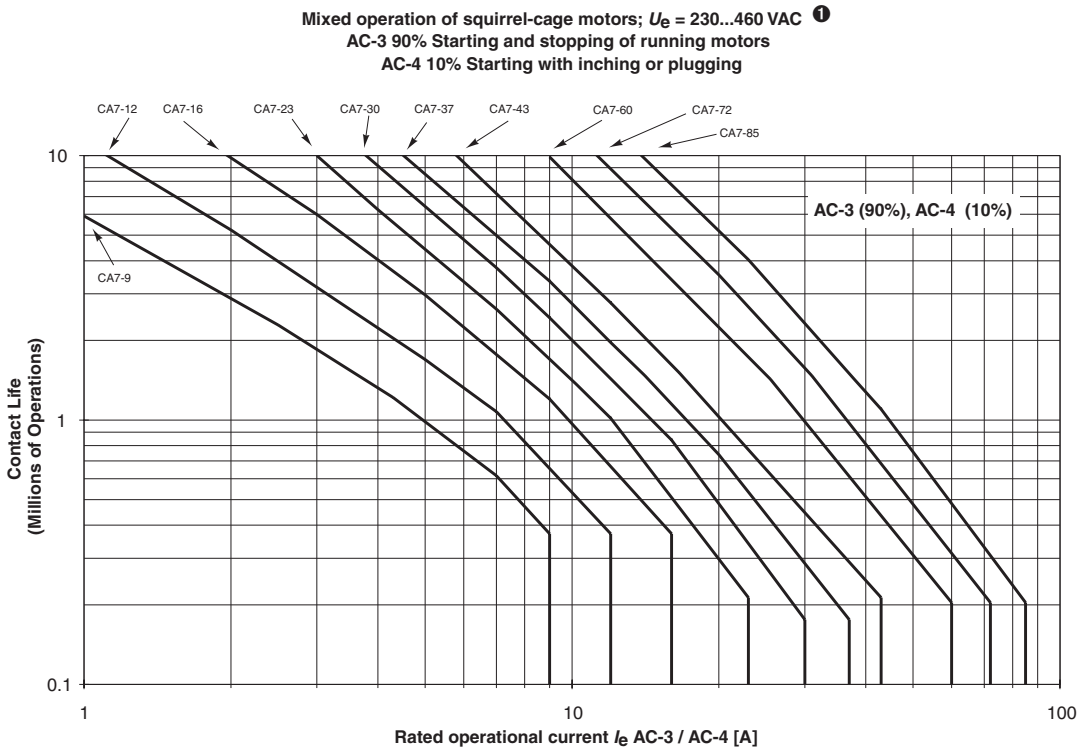
AC-4
(to 690V)



NOTE: The life-load curves shown here are based on Sprecher+Schuh tests according to the requirements defined in IEC 60947-4-1. Since contact life in any given application is dependent on environmental conditions and duty cycle, actual application contact life may vary from that indicated by the curves shown here.

Life-Load Curves

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



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

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

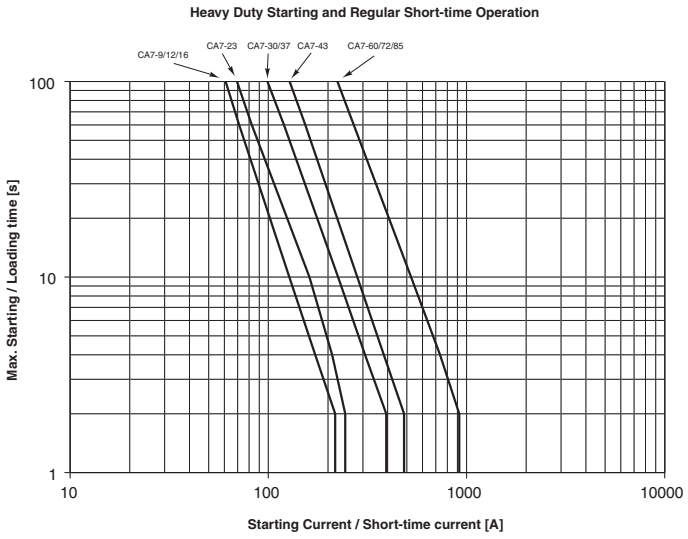
$$L_{mixed} = L_{ac3} / [1+P_{ac4} \times (L_{ac3}/L_{ac4}-1)]$$, where:

L_{mixed} Approximate contact life in operations for a mixed AC-3/AC-4 utilization category application.

L_{ac3} Approximate contact life in operations for a pure AC-3 utilization category (from the AC-3 life-load curve).

L_{ac4} Approximate contact life in operations for a pure AC-4 utilization category (from the AC-4 life-load curve).

P_{ac4} Percentage of AC-4 operations



NOTE: The life-load curves shown here are based on Sprecher+Schuh tests according to the requirements defined in IEC 60947-4-1. Since contact life in any given application is dependent on environmental conditions and duty cycle, actual application contact life may vary from that indicated by the curves shown here.

❶ 575V applications use 85% of curve value.

Operating Rates

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

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

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

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

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

Table B – Standard Operating Rates by Contactor and Utilization Category

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

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

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

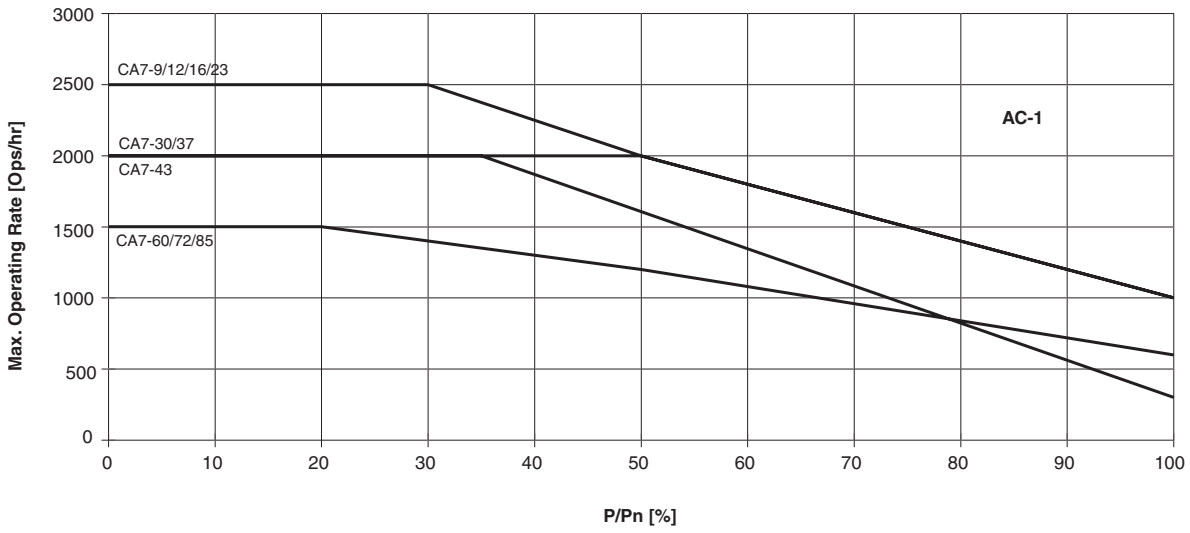
To determine the "on" time and "off" time:

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

Operating Rate Curves

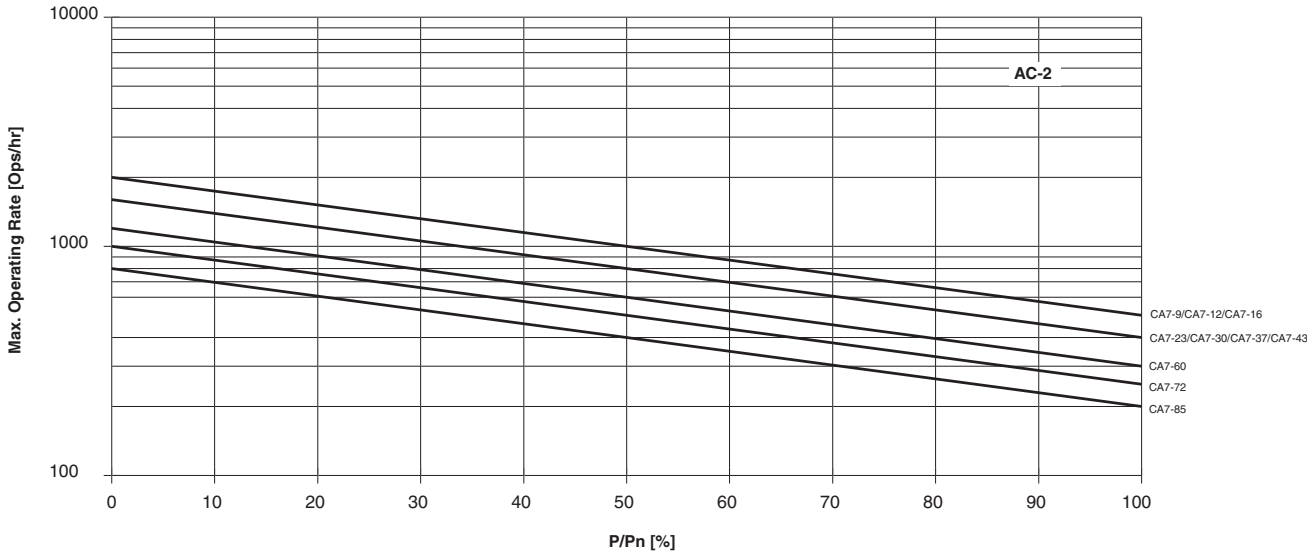
AC-1

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



AC-2

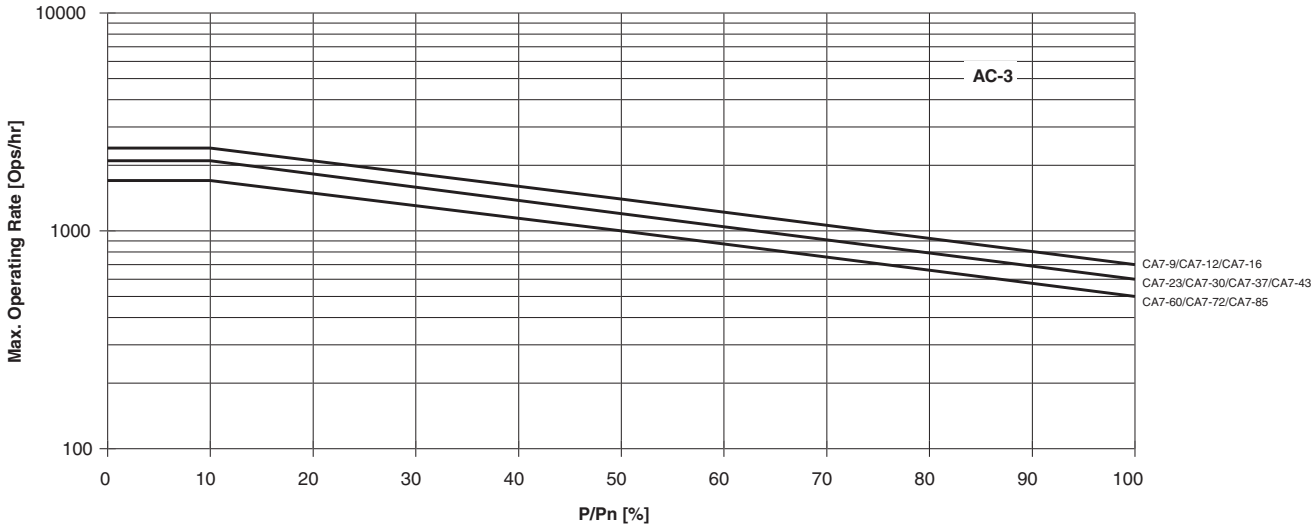
Slip-ring motors: starting, switching off; U_e = 230...460 VAC



Operating Rate Curves

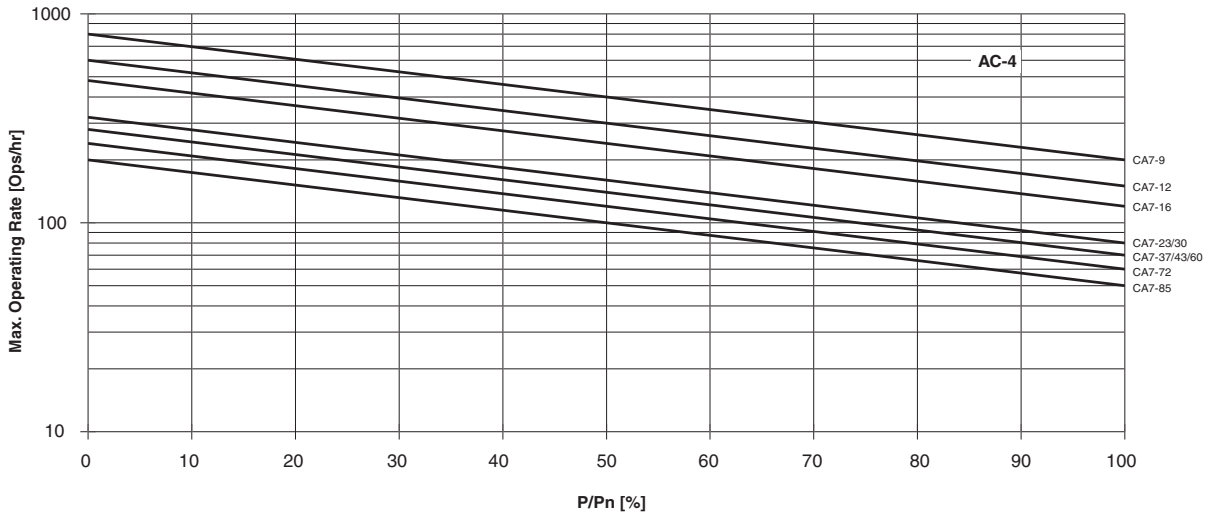
AC-3

Squirrel-cage motors: starting, switching off motors during running; U_e = 230...460 VAC
Relative operating time 40%, Starting time t_A= 0.25s

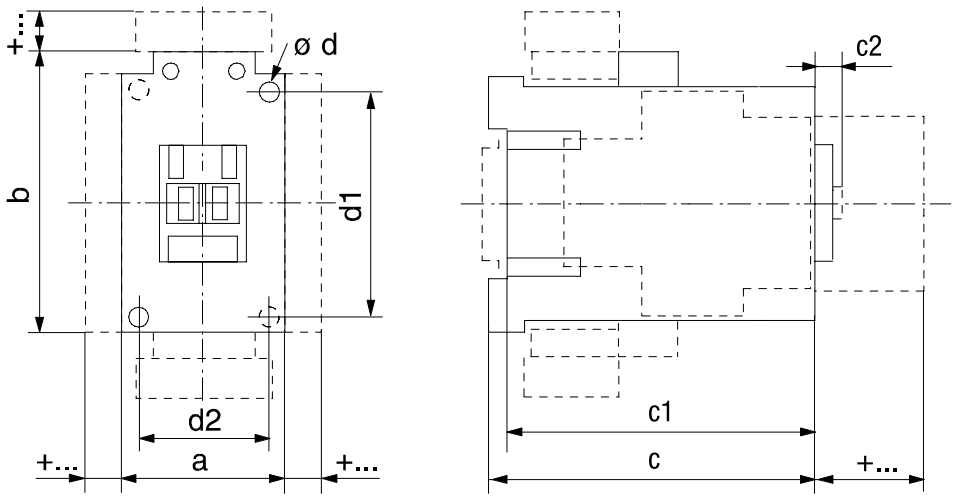


AC-4

Squirrel-cage motors: starting, plugging, inching; U_e = 230 ...460 VAC
Starting Time t_A = 0.25s



Series CA7, CAU7, CAQ7, CNX, CAN7 and CAL7 (Contactors, Reversing Contactors & Special Use Contactors)



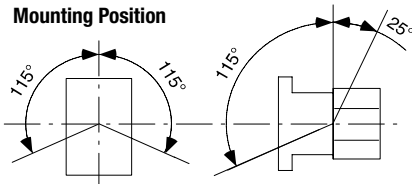
- Dimensions are in millimeters (inches)
- Dimensions not intended for manufacturing purposes

	Catalog Number	a	b	c	c1	c2	ød	d1	d2
AC Contactors	CA7-9...CA7-23; CAQ7-16; CAN7-12, CNX-205...208; CAN7-12, CA(V)L7-20	45 (1-25/32)	80 (3-3/16)	80.5 (3-11/64)	75.5 (3-3/32)	6 (1/4)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-25/64)
	CA7-30...CA7-37; CNX-209; CAN7-30... CAN7-37	45 (1-25/32)	81 (3-3/16)	97.5 (4)	92.6 (3-49/64)	6.5 (17/64)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-25/64)
	CA7-40	59 (2-21/64)	81 (3-3/16)	100.5 (4-7/64)	95.5 (3-49/64)	6.5 (17/64)	2-4.5 (2-3/16)	60 (2-23/64)	45 (1-25/32)
	CA7-43, CNX-212	54 (2-1/8)	81 (3-3/16)	100.5 (4-7/64)	95.5 (3-49/64)	6.5 (17/64)	2-4.5 (2-3/16)	60 (2-23/64)	45 (1-25/32)
	CA7-60...CA7-85 CNX-218	72 (2-53/64)	122 (4-51/64)	117 (4-49/64)	111.5 (4-35/64)	8.5 (21/64)	4-5.4 (4-7/32)	100 (3-15/16)	55 (2-11/64)
	CA7-90	95 (3-3/4)	81 (3-3/16)	117 (4-49/64)	111.5 (4-35/64)	8.5 (21/64)	4-5.4 (4-7/32)	100 (3-15/16)	55 (2-11/64)
True DC Contactors	CA7-9C...CA7-16C, CAQ7-16C CNX-205C...206C; CAN7-12C	45 (1-25/32)	81 (3-3/16)	106.5 (4-3/16)	101.5 (4)	6 (1/4)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-25/64)
	CA7-23C CNX-207C...208C	45 (1-25/32)	81 (3-3/16)	123.5 (4-55/64)	119 (4-43/64)	6 (1/4)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-25/64)
	CA7-30C...CA7-37C; CAQ7-37C; CNX-209C; CAN7-30C...CAN7-37C	45 (1-25/32)	81 (3-3/16)	141.5 (5-37/64)	136.5 (5-3/8)	6.5 (17/64)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-25/64)
	CA7-40C	59 (2-21/64)	81 (3-3/16)	144.5 (5-11/16)	139.5 (5-1/2)	6.5 (17/64)	2-4.5 (2-3/16)	60 (2-23/64)	45 (1-25/32)
	CA7-43C, CNX-212C	54 (2-1/8)	81 (3-3/16)	144.5 (5-11/16)	140 (5-33/64)	6.5 (17/64)	2-4.5 (2-3/16)	60 (2-23/64)	45 (1-25/32)

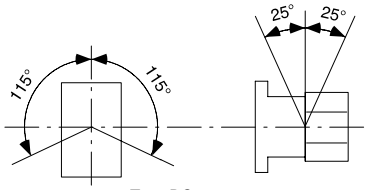
Reversing Contactors, Capacitor Contactors & Accessories (+...)

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

Mounting Position



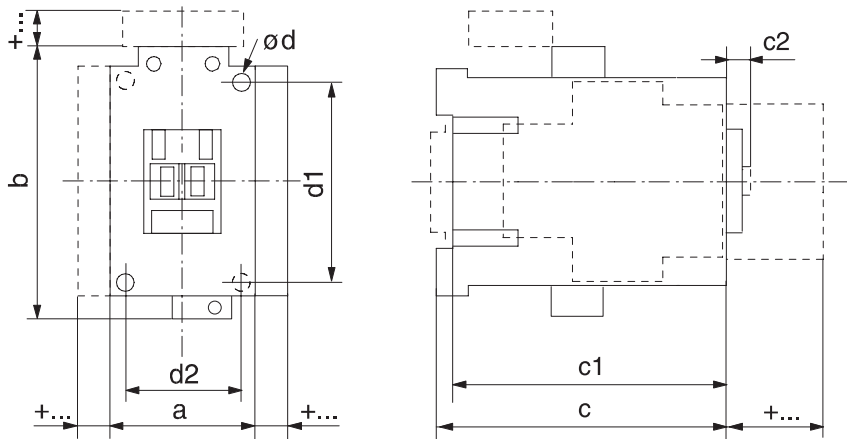
AC contactors



True DC contactors

Series CA7 with Two Winding DC Coil

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

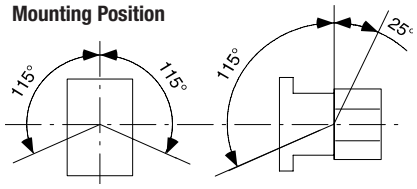


	Catalog Number	a	b	c	c1	c2	ød	d1	d2
AC Contactors	CA7-9Y...CA7-23Y	54 (2-9/64)	90 (3-35/64)	80.5 (3-11/64)	75.5 (3-3/32)	6 (1/4)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-25/64)
	CA7-30Y, CA7-37Y	54 (2-9/64)	90 (3-35/64)	97.5 (4)	92.6 (3-49/64)	6.5 (17/64)	2-4.5 (2-3/16)	60 (2-23/64)	35 (1-25/64)
	CA7-43Y	63 (2-31/64)	90 (3-35/64)	100.5 (4-7/64)	95.6 (3-7/8)	6.5 (17/64)	2-4.5 (2-3/16)	60 (2-23/64)	45 (1-25/32)
	CA7-60D...CA7-85D CAN7-72D, CNX-218D	81 (3-3/16)	131 (5-5/32)	117 (4-49/64)	111.5 (4-35/64)	8.5 (21/64)	4-5.4 (4-7/32)	100 (3-15/16)	55 (2-11/64)
	CA7-90D	95 (3-3/4)	122 (4-51/64)	117 (4-49/64)	111.5 (4-35/64)	8.5 (21/64)	4-5.4 (4-7/32)	100 (3-15/16)	55 (2-11/64)

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

	Contactors with...	Dim. [mm]	Dim. [inches]
auxiliary contact block-front mounting	2-, or 4-pole	c/c1 + 39	c/c1 +1-37/64
auxiliary contact block- left side mounting	1-, or 2 pole	a + 9	a + 23/64
pneumatic timing module		c/c1 + 58	c/c1 + 2-23/64
electronic timing module	on coil terminal side	b + 24	b + 15/16
mechanical latch		c/c1 + 61	c/c1 +61
interface module	on coil terminal side	b + 9	c/c1 + 2-31/64
Labeling with...	label sheet marking tag sheet with clear cover marking tag adapter for V7 Terminals	+0 +0 +5.5	+0 +0 +7/32

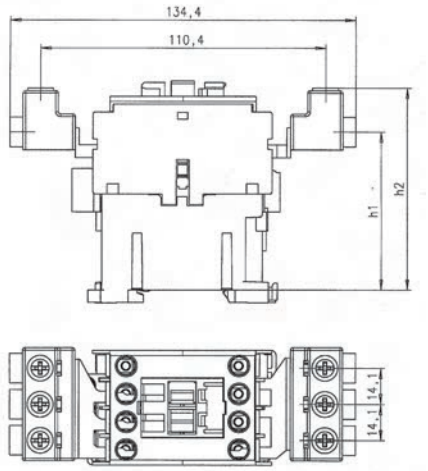
Mounting Position



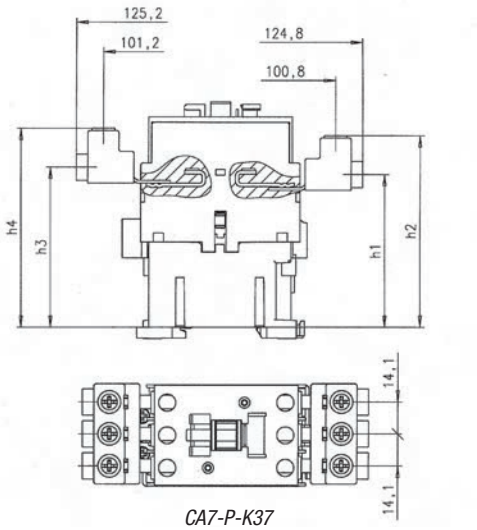
Two Winding DC contactors

CA7 Contactors with Terminal Lugs

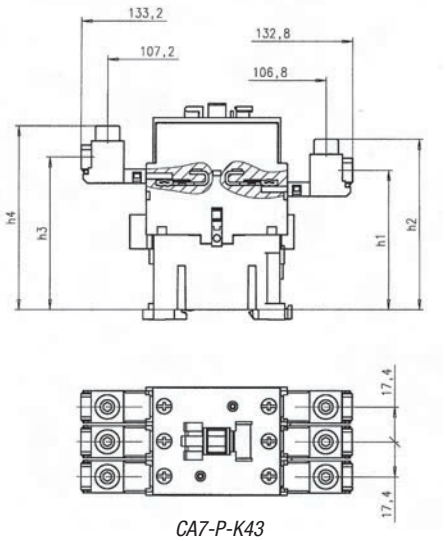
- Dimensions are in millimeters (inches)
- Dimensions not intended for manufacturing purposes



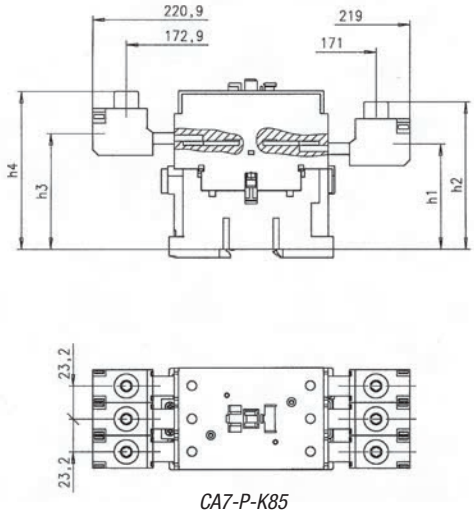
CA7-P-KN23 / KL23



CA7-P-K37



CA7-P-K43

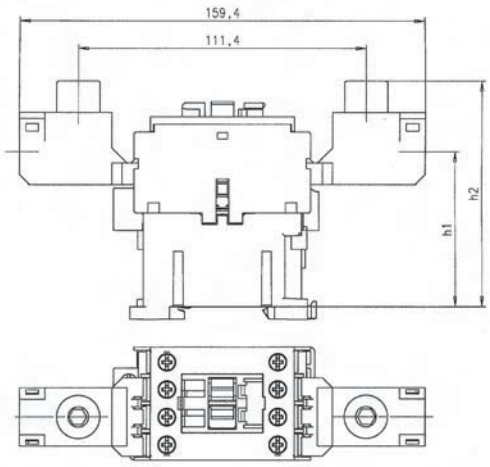


CA7-P-K85

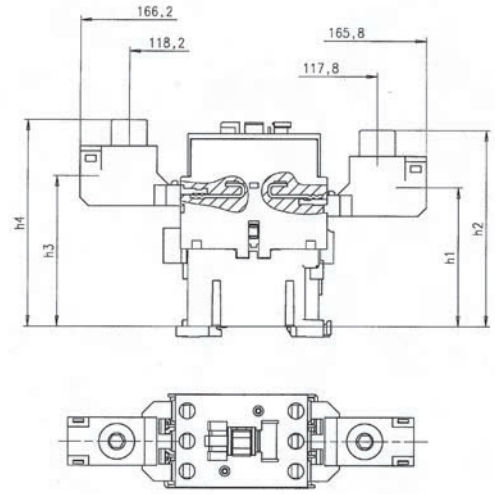
Catalog Number	With Contactor	AC Operated Contactor				DC Operated Contactor			
		h1	h2	h3	h4	h1	h2	h3	h4
CA7-P-KN23 / KL23	CA7-9...16	61.6 (2-27/64)	78.6 (3-3/32)	~	~	87.2 (3-7/16)	104.2 (4-3/32)	~	~
	CA7-23	61.6 (2-27/64)	78.6 (3-3/32)	~	~	105.2 (4-9/64)	122.2 (4-13/16)	~	~
CA7-P-K37	CA7-30 & 37	67.6 (2-21/32)	84.6 (3-21/64)	71.5 (2-13/16)	88.5 (3-31/64)	111.2 (4-3/8)	128.2 (5-3/64)	115.1 (4-17/32)	132.1 (5-13/64)
CA7-P-K43	CA7-43	69.0 (2-23/32)	85.0 (3-11/32)	74.5 (2-15/16)	90.5 (3-9/16)	112.6 (4-7/16)	128.6 (5-1/16)	118.1 (4-21/32)	134.1 (5-9/32)
CA7-P-K85	CA7-60...85	79.7 (3-1/8)	104.7 (4-1/8)	86.7 (3-13/64)	111.7 (4-3/8)	79.7 (3-1/8)	104.7 (4-1/8)	86.7 (3-13/64)	111.7 (4-3/8)

CA7 Contactors with Paralleling Links

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



CA7-P-B23



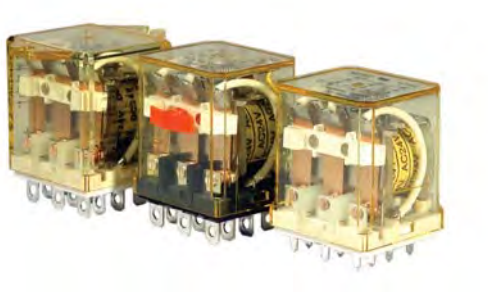
CA7-P-B37

Catalog Number	With Contactor	AC Operated Contactor				DC Operated Contactor			
		h1	h2	h3	h4	h1	h2	h3	h4
CA7-P-B23	CA7-9...16	65.1 (2-9/16)	90.1 (3-9/16)	~	~	90.7 (1/4)	104.2 (2-3/16)	~	~
	CA7-23	65.1 (2-9/16)	90.1 (3-9/16)	~	~	108.7 (4-9/32)	133.7 (5-17/64)	~	~
CA7-P-K37	CA7-30 & 37	69.0 (2-23/32)	94.0 (3-45/64)	74.5 (2-15/16)	99.5 (3-29/32)	112.6 (4-7/16)	137.6 (5-13/32)	118.1 (4-21/32)	143.1 (5-5/8)

RH Series Compact Power Relays

SPDT through 4PDT, 10A contacts
Compact power type relays

The RH series are miniature power relays with a large capacity. The RH relays feature 10A contact capacity as large as the RR series but in a miniature package. The compact size saves space.



Part Number Selection

Contact	Model	Part Number: Blade Terminal	Part Number: PCB Terminal	Coil Voltage Code (Standard Stock in bold)
SPDT 	Basic	RH1B-U	RH1V2-U	AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator	RH1B-UL	—	
	With Check Button	RH1B-UC	—	
	With Indicator and Check Button	RH1B-ULC	—	
	Top Bracket Mounting	RH1B-UT	—	
	With Diode (DC coil only)	RH1B-UD	RH1V2-UD	DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator and Diode (DC coil only)	RH1B-ULD	—	**DC12V**, **DC24V**, DC48V, DC110V
DPDT 	Basic	RH2B-U	RH2V2-U	AC6V, AC12V, **AC24V**, **AC110-120V**, **AC220-240V** DC6V, **DC12V**, **DC24V**, DC48V, DC100-110V
	With Indicator	RH2B-UL	RH2V2-UL	
	With Check Button	RH2B-UC	—	
	With Indicator and Check Button	RH2B-ULC	—	
	Top Bracket Mounting	RH2B-UT	—	
	With Diode (DC coil only)	RH2B-UD	RH2V2-UD	DC6V, **DC12V**, **DC24V**, DC48V, DC100-110V
	With Indicator and Diode (DC coil only)	RH2B-ULD	—	
3PDT 	Basic	RH3B-U	RH3V2-U	AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator	RH3B-UL	RH3V2-UL	
	With Check Button	RH3B-UC	—	
	With Indicator and Check Button	RH3B-ULC	—	
	Top Bracket Mounting	RH3B-UT	—	
	With Diode (DC coil only)	RH3B-D*	RH3V2-D*	DC6V, DC12V, DC24V, DC48V, DC110V
	With Indicator and Diode (DC coil only)	RH3B-LD*	—	
4PDT 	Basic	RH4B-U	RH4V2-U	AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator	RH4B-UL	RH4V2-UL	
	With Check Button	RH4B-UC	—	
	With Indicator and Check Button	RH4B-ULC	—	
	Top Bracket Mounting	RH4B-UT	—	
	With Diode (DC coil only)	RH4B-UD	RH4V2-UD	DC6V, DC12V, DC24V, DC48V, DC110V
	With Indicator and Diode (DC coil only)	RH4B-LD*	—	

1. *Carries no UL recognition mark.
2. PCB terminal relays are designed to mount directly to a circuit board without any socket.

Ordering Information
When ordering, specify the Part No. and coil voltage code:
(example) **RH3B-U** (Part No.) **AC120V** (Coil Voltage Code)

Sockets (for Blade Terminal Models)

Relays	Standard DIN Rail Mount [1]	Finger-safe DIN Rail Mount [1]	Through Panel Mount	PCB Mount
RH1B	SH1B-05	SH1B-05C	SH1B-51	SH1B-62
RH2B	SH2B-05	SH2B-05C	SH2B-51	SH2B-62
RH3B	SH3B-05	SH3B-05C	SH3B-51	SH3B-62
RH4B	SH4B-05	SH4B-05C	SH4B-51	SH4B-62
				

1. DIN Rail mount socket comes with two horseshoe clips. Do not use unless you plan to insert pullover wire spring. Replacement horseshoe clip part number is Y778-011.

Hold Down Springs & Clips

Appearance	Description	Relay	For DIN Mount Socket	For Through Panel & PCB Mount Socket	Min Order Qty
	Pullover Wire Spring	RH1B	SY2S-02F1 [2]	SY4S-51F1	10
		RH2B	SY4S-02F1 [2]		
		RH3B	SH3B-05F1 [2]		
		RH4B	SH4B-02F1 [2]		
	Leaf Spring (side latch)	RH1B, RH2B, RH3B, RH4B	SFA-202 [3]	SFA-302 [3]	20
	Leaf Spring (top latch)	RH1B, RH2B, RH3B, RH4B	SFA-101 [3]	SFA-301 [3]	

2. Must use horseshoe clip when mounting in DIN mount socket. Replacement horseshoe clip part number is Y778-011.
3. Two required per relay.

AC Coil Ratings

Voltage (V)	Rated Current (mA) ±15% at 20°C								Coil Resistance (Ω) ±10% at 20°C				Operation Characteristics (against rated values at 20°C)		
	AC 50Hz				AC 60Hz										
	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	Max. Continuous Applied Voltage	Pickup Voltage	Dropout Voltage
6	170	240	330	387	150	200	280	330	330	9.4	6.4	5.4	110%	80% maximum	30% minimum
12	86	121	165	196	75	100	140	165	165	39.3	25.3	21.2			
24	42	60.5	81	98	37	50	70	83	83	153	103	84.5			
110	9.6	—	18.1	21.6	8.4	—	15.5	18.2	18.2	—	2,200	1,800			
110-120	—	9.4-10.8	—	—	—	8.0-9.2	—	—	—	—	—	—			
120	8.6	—	16.4	19.5	7.5	—	14.2	16.5	16.5	—	10,800	7,360			
220	4.7	—	8.8	10.7	4.1	—	7.7	9.1	9.1	—	10,800	7,360			
220-240	—	4.7-5.4	—	—	—	4.0-4.6	—		—	18,820	—	—			
240	4.9	—	8.2	9.8	4.3	—	7.1	8.3	8.3	—	12,100	9,120			

DC Coil Ratings

Voltage (V)	Rated Current (mA) ±15% at 20°C				Coil Resistance (Ω) ±10% at 20°C				Operation Characteristics (against rated values at 20°C)		
	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	Max. Continuous Applied Voltage	Pickup Voltage	Dropout Voltage
6	128	150	240	250	47	40	25	24	110%	80% maximum	10% minimum
12	64	75	120	125	188	160	100	96			
24	32	36.9	60	62	750	650	400	388			
48	18	18.5	30	31	2,660	2,600	1,600	1,550			
100-110	—	8.2-9.0	—	—	—	12,250	—	—			
110	8	—	12.8	15	13,800	—	8,600	7,340			

Standard coil voltages are in **BOLD**.

Contact Ratings

Maximum Contact Capacity						
Model	Continuous Current	Allowable Contact Power		Rated Load		
		Resistive Load	Inductive Load	Voltage (V)	Res. Load	Ind. Load
SPDT	10A	1540VA 300W	990VA 210W	110 AC	10A	7A
				220 AC	7A	4.5A
				30 DC	10A	7A
DPDT 3PDT 4PDT	10A	1650VA 300W	1100VA 225W	110 AC	10A	7.5A
				220 AC	7.5A	5A
				30 DC	10A	7.5A

Note: Inductive load for the rated load — cos ø = 0.3, L/R = 7 ms

TÜV Ratings

Voltage	RH1	RH2	RH3	RH4
240V AC	10A	10A	7.5A	7.5A
30V DC	10A	10A	10A	10A

AC: cos ø = 1.0, DC: L/R = 0 ms

UL Ratings

Voltage	Resistive			General Use			Horse Power Rating		
	RH1 RH2	RH3	RH4	RH1 RH2	RH3	RH4	RH1 RH2	RH3	RH4
240V AC	10A	7.5A	7.5A	7A	6.5A	5A	1/3 HP	1/3 HP	—
120V AC	—	10A	10A	—	7.5A	7.5A	1/6 HP	1/6 HP	—
30V DC	10A	10A	—	7A	—	—	—	—	—
28V DC	—	—	10A	—	—	—	—	—	—

CSA Ratings

Voltage	Resistive				General Use				Horse Power Rating
	RH1	RH2	RH3	RH4	RH1	RH2	RH3	RH4	RH1, 2, 3
240V AC	10A	10A	—	7.5A	7A	7A	7A	5A	1/3 HP
120V AC	10A	10A	10A	10A	7.5A	7.5A	—	7.5A	1/6 HP
30V DC	10A	10A	10A	10A	7A	7.5A	—	—	—

Socket Specifications

	Sockets	Terminal	Electrical Rating	Wire Size	Torque
DIN Rail Mount Sockets	SH1B-05	(Coil) M3 screws (contact) M3.5 screws with captive wire clamp	250V, 10A	Maximum up to 2–#12AWG	5.5 - 9 in•lbs 9 - 11.5 in•lbs
	SH2B-05 SH3B-05 SH4B-05	M3.5 screws with captive wire clamp	300V, 10A	Maximum up to 2–#12AWG	9 - 11.5 in•lbs
Finger-safe DIN Rail Mount	SH1B-05C	(coil) M3 screws (contact) M3.5 screws with captive wire clamp, fingersafe	250V, 10A	Maximum up to 2–#12AWG	5.5 - 9 in•lbs 9 - 11.5 in•lbs
	SH2B-05C SH3B-05C SH4B-05C	M3.5 screws with captive wire clamp, fingersafe	300V, 10A	Maximum up to 2–#12AWG	9 - 11.5 in•lbs
Through Panel Mount Socket	SH1B-51 SH2B-51 SH3B-51 SH4B-51	Solder	300V, 10A	—	—
PCB Mount Socket	SH1B-62	PCB mount	250V, 10A	—	—
	SH2B-62 SH3B-62 SH4B-62	PCB mount	300V, 10A	—	—

Accessories

Description	Appearance	Use with	Part No.	Remarks
Aluminum DIN Rail (1 meter length)		All DIN rail sockets	BNDN1000	IDEC offers a low-profile DIN rail (BNDN1000). The BNDN1000 is designed to accommodate DIN mount sockets. Made of durable extruded aluminum, the BNDN1000 measures 0.413 (10.5mm) in height and 1.37 (35mm) in width (DIN standard). Standard length is 39" (1,000mm).
DIN Rail End Stop		DIN rail	BNL5	9.1 mm wide.
Replacement Hold-Down Spring Anchor		DIN mount sockets and hold down springs.	Y778-011	For use on DIN rail mount socket when using pullover wire hold down spring. 2 pieces included with each socket.

Specifications

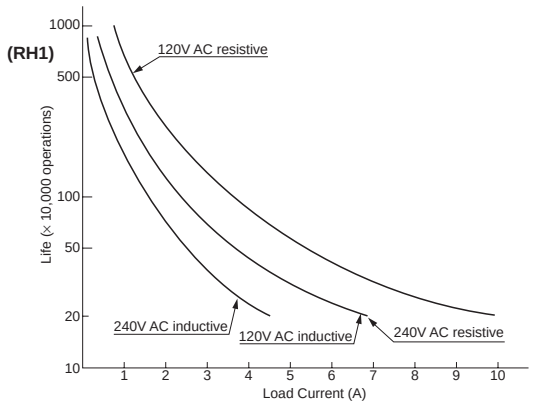
Contact Material		Silver cadmium oxide
Contact Resistance [1]		50mΩ maximum
Minimum Applicable Load		24V DC, 30 mA; 5V DC, 100 mA (reference value)
Operate Time [2]	SPDT DPDT	20ms maximum
	3PDT 4PDT	25ms maximum
Release Time [2]	SPDT DPDT	20ms maximum
	3PDT 4PDT	25ms maximum
Power Consumption (approx.)	SPDT	AC: 1.1VA (50Hz), 1VA (60Hz) DC: 0.8W
	DPDT	AC: 1.4VA (50Hz), 1.2VA (60Hz) DC: 0.9W
	3PDT	AC: 2VA (50Hz), 1.7VA (60Hz) DC: 1.5W
	4PDT	AC: 2.5VA (50Hz), 2VA (60Hz) DC: 1.5W
Insulation Resistance		100MΩ minimum (500V DC megger)
Dielectric Strength [3]	SPDT	Between live and dead parts: 2,000V AC, 1 minute Between contact and coil: 2,000V AC, 1 minute Between contacts of the same pole: 1,000V AC, 1 minute
	DPDT 3PDT 4PDT	Between live and dead parts: 2,000V AC, 1 minute Between contact and coil: 2,000V AC, 1 minute Between contacts of different poles: 2,000V AC, 1 minute Between contacts of the same pole: 1,000V AC, 1 minute
Operating Frequency		Electrical: 1,800 operations/hour maximum Mechanical: 18,000 operations/hour maximum
Vibration Resistance		Damage limits: 10 to 55Hz, amplitude 0.5 mm Operating extremes: 10 to 55Hz, amplitude 0.5 mm
Shock Resistance		Damage limits: 1,000m/s² (100G) Operating extremes: 200m/s² (20G - SPDT, DPDT) 100m/s² (10G - 3PDT, 4PDT)
Mechanical Life		50,000,000 operations minimum
Electrical Life	DPDT	500,000 operations minimum (120V AC, 10A)
	SPDT 3PDT 4PDT	200,000 operations minimum (120V AC, 10A)
Operating Temperature [4]	SPDT	–25 to +50°C (no freezing)
	DPDT 3PDT 4PDT	–25 to +40°C (no freezing)
Operating Humidity		45 to 85% RH (no condensation)
Weight (approx.)		SPDT: 24g, DPDT: 37g, 3PDT: 50g, 4PDT: 74g

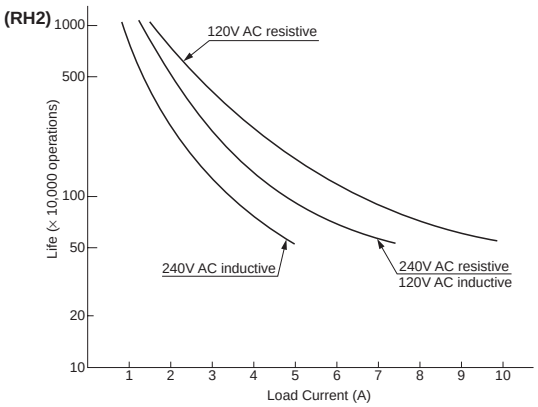
Note: Above values are initial values.
1. Measured using 5V DC, 1A voltage drop method
2. Measured at the rated voltage (at 20°C), excluding contact bouncing
   Release time of relays with diode: 40 ms maximum
3. Relays with indicator or diode: 1000V AC, 1 minute
4. For use under different temperature conditions, refer to Continuous Load Current vs. Operating Temperature Curve. The operating temperature range of relays with indicator or diode is –25 to +40°C.

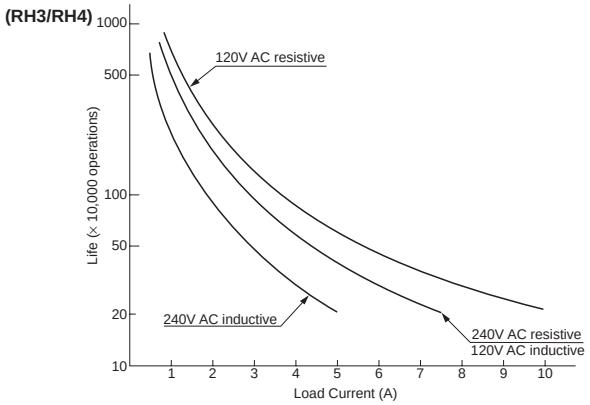
Characteristics (Reference Data)

Electrical Life Curves

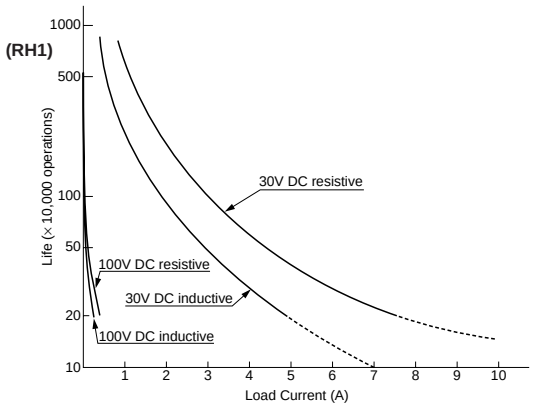
AC Load

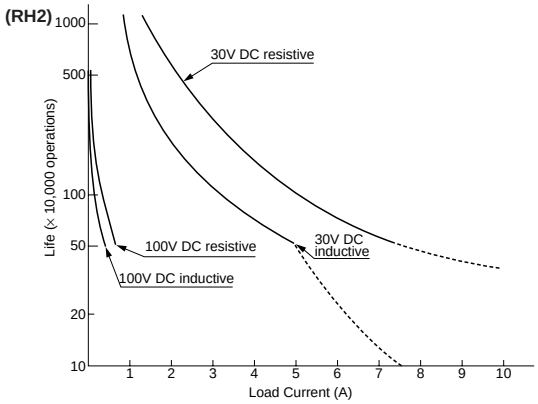


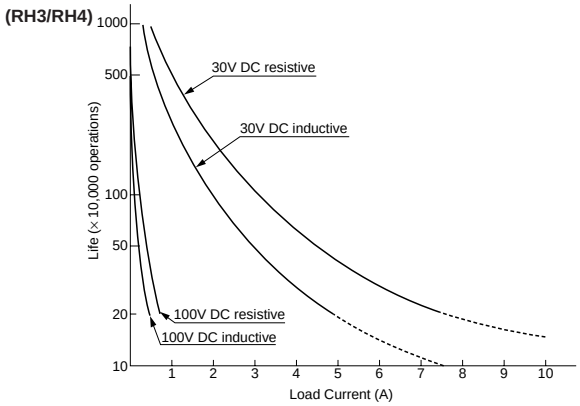




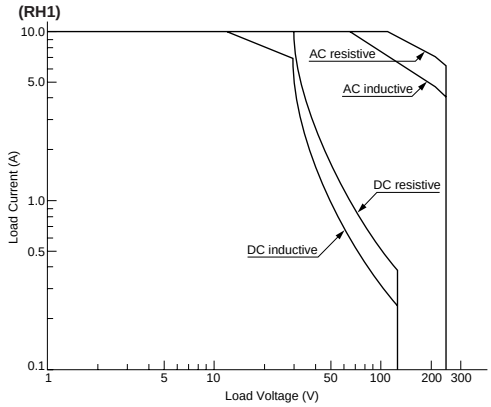
DC Load

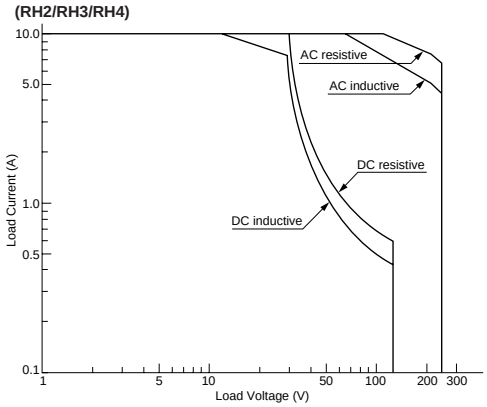






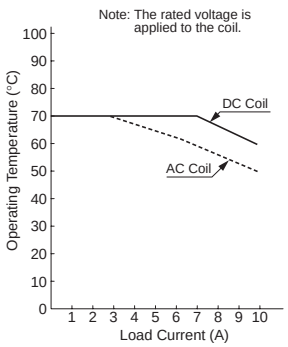
Maximum Switching Capacity



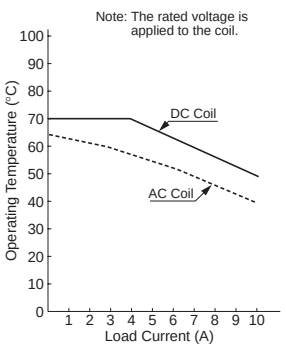


Continuous Load Current vs. Operating Temperature Curve (Basic Type, With Check Button, and Top Bracket Mounting Type)

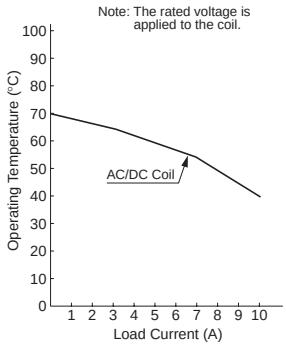
(RH1)



(RH2)

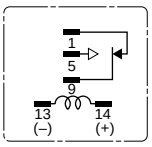
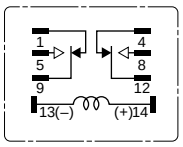
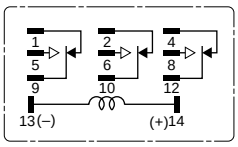
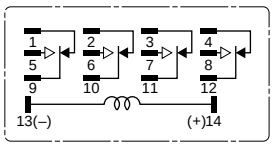
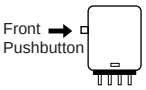


(RH3/RH4)

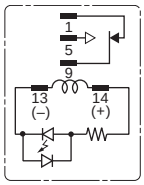
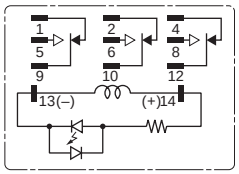
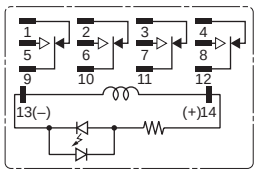
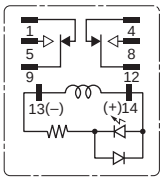
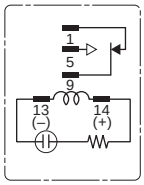
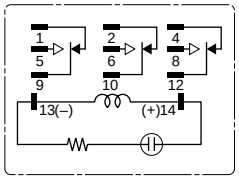
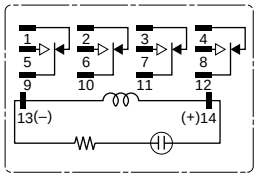
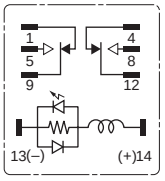


Internal Connection (View from Bottom)

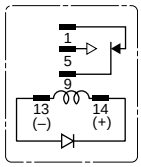
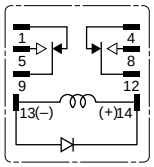
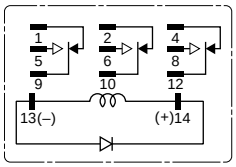
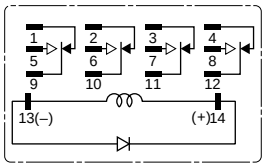
Basic Type

SPDT	DPDT	3PDT	4PDT	With Check Button
				 Contacts can be operated by pressing the check button.

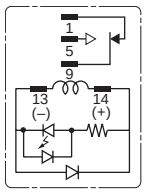
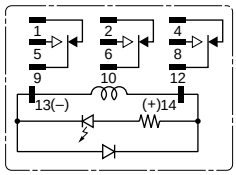
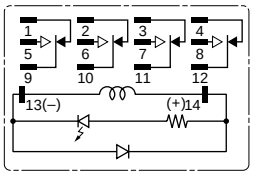
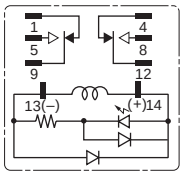
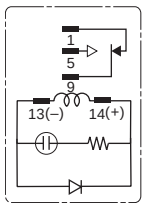
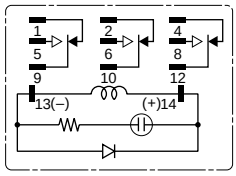
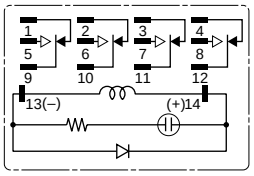
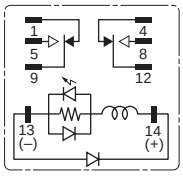
With Indicator (-L type)

	SPDT	3PDT	4PDT		DPDT	
Below 100V AC/DC				Below 24V AC/DC		When the relay is energized, the indicator goes on. • Relay coils less than 100V DC do not contain a protection diode (except DPDT). • Relay coils below 100V use LED indicator, coils above 100V use neon lamp indicator.
100V AC/DC and over				24V AC/DC and over		

With Diode (-D type)

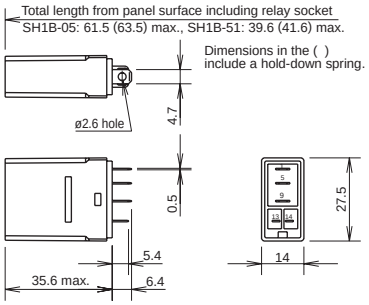
SPDT	DPDT	3PDT	4PDT	
				Contains a diode to absorb the back emf generated when the coil is de-energized. The release time is slightly longer. Available for DC coil only. • Diode Characteristics Reverse withstand voltage: 1,000V Forward current: 1A

With Indicator LED & Diode (-LD type)

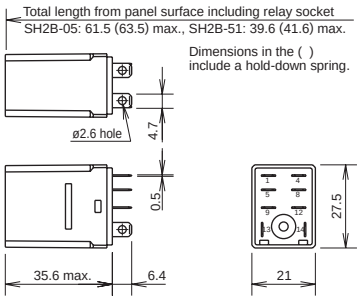
	SPDT	3PDT	4PDT		DPDT	
Below 100V DC				Below 24V AC/DC		Contains an LED indicator and a surge absorber, and has the same height as the basic type.
100V DC and over				24V AC/DC and over		

Dimensions (mm)

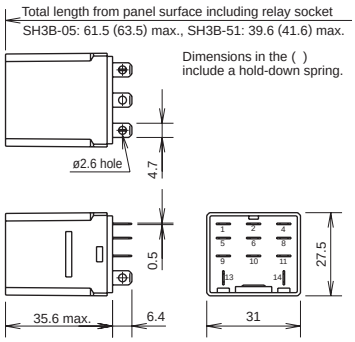
RH1B-U/RH1B-UL/RH1B-UD/RH1B-ULD



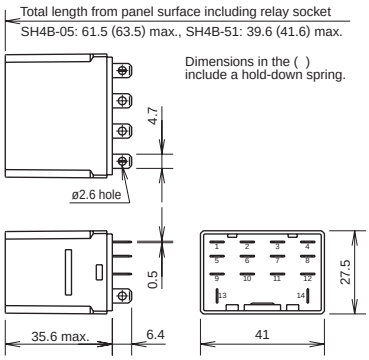
RH2B-U/RH2B-UL/RH2B-UD/RH2B-ULD



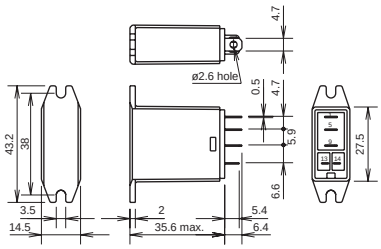
RH3B-U/RH3B-UL/RH3B-D/RH3B-LD



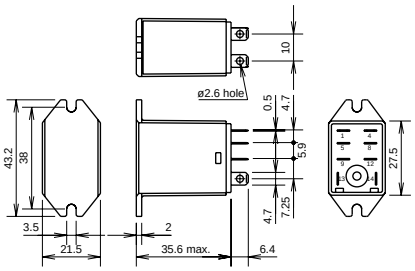
RH4B-U/RH4B-UL/RH4B-UD/RH4B-LD



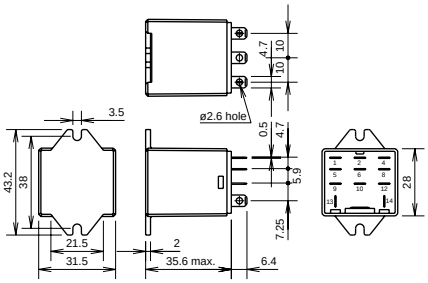
RH1B-UT



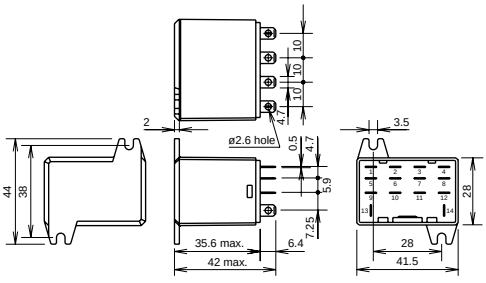
RH2B-UT



RH3B-UT

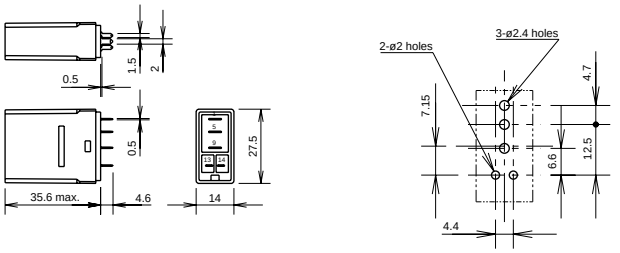


RH4B-UT

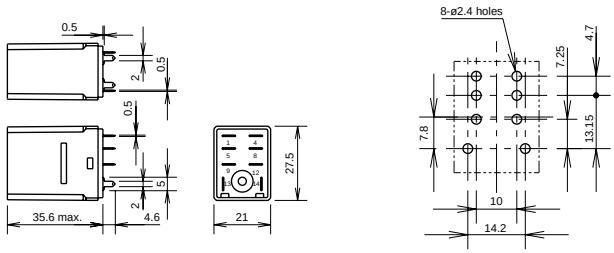


Dimensions con't (mm)

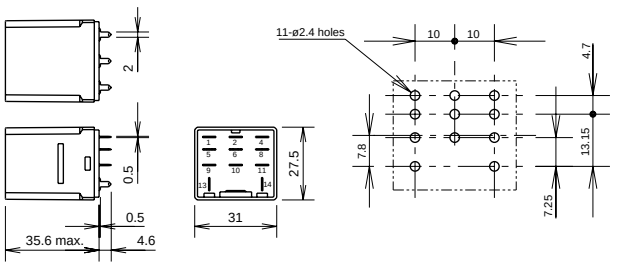
RH1V2-U/RH1V2-UD



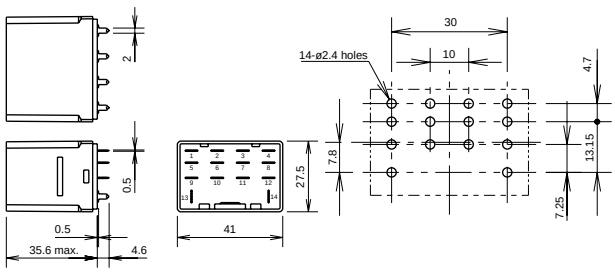
RH2V2-U/RH2V2-UL/RH2V2-UD



RH3V2-U/RH3V2-UL/RH3V2-D

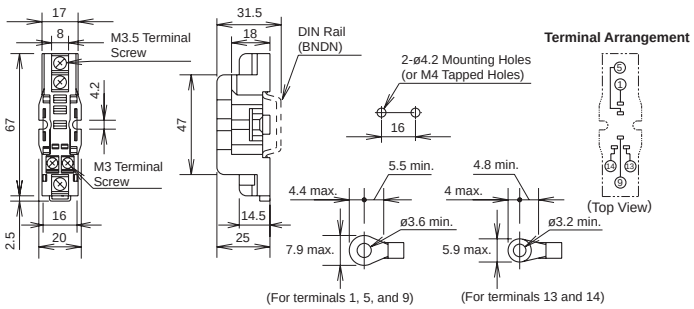


RH4V2-U/RH4V2-UL/RH4V2-UD

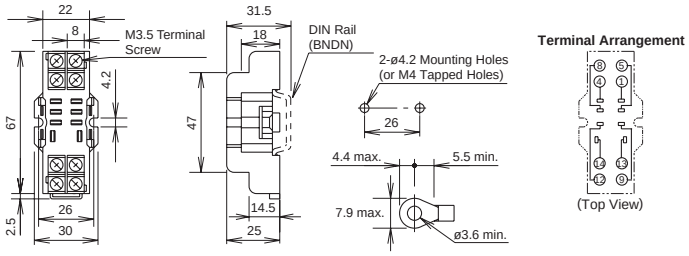


Standard DIN Rail Mount Sockets

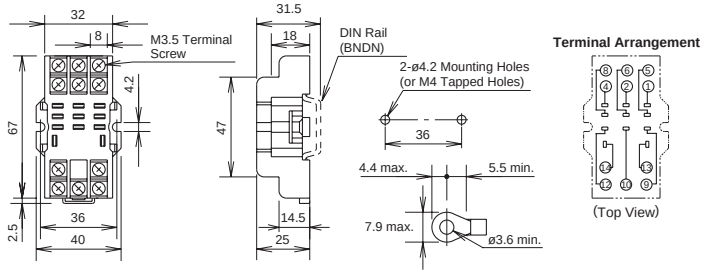
SH1B-05



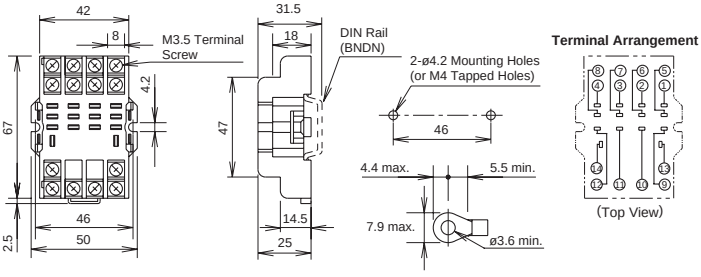
SH2B-05



SH3B-05



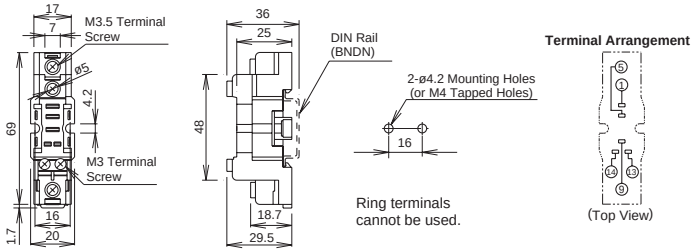
SH4B-05



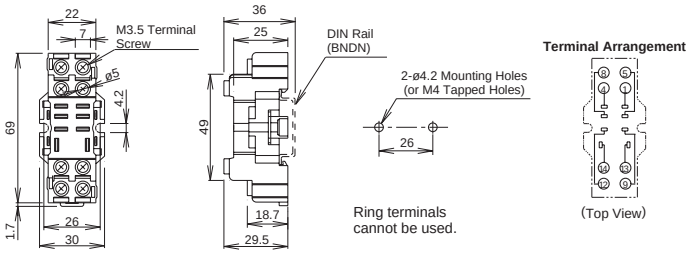
Dimensions con't (mm)

Finger-safe DIN Rail Mount Sockets

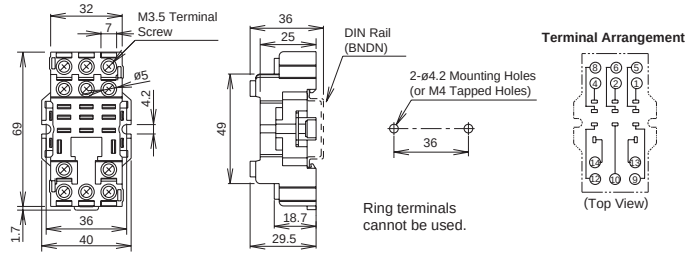
SH1B-05C



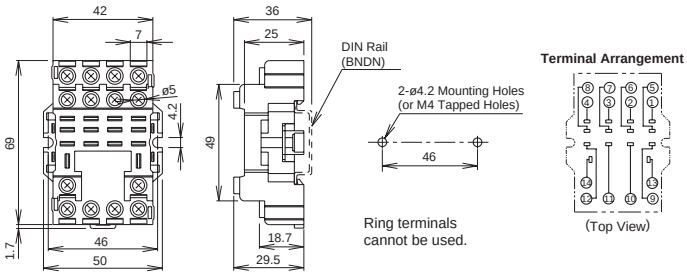
SH2B-05C



SH3B-05C

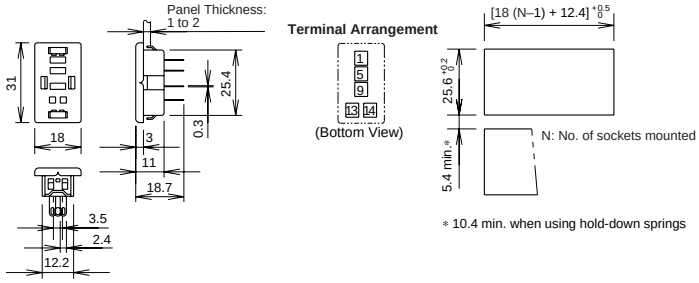


SH4B-05C

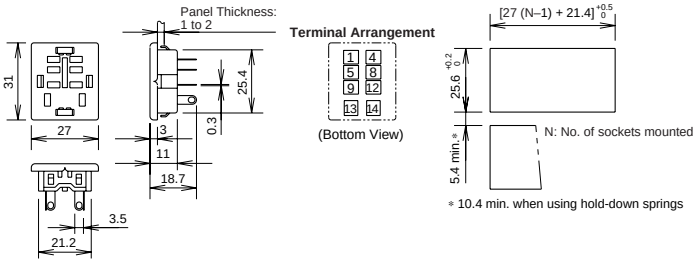


Through Panel Mount Socket

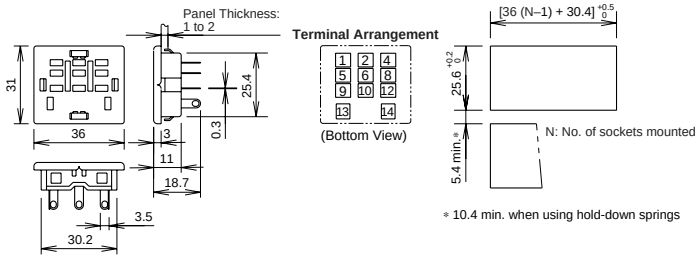
SH1B-51



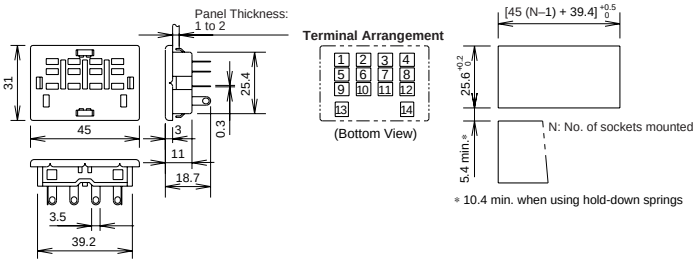
SH2B-51



SH3B-51



SH4B-51



Small, compact Thermostat KTO 011 / KTS 011



Large setting range
Small size
Simple to mount
High switching performance

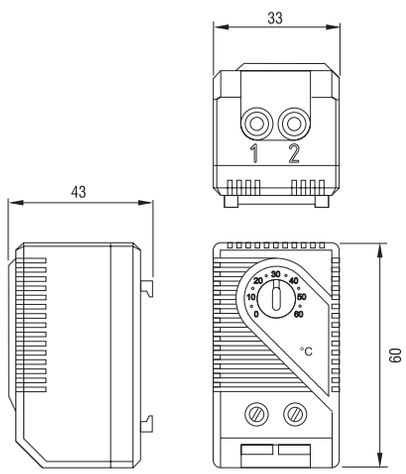
KTO 011: Thermostat (normally closed); contact breaker for regulating heaters.

KTS 011: Thermostat (normally open); contact maker for regulating of filter fans and heat exchangers or for switching signal devised when temperature limit has been exceeded.

CE

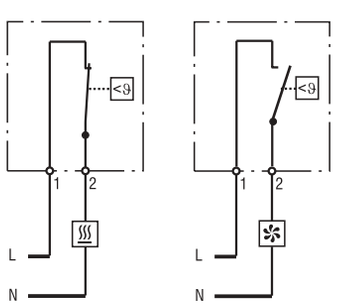
Technical Data

Switch temperature difference	7K (± 4K tolerance)
Sensor element	thermostatic bimetal
Contact type	snap-action contact
Contact resistance	< 10mOhm
Service life	> 100,000 cycles
Max. Switching capacity	250VAC, 10 (2) A
	120VAC, 15 (2) A
	DC 30W
EMC	acc. to EN 55014-1-2, EN 61000-3-2, EN 61000-3-3
Connection	2-pole terminal for 2.5mm², clamping torque 0.8Nm
Mounting	clip for 35mm DIN rail, EN50022
	(or for exit filter EF 118 Series)
Casing	plastic according to UL94 V-0, light grey
Dimensions	60 x 33 x 43mm
Weight	approx. 40g
Fitting position	variable
Operating/Storage temperature	-20 to +80 °C (-4 to +176 °F) / -45 to +80 °C (-49 to +176 °F)
Protection type	IP20

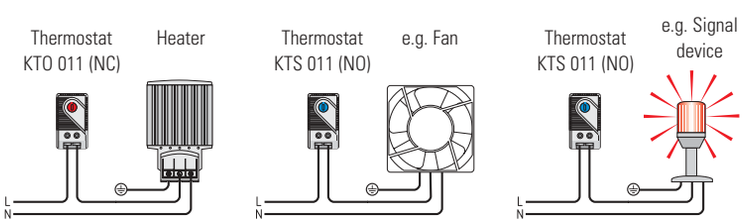


Thermostat KTO 011 (NC)

Thermostat KTS 011 (NO)



Example of connection



Example of connection

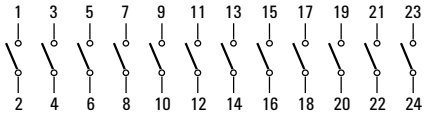
Setting range	Art. No. Contact Breaker (NC)	Art. No. Contact Maker (NO)	Approvals
0 to +60°C	01140.0-00	01141.0-00	VDE
-10 to +50°C	01142.0-00	01143.0-00	VDE
+20 to +80°C	01159.0-00	01158.0-00	VDE
+32 to +140°F	01140.9-00	01141.9-00	UL File No. E164102
+14 to +122°F	01142.9-00	01143.9-00	UL File No. E164102
0 to +60°C	01146.9-00	01147.9-00	UL File No. E164102

1.3. PUSHBUTTONS & SELECTOR SWITCHES

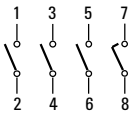
- KRAUS & NAIMER – **CA10-A221-FT2**– 'LOCAL REMOTE' Selector Switch
- SPRECHER & SCHUH – **D7P-MT44-PX01** – Emergency Stop Pushbutton

Switch Function and Configuration — C, CA, CAD, CL Switches

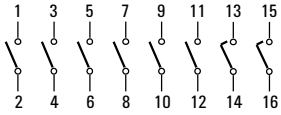
Function	Escutch. Plate	Type/Handle: CA4 CA4-1 CL4	Type/Handle: CAD.. CA10- CA25 CL10	Type/Handle: CA10B- CA25B	Type/Handle: C26- C315	Code	Stages	Connection Diagram
ON/OFF Switches with 60° Switching								
1 pole						A200-600	1	
2 pole						A201-600	1	
3 pole						A202-600	2	
3 pole with red handle						A202-626	2	
3 pole with V850 padlock attachment						A202-627	2	
4 pole						A203-600	2	
4 pole 1 pole preclose 6°[1]						A653-600	2	
5 pole						A341-600	3	
6 pole						A342-600	3	
7 pole						A343-600	4	
8 pole						A344-600	4	
8 pole 2 pole preclose 6°[1]						A654-600	4	
9 pole						A345-600	5	
10 pole						A346-600	5	
11 pole						A347-600	6	
12 pole						A348-600	6	
1 pole						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]						A653-620	2	
5 pole						A341-620	3	
6 pole						A342-620	3	
7 pole						A343-620	4	
8 pole						A344-620	4	
8 pole 2 pole preclose 6°[1]						A654-620	4	
9 pole						A345-620	5	
10 pole						A346-620	5	
11 pole						A347-620	6	
12 pole						A348-620	6	
1 pole						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]						A653-621	2	
5 pole						A341-621	3	
6 pole						A342-621	3	
1 pole						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]						A653-622	2	
5 pole						A341-622	3	
6 pole						A342-622	3	
1 pole						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]						A653-623	2	
5 pole						A341-623	3	
6 pole						A342-623	3	
1 pole						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]						A653-624	2	
5 pole						A341-624	3	
6 pole						A342-624	3	
1 pole						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]						A653-625	2	
5 pole						A341-625	3	
6 pole						A342-625	3	



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

Mounting

C, CA, CAD, CL Switches

Single Hole Mounting	Terminals rotated 90°	Code	CA4 CA4-1 CL4	CAD.. CA10- CA25 CL10
With locking nut and shaft seal, protection IP 66			mm	mm
 Without escutcheon plate		FS1	16/22	
	●	FS1-V	16/22	
		FT1		22
	●	FT1-V		22
		FT3		22/30
	●	FT3-V		22/30
 With square escutcheon plate		FS2	16/22	
	●	FS2-V	16/22	
		FT2		22
	●	FT2-V		22
		FT4		22/30
	●	FT4-V		22/30
 With rectangular escutcheon plate		FS4	16/22	
	●	FS4-V	16/22	
 With size S1 escutcheon plate and heavy duty latching		FH3		22
	●	FH3-V		22
 Mounting key for locking nut		S00 T170 09		

Selection Data

			CA4		CA10		CA11	CA20	CA25			C42			
			CA4-1	CL4	CA10B	CL10	CA11B	CA20B	CA25B	C26	C32	C43	C80	C125	C315/C316
Rated Insulation Voltage U_i	IEC 60947-3, EN 60947-3[1]														
	VDE 0660 part 107[1]	V	440	440	690	690	690	690	690	690	690	690	690	690	690/1000
	SEV[4]	V	380	380	660	690	660	660	690	660	660	660	660	660	660
	UL/Canada	V	300	300	300	600	600	600	300	600	600	600	600	600	600
	CEE/NEMKO	V	400/380	–	380	–	400	400	–	400	400	400	400	–	–
	min. voltage	V							on request						
Rated Impulse Withstand Voltage U_{imp}		kV	4	4	6	6	6	6	6	6	6	6	6	6	6/8
Rated Thermal Current I_u/I_{th}	IEC 60947-3, EN 60947-3														
	VDE 0660 part 107	A	10	10	20	20	20	25	32	32	50	63	115	150	315
	SEV[4] 380 V	A	10	10	16	16	16	25	32	32	40	63	100	160	315
	660 V	A	–	–	12	12	12	25	32	32	40	63	–	–	315
	UL/Canada	A	10	10	20	20	20	30	30	40	50	65	100	150	240
Rated Operational Current I_e															
AC-21A Switching of resistive loads, including moderate overloads	IEC 60947-3, EN 60947-3 VDE 0660 part 107	A	10	10	20	20	20	25	32	32	40	63	100	150	315
AC-1 Resistive or low inductive loads	SEV[4] 380 V	A	10	10	16	16	16	25	32	32	40	63	100	160	315
	660 V	A	–	–	12	12	12	20	32	32	40	63	–	–	315
AC-22A Switching of combined resistive or low inductive loads including moderate overloads	IEC 60947-3, EN 60947-3 VDE 0660 part 107 220 V-500 V	A	10	10	20	20	20	25	32	32	40	63	100	150	315
	660 V-690 V	A	–	–	20	20	20	25	32	32	40	63	100	125	125
AC-15 Switching of control devices, contactors, valves etc.	IEC 60947-3, EN 60947-3 VDE 0660 part 107 220 V-240 V	A	2,5	2,5	5	5	5	8	12	14	16	–	–	–	–
	380 V-440 V	A	1,5	1,5	4	4	4	5	6	6	7	–	–	–	–
Pilot Duty	UL/Canada[4] Heavy		A300	C300	A300	A600	A600	A600	A300	A600	A600	A600	–	–	A600
Ampere Rating Resistive or low inductive loads	UL/Canada[4]	A	10	10	20	20	20	30	30	40	50	65	100	150	240
Resistive load/motor load	CEE	A	4/2	–	10/6	–	10/6	16/10	–	25/10	32/10	40/10	63/10	–	–
	NEMKO	A	6/4[2]	–	10/6	–	–	20/10	–	–	–	–	–	–	–
Breaking capacity	220 V-240 V	A	50	50	150	150	150	200	280	280	380	550	860	1100	2000
	380 V-440 V	A	50	50	150	150	150	200	250	250	360	550	860	1100	2000
	660 V-690 V	A	–	–	80	80	80	125	150	150	270	365	400	490	340
Power loss per contact at I_u		W	0,4/0,9	0,4	0,9	1	0,9	0,9	0,7	1,3	1,3	1,7	5,8	3,8	17
Resistance to vibration					min. 4 g, 2-100 Hz, 1,6 mm							on request			
Resistance to shock					min. 6 g, 6 ms							on request			
Short Circuit Protection															
Max. fuse size	(gL-characteristic)	A	10	10	25	25	25	35	35	50	63	80	125	200	315
Rated short-time withstand current	(1s-current)	A	60	90	140	140	140	280	480	350	800	1000	1300	2000	4200

DC Switching Capacity[6]

Rated Operational Current I_e

No. of series contacts	1	2	3	4	5	6	8		CA4		CA10		CA11	CA20	CA25						C315[3]
	Voltage V								CA4-1	CL4	CA10B	CL10	CA11B	CA20B	CA25B	C26S	C32S	C42S	C80	C125	C316[3]
Resistive loads	24	48	70	95	120	145	190	A	10	10	20	20	20	25	32	–	50	–	115	–	315
T ≤ 1 ms	48	95	140	190	240	290	350		6	6	12	12	12	20	25	32	40	63	100	150	250
	60	120	180	240	300	360	450		2,5	2,5	4,5	4,5	4,5	7,5	10	23	27	30	–	–	–
	110	220	330	440	550	660	–		0,7	0,7	1	1	1	1,5	2	6,5	–	–	–	–	–
	220	440	660	–	–	–	–		0,3	0,3	0,4	0,4	0,4	0,5	0,6	1,2	–	–	–	–	–
	440	660	–	–	–	–	–		0,2	0,2	0,27	0,27	0,27	0,3	0,3	0,4	–	–	–	–	–
Inductive loads	24	48	70	95	120	145	190	A	6	6	12	12	12	20	25	32	40	63	100	150	250
T = 50 ms	30	60	90	120	150	180	240		3	3	5	5	5	9	12	25	30	55	33	50	70
	48	95	140	190	240	290	350		1	1	2	2	2	3	3	16	20	–	–	–	–
	60	120	180	240	300	360	450		0,7	0,7	1	1	1	1,5	1,5	11	15	–	–	–	–
	110	220	330	440	550	660	–		0,3	0,3	0,4	0,4	0,4	0,5	0,5	3,2	3,5	–	–	–	–

Ambient Temperature of Stages[5, 7]	open at 100 % I_u/I_{th}	55 °C during 24 hours with peaks up to 60 °C
	enclosed at 100 % I_{the}	35 °C during 24 hours with peaks up to 40 °C

[1] Valid for lines with grounded common neutral termination, overvoltage category III, pollution degree 3. Values for other supply systems on request. [2] Valid for CA4 only. [3] DC switching capacity applies to ON/OFF switches. Switching capacity for other configurations on request. [4] International Standards and Approvals, refer to page 39. [5] For electromagnetic optional extras see additional data in Catalog 101. [6] Values for switches with spring return on request. [7] Storage temperature: -40 °C to 85 °C (in case of temperature below -5 °C no shock load permissible).

Technical Data — C, CA, CL Switches

Selection Data

					CA4		CA10		CA11	CA20	CA25			C42			C315
					CA4-1	CL4	CA10B	CL10	CA11B	CA20B	CA25B	C26	C32	C43	C80	C125	C316
Rated Utilization Category		IEC 60947-3, EN 60947-3 VDE 0660 part 107															
AC-2	Slip ring motor starting, reversing and plugging, star-delta starting CA4-C32	3 phase 3 pole	220 V-240 V		2,5	2,5	4	4	4	5,5	7,5	8	10	18,5	30	37	55
			380 V-440 V	kW	4,5	4,5	7,5	7,5	7,5	11	15	15	18,5	30	45	55	90
			500 V		–	–	10	10	10	15	18,5	18,5	22	40	55	75	110
			660 V-690 V		–	–	10	10	10	13	15	15	22	37	55	55	55
AC-3	Direct-on-line starting, star-delta starting C42-C315	3 phase 3 pole	220 V-240 V		1,5	1,5	3	3	3	4	5,5	5,5	7,5	11	15	22	37
			380 V-440 V	kW	2,2	2,2	5,5	5,5	5,5	7,5	11	11	15	18,5	30	37	55
			500 V		–	–	5,5	5,5	5,5	7,5	11	11	15	18,5	30	37	55
			660 V-690 V		–	–	5,5	5,5	5,5	7,5	11	11	15	18,5	30	30	37
		1 phase 2 pole	110 V-120 V		0,3	0,3	0,6	0,6	0,6	1,5	2,2	2,2	2,5	3	3,7	5,5	11
			220 V-240 V	kW	0,55	0,55	2,2	2,2	2,2	3	4	4	5,5	6	7,5	11	22
			380 V-440 V		0,75	0,75	3	3	3	3,7	5,5	5,5	7,5	11	13	18,5	30
AC-4	Direct-on-line starting, reversing, plugging and inching	3 phase 3 pole	220 V-240 V		0,37	0,37	0,55	0,55	0,55	1,5	2,5	2,7	3,7	5,5	6	10	15
			380 V-440 V	kW	0,55	0,55	1,5	1,5	1,5	3	5,5	5,5	6	7,5	11	15	25
			500 V		–	–	1,5	1,5	1,5	3	5,5	5,5	6	7,5	11	15	25
			660 V-690 V		–	–	1,5	1,5	1,5	3	5,5	5,5	6	7,5	11	15	22
		1 phase 2 pole	110 V-120 V		0,15	0,15	0,3	0,3	0,3	0,45	0,75	0,75	1,1	1,2	1,5	2,2	4
			220 V-240 V	kW	0,25	0,25	0,75	0,75	0,75	1,1	1,5	1,5	2,2	2,4	3	4	7,5
			380 V-440 V		0,5	0,5	1,5	1,5	1,5	2,2	3	3	3,7	4	5,5	7,5	11
AC-23A	Frequent switching of motors or other high inductive loads	3 phase 3 pole	220 V-240 V		1,8	1,8	3,7	3,7	3,7	5,5	7,5	7,5	11	15	30	37	75
			380 V-440 V	kW	3	3	7,5	7,5	7,5	11	15	15	22	30	45	75	132
			500 V		–	–	7,5	7,5	7,5	11	15	15	30	45	55	90	132
			660 V-690 V		–	–	7,5	7,5	7,5	11	15	15	22	40	45	55	37
		1 phase 2 pole	110 V-120 V		0,37	0,37	0,75	0,75	0,75	1,5	2,2	2,2	2,5	4	5,5	11	18,5
			220 V-240 V	kW	0,75	0,75	2,5	2,5	2,5	3	4	4	5,5	10	15	22	37
			380 V-440 V		1,1	1,1	3,7	3,7	3,7	5,5	7,5	7,5	11	18,5	22	37	55
Ratings		UL/Canada															
	Standard motor load DOL-Rating (similar AC-3)	3 phase 3 pole	110 V-120 V		0,75	0,75	1,5	1,5	1,5	3	5	5	7,5	7,5	10	15	30
			220 V-240 V	HP	1	1	3	3	3	7,5	10	10	15	15	20	25	75
			440 V-480 V		–	–	–	5	5	10	–	20	25	25	30	40	75
			550 V-600 V		–	–	–	5	5	10	–	25	30	30	40	50	60
		1 phase 2 pole	110 V-120 V		0,33	0,33	0,5	0,5	0,5	1,5	2	2	3	3	5	7,5	15
			220 V-240 V		0,75	0,75	1	1	1	3	5	5	7,5	7,5	10	15	40
			277 V	HP	0,75	0,75	2	2	2	3	5	5	7,5	7,5	10	15	40
			440 V-480 V		–	–	–	2	2	5	–	10	15	15	20	25	50
			550 V-600 V		–	–	–	2	2	5	–	15	20	20	25	30	50
	Heavy motor load Reversing-Rating (similar AC-4)	3 phase 3 pole	110 V-120 V		–	–	0,5	–	0,5	1	2	2	3	5	7,5	10	15
			220 V-240 V	HP	–	–	1	–	1	2	3	3	5	7,5	15	20	30
			440 V-600 V		–	–	–	–	3	5	–	10	15	20	25	30	40
		1 phase 2 pole	110 V-120 V		–	–	0,17	–	0,17	0,33	1,5	1,5	1,5	2	3	5	7,5
			220 V-240 V	HP	–	–	0,5	–	0,5	0,75	3	3	3	5	7,5	10	15
			277 V		–	–	0,6	–	0,6	1	3	3	3	5	7,5	10	15
Max. Permissible Wire Gage - Use copper wire only					2x	1x[2]	2x	1x[2]	2x	2x	2x	2x	2x	2x			
Single-core or stranded wire				mm²	1,5	0,5-1,5	2,5	0,5-2,5	2,5	4	6	6	10	16	35	70	185[1]
				AWG	14	20-16	12	20-14	12	10	8	8	8	6	2	2/0	MCM 350
					2x	1x[2]	2x	1x[2]	2x	2x	2x	2x	2x	2x			
Flexible wire (sleeving in accordance with DIN 46228)				mm²	1,5	0,5-1,5	2,5	0,5-2,5	2,5	4	4	6	6	10	25	50	150[1]
					(–)	(–)	(2,5)	(–)	(2,5)	(2,5)	(4)	(4)	(6)	(10)	(25)	(50)	
Flexible AWG wires (without sleeve)				AWG	16	20-16	14	20-14	14	12	10	10	8	6	3	1/0	MCM 300
Connecting wire - outside diameter				mm	–	1,5-2,8	–	1,5-3,6	–	–	–	–	–	–	–	–	–
Connecting wire - plug-in depth				mm	–	8,5	–	11,5	–	–	–	–	–	–	–	–	–
Permissible connecting ambiente temperature range				°C	–	5-40	–	5-40	–	–	–	–	–	–	–	–	–

[1]Cable lug must accept M12 screw. [2]The insulation material of the conductor has to be PVC (typical wire codes are H05V-K0,5 ... H07V-K1,5 or H05V-U0,5 ... H07V-U1,5 etc.). Other materials on request. Connected conductors, which have to be disconnected and re-connected again must be cut in order to ensure a proper electrical connection and to prevent a complete cut-off of the wire insulation. The permissible ambient temperature range when connecting the wires is 5-40 °C.

Technical Data — CAD Switches

Selection Data				CAD11	CAD12
Rated Insulation Voltage U_i	IEC 60947-3, EN 60947-3[1]				
	VDE 0660 part 107		V	600	600
	SEV[2]		V	600	600
	UL/Canada		V	300	300
	min. voltage		V	1	6
Rated Impulse Withstand Voltage U_{imp}				on request	
Rated Thermal Current I_u/I_{th}	IEC 60947-3, EN 60947-3				
	VDE 0660 part 107		A	6	6
	SEV[2]		A	5	5
	UL/Canada		A	6	6
Rated Operational Current I_e	IEC 60947-3, EN 60947-3 VDE 0660 part 107				
AC-21A Switching of resistive loads, including moderate overloads	UL/Canada[3]	1 V/6 V	A	6/3	–/6
		12 V/24 V	A	2/1	5/5
		48 V/110 V	A	0,8/0,4	4/3
		220 V/400 V	A	0,2/0,13	2/1,3
		440 V/500 V	A	0,1/0,08	1/0,8
		600 V	A	0,05	0,5
AC-1 Resistive or low inductive loads	SEV[2]	1 V/6 V	A	5/3	–/5
		12 V/24 V	A	2/1	5/5
		48 V/110 V	A	0,8/0,4	4/3
		220 V/380 V	A	0,2/0,13	2/1,3
		440 V/500 V	A	0,1/0,08	1/0,8
		600 V	A	0,05	0,5
Power loss per contact at I_u			W	0,5	0,2
Short Circuit Protection					
Max. fuse size		(gL-characteristic)	A	6	6
Rated short-time withstand current		(1s-current)	A	35	50
DC Switching Capacity[5]	IEC 60947-3, EN 60947-3 VDE 0660 part 107				
DC-1 Resistive load T = 1 ms	SEV[2]	1 V/6 V	A	4/2,5	–/4
	UL/Canada[3]	12 V/24 V	A	1,5/0,8	3/2,2
		48 V/60 V	A	0,3/0,27	1,2/1
		110 V/220 V	A	0,2/0,1	0,6/0,3
		240 V/500 V	A	0,08/0,03	0,25/0,1
		600 V	A	0,02	0,1
Max. Permissible Wire Gage - Use copper wire only					
				2x	2x
Single-core or stranded wire			mm^2	2,5	2,5
			AWG	12	12
				2x	2x
Flexible wire (sleeving in accordance with DIN 46228)			mm^2	2,5	2,5
				(2,5)	(2,5)
			AWG	14	14
Ambient Temperature of Stages[4, 6]		open at 100 % I_u/I_{th}		55 °C during 24 hours with peaks up to 60 °C	
		enclosed at 100 % I_{the}		35 °C during 24 hours with peaks up to 40 °C	

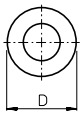
[1]Valid for lines with grounded common neutral termination, overvoltage category III, pollution degree 3. Values for other supply systems on request.
[2]International Standards and Approvals, refer to page 39. [3]Max. 300 V. [4]For electromagnetic optional extras see additional data in Catalog 101.
[5]Values for switches with spring return on request. [6]Storage temperature: -40 °C to 85 °C (in case of temperature below -5 °C no shock load permissible).

Dimensions

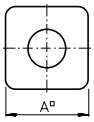
mm
inch

Single Hole Mounting or Base Mounting

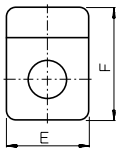
FS1...
FT1...
FT3...

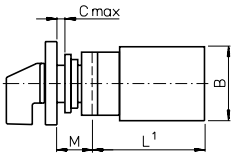


FH3...
FS2...
FT2...
FT4...

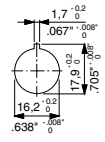


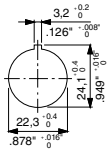
FS4...



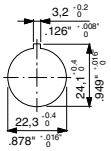


FS1...
FS2...
FS4...

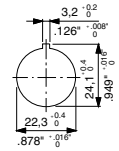


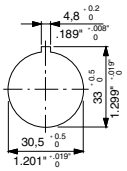


FH3...
FT1...
FT2...



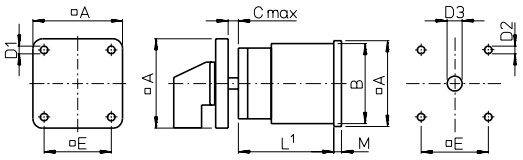
FT3...
FT4...



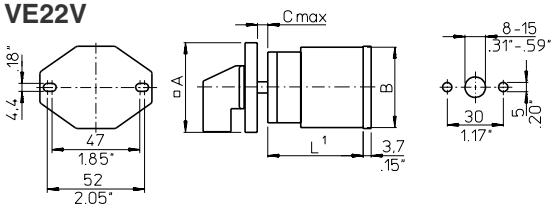


		CA4 CA4-1	CL4	CA10 CA11 CAD11 CAD12	CL10	CA20	CA25
A/E		30 1.18	30 1.18	48 1.89	48 1.89	48 1.89	48 1.89
	FH3...	- -	- -	64 2.52	64 2.52	64 2.52	64 2.52
B		28 1.10	38x46 1.50x1.81	43 1.69	50x56 1.97x2.20	45 1.77	46 1.81
C		5 .20	5 .20	6 .24	6 .24	6 .24	6 .24
D		29,5 1.16	29,5 1.16	39 1.54	39 1.54	39 1.54	39 1.54
F		39 1.54	39 1.54	- -	- -	- -	- -
M		12,5 .49	12,5 .49	18,2 .72	18,2 .72	18,2 .72	18,2 .72
	FH3...	- -	- -	25,2 .99	25,2 .99	25,2 .99	25,2 .99

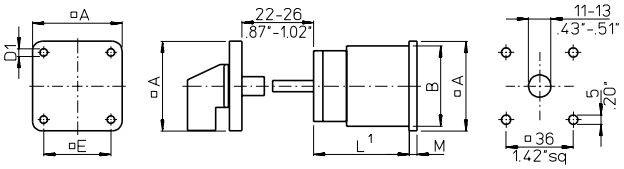
VE
VE-V



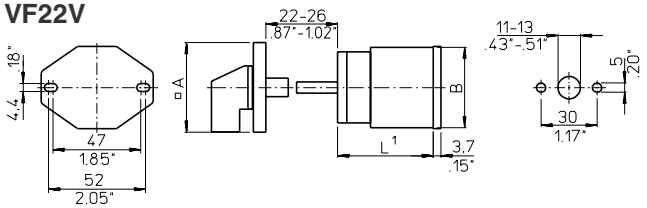
VE22
VE22V



VF
VF-V



VF22
VF22V



	CA10 CA11 CAD11 CAD12	CL10	CA20	CA25[2]	CA10B CA11B CA20B	CA25B	C26	C32	C42[2]	C43	C80	C125	C315 L switches Size S2	C315 L switches Size S3
A	48 1.89	48 1.89	48 1.89	48 (64) 1.89 (2.52)	64 2.52	64 2.52	64 2.52	64 2.52	64 (88) 2.52 (3.46)	88 3.46	88 3.46	88 3.46	88 3.46	128 5.04
B	43 1.69	50x56 1.97x2.20	45 1.77	46 1.81	56 2.20	56 2.20	58 2.28	60 2.36	66 2.60	84 3.30	84 3.30	88 3.46	88 3.46	126 4.96
C	10,5 .41	10,5 .41	10,5 .41	10,5 .41	13,5 .53	13,5 .53	13,5 .53	13,5 .53	13,5 .53	16 .63	16 .63	16 .63	16 .63	19,3 .76
D1	4,1 .16	- -	4,1 .16	4,1 .16	4,1 .16	4,1 .16	4,1 .16	4,1 .16	5,4 .21	5,4 .21	5,4 .21	5,4 .21	5,4 .21	7 .28
D2	5 .20	- -	5 .20	5 .20	5 .20	5 .20	5 .20	5 .20	5 .20	6 .24	6 .24	6 .24	6 .24	7 .28
D3	8-15 .31-.59	- -	8-15 .31-.59	8-15 .31-.59	10-15 .39-.59	10-15 .39-.59	10-15 .39-.59	10-15 .39-.59	10-15 .39-.59	13-17 .51-.67	13-17 .51-.67	13-17 .51-.67	13-17 .51-.67	15,5-20 .61-.79
E	36 1.42	- -	36 1.42	36 (48) 1.42 (1.89)	48 1.89	48 1.89	48 1.89	48 1.89	48 (68) 1.89 (2.68)	68 2.68	68 2.68	68 2.68	68 2.68	104 4.09
M	2,2 .09	- -	2,2 .09	3,2 .13	2,5 .10	2,5 .10	5 .20	5 .20	5 .20	7 .28	8,9 .35	8,9 .35	27 1.06	11,4 .45

[2]Dimensions in ( ) for revertive mounting plate

[1]see page 51

sprecher+schuh

NHP

Emergency stop operators

Components

- Protection class IP 66
- Individually packaged
- 3 part ordering
- 22.5 mm mounting



D7P-MT44



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		D7M-MT34		-		-	
40 mm Red operator	D7P-MT44		D7M-MT44		D7P-LMT44		D7M-LMT44	
60 mm Red operator	D7P-MT64		D7M-MT64		D7P-LMT64		D7M-LMT64	
40 mm Red operator	D7P-MK44		D7M-MK44		-		-	



D7ALP

2 Coupling plates

Description	Cat. No.	Price $
Plastic coupling plate	D7-ALP	
Metal coupling plate	D7-ALM	



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		D7-BX01	
Normally closed contact block with spring clamp terminals	Red	1 N/C	D7-Q01		D7-BQ01	
Normally closed late break	Brown	N/C L.B.	D7-X01L		D7-BX01L	
Normally closed early break	Brown	N/C E.B.	D7-X01B		–	
Normally closed low voltage (*Quadfurcated* gold contacts)	Blue	1 N/C	D7-X01V		D7-BX01V	
Dual circuit 2 normally closed [2]	Red	2 N/C	D7-X02D		-	
"Auto break" safety contact block for emergency stop operators [2]	Yellow	1 N/C safety	D7-X01S		-	



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		D7MX10	
1 N/C contact block + coupling plate	D7PX01		D7MX01	
1 N/O and 1 N/C contact block + coupling plate	D7PX11		D7MX11	

Price Schedule 'A2'

Notes: [1] For LED 2 lamps refer 2 - 32.
[2] Dual circuit and 'Auto Break' cannot be mounted in D7 low profile enclosures.
For Accessories refer 2 - 33.

1.4. POWER SUPPLIES, GPOs, PLUGS & SOCKETS

- CLIPSAL – **2015 + 90B** – 15A Outlet + Shroud
- PROCONNECT – **3PS6A3NE01 + 3PS6PC** – 63A 3Phase N&E Inlet + Cover
- WILCO – **WIBN27** – 27Pin Inlet Socket
- POWERBOX – **PB251-24CM-CC-T** – 24VDC 10A RTU Power Supply
- POWERBOX – **PBIH-2412J-CC** – Radio Power Supply
- Yuasa – **NP7.2-12** – 12V 7Ah Battery

HOW TO ORDER SWITCHED SOCKET OUTLETS

Switched Socket Outlets are often referred to as GPOs (General Purpose Outlets), Powerpoints or Power Outlets. So that there is no confusion, the description 'Switched Socket Outlets' will be used throughout this brochure. Single and Twin Socket Outlets are available in 2000 Series in horizontal and vertical formats.

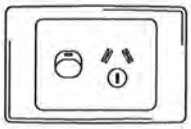
Catalogue Numbers will vary depending on the number of sockets and whether the product is horizontally or vertically mounted.

This number indicates the **number of switched sockets** included in the product. The plate size remains the same for both single and twin switched socket outlets, only the number of switches and sockets vary.

2 0 1 5 V

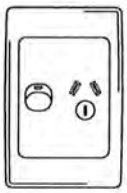
The letter **'V'** indicates that the product is **vertically mounted.** Where there is no letter **'V'**, the product is **horizontally mounted.**

Single Horizontal



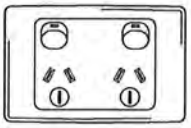
2015

Single Vertical



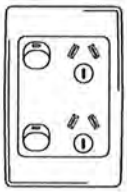
2015V

Twin Horizontal



2025

Twin Vertical



2025V

Please note: Single Automatically Switched Socket Outlets are also available (Catalogue Number 2010 - Page 28).

Special Features and Options

2000 Series Switched Socket Outlets may also be ordered with special features, including an extra switch mechanism, safety shutters, neons, double pole switched versions, deep plate format products and more. Please see the main part of the brochure for Combination (Page 30) and Automatic (Page 28) versions with special features.

Ordering Colours

When ordering Switched Socket Outlets, colour variations also have to be taken into consideration, as the Catalogue Number will change depending on the colour of the product. Each colour has its own 'code', for example, the code for White Electric is **'WE'** and the code for Cream is **'CM'**. The Catalogue Number for a 2000 Series Twin Switched Socket Outlet in White Electric is 2025,**WE**.



Refer to '2000 Series Colours' on page 12 for colour options and their corresponding codes.

COMBINATION SWITCHED SOCKET OUTLETS

No other range of switched sockets matches the versatility of the 2000 Series Combination Switched Sockets. The twin combination switched sockets are not only the most popular products in the 2000 Series, but in the entire Clipsal product range.

Available in 10A, 15A and 20A ratings, in vertical and horizontal formats, they also come with a number of options such as neons, extra switches and safety shutters to offer a level of flexibility that meets the needs of almost every domestic and commercial application. All terminal screws face the same direction and are backed off for simple cable insertion. Socket terminal bores are 5.5mm.

Combinations are manufactured in accordance with AS/NZ 3100, AS/NZ 3112, AS/NZ 3133 and other relevant Australian and New Zealand Standards, and comply with all relevant Wiring Rules and Electrical Supply Authorities requirements.

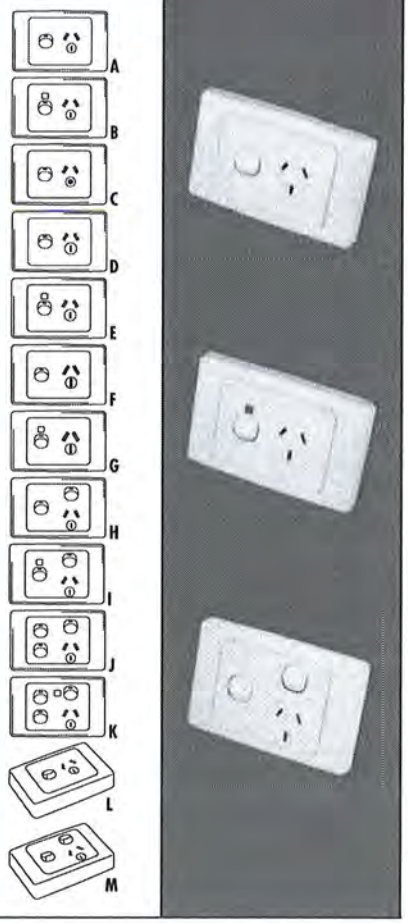
Double Pole Switched Socket Outlets

The safety features of double pole switched socket outlets has seen them become an important range of electrical accessories over the last few years. 2000 Series Double Pole Switched Socket Outlets enable marine craft, caravan and mobile home manufacturers to install double pole switched sockets in their boats, vans and homes to offer a high level of safety, with the stylish good looks that the 2000 Series brings to other homes.

STANDARD SIZE SINGLE SWITCHED SOCKET OUTLETS - HORIZONTALLY MOUNTED

Cat. No.	Length	Width	Depth	Mounting Centres
2015, 2015S, 2015N, 2015D, 2015L, 2015/15, 2015/15N, 2015/20, 2015N20, 2015D20, 2015DN20, 2015X, 2015XN, 2015XX, 2015XXN	116mm	76mm	28mm	84mm apart
2015SM, 2015XSM	116mm	76mm	30mm	84mm apart

2015	A	Single Switched Socket Outlet, 250V/10A.
2015S	A	Single Switched Socket Outlet, 250V/10A, with safety shutter.
2015N	B	Single Switched Socket Outlet, 250V/10A, with safety shutter and neon.
2015D	A	Single Switched Socket Outlet, 250V/10A, double pole.
2015L	C	Single Switched Socket Outlet, 250V/10A, with round earth pin for lighting.
2015/15	D	Single Switched Socket Outlet, 250V/15A.
2015/15N	E	Single Switched Socket Outlet, 250V/15A, with safety shutter and neon.
2015/20	F	Single Switched Socket Outlet, 250V/20A.
2015N20	G	Single Switched Socket Outlet, 250V/20A, with neon.
2015D20	F	Single Switched Socket Outlet, 250V/20A, double pole.
2015DN20	G	Single Switched Socket Outlet, 250V/20A, double pole with neon and safety shutter.
2015X	H	Single Switched Socket Outlet, 250V/10A, with removable extra switch.
2015XN	I	Single Switched Socket Outlet, 250V/10A, with safety shutter, neon and removable extra switch.
2015XX	J	Single Switched Socket Outlet, 250V/10A, with 2 removable extra switches.
2015XXN	K	Single Switched Socket Outlet, 250V/10A, safety shutter, neon and 2 removable extra switches.
2015SM	L	Single Switched Socket Outlet, 250V/10A, with surface mounting kit.
2015XSM	M	Single Switched Socket Outlet, 250V/10A, with surface mounting kit and extra switch.

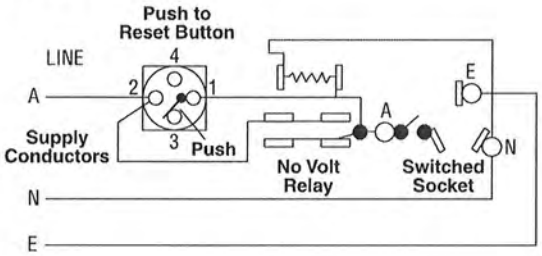


All models accommodate 4 x 2.5mm² cables and have a base projection of 25mm.
30 Series Switch Terminals on the 2015/20 and 2015X series accommodate 3 x 2.5mm² cables.

* Refer to **Page 53** for mounting templates.

SCHEMATIC WIRING DIAGRAMS

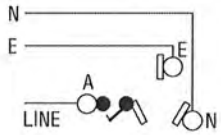
No Voltage Relay Switched Sockets





2015X15RZ

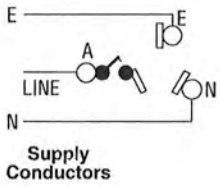
Automatic Socket





2010

Standard Pattern Mounting, Single Gang

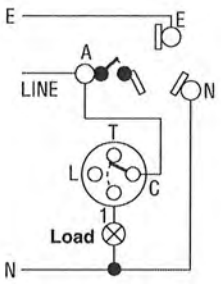




2015
2015/2

2015V

Switched Socket with One Extra Switch

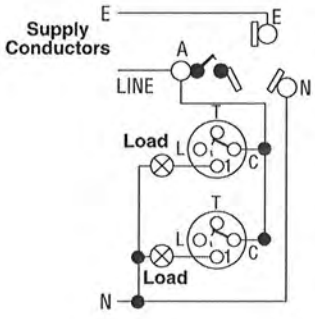




2015X

2015VX

Switched Socket with Two Extra Switches





2015XX

2015VXX

2000 SERIES PRODUCT LISTING

STANDARD SIZE SINGLE AUTOMATICALLY SWITCHED SOCKET OUTLETS - HORIZONTAL MOUNTING						
Cat No	**Description**	**Length**	**Width**	**Depth**	**Mounting Centres**	**PAGE**
2010	Single Auto Socket Outlet, 250V/10A	116mm	76mm	31mm	84mm apart	29
2010/15	Single Auto Socket Outlet, 250V/15A	116mm	76mm	31mm	84mm apart	29
2010/15N	Single Auto Socket Outlet, 250V/15A, with safety shutter and neon	116mm	76mm	31mm	84mm apart	29
2010/15S	Single Auto Socket Outlet, 250V/15A, with safety shutter	116mm	76mm	31mm	84mm apart	29
2010/20	Single Auto Socket Outlet, 250V/20A, with round earth pin	116mm	76mm	31mm	84mm apart	29
2010L	Single Auto Socket Outlet, 250V/10A, with round earth pin	116mm	76mm	31mm	84mm apart	29
2010LN	Single Auto Socket Outlet, 250V/10A, with round earth pin, safety shutter and neon	116mm	76mm	31mm	84mm apart	29
2010LS	Single Auto Socket Outlet, 250V/10A, with round earth pin and safety shutter	116mm	76mm	31mm	84mm apart	29
2010N	Single Auto Socket Outlet, 250V/10A, with safety shutter and neon	116mm	76mm	31mm	84mm apart	29
2010S	Single Auto Socket Outlet, 250V/10A, with safety shutter	116mm	76mm	31mm	84mm apart	29
STANDARD SIZE SINGLE SWITCHED SOCKET OUTLETS - HORIZONTAL MOUNTING						
2015	Single Switched Socket Outlet, 250V/10A	116mm	76mm	28mm	84mm apart	31
2015S	Single Switched Socket Outlet, 250V/10A, with safety shutter	116mm	76mm	28mm	84mm apart	31
2015N	Single Switched Socket Outlet, 250V/10A, with safety shutter and neon	116mm	76mm	28mm	84mm apart	31
2015D	Single Switched Socket Outlet, 250V/10A, double pole	116mm	76mm	28mm	84mm apart	31
2015L	Single Switched Socket Outlet, 250V/10A, with round earth pin	116mm	76mm	28mm	84mm apart	31
2015/15	Single Switched Socket Outlet, 250V/15A	116mm	76mm	28mm	84mm apart	31
2015/15N	Single Switched Socket Outlet, 250V/15A, with safety shutter and neon	116mm	76mm	28mm	84mm apart	31
2015/20	Single Switched Socket Outlet, 250V/20A	116mm	76mm	28mm	84mm apart	31
2015N20	Single Switched Socket Outlet, 250V/20A, with neon	116mm	76mm	28mm	84mm apart	31
2015D20	Single Switched Socket Outlet, 250V/20A, double pole	116mm	76mm	28mm	84mm apart	31
2015DN20	Single Switched Socket Outlet, 250V/20A, double pole with neon and safety shutter	116mm	76mm	28mm	84mm apart	31
2015X	Single Switched Socket Outlet, 250V/10A, with removable extra switch	116mm	76mm	28mm	84mm apart	31
2015XN	Single Switched Socket Outlet, 250V/10A, with safety shutter, neon and removable extra switch	116mm	76mm	28mm	84mm apart	31
2015XX	Single Switched Socket Outlet, 250V/10A, with 2 removable extra switches	116mm	76mm	28mm	84mm apart	31
2015VXXN	Single Switched Socket Outlet, 250V/10A, safety shutter, neon, 2 removable extra switches (vertical)	116mm	76mm	28mm	84mm apart	31
2015SM	Single Switched Socket Outlet, 250V/10A, with surface mounting kit	116mm	76mm	30mm	84mm apart	31
2015XSM	Single Switched Socket Outlet, 250V/10A, with surface mounting kit and extra switch	116mm	76mm	30mm	84mm apart	31
SURFACE MOUNTED SOCKET OUTLETS & ACCESSORIES						
2015SM	Single Socket Outlet, 250V/10A - surface mounted	116mm	76mm	30mm	84mm apart	32
2015XASM	Single Socket Outlet, 250V/10A - surface mounted, with removable extra switch	116mm	76mm	30mm	84mm apart	32
2025SM	Double Socket Outlet, 250V/10A - surface mounted	116mm	76mm	30mm	84mm apart	32
2025XASM	Double Socket Outlet, 250V/10A - surface mounted, with removable extra switch	116mm	76mm	30mm	84mm apart	32
2000SMK	Surface Mounting Kit for 2000 Series grid assemblies	118mm	78mm	27mm	84mm apart	32
2449ASD	Mounting Flange for 2000 Series accessories, six mounting positions	114mm	69mm	14mm	84mm apart	32
449A	Surface Mounting Block for 2000 Series	122mm	80mm	34mm	84mm apart	32
2000SM	Surface Mounting Deep Surround for 2000 Series	116mm	76mm	26mm	N/A	32

PROCONECT®

ISO Connect

3PS63 Series

Maximum cable sizes:	50 mm^2 strandard 35 mm^2 flexible
Cable outside diameter:	minimum 11 mm maximum 29 mm
Stripping length:	sheathing 60 mm insulation 30 mm
IP rating:	socket outlet IP 66 outlet and inlet IP 66

Rated current:	AC23 63 A/440 V AC (AS/NZ 3947-3 / IEC60947-3) 90 A maximum rated current (IEC60309-1)
Housing material:	polyamide 6





Contacts	Voltage rating	Socket outlet Cat. No.	Appliance inlet Cat. No.
1P+N+E	220-240 V AC	**3PS6D1NE01**	**3PS6A1NE01**
3P+E	380-440 V AC	**3PS6D30E01**	**3PS6A30E01**
3P+N+E	380-440 V AC	**3PS6D3NE01**	**3PS6A3NE01**
1P+N+E+2p	220-240 V AC	**3PS63D1NE01P [1])**	**3PS63A1NE01P [1])**
3P+E+2p	380-440 V AC	**3PS63D30E01P [1])**	**3PS63A30E01P [1])**
3P+N+E+2p	380-440 V AC	**3PS63D3NE01P [1])**	**3PS63A3NE01P [1])**



3PS63 Series accessories

Description	Cat. No.
Angled wall box 30° M40X1.5 (without cable gland)	**3PS6WAS**
Handle – maximum outside cable diameter 29 mm	**3PS6G**
Handle with 50 mm thread with cable gland	**3PS6GFP**
30° incline sleeve	**3PS6LB**
Appliance inlet plug cap	**3PS6PC**

Note: [1]) Includes 2 x 16 A pilot pins.

Price Schedule 'B4'

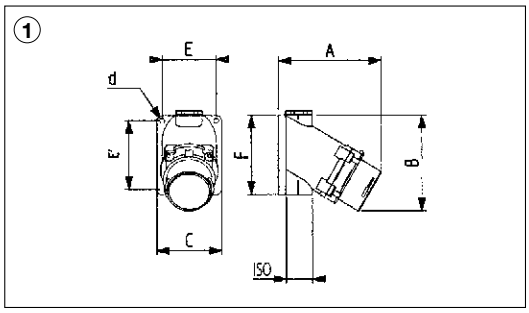
PROCONECT®

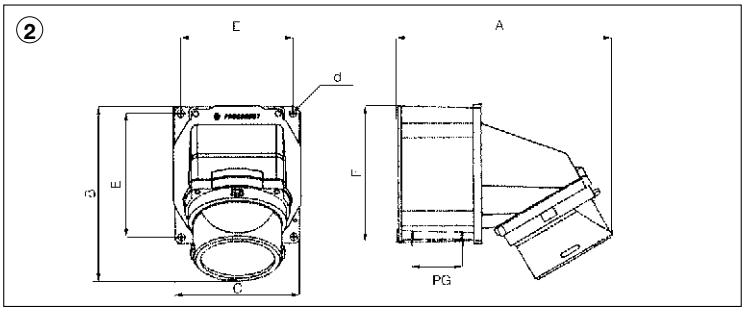
ISO Connect

Dimensions (mm)

Angled wall box with appliance inlet

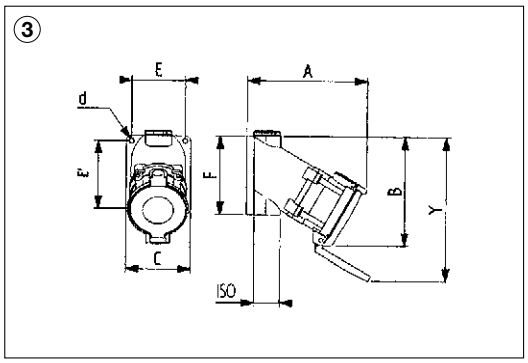
Series	A	B	C	d	E	E'	F	Kg	Draw. No	ISO
3PS16	114	108	82	6	69	69	82	0.22	1	M20x1.5
3PS32	134	128	91	7	78	88	101	0.36	1	M25x1.5
3PS63	169	156	106	8	88	111	129	0.64	1	M40x1.5
3PS125	223	204	155	9	139	154	170	-	2	M50x1.5
3PS200	266	216	155	9	139	154	170	-	2	M63x1.5

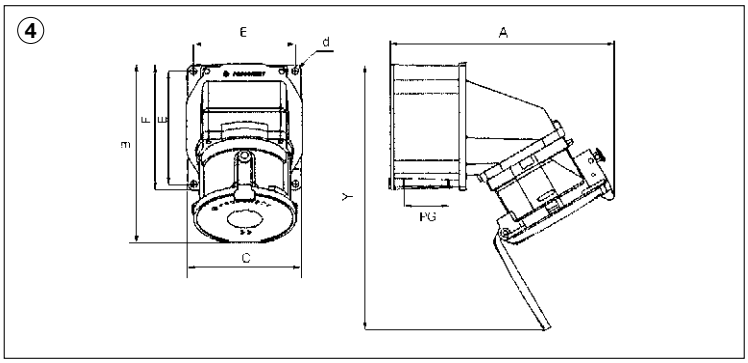




Angled wall box with socket outlet

Series	A	B	C	d	E	E'	F	Y	Kg	Draw. No	ISO
3PS16	141	126	82	6	69	69	82	196	0.31	3	M20x1.5
3PS32	162	148	91	7	78	88	101	226	0.50	3	M25x1.5
3PS63	202	180	106	8	88	111	129	273	0.88	3	M40x1.5
3PS125	285	242	155	9	139	154	170	354	-	4	M50x1.5
3PS200	308	248	155	9	139	154	170	375	-	4	M63x1.5



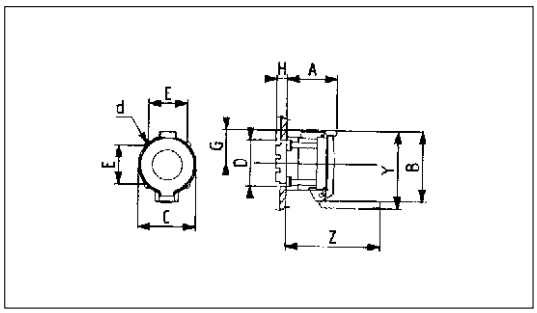


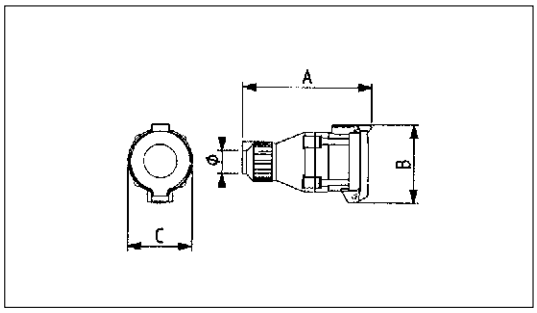
ISO Connect

Dimensions (mm)

Socket outlet

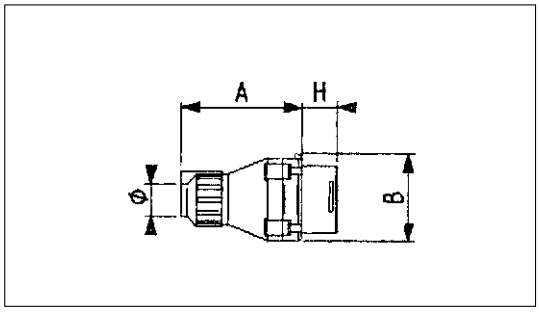
Series	A	B	C	D	d	E	G	H	Y	Z	Kg
3PS16	71	92	72	57	4.5	48	47	13	107	120	0.24
3PS32	77	106	82	67	4.5	55	51	17	116	135	0.38
3PS63	89	122	99	80	5.5	66	59	25	132	163	0.64
3PS125	120	140	129	100	6	81	68	24	152	218	1.50
3PS200	122	179	144	120	7	98	94	35	190	230	2.40





Socket outlet with handle

Series	A	B	C	Diam.	Kg
3PS16	151	97	72	18	0.30
3PS32	172	107	82	22	0.47
3PS63	201	123	99	29	0.79
3PS125	261	145	129	45	1.90
3PS200	353	177	144	58	3.15



Appliance inlet with handle

Series	A	B	C	Diam.	Kg
3PS16	100	71	30.5	18	0.22
3PS32	115	82	34	22	0.33
3PS63	133	96	40	29	0.56
3PS125	167	125	48	45	1.20
3PS200	260	143	54	58	2.60

PROCONECT®

ISO Connect - Cross reference chart

3PS Series



Socket outlet

Note: Not all units are interchangeable

NHP - 3PS16	Contacts	Marechal - DS 1	Eaton - CH 1
3PS1D1NE01	1P+N+E	3114015	CH1D1NE01
3PS1D30E01	3P+E	3114013	CH1D30E01
3PS1D3NE01	3P+N+E	3114017	CH1D3NE01
3PS16D1NE01P	1P+N+E+2P	3114015972	CH1D1NE01P
3PS16D30E01P	3P+E+2P	3114013972	CH1D30E01P
3PS16D3NE01P	3P+N+E+2P	3114017972	CH1D3NE01P
NHP - 3PS32	**Contacts**	**Marechal - DS 3**	**Eaton - CH 3**
3PS3D1NE01	1P+N+E	3134015	CH3D1NE01
3PS3D30E01	3P+E	3134013	CH3D30E01
3PS3D3NE01	3P+N+E	3134017	CH3D3NE01
3PS32D1NE01P	1P+N+E+2P	3134015972	CH3D1NE01P
3PS32D30E01P	3P+E+2P	3134013972	CH3D30E01P
3PS32D3NE01P	3P+N+E+2P	3134017972	CH3D3NE01P
NHP - 3PS63	**Contacts**	**Marechal - DS 6**	**Eaton - CH 6**
3PS6D1NE01	1P+N+E	3164015	CH6D1NE01
3PS6D30E01	3P+E	3164013	CH6D30E01
3PS6D3NE01	3P+N+E	3164017	CH6D3NE01
3PS63D1NE01P	1P+N+E+2P	3164015972	CH6D1NE01P
3PS63D30E01P	3P+E+2P	3164013972	CH6D30E01P
3PS63D3NE01P	3P+N+E+2P	3164017972	CH6D3NE01P
NHP - 3PS125	**Contacts**	**Marechal - DS 9**	**Eaton - CH 9**
3PS9D1NE01	1P+N+E	3194015	CH9D1NE01
3PS9D30E01	3P+E	3194013	CH9D30E01
3PS9D3NE01	3P+N+E	3194017	CH9D3NE01
3PS9D1NE01P	1P+N+E+2P	3194015972	CH9D1NE01P
3PS9D30E01P	3P+E+2P	3194013172	CH9D30E01P
3PS9D3NE01P	3P+N+E+2P	3194017972	CH9D3NE01P
NHP - 3PS200	**Contacts**	**Marechal - DS 2**	**Eaton - CH 2**
3PS2D1NE01	1P+N+E	3924015	CH2D1NE01
3PS2D30E01	3P+E	3924013	CH2D30E01
3PS2D3NE01	3P+N+E	3924017	CH2D3NE01
3PS2D1NE01P	1P+N+E+2P	3924015972	CH2D1NE01P
3PS2D30E01P	3P+E+2P	3924013972	CH2D30E01P
3PS2D3NE01P	3P+N+E+2P	3924017972	CH2D3NE01P

PROCONECT®

ISO Connect - Cross reference chart

3PS Series



Appliance inlet

Note: Not all units are interchangeable

NHP - 3PS16	Contacts	Marechal - DS 1	Eaton - CH 1
3PS1A1NE01	1P+N+E	3118015	CH1A1NE01
3PS1A30E01	3P+E	3118013	CH1A30E01
3PS1A3NE01	3P+N+E	3118017	CH1A3NE01
3PS16A1NE01P	1P+N+E+2P	3118015972	CH1A1NE01P
3PS16A30E01P	3P+E+2P	3118013972	CH1A30E01P
3PS16A3NE01P	3P+N+E+2P	3118017972	CH1A3NE01P
NHP - 3PS32	**Contacts**	**Marechal - DS 3**	**Eaton - CH 3**
3PS3A1NE01	1P+N+E	3138015	CH3A1NE01
3PS3A30E01	3P+E	3138013	CH3A30E01
3PS3A3NE01	3P+N+E	3138017	CH3A3NE01
3PS32A1NE01P	1P+N+E+2P	3138015972	CH3A1NE01P
3PS32A30E01P	3P+E+2P	3138013972	CH3A30E01P
3PS32A3NE01P	3P+N+E+2P	3138017972	CH3A3NE01P
NHP - 3PS63	**Contacts**	**Marechal - DS 6**	**Eaton - CH 6**
3PS6A1NE01	1P+N+E	3168015	CH6A1NE01
3PS6A30E01	3P+E	3168013	CH6A30E01
3PS6A3NE01	3P+N+E	3168017	CH6A3NE01
3PS63A1NE01P	1P+N+E+2P	3168015972	CH6A1NE01P
3PS63A30E01P	3P+E+2P	3168013972	CH6A30E01P
3PS63A3NE01P	3P+N+E+2P	3168017972	CH6A3NE01P
NHP - 3PS125	**Contacts**	**Marechal - DS 9**	**Eaton - CH 9**
3PS9A1NE01	1P+N+E	3198015	CH9A1NE01
3PS9A30E01	3P+E	3198013	CH9A30E01
3PS9A3NE01	3P+N+E	3198017	CH9A3NE01
3PS9A1NE01P	1P+N+E+2P	3198015972	CH9A1NE01P
3PS9A30E01P	3P+E+2P	3198013172	CH9A30E01P
3PS9A3NE01P	3P+N+E+2P	3198017972	CH9A3NE01P
NHP - 3PS200	**Contacts**	**Marechal - DS 2**	**Eaton - CH 2**
3PS2A1NE01	1P+N+E	3928015	CH2A1NE01
3PS2A30E01	3P+E	3928013	CH2A30E01
3PS2A3NE01	3P+N+E	3928017	CH2A3NE01
3PS2A1NE01P	1P+N+E+2P	3928015972	CH2A1NE01P
3PS2A30E01P	3P+E+2P	3928013972	CH2A30E01P
3PS2A3NE01P	3P+N+E+2P	3928017972	CH2A3NE01P

PB251A Series

220-330 WATTS DC UPS

Features

- **Ultra-low noise output**
- **Independent battery charging**
- **DC OK & battery charger OK alarms & LEDs**
- **Battery disconnected alarm**
- **Battery Low Voltage Disconnect - LVD**
- **Battery fuse fail LED**
- **Over-temperature protection**
- **Analogue meters on standard model**
- **Optional : Liquid Crystal Display**
- **Optional : Network Enabled**
- **Models available Q1 2010**



Specifications

INPUT

Voltage:	190 to 264 vac, or 190 to 400VDC
Line regulation:	0.2%typical
Current:	1.4A maximum
Inrush current:	10A maximum
Frequency:	45 to 65 Hz

OUTPUT

Voltage	See table
Current	See table
Load regulation	0.5%typical
Current limit type	load cct Constant current
Current limit type	batt. cct Constant current
Short circuit protection	Indefinite, auto-resetting
Over-voltage protection	17.5 to 20V latching (13.8Vdc output) 31.5 to 39V latching (27.6Vdc output)
Ripple & noise	100 MHz bandwidth 28mVp-p (13.8Vdc output) 55mVp-p (27.6Vdc output)

ENVIRONMENTAL

Operating temperature	0 to 70oC ambient with derating, 5...90% relative humidity (non-condensing)
Over-temperature protection	Automatic & auto-resetting
Cooling requirement	Natural convection
Efficiency	80% minimum

STANDARDS & APPROVALS

Safety	Complies with AS/NZS 60950, class 1, NSW Office of Fair Trading Approval N20602
EMC	Emissions comply with AS/NZS CISPR11, Group 1, Class B. Complies with ACA EMC Scheme, Safety & EMC Regulatory Compliance Marked
Isolation input - output input - ground output - ground	4242VDC for 1 minute 2121VDC for 1 minute 707VDC for 1 minute

ALARMS & BATTERY FUNCTIONS

DC OK	Green LED : ON=OK voltage free change over contacts (32V,1A) Alarms on loss of AC mains power or failure of off-line AC/DC converter / battery charger
Battery OK	Green LED : ON=OK voltage free change over contacts (32V,1A) Alarms on battery low voltage, failure of battery fuse or battery disconnected. Alarm cancelled when fuse or battery replaced, or AC input restored
Battery Low Voltage Disconnect (LVD)	Low voltage disconnect 10.5V for 12V battery, 21V for 24V battery, adjustable 1.6 to 2.0V / cell all models
Charger over-load protection	Auto-resetting electronic circuit breaker
Reverse polarity protection	Internal battery fuse
Battery to load voltage drop	0.2 to 0.35V typical model dependant

OPTIONS

Liquid Crystal Display	16 character 2 line display, add -LCD to rack mount model
Network Enabled	Internal network card in conjunction with PB251A becomes a network enabled device combining the benefits of SNMP V1, XML and an embedded webpage. Add -N to all model

MECHANICAL

Chassis mount case size	264 L x 172 W x 67 H mm
CM case size with heatsink	264 L x 186 W x 67 H mm
Rack mount size	232 D x 19" W x 2RU H
Weight	1.9 kg
Weight with heatsink	2.1 kg
Weight (rack mounted version)	5.5 kg

Selection Table

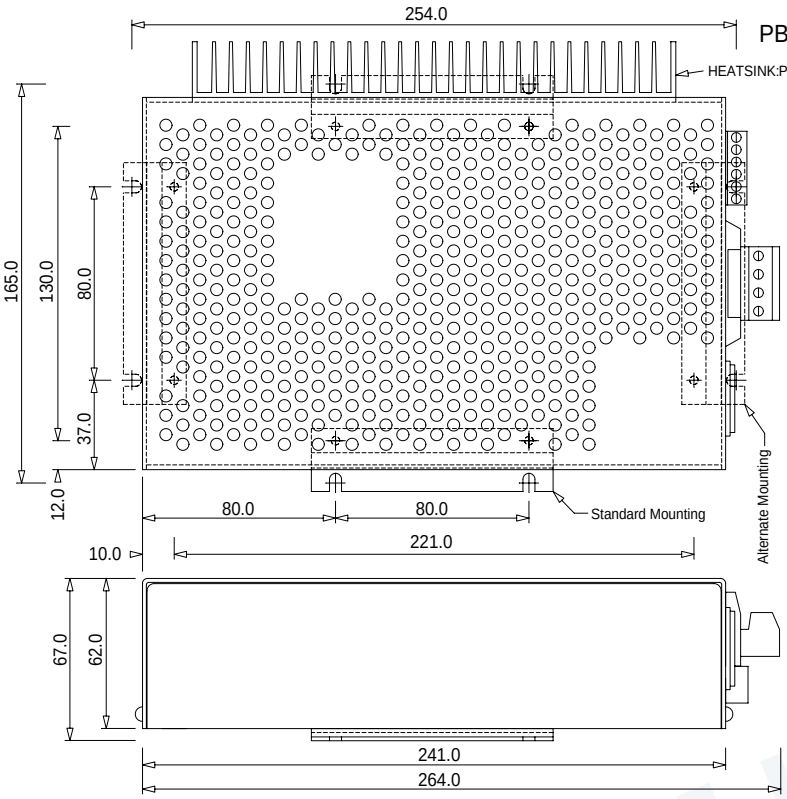
MODEL NUMBER	OUTPUT VDC	OUTPUT I_{LOAD}	OUTPUT I_{BATT}	OUTPUT POWER	MECHANICAL
PB251A-12CM	13.8V	16A	2A	220W	chassis mount
PB251A-24CM	27.6V	11	2A	300W	chassis mount
PB251A-12CM-H	3.8V	20A	2A	275W	chassis mount / heatsink
PB251A-24CM-H	27.6V	12A	2A	330W	chassis mount / heatsink
PB251A-12RML	13.8V	20A	4A	275W	rack mount / screw terminals
PB251A-24RML	27.6V	12A	2A	330W	rack mount / screw terminals
PB251A-12B	13.8V	20A	20A	275W	rack mount / Hirose connector
PB251A-24B	27.6V	12A	12A	330W	rack mount / Hirose connector

NOTE: Non standard battery charging current available on request. ie PB251-12CM-H-10 for

PB251A Series

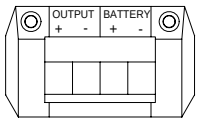
2 2 0 - 3 3 0 WAT T S D C U P S

PB251A-**CM (-H) MECHANICAL OUTLINE

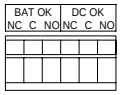


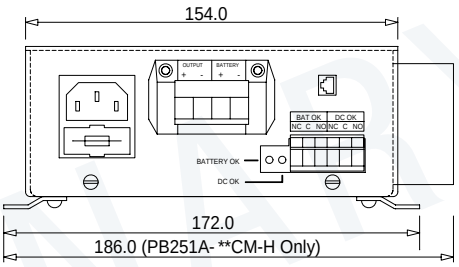
NOTES:
1. Mounting Centres: Suitable for M4 Hardware
   Standard: 165 x 80 mm
   Alternate: 254 x 80 mm
2. M3 threaded holes on bottom of base.
   Standard: 130 x 80 mm centres
   Alternate: 221 x 80 mm centres
3. AC Mains: 10A Class 1 IEC60320 power inlet
4. Output and Battery: 4W Pluggable Screw Terminal Block
   Suitable for up to 4 sq. mm wire.
5. Alarms: 6W Pluggable Screw Terminal Block
   Suitable for up to 1.5 sq. mm wire.

OUTPUT / BATTERY TERMINATIONS

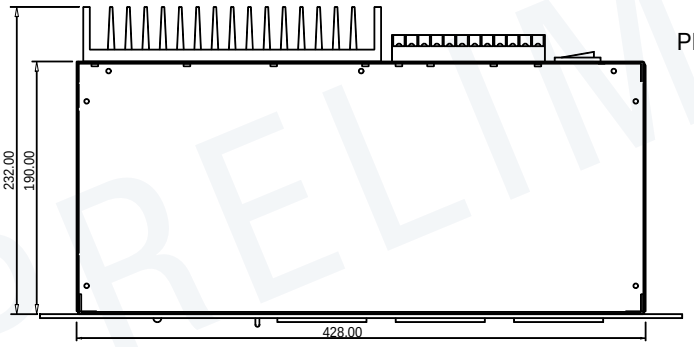


ALARM TERMINATIONS

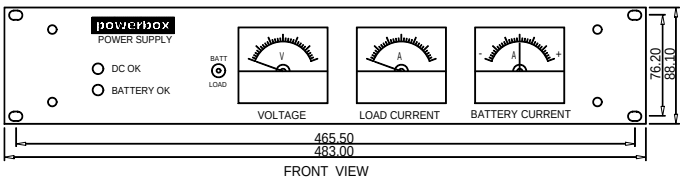


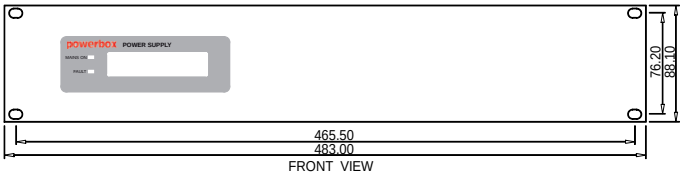


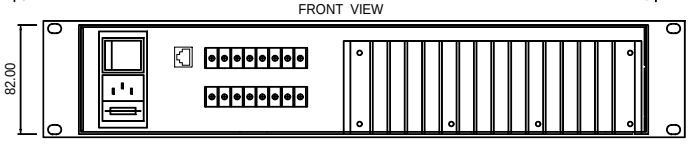
PB251A-**RML & -12B MECHANICAL OUTLINE



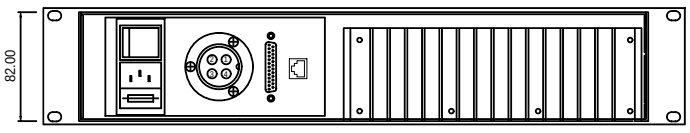
NOTES:
1. 2RU x 19" rack enclosure per IEC297
2. Mounting slots are suitable for M6 hardware.
3. Input connector is a 10A Class 1 IEC60320 inlet.
4. 2 meter IEC mains cord with Australian plug is supplied with unit.
5. PB251A-12B alarm terminal is DB25 female.
6. PB251A-12B output and battery connector is Hirose pn. HS28R-4A.
   Mating connector is Hirose pn. HS28P-4A (not supplied).
7. PB251A-**RML alarm and output terminals are M3.5 screws
   suitable for ring or fork lugs up to 8 mm wide.





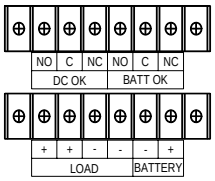


REAR VIEW (PB251A-**RML)

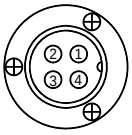


REAR VIEW (PB251A-12B)

PB251A-**RML ALARM AND OUTPUT TERMINALS

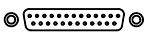


PB251A-12B OUTPUT & BATTERY CONNECTOR



PIN1: + OUTPUT
PIN2: - OUTPUT
PIN3: + BATTERY
PIN4: - BATTERY

PB251A-12B ALARM CONNECTOR



PIN 1: COMMON
PIN 6: DC OK (NC)
PIN 15: BATTERY OK (NO)

PRELIMINARY

1.5. SURGE PROTECTION & FUSES

- CRITEC – **TDS-1100-2SR-277**– Surge Diverter
- CRITEC – **DAR-275V** – Surge Diverter Alarm Relay
- CRITEC – **TDF-10A-240V** – Surge Reduction Filter RTU
- NHP – **NC63FW + NTIS63** – 63A Fuse Cartridge & 63A Fuse Holder
- NHP – **NC32FW + NNIT6** – 6A Fuse Cartridge & 32A Fuse Holder
- RF Industries – **IS-50NX-C2** – Radio Coax Surge Protection Unit

NHP COMPACT FUSES

BS fuse holders

FUSES PROVIDE SUPERIOR SHORT CIRCUIT PROTECTION

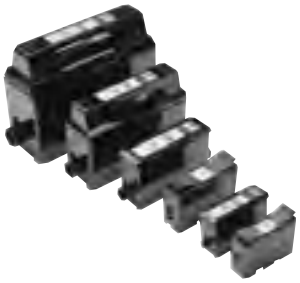
Refer Catalogue NF

Compact fuse holders (Bolt-in)

- New compact size
- Front (FW) or stud/front (SFW) versions
- Smaller dimensions
- Saves panel space

SAVE PANEL SPACE SAVE $$$ WITH NEW COMPACT FUSE HOLDERS

UP TO 30% SMALLER



Dimensions (mm)

	H	W	D	Suggested Max. cable size
NC32_	87	27	50	10 mm²
NC63_	109	31	62	25 mm²
NC100_	118	35	72	50 mm²
NC200_	154	54	108	95 mm²

Rating (A)	Fuse link to suit	Cat. No.
Front wired – bolt in		
32	NNIT	**NC32FW**
63	NTIA NTIS	**NC63FW**
100	NOS NTIA NTIS	**NC100FW**
200	NTIA [1] NTIS [1] NTFP NOS [1] NTCP	**NC200FW**
Back stud/front wired – bolt in		
32	NNIT	**NC32SFW**
63	NTIA NTIS	**NC63SFW**
100	NOS NTIA NTIS	**NC100SFW**
200	NTIA [1] NTIS [1] NTFP NOS [1] NTCP	**NC200SFW**

Note: [1] Fuses can be fitted using adaptor 100M FLK.

Standard fuse holders (Bolt-in)

- Ratings from 20 to 200 A
- Front (FW) or stud/front (SFW) versions
- Complies with BS88



OLD STYLE

N20FW

Dimensions (mm)

	H	W	D	Suggested Max. cable size
N20_	87	27	50	10 mm²
N32_	109	31	62	10 mm²
N63_	118	35	72	50 mm²
N100_	154	54	108	70 mm²
N200_	193	70	149	150 mm²

Rating (A)	Fuse link to suit	Cat. No.
Front wired – bolt in		
20	NNIT	**N20FW**
32	NTIA	**N32FW**
63	NTIA NTIS	**N63FW**
100	NTIA [1] NTIS [1] NOS [1] NTCP	**N100FW**
200	NTBC NTC NTF	**N200FW**
Back stud/front wired – bolt in		
20	NNIT	**N20SFW**
32	NTIA	**N32SFW**
63	NTIA NTIS	**N63SFW**
100	NTIA [1] NTIS [1] NOS [1] NTCP	**N100SFW**
200	NTBC NTC NTF	**N200SFW**

Clip-in fuse holders - DIN rail mount

Fast, reliable fitting and removal of fuse links



NV20FW



NV32FW



NV63FW

Rating (A)	Fuse link to suit	Cat. No.
Front wired – clip-in – Black		
20	NSS	**NV20FW**
32	NSS	**NV32FW**
63	NES	**NV63FW**
Front wired – Clip-in – White		
32	NNS	**NV32FWW**
63	NES	**NV63FWW**

NHP COMPACT FUSES

Fuse equivalent chart

This chart is designed to help choose the correct fuse to fit a particular switch-fuse (or vice versa) and to help choose the correct replacement fuse. Some data is from other manufacturers publications and as such cannot be guaranteed by NHP. Beware that some motor start fuses are in a larger body size than a normal fuse. It is wise to consult the fuse manufacturer's data to determine their particular fuse sizes (i.e. A2-C3).

Fuse manufacturer's part numbers - Australian/British standard

BS Ref.	Amps	NHP COMPACT FUSES	EATON/ MEM	Holec	Alstom GEC	Bussmann	PDL	Siemens
F1	2...32	NNS	SN2	NS	NS	NSD	N20C	3NW NS
F2	20...63	NES	SP	MES	ES	ESD	N63E	3NW ES
A1	2...32	NNIT	SA2	NIT	NIT	NITD	N20B	3NW NIT
A2	2...32	NTIA	SB3	TIA	TIA	AAO	N32B	3NW TIA
A3	35...63	NTIS	SB4	TIS	TIS	BAO	N63B	3NW TIS
Hybrid (A3)	80...100	NOS	SO	-	OS	OSD	NOSD	3NW OS
Hybrid (A3)	125...160	NTSL00	–	–	–	–	–	–
A4	80...100	NTCP	SD5	TCP	TCP	CEO	N100B	3NW TCP
Hybrid (A4)	125...200	NTFP [1])	SD6	TFP	TFP	DEO	N200B	3NW TFP
-	2...32/40...63	NTB	SE3/SE4	TB	TB	AC/BC	N_TB	3NW TB
B1	2...32/40...63	NTBC	SF3/SF4	TBC	TBC	AD/BD	N63B_	3NW TBC
B1	80...100	NTC	SF5	TC	TC	CD	N100B_C	3NW TC
B2	125...200	NTF	SF6	TF	TF	DD	N200B_C	3NW TF
B3	250...315	NTKF	SF7	TKF	TKF	ED	N315B_C	3NW TKF
-	250...315	NTKM	SG7	TKM	TKM	EFS	N315B_C	3NW TKM
B4	355...400	NTMF	SF8	TMF	TMF	ED	N400B_C	3NW TMF
Hybrid (B4)	450...630	NTSL3	–	–	–	–	–	–
C1	355...400	NTM	SH8	TM	TM	EF	N404B_C	3NW TM
C2	450...630	NTTM	SH9	TTM	TTM	FF	N504B_C	3NW TTM
-	450...630	NTT	SY9	TT	TT	FG	N630B_C	3NW TT
C3	710...800	NTLM	SH10	TLM	TLM	GF	N804B_C	3NW TLM
-	710...800	NTLT	SY10	TLT	TLT	GG	B804B_C	3NW TLT
D1	1000...1250	NTXU	SJ11	TXU	TXU	GH	N_U44	3NW TXU
DIN pattern								
00	6...160	N00	NH00	-	NHG-00	NH00G	-	3NA5
1	25...250	N1	NH01	-	NHG-1	NH1G	-	3NA4 144
2	80...400	N2	NH02	-	NHG-2	NH2G	-	3NA4 260
3	315...800	N3	NH03	-	NHG-3	NH3G	-	3NA1
Fuse holders								
Clip-in	20A	NV20FW	V20FF	-	SC20H	-	FC20FW	-
	32A	NV32FW	V32FF	-	SC32H	32NNSF	NC32FW	3NW 32NNSF
Front wired	20A	N20FW	20MFB	-	RSM20H	-	FB20FW	3NWCM20FC
	32A	NC32FW	32MFB	200846	RSM32H	-	FB32FW	3NW CM32F
	63A	NC63FW	63MFB	LCF63FCFC	RSM63H	-	FB63FW	3NW CM63F
	100A	NC100FW	100MFB	-	RSM100H	-	FB100FW	3NW CM100F
	200A	NC200FW	200MFB	-	RSM200H	-	FB200FW	3NW 200DF
Stud/	20A	N20SFW	20MFD	-	RSM20PH	-	FB20SF	-
front wired	32A	NC32SFW	32MFD	LCF32FCBC	RSM32PH	-	FB32SF	-
	63A	NC63SFW	63MFD	LCF63FCBC	RSM63PH	-	FB63SF	-
	100A	NC100SFW	100MFD	-	RSM100PH	-	FB100SF	-
	200A	NC200SFW	200MFD	-	RSM200PH	-	FB200SF	-

Note: [1]) This hybrid type fuse is actually an A4 size fuse, but as it is over 100 amps it cannot be called an A4 fuse to AS 2005.

11

NHP COMPACT FUSES

Fuse-link terminology

NHP Compact fuses

HRC
High rupturing capacity (HRC) or High breaking capacity denotes the ability of a fuse-link to interrupt extremely high fault currents, usually up to 80kA.

Current limiting fuse-link
A fuse-link that limits the circuit current during it's operation to a value much lower than the peak value of the prospective current. In practice, the terms HRC and current limiting are synonymous.

Rated breaking capacity
The highest value of fault current that a fuse-link has been tested to interrupt eg. 80kA.

Rated voltage
The maximum system voltage that the fuse-link is designed to interrupt. Rated voltages may be in AC, DC, or both.

Current rating
The value of current that a fuse-link will carry continuously without deterioration under specified conditions.

Minimum fusing current
The minimum value of current that will cause melting of the fuse element.

Power dissipation
The power released in a fuse-link carrying rated current under a specified condition, usually expressed in watts.

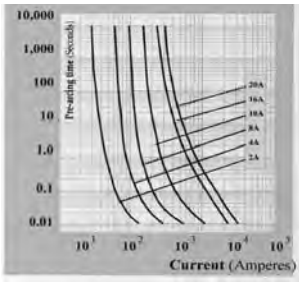
Time current characteristics (refer table 1)
A curve detailing the pre-arcing or operating time as a function of prospective current.

Let through characteristics (I^2t) (refer table 2)
A curve or chart showing values 'pre-arcing' and 'operating' let through energies as a function of prospective current, I^2t is proportional to energy in Amp^2 seconds.

Cut off characteristics (refer table 3)
A curve detailing the cut off current as a function of prospective current. Cut off current being the maximum instantaneous value of current let through by the fuse-link during operation.

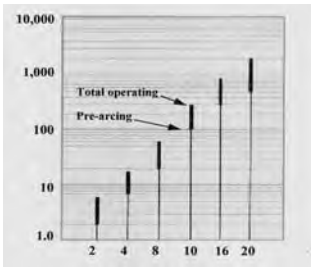
Discrimination (refer tables 4 and 5)
Discrimination is the ability of fuse-links to operate selectively and to disconnect only the parts of the circuit that are subject to faults. Discrimination can be checked by ensuring that the time current characteristics, including their tolerances, do not overlap at any point and that the total let through energy (I^2t) of the downstream (or minor) fuse-link does not exceed the pre-arcing energy (I^2t) of the upstream (or major) fuse-link at the applied system voltage. Discrimination is normally achieved with the ratio of 1.6 between upstream and downstream fuses.

Table 1



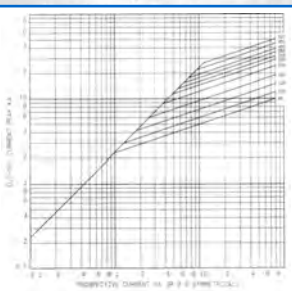
Typical time current curves

Table 2



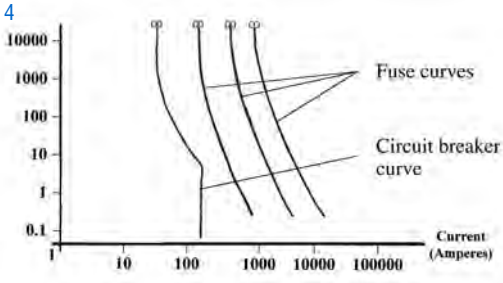
Operating and pre-arcing I^2t values

Table 3



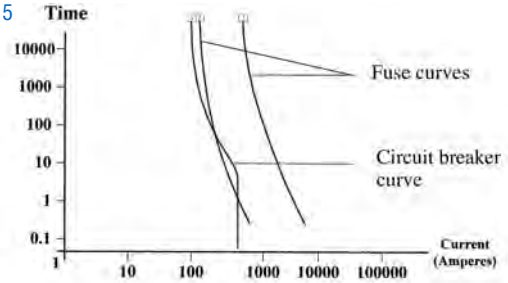
Cut off characteristics

Table 4



Discrimination achieved

Table 5



Discrimination *NOT* achieved

NHP COMPACT FUSES

I²t characteristics

BS fuses I²t data

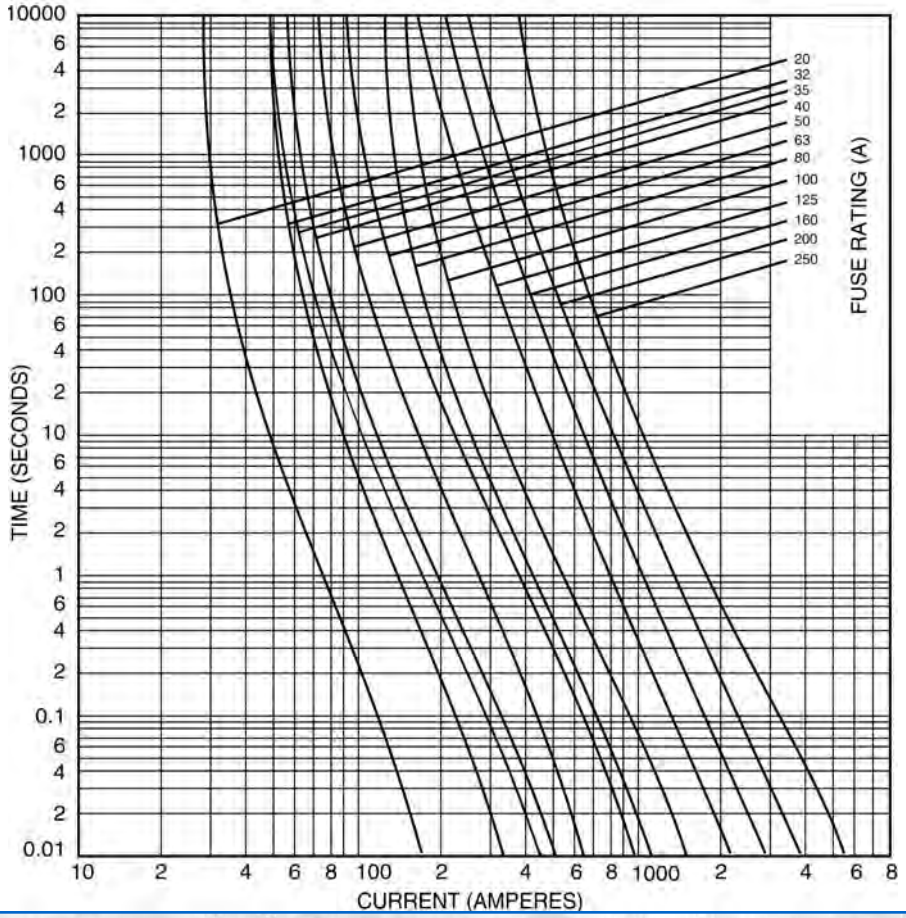
I²t characteristics

Rating (amperes)	I²t pre-arcing	I²t total @ 240 volts	I²t total @ 415 volts
2	2	2	4
4	10	15	21
6	34	52	74
10	188	289	408
16	92	211	412
20	155	355	690
20M25	574	1084	1809
20M32	574	1561	2605
25	826	1084	1809
32	826	1561	2605
35	1200	2400	4100
32M40	2482	4416	7019
32M50	3305	5879	9345
32M63	5875	10452	16612
40	2482	4416	7019
50	3305	5879	9345
63	5875	10452	16612
80 & 63M80	7800	15500	26000
100 & 63M100	14000	28000	46000
125 & 100M125	30000	51000	75500
160 & 100M160	58500	99000	145000
200 & 100M200	120000	205000	300000
250 & 200M250	210000	360000	530000
315 & 200M315	270000	460000	680000
355	365000	620000	915000
400 & 315M400	480000	820000	1200000
450	755000	1300000	1900000
500	1100000	1850000	2700000
560	1200000	2400000	4000000
630	1550000	3100000	5150000
710	1903565	2992861	4306813
800	3820349	6006505	8643534
1000	7000000	1500000	16000000
1250	12000000	20500000	30000000

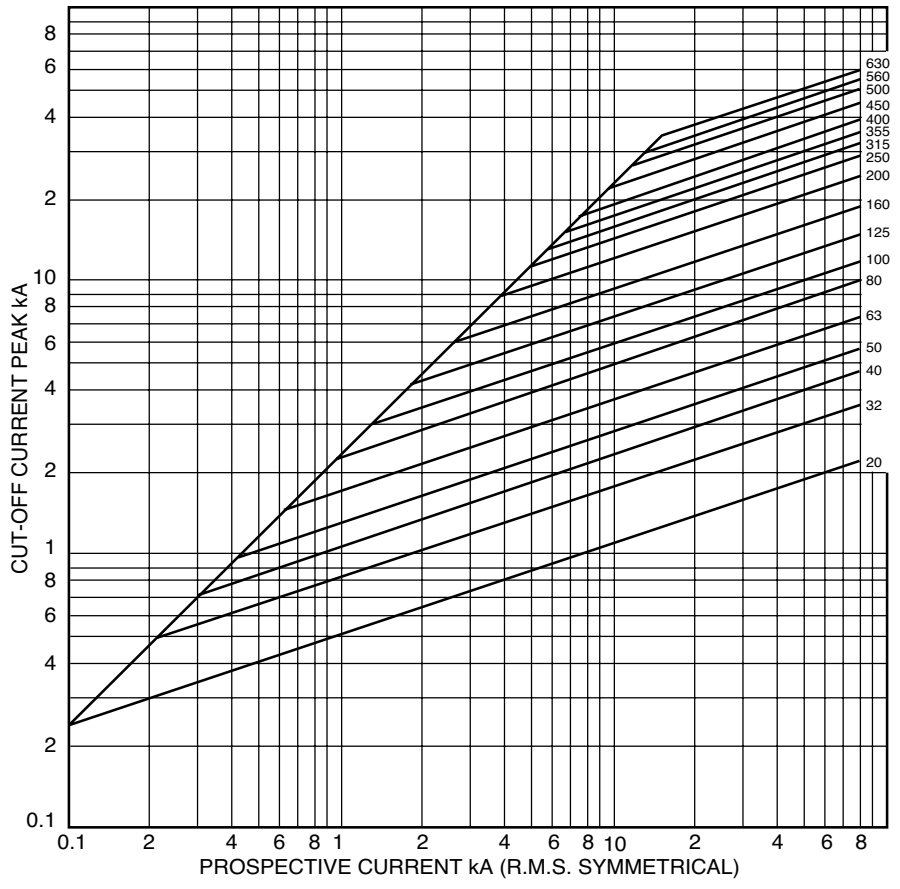
NHP COMPACT FUSES

Fuse curves

BS fuse curves



NHP Compact BS fuses from 20 to 250 amps



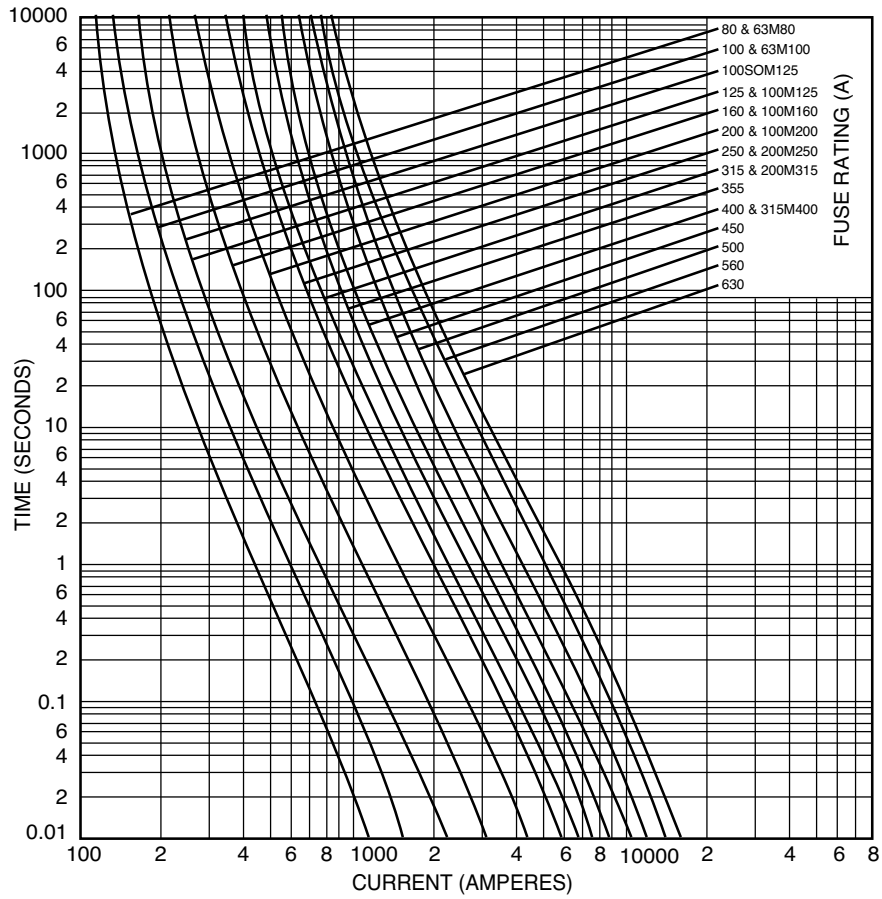
NHP Compact BS fuses cut-off current data from 20 to 630 amps

NHP COMPACT FUSES

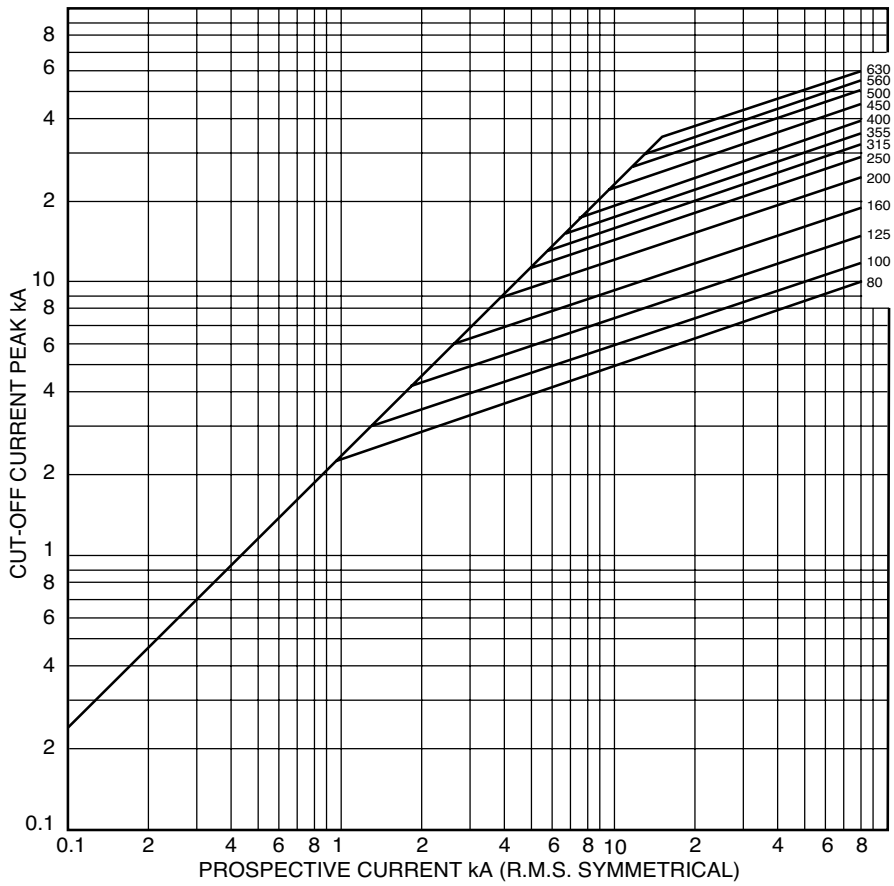
Fuse curves

BS fuse curves

NHP Compact BS fuses from 80A to 630 amps (including motor rated fuses)

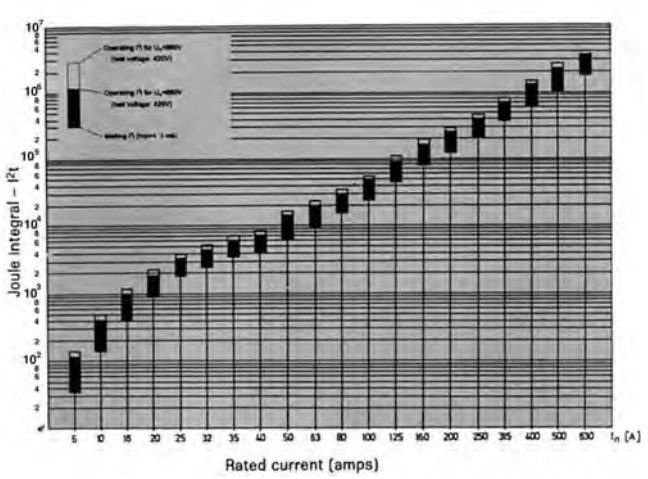


NHP Compact BS fuses cut-off current data from 80 to 630 amps



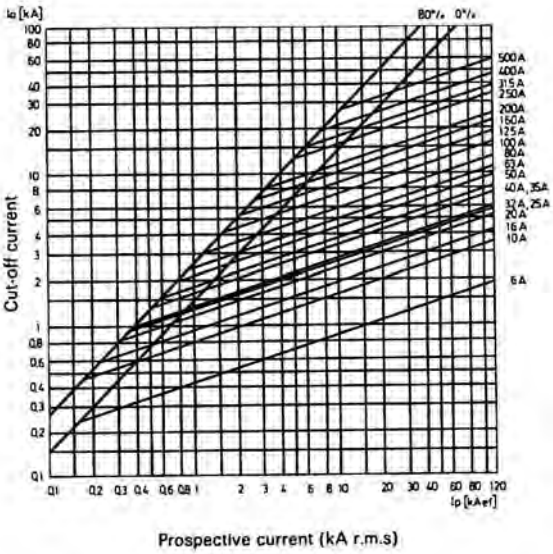
NHP COMPACT FUSES

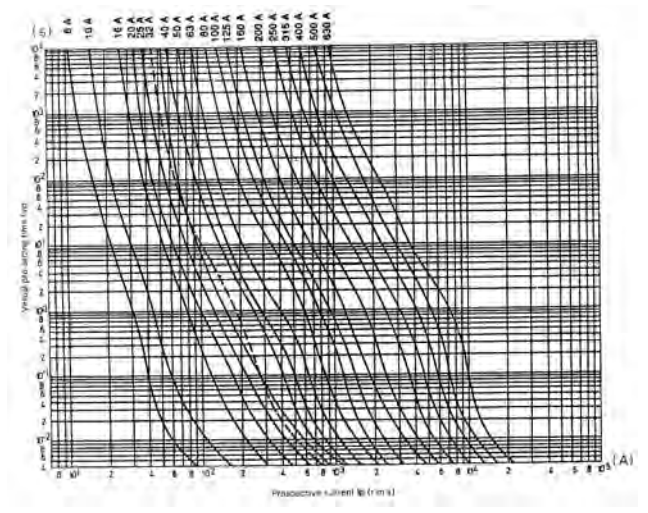
DIN fuses curves and data



NHP Compact DIN fuses
Pre-arcing and Total I²t energies, from 6 to 630 amps

NHP Compact DIN fuses
cut-off current data
from 6 to 500 amps

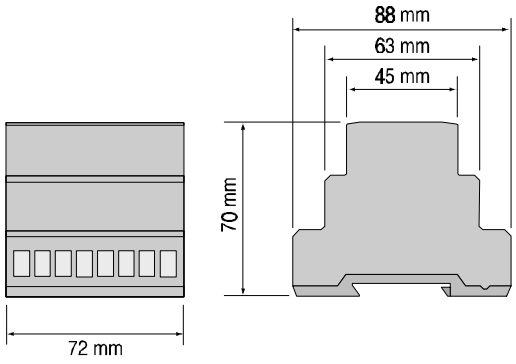




NHP Compact DIN fuses
Fuse curves
from 6 to 630 amps

FACILITY ELECTRICAL PROTECTION

CRITEC™





Detailed Specifications for ERICO's TDS-DINLINE SURGE DIVERTER TDS180-4S

Applications

Lightning transients and surges are a major cause of expensive electronic equipment failure and business disruption. Damage may result in loss of computers, data and communications, loss of revenue, and loss of profits. The new TDS-DINLINE family of surge diverters and filters offer economical and reliable protection from power transients in even the most strenuous applications.

Transient Discriminating Technology (TDS) introduces the first quantum leap in transient suppression technology for mains powered equipment. It offers a new level of safety and reliability, yet retains optimum protection levels critical for electronic equipment. TDS is an active frequency based device that discriminates between the slower mains voltages and the higher speed transients. When transient frequencies are detected the patented TDS "Quick-Switch" technology "switches in" robust protection devices to limit the transient to safe levels. The frequency discrimination circuit controlling the TDS "Quick-Switch" ensures that the device is virtually immune to the effects of the 50/60Hz sustained over-voltages, allowing fault voltages of up to 480Vrms without degradation, and providing over-voltage robustness in excess of the demanding new and emerging standards.

TDS technology is essential for any site where abnormal over-voltages can occur or where the possible catastrophic failure of traditional technologies due to over-voltage events can not be tolerated.

The TDS180-4S unit provides this technology in a single mode shunt-only, 72mm width module. Its unique design allows it to be configured for Ph-N or Ph-E or N-E applications.

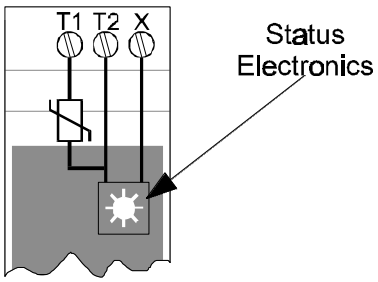
Rated to a surge capacity of 80kA (8/20µs), internally 160kA of surge material is provided for additional robustness and to provide long service life. The unit is designed for sites with a medium risk of transients or for secondary protection applications. For the protection of high exposure sites or critical equipment higher surge rated TDS DINLINE units, or TDS MOVTEC™ should be installed.

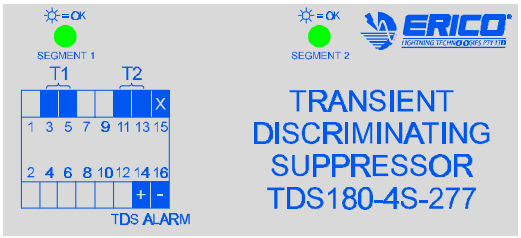
Features

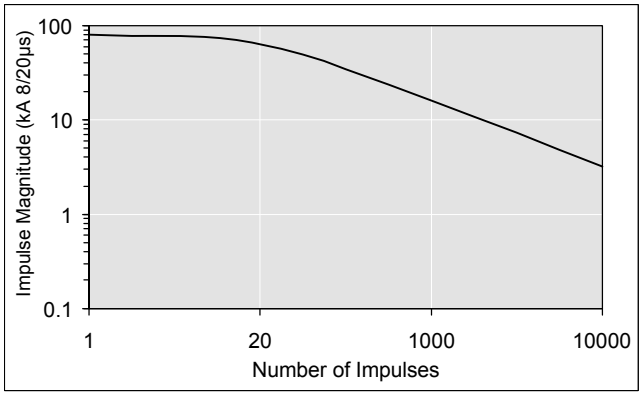
- Robust against abnormal over-voltage
- UL1449 Edition 2 compliant
- Single phase primary protection for medium exposure sites or secondary protection applications
- Single mode protection, configurable to Ph-N, Ph-E or N-E protection
- 35mm DIN rail mount, DIN 43 880 profile matches common MCBs
- 72mm width compact design fits into most switch and distribution boards
- Electronic status indicator ideal for poorly illuminated locations
- Long Service life
- Optional retrofittable TDS Alarm Relay for remote alarms

TDS-DINLINE SURGE DIVERTER TDS180-4S

SPECIFICATIONS







Operation:	
Nominal input voltage	220 -277 Vrms
Input frequency	50/60 Hz
Max. permissible abnormal over-voltage	480 Vrms
Power systems	TN-C, TN-S, TN-C-S (MEN), TT
Earth leakage current	<2mA
Protection:	
Modes	Ph-N, Ph-E or N-E
Let through voltage @ 3kA 8/20µs	<720V
Let through voltage @ 20kA 8/20µs	<910V
Surge rating 8/20µs	80kA
Surge rating 10/350µs	16kA
Energy rating	3840J
Multipulse™ capability	Yes
Aggregate surge material	160kA 8/20µs
Alarms and Indicators:	
Protection status indication	Two, electronic. On = OK
Alarm contacts	User configurable, with optional TDS-AR
Physicals:	
Environmental rating	IP20
Operating conditions	-35 to +55°C, 0-90% humidity
Enclosure style	DIN 43880
Dimensions (W x D x H)	72 x 88 x 70mm
Weight	350g (approx.)
Encapsulation	Shockguard
Enclosure material	Flame Retardent UL94V-0
Surface finish	Spark eroded finish
Wiring terminals	Accepts up to 6mm²
Warranty	5 years
Test standards:	
Approvals	UL1449 Edition 2 AS 3260, IEC 950 Certificate of suitability, Electricity Regulator
Surge rated to meet	ANSI/IEEE C62.41-1991 Cat A, Cat B, Cat C. ANSI/IEEE C62.45-1987 Life cycle testing. AS/NZS 1768-1991 Cat A, Cat.B, Cat C. BS 6651:1992 Cat A, Cat B. IEC801-5 Installation Class 5. IEC 61643-1

Note: Other operating voltages and frequencies are available on application.
For specifications on other DINLINE products, refer to relevant Specifications Sheet.
Exceeding nominal operating voltage while transient events occur may affect product life.

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Model Number	Description
TDS180-4S-277	TDS 277V 80KA SURGE SUPPRESSOR

Hobart	ph:+61 3 6237-3200	fax:+61 3 6273-0399	Adelaide	ph:+61 8 8366-6555	fax:+61 8 8366-6556
Sydney	ph:+61 2 9479-8500	fax:+61 2 9980-5092	Perth	ph:+61 8 9358-1233	fax:+61 8 9358-1404
Melbourne	ph:+61 3 9894-2677	fax:+61 3 9894-3216	Singapore	ph:+ 65-763-2477	fax:+ 65 763-2397
Canberra	ph:+61 2 6257-3055	fax:+61 2 6257-3127	Thailand	ph:+ 662 627-9037-8	fax:+662 627-9168

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TDS180.PM5 ISSUE 2.0

ERICO

DINLINE ALARM RELAY (DAR)

INSTALLATION INSTRUCTIONS



MODEL NUMBER
DAR 275V

1. PREPARATION

DANGER: *Electrical shock or burn hazard. Installation of this device should only be made by qualified personnel. Failure to lockout electrical power during installation or maintenance can result in fatal electrocution or severe burns. Before making any connections be sure that power has been removed from all associated wiring, electrical panels, and other electrical equipment.*

CAUTION NOTES:

1. *The installation of this device should follow all applicable electrical codes, such as the National Electrical Code.*
2. *Check to make sure line voltage does not exceed DAR275V voltage ratings.*
3. *Follow all instructions to ensure correct and safe operation.*
4. *Do not attempt to open or tamper with the DAR in any way as this may compromise performance and will void warranty. No user serviceable parts are contained.*

2. INTRODUCTION

Selected DSD, TDS & TDF DINLINE Surge Protection Devices include status monitoring circuits which provide visual status display of device capacity. They may also provide a low voltage opto-coupler alarm output circuit that can be connect to the DAR to provide potential free (Form C) change-over contacts. The DAR alarm contacts may be used to provide output to external alarm systems or remote monitoring circuits.

One DAR can be used per DSD/TDS/TDF opto-coupler alarm or up to 16 DSD opto-coupler alarms can be connected in series to the one DAR to provide a common output. It is recommended that the DAR be powered from the same power circuit that feeds the device(s) being monitored, however the DAR can be powered from other circuits. This allows for example, one DAR unit to be connected to separate SPDs that are protecting a three phase circuit.

Note. Depending upon the usage of the DAR output contacts, failure of power to the DAR may be interpreted as a failure of one or more of the SPDs being monitored. Visual inspection of the DAR and SPDs status displays would determine this.

3. MOUNTING

The DAR is designed to clip to 35mm (top hat) DIN rails (standard EN50022). Unless otherwise mechanically restrained, use horizontal DIN rails with the DAR module spring clips to the bottom and the label text the correct way up.

NOTE: The DAR must be installed in an enclosure or panel that:

- *prevents the DAR temperature from exceeding 131°F (55°C)*
- *provides adequate electrical and safety protection*
- *prevents the ingress of moisture and water*
- *allows DAR status indicators to be inspected*

4. ELECTRICAL CONNECTION

The interconnecting wiring should:

- be of size #10 to #14 AWG (2.5mm² to 6mm²) solid or stranded conductor.
- The wire insulation should be stripped back 5/16" (8mm).
- NOTE: Do not use greater than 9inlbs (1Nm) of torque when tightening the terminals.

CONNECTION TO TELECOMMUNICATIONS NETWORKS

The DAR is approved for use in Australia where the alarm contacts may be connected to private lines or building cabling associated with the telecommunications network. NO direct connection to the public switched network should be made.

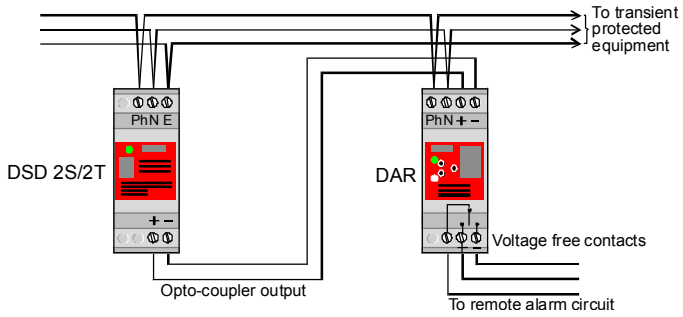
ERICO

DINLINE ALARM RELAY

INSTALLATION INSTRUCTIONS

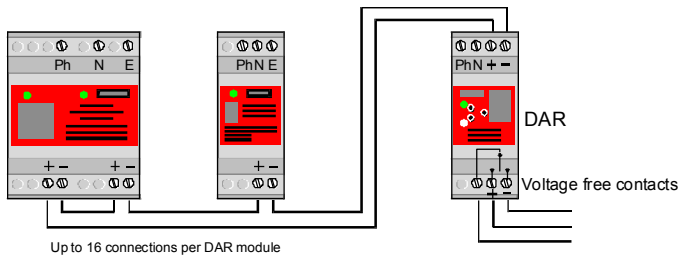
5. INTERCONNECTION

When connecting the DAR to a single opto-coupler output the + terminal of the SPD should connect to the + terminal on the DAR. The – terminal should connect to the -- terminal.



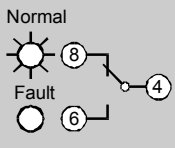
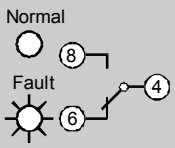
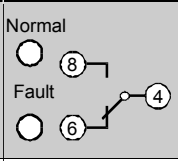
+/- terminal connections are polarity sensitive. Do not reverse.

When connecting the DAR to multiple opto-couplers the opto-couplers should be connected in series with + terminal of one connected to the – terminal of the next. The DAR + terminal should connect to + SPD terminal at one end of the series connection and the – DAR terminal connect to the – SPD terminal at the other end of the series connection.



+/- terminal connections are polarity sensitive. Do not reverse.

5. STATUS INDICATION

	✓	!	✗
STATUS	Protection Operational	Protection Alarm	Fault Mode
DISPLAY			
EXPLANATION	Normal operation Normal (green) indicator ON Red indicator OFF Relay is energised Power is supplied	DSD in alarm mode or power to DSD has been removed Normal (green) indicator OFF Red indicator ON Relay is de-energised Power is supplied	Power to DAR removed Protection status unknown Normal (green) indicator OFF Red indicator OFF Relay is de-energised Power is OFF

6. FUSING AND ISOLATION

Overcurrent protection must be installed in the upstream circuit of the power supply to the DAR to provide protection to the unit itself and the wiring in case of fault conditions.

The fuse rating should be based on the wiring size used to connect to the DAR Ph & N terminals. Australian regulations AS3000-1991, Table B2 specifies the following upstream protection for single phase circuits, unenclosed in air.

Cable Size	HRC Fuse or	CB Rewirable Fuse
1.5mm^2	16A	12A
2.5mm^2	20A	16A
4mm^2	25A	20A
6mm^2	32A	25A

Where overcurrent protection of the appropriate rating or smaller is already fitted in the upstream circuit, overcurrent protection at the DAR will not be required

6. MAINTENANCE & TESTING

Before removing a DAR unit from service, ensure that the power has been removed. Maintenance, testing and replacement should only be undertaken by qualified personnel.

Testing of a DAR unit which is connected to a fully functional DSD unit can be accomplished by removing power to the DSD only. The DAR Status indication and output contacts should alter from the Normal to Fault condition.

Testing of the DAR unit alone may be accomplished by disconnecting the + / -connections to the unit. When power is applied the DAR “Fault” Status Indicator should be illuminated. By connecting the + / - terminals together, the “Normal” Status Indicator should be illuminated. The output contacts should alter to the appropriate state.

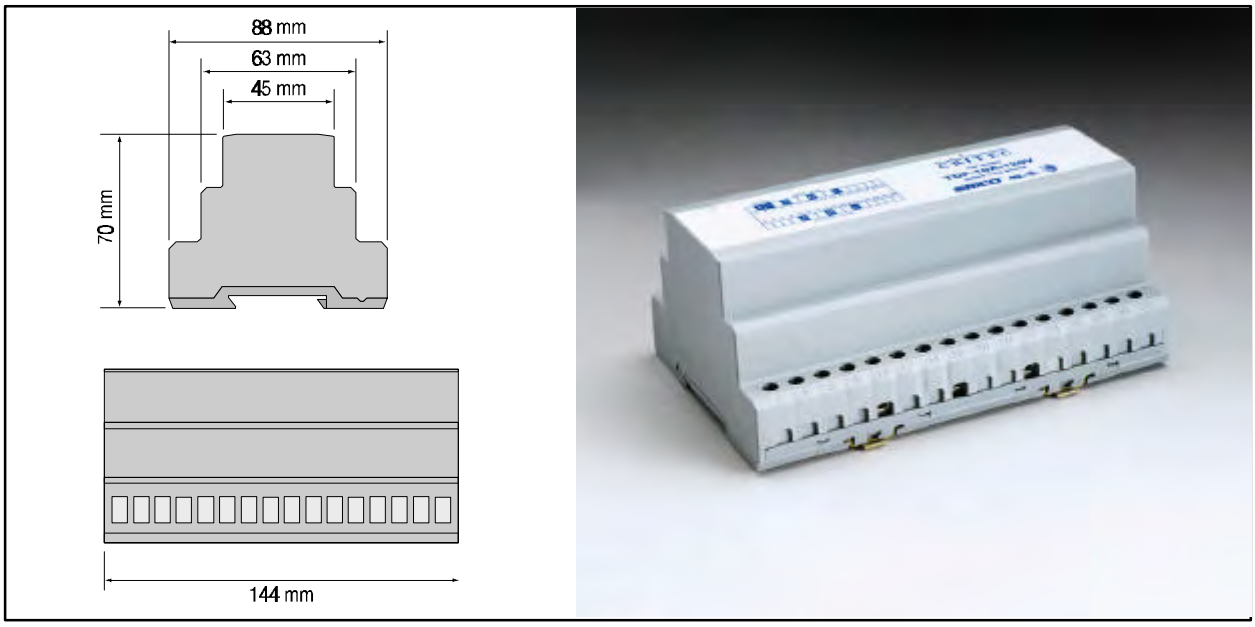
7. USE OF OTHER INTERFACES

Only DAR units are recommended for the interfacing of equipment to the DSD, TDS & TDF opto-coupler alarm output circuit(s). The direct connection of other equipment to these opto-coupler alarm outputs may not provide sufficient isolation or exceed the opto-coupler specifications. This may damage the SPD and/or the connected equipment. Warranty may be voided under such circumstances.

NOTE: *In connecting to the SPD opto-coupler alarm output(s), do not reverse the +/- connections as damage may occur.*

FACILITY ELECTRICAL PROTECTION

CRITEC™



Detailed specifications for ERICO's

TRANSIENT DISCRIMINATING FILTER, TDF-10A SERIES

Applications

Lightning transients and surges are a major cause of expensive electronic equipment failure and business disruption. Damage may result in loss of computers, data commmunications, loss of revenue, and loss of profits. The new Transient Discriminating Filter™ family of TVSS devices offer economical and reliable protection from power transients with the convenience of easy installation on 35mm DIN rail mountings.

The TDF series has been specifically designed for process control applications to protect the switched mode power supply units on devices such as PLC controllers, SCADA systems and motor controllers. Units are available for 3A, 10A and 20A loads and in a range of clamping voltages including 30V, 150V, 275V. The range is intended for use in conjunction with ERICO's Universal Transient Barrier UTB's to provide a coordinated approach to protection of both the power and data control circuits.

The TDF is a series connected **single phase surge filter** providing an aggregate surge capacity of 50kA (8/20µs) - 20kA L-N & L-G and 10kA N-G. The space efficient low pass filter, provides some 65dB of attenuation to voltage transients. Not only does this reduce the residual let through voltage, but it helps further reduce the steep rates of rise of voltage and current providing superior protection for sensitive electronic equipment.

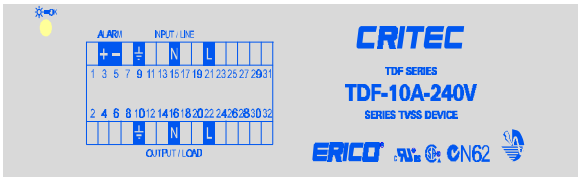
Features

- Compact design fits into most distribution boards and motor control centres
- High efficiency filtering - ideal for the protection of switched mode power supplies from large dv/dt and di/dt transients
- Three modes of protection L-N, L-G, N-G
- 35mm DIN rail mount - DIN 43 880 profile matches common MCB's
- LED indication and opto-isolated output for remote status monitoring
- Transient Discriminating Technology ensures safe operation during abnormal over-voltage events
- UL1449 Edition 2 recognized
- Large 50kA surge capacity provides a high level of protection and long operational life
- 5 year limited warranty

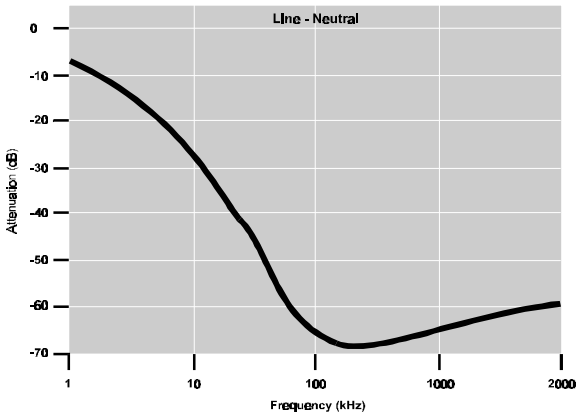
CADWELD® WELDED ELECTRICAL CONNECTIONS CRITEC® SURGE PROTECTION DEVICES ERITECH® LIGHTNING PROTECTION/GROUNDING ERICO®

PROCESS CONTROL TVSS PROTECTION

SPECIFICATIONS



Operation:		
Models available	TDF-10A-120V	TDF-10A-240V
Nominal line voltage	120VAC/125VDC	240VAC
Max Continuous Operating Voltage MCOV	170Vrms	340Vrms
Max Load Current	10A	
Input frequency	50/60Hz	
Earth leakage current	<0.2mA	
Protection:		
Max aggregate surge rating	50kA 8/20µs	
Protection modes	L-N, L-G and N-G	
Max surge current/mode L-N	20kA 8/20µs	
L-G	20kA 8/20µs	
N-G	10kA 8/20µs	
SPD circuit description	Series low pass LC filter Transient Discriminating Technology Thermal fusing	
Filter:		
Inductor	Ferrite cored	
Capacitor type	X & Y grade interference suppression polypropylene film	
Attenuation @100kHz L-N	65dB	
Performance:		
UL1449 SVR L-N	500V	700V
ANSI/IEEE C62.41 Cat B3 - 500A ringwave	22V	28V
Cat C1 - 3kA, 8/20µs	262V	481V
Alarms and Indicators:		
Protection status indication	Red LED, On = OK. Opto-isolated output	
Physical Data:		
Dimensions(W x D x H)	144mm x 88mm x x70mm	
Weight	750g (approx)	
Enclosure material	Flame Retardant UL94V-O	
Connection means	Screw terminals	
Wire size	1.0mm^2 - 6.0mm^2	
Mounting method	DIN T35 Rail	
Enclosure style	DIN 43880	
Environmental rating	IP20	
Opearting temperature	-30°C to +55°C	
Humidity	0-90%	
Surface finish	Spark eroded finish	
Warranty	5 years	
Test standards:		
Approvals	UL1449 Ed 2, UL1283 recognised, CSA22.2 C-Tick AS3260	
Surge rated to meet	ANSI/IEEE C62.41 Cat A, Cat B, Cat C AS/NZS 1768-1991 Cat A, B, C	



Frequency performance of TDF-10A filter

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Part Number	Description
TDF-10A-120V	120V 1 phase, 50kA 8/20µs, 10A series TVSS protector
TDF-10A-240V	240V 1 phase, 50kA 8/20µs, 10A series TVSS protector

Hobart	ph:+61 3 6237-3200	fax:+61 3 6273-0399	Adelaide	ph:+61 8 8366-6555	fax:+61 8 8366-6556
Sydney	ph:+61 2 9479-8500	fax:+61 2 9980-5092	Perth	ph:+61 8 9358-1233	fax:+61 8 9358-1404
Melbourne	ph:+61 3 9894-2677	fax:+61 3 9894-3216	Singapore	ph:+ 65-763-2477	fax:+ 65 763-2397
Canberra	ph:+61 2 6257-3055	fax:+61 2 6257-3127	Thailand	ph:+ 662 627-9037-8	fax:+662 627-9168

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tdf10a.pm5

1.6. RTU & RADIO

- KINGFISHER – **BA-6** – RTU Backplane (6 Slot)
- KINGFISHER – **PS-22** – Power Supply
- KINGFISHER – **CP-12** – Processor Module
- KINGFISHER – **DI-5** – 16 Channel Digital Input Module
- KINGFISHER – **DO-1** – 8 Channel Digital Output Module
- KINGFISHER – **IO-3** – Mixed I/O Module
- RADTEL – **MIRI AD2006** - Radio

Kingfisher PLUS+

Modular RTU Hardware Reference Manual 7.12



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Revision History		
Version Number	**Date**	**Summary**
6.11	2/10/2010	Added PSU-4 power supply (higher power version of the PSU-3). PS-xx temperature sensor wires are now red with a black stripe. Added PS-22, IO-5 and MC-31 modules
7.0 7.1 7.12	28/10/2011	Update: adaptor ADP-22B (include Wavecom extend) Update: temp sensor is white / white with a black strip Update: power requirements of T option board Update: power calculation tables Update: Comms option boards selection table Update: safety warnings Update: Lenses for PS-12 and PS-22 Update: Lens for MC-31 Proposed 'Linked Backplane Example' chapter removed Update: Various errors found in first release Added CP-12 power consumption Added CP-30/MC-30/MC-31 to compatibility chapter Corrected compatibility chapter and added CP-12 Corrected various spelling and grammatical mistakes.

Contents

1. INTRODUCTION 7
2. BACKPLANES 8
2.1. Module Dimensions 9
2.2. BA-4-PLUS: 4 Slot Backplane 10
2.3. BA-4-PLUS External Connections 11
2.4. BA-40-PLUS: 4 Slot Backplane 12
2.5. BA-40-PLUS External Connections 13
2.6. BA-6-PLUS: 6 Slot Backplane 14
2.7. BA-6-PLUS External Connections 15
2.8. BA-12-PLUS: 12 Slot Backplane 16
2.9. BA-12-PLUS External Connections 17
2.10. Linking Backplanes 18
2.11. Rack Slot Numbering 19
2.12. Backplane DIP Switch Settings 20
3. POWER SUPPLY MODULES 21
3.1. PS-12 Power Supply module 22
3.2. PS-22 Power Supply Module 31
3.3. PSU-3: 40 Watt AC Power Supply Unit 39
3.4. PSU-4: 40 Watt AC Power Supply Unit 42
3.5. Calculating Power Requirements 45
3.6. 5 V Rail Overload Check 47
3.7. Total Power Load 49
3.8. Battery Backup 50
4. PROCESSOR MODULES 51
4.1. PC-1: Power & Processor Module 53
4.2. CP-12 Processor Module 59
4.3. CP-30: High Performance Processor Module 64
5. COMMUNICATIONS MODULES 69
5.1. MC-12 Communications Module 70
5.2. MC-31 Communications Module 74
6. COMMUNICATIONS OPTION BOARDS 78
6.1. Option Board I: Isolated serial 79
6.2. Option Board F: Fibre Optic Serial Board 82
6.3. Option Board D: 33.6 Kbps Dial Option Board 83
6.4. Option Board L: Line/Analogue Radio Interface 85
6.5. Option Board H: HART Interface 90
6.6. Option Board T3: 10/100 Ethernet Controller 93
6.7. Option Board A3:Fibre Optic Ethernet 93
6.8. Option Board R2: Australian Spread Spectrum Radio 94
6.9. Option Board R3: International Spread Spectrum Radio 96
6.10. Option Board R4: US/Canada Spread Spectrum Radio 98
7. PC-1 OPTION BOARDS 100
7.1. PC-1 Serial Option Board 100
7.2. PC-1 Modem Board PL: Two Wire Line 101

7.3. PC-1 MODEM BOARD: ANALOGUE RADIO INTERFACE 102
8. COMPATIBILITY 103
Communications Option Boards 103
9. ANALOGUE INPUT MODULES 104
9.1. AI-1: 8 CHANNEL ANALOGUE CURRENT INPUT MODULE 105
9.2. AI-10: 8 CHANNEL HIGH IMPEDANCE ANALOGUE INPUT MODULE 110
10. ANALOGUE OUTPUT MODULE 115
10.1. AO-3: ANALOGUE OUTPUT MODULE 115
11. DIGITAL INPUT MODULES 120
11.1. DI-5: DC INPUT 16 CHANNEL DIGITAL INPUT MODULE 121
12. DIGITAL OUTPUT MODULES 130
12.1. DO-1: 8 CHANNEL ISOLATED RELAY OUTPUT MODULE 132
12.2. DO-2: 16 CHANNEL RELAY OUTPUT MODULE 136
12.3. DO-6: 16 CHANNEL OPEN DRAIN OUTPUT MODULE 140
13. RELAY EXPANSION BOARDS 144
13.1. TEL REL 002: SPST RELAY BOARD 145
13.2. TEL REL 003: SPST RELAY BOARD 149
13.3. TEL REL 004: DPDT RELAY BOARD 153
14. COMBINATION IO MODULES 157
14.1. IO-2: COMBINATIONAL DIGITAL IO MODULE 158
14.2. IO-3: COMBINATIONAL ANALOG/DIGITAL IO MODULE 162
14.3. IO-4: COMBINATIONAL ANALOGUE / DIGITAL IO MODULE 170
14.4. IO-5: COMBINATIONAL ANALOGUE / DIGITAL IO MODULE 177
15. ADAPTORS AND CABLES 184
15.1. RTU TEST CABLES 186
RJC-X-Over: Kingfisher PLUS RJ45 to RH45 RS232 Null Modem Cable (serial crossover) 186
RJC-X-Over-E: Kingfisher PLUS+ RJ45 to RJ45 Ethernet Crossover Cable 186
15.2. DEVICE CABLES AND ADAPTORS 187
ADP-04: PC-1/MC-1 Radio Port to Tait T2010 or Maxon RDM-01 Radio (SD125) 187
ADP-05: RTU Serial Port to PC Serial Port (Creates a null modem cable) 187
ADP-07: RTU Serial Port to External PSTN Modem 188
ADP-08: RJ45 to DB9 Female Converter (Straight Connect) 188
ADP-08-M: Serial Port to Digi External Spread Spectrum Radio 189
ADP-09: Serial Port to HITECH or Nematron Display Panel 189
ADP-16: Serial Port to Trio D-Series Radio or Trio E Series Radio 190
RJC-ADP-17: PC-1/MC-1 Radio Port to Trio S- Series Radio 190
RJC-ADP-18: CP-xx Line Option Board to Maxon Analogue Radio (Maxon SD-125) 191
RJC-ADP-20: CP-xx Line Option Board to Trio S Series Analogue Radio 192
RJC-ADP-21: CP-xx Line Option Board to Tait T2010 Analogue Radio 193
RJC-ADP-22B: Serial Port to Wavecom GSM 194
RJC-ADP-23: PC-1/MC-1 Radio Port/Serial Port to Trio S- Series (SB) Repeater 195
RJC-ADP-26: Serial Port to Maxon MM-6280IND 3G Data Modem 195
RJC-ADP-27: RTU Serial Port to Motorola 9522 Satellite Transceiver 196
ADP-28: RTU Serial Port to Trio H–Series Spread Spectrum Radio 196
ADP-29: Serial Port to Trio M Series Radio (with modem fitted) E.g. MR540 197
RJC-ADP-30: CP-xx Line Option Board to Trio M Series Analogue Radio 197
ADP-31: PC-1/MC-1 Radio Port to Trio M Series Analogue Radio (no modem fitted) E.g. MR540 198
CAB-FO-PATCH-1: A3 Ethernet MTRJ Fibre Optic to 2 × ST adaptor cable 199

CAB-FO-PATCH-2: A3 Ethernet MTRJ Fibre Optic to 2 × SC adaptor cable.....199
16. ACCESSORIES.....200
17. GLOSSARY 203
18. APPENDIX.....204

1. Introduction

A Kingfisher PLUS+ Remote Terminal Unit (RTU) is a highly configurable device that can monitor and control a wide range of equipment.

This manual details the specifications for each type of module, option board, cable and accessory available for use with a Kingfisher PLUS+ Modular RTU.

There are three types of Kingfisher PLUS+ modular RTUs identified by the processor module they contain: PC-1, CP-12 or CP-30



PC-1 CP-12 CP-30

Modular RTUs support up to 64 modules, 16 communications ports and 1008 IO (input/output) points. Each modular RTU has at least one backplane, a power supply and a processor module.

A PC-1 RTU is powered using an external AC/DC power supply. A PC-1 processor module is only used on a BA-4 PLUS backplane (4 slot).

A CP-12 or CP-30 RTU is powered using a power supply module (or modules) and utilizes one of three backplanes: a BA-40 PLUS (4 slot), a BA-6 PLUS (6 slot) or a BA-12 PLUS (12 slot).

IO (input/output) modules can be added to the RTU in any combination as required. To obtain more communications ports, one or more communications modules can be added to the RTU.

2. Backplanes

Backplanes allow the processor module to communicate with the other modules in the RTU. The backplane also allows power to be supplied to each module. Multiple backplanes can be linked together to create an RTU with up to 64 modules. All backplanes can be surface mounted. BA-12 backplanes can also be mounted in a 19" rack.

Backplanes are available in four versions:

BA-4 : 4 slot backplane for use with PC-1

BA-40 : 4 slot backplane

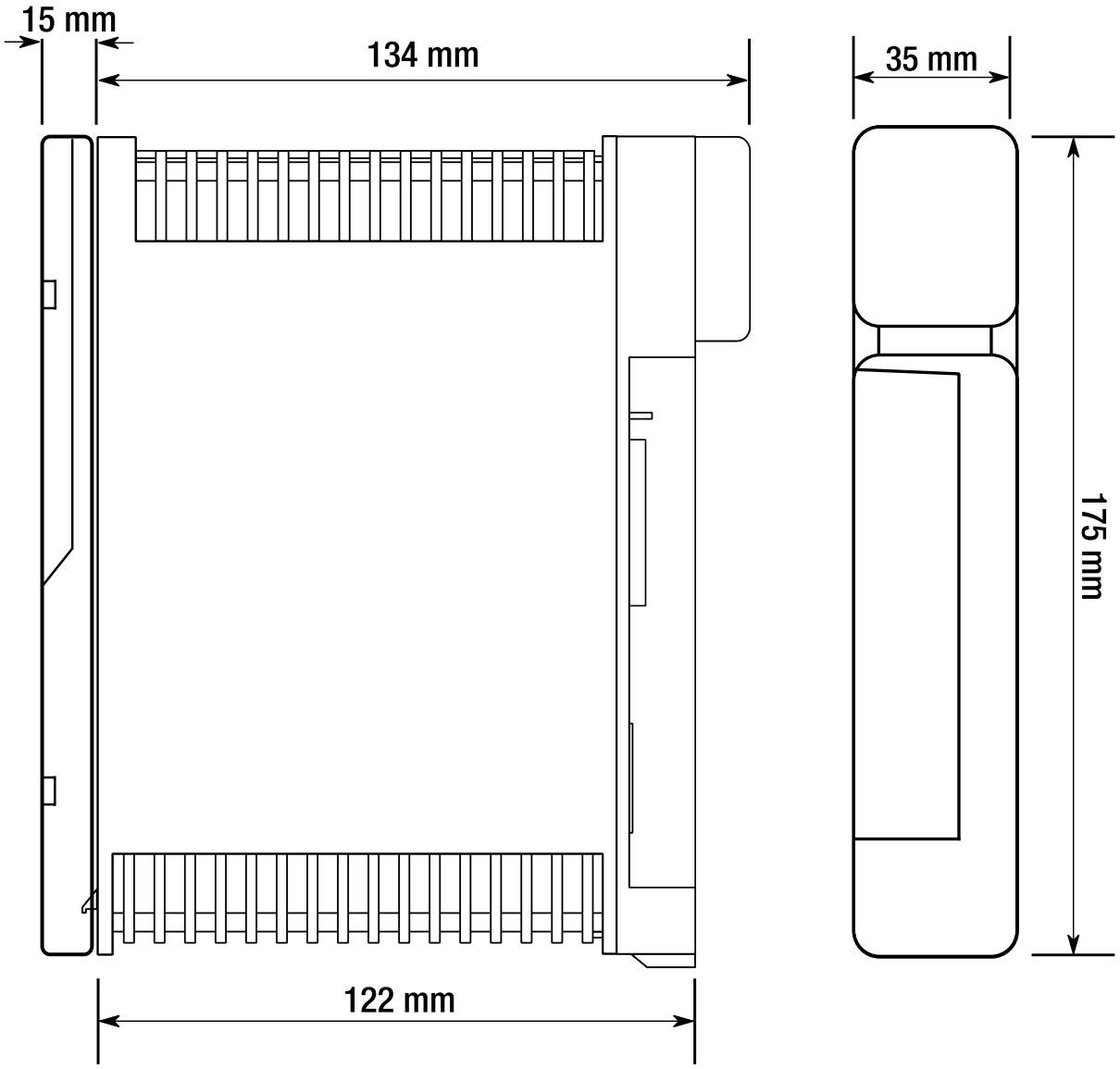
BA-6 : 6 slot backplane

BA-12 : 12 slot backplane

Note: the above part number is followed by **-PLUS** when the backplane uses the green Phoenix terminals for the inter-rack data connectors.

A pair of Phoenix plugs can be obtained to create an inter-rack data cable. Use Phoenix Contact type **Plug MC 1.5/7-ST-3.5 (1840418)** or equivalent. Alternatively, data cables can be ordered from your Kingfisher supplier.

2.1. Module Dimensions



Module is shown in backplane.

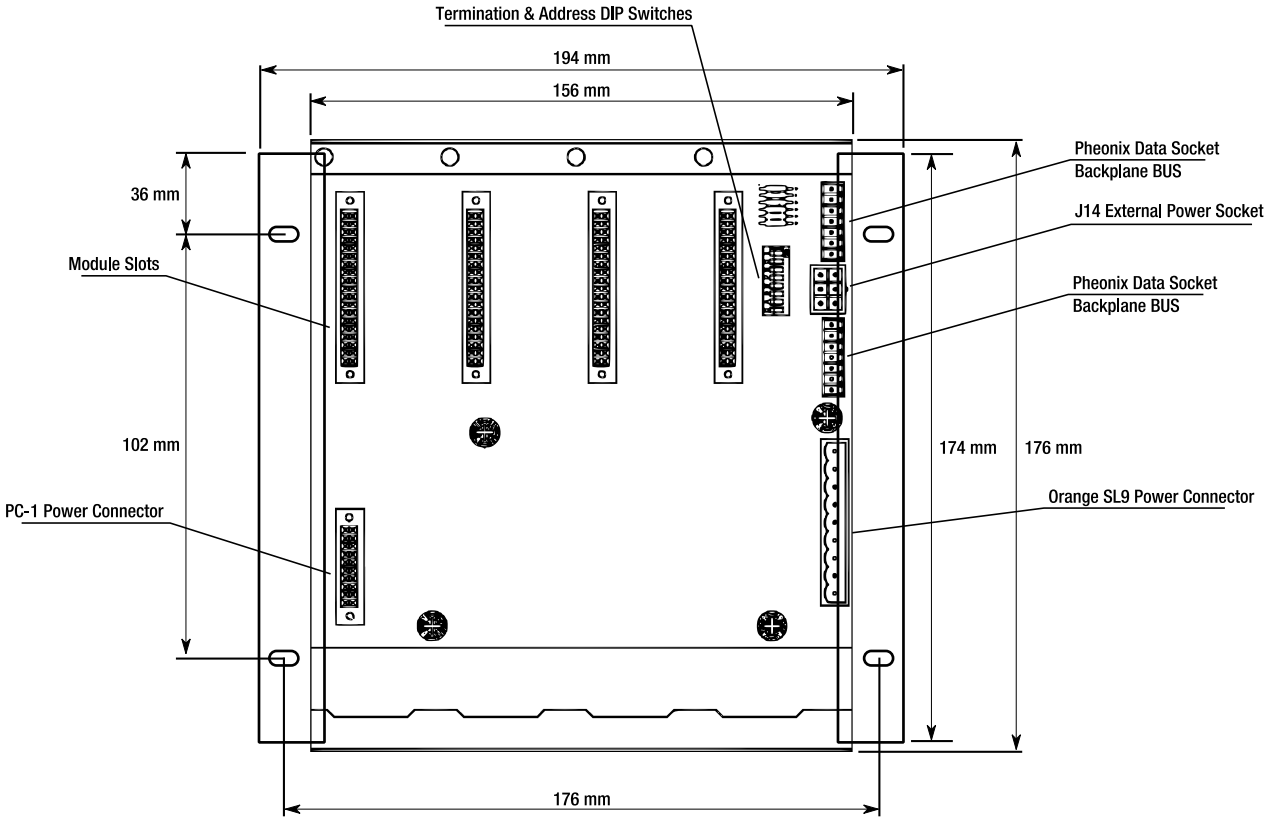
2.2. BA-4-PLUS: 4 Slot Backplane

A BA-4 PLUS backplane is designed to be used with a PC-1 power and processor module. The PC-1 is installed in the left slot and any IO or communications modules can be installed in the other 3 slots.

Please use a BA-40 PLUS backplane if requiring a 4 slot backplane for use with a processor and PS-xx power supply.

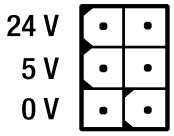
There are three (3) connectors at the far right of the backplane. There are two green 7-way connectors for linking backplanes together and there is one 6-way connector to supply power to a second linked backplane.

The 4-slot backplane is designed for surface mounting. Mounting brackets (2 pieces) are supplied for user fitting.

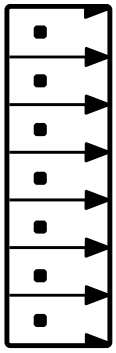


2.3. BA-4-PLUS External Connections

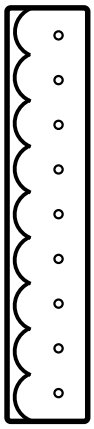
J14 Power Socket:



J13 (in) and J15 (out) inter-rack Phoenix Data Sockets:



Orange SL9 Power Socket:



The SL9 connector is only present on the **BA-4 PLUS** backplane for use with the **PC-1** Power Supply & Processor Module.

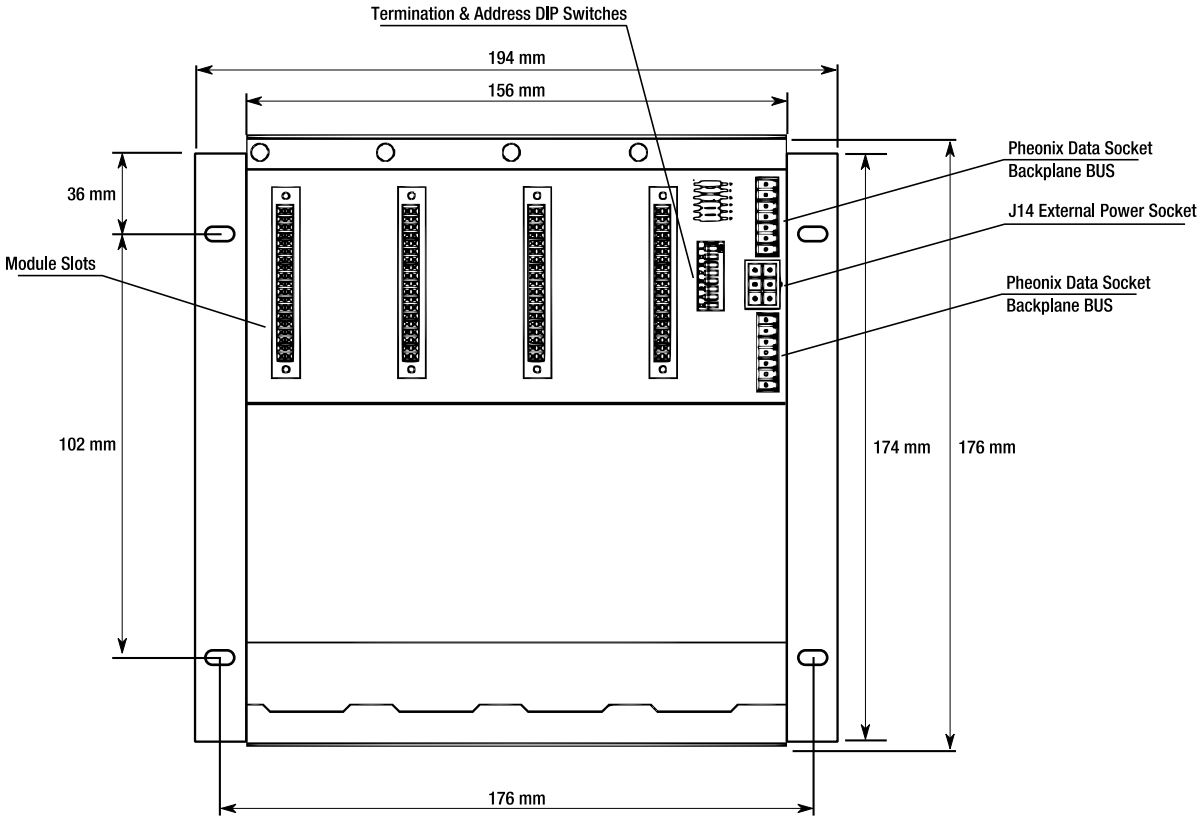
2.4. BA-40-PLUS: 4 Slot Backplane

A BA-40 PLUS backplane is identical to a BA-4 PLUS backplane excepting the J5 (PC-1 lower connector) and SL-9 (PC-1 power) connectors have been removed.

A BA-40 PLUS is designed to be used with a **PS-xx** power supply and a **CP-xx** processor module or linked to any other backplane to provide additional slots.

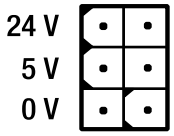
There are three (3) connectors at the far right of the backplane. There are two green 7-way data connectors for linking backplanes together and there is one 6-way connector for external power (+5 V and +12 V DC) if a power supply module is not installed on the backplane.

The 4-slot backplane is designed for surface mounting. Mounting brackets (2 pieces) are supplied for user fitting.

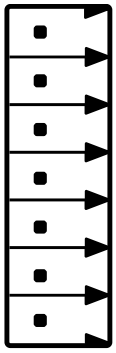


2.5. BA-40-PLUS External Connections

J14 Power Socket:



J13 (in) and J15 (out) inter-rack Phoenix Data Sockets:

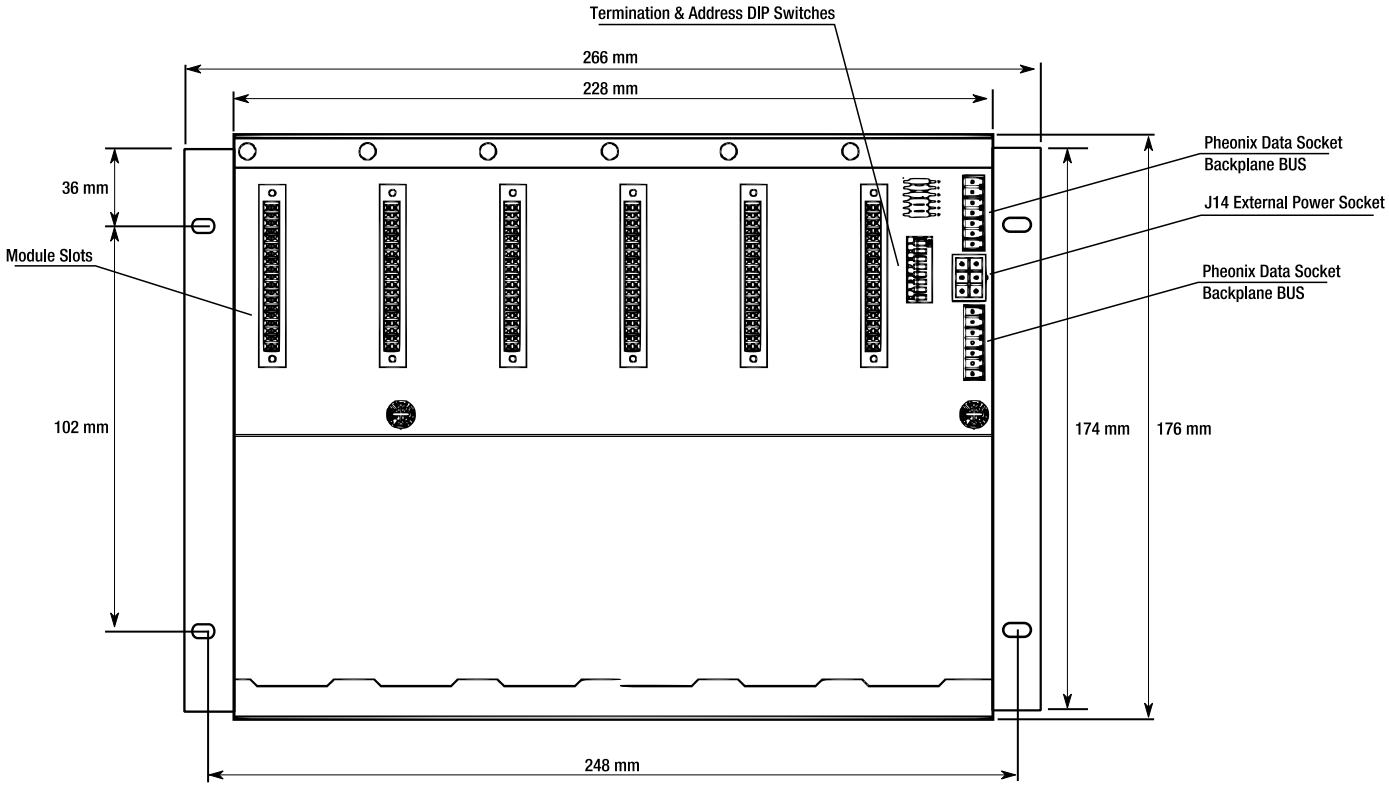


2.6. BA-6-PLUS: 6 Slot Backplane

The BA-6-PLUS six slot backplane is designed to support any power supply, IO or communications module in any slot position. A BA-6-PLUS is designed to be used with a **PS-xx** power supply and a **CP-xx** processor module or linked to any other backplane to provide additional slots.

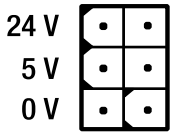
There are three (3) connectors at the far right of the backplane. There are two green 7-way data connectors for linking backplanes together and there is one 6-way connector for external power (+5 V and +12 V DC) if a power supply module is not installed on the backplane.

This backplane is designed for surface mounting. Mounting brackets (2 pieces) are supplied for user fitting.

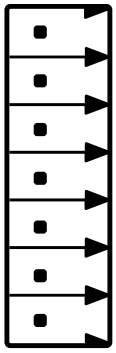


2.7. BA-6-PLUS External Connections

J14 Power Socket:



J13 (in) and J15 (out) inter-rack Phoenix Data Sockets:



CM- Communications Link
CM+ Communications Link
CSR Processor Interrupt
GND Signal Ground
PCON Power Control
IO- IO Link
IO+ IO Link

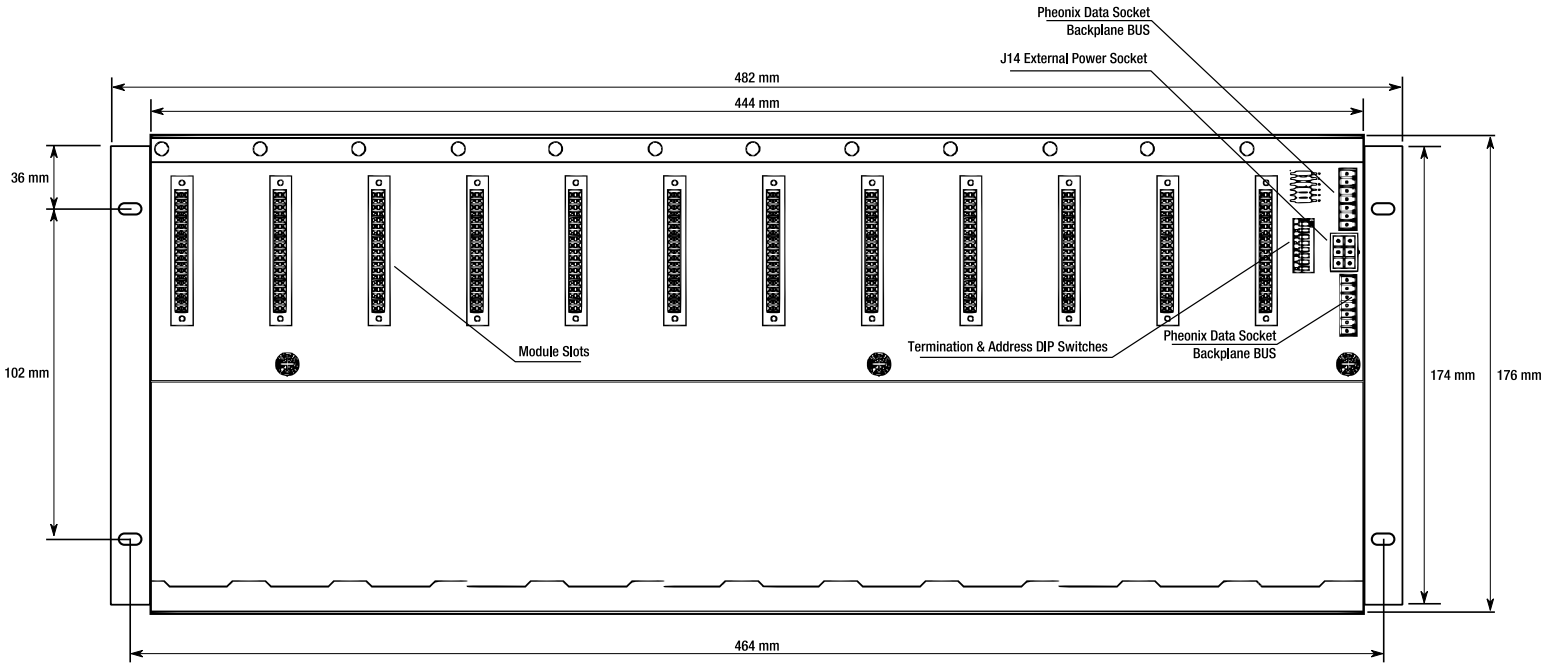
2.8. BA-12-PLUS: 12 Slot Backplane

TheBA-12-PLUS twelve slot backplane is designed to support any power supply, IO or communications module in any slot position.

A BA-12-PLUS is designed to be used with a PS-xx power supply and a CP-xx processor module or linked to any other backplane to provide additional slots.

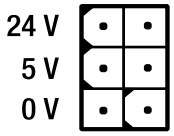
There are three (3) connectors at the far right of the backplane. There are two green 7-way data connectors for linking backplanes together and there is one 6-way connector for external power (+5 V and +12 V DC) if a power supply module is not installed on the backplane.

This backplane is designed for surface mounting. Mounting brackets (2 pieces) are supplied for user fitting. Mounting in a 19" rack may be achieved using the alternative MBR-3 rack mounting brackets.

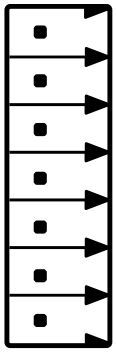


2.9. BA-12-PLUS External Connections

J14 Power Socket:

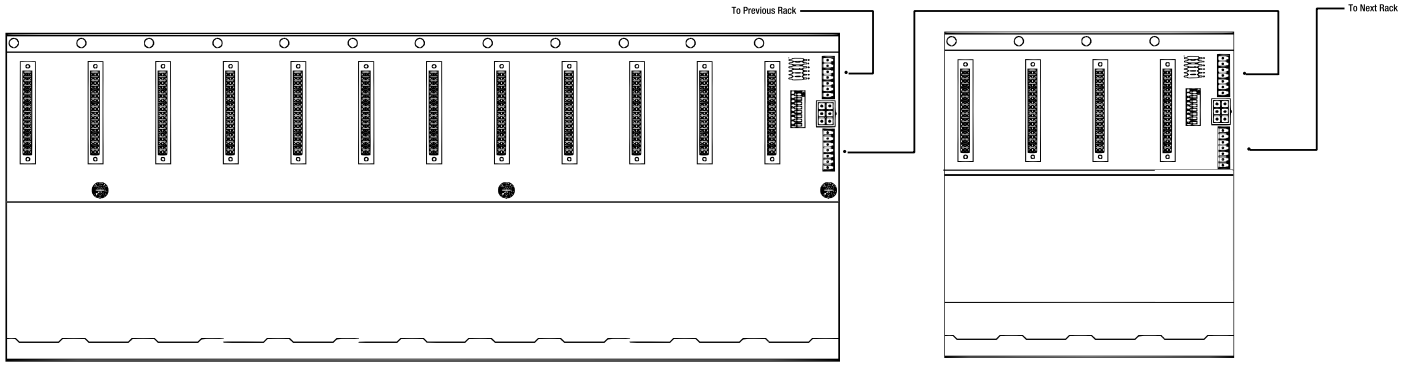


J13 (in) and J15 (out) inter-rack Phoenix Data Sockets:



2.10. Linking Backplanes

Backplanes can be linked together into ‘racks’. Each rack can have a maximum of 16 slots. Below is a full rack consisting of a BA-40 PLUS linked to a BA-12-PLUS.



Each backplane has an IN and an OUT connector linking it to the RTU data bus. The connector used (J13 or J15) varies according to the revision number of the backplane.

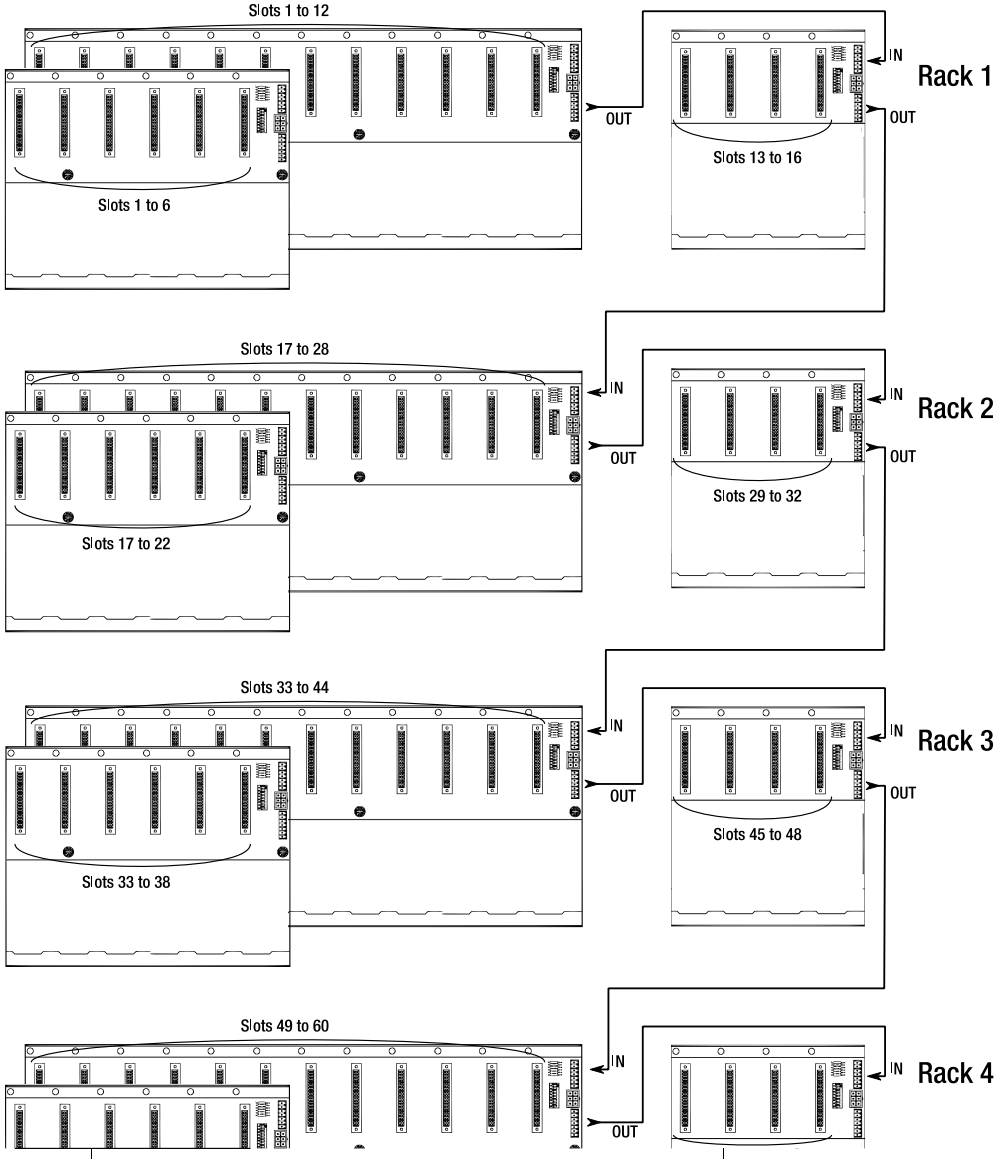
A single RTU can support up to 4 racks providing a total of 64 modules slots.

Each backplane has data bus terminators (resistors) that can be switched ON or OFF. A chain of backplanes requires the terminators to be switched ON for the first and last backplane in the chain as detailed below. Intermediate backplanes must have terminators switched OFF.

2.11. Rack Slot Numbering

Backplanes have hard-coded Slot Numbers that can be set to four different ranges that determine the Rack Number. The BA-4 PLUS and BA-6-PLUS backplanes occupy the start of each rack, while the BA-4 PLUS (and BA-40 PLUS) occupies the later address space of each rack.

Each backplane has an IN and OUT connector linking it to the data bus, and termination resistors that can be toggled ON and OFF via DIP switches. Linked backplanes that use the same address space (by default) must be set to different rack numbers to avoid clashes. Users should be mindful of these settings.



2.12. Backplane DIP Switch Settings

The following table outlines the DIP switch configuration required for the most recent hardware revisions (2.1, 2.2 and 3.2).

For previous hardware versions please refer to the superseded hardware manual available on MyKingfisher.

	Total Number of Racks in RTU			
Switch Settings	**1 Rack**	**2 Racks**	**3 Racks**	**4 Racks**
1st Rack				
2nd Rack				
3rd Rack				
4th Rack				

Note that supplementary to the data bus connection, each backplane requires a Power Supply Module or a power cable connected to J14.

3. Power Supply Modules

The Kingfisher Power Supply Modules allow real time monitoring of currents, voltages and temperatures supplied to the RTU and the backup battery. The monitoring capability also allows the RTU to determine when a supply has failed if in a redundant configuration.

If fitted, auxiliary supplies can be overridden manually or by logic to allow for external equipment or sensor loops to be shut down or reset.

The two following modules are the current hardware revision. For previous generations of Power Supply Modules, please refer to the superseded Hardware Manual available on MyKingfisher.

3.1. PS-12 Power Supply module

- **Monitoring of rail voltages, supply & battery currents and temperature**
- **AC or DC input**
- **Support for redundancy (several supplies per backplane)**
- **Isolated DC output**
- **Sealed Lead Acid battery connection with charging/monitoring and low voltage protection**
- **Software controlled power to the Backplane and Aux Outputs**

The PS-12 provides AC/DC conversion into 12 VDC and 5 VDC for the backplane, as well as 12 VDC and optional 24 VDC auxiliary outputs. Both auxiliary outputs can be controlled by the RTU logic configuration.

The PS-12 is supplied with internal temperature sensor to monitor its PCB temperature and an optional external temperature sensor to monitor an attached battery. When a backup battery is connected, the supplied external sensor should be mounted as close as possible to the negative terminal of the battery to ensure correct temperature compensation. If readings from the external sensor are out of range, internal sensor data is used. Please note the charge circuitry is designed for float operation and short term boost of batteries already charged and in good condition. Use of this supply on flat or fully discharged batteries may cause damage to the module.

The Rail Voltage, Supply Current, Battery Current, internal and, optionally, external temperature monitoring circuits enable the RTU to monitor and to control all functions of the PS-12 module. The Processor Module has access to many of these values as analog and digital points in the system.

If the Mains supply fails and the system is powered from the backup battery, the PS-12 enters Low Battery Shutdown when battery voltage drops below 10.6 V. All outputs are switched OFF for battery preservation, including Backplane power as well – effectively meaning that the whole RTU will be shut down. PS-12 switches itself to the lowest power consumption mode possible, further preserving the battery from deep discharge. PS-12 checks rail voltage regularly, and the Backplane power will be restored when +12V_RAIL voltage rises above 12.4 V (if no Mains present) or 11.5 V (if Mains present).

Besides various hardware protection features, PS-12 firmware provides additional protection from overload. If output power exceeds its maximum specified power, the SMPS will enter an Overload Mode. Its output voltage will be ramped down and, if overload still exists when it reaches 10.0 V (minimal output voltage), it will switch all outputs off, similar to Low Battery Shutdown. PS-12 will attempt to switch the Backplane ON again regularly. RTU power will be restored permanently when overload condition is removed.

A power supply module can be installed in any I/O slot of a 4, 6 or 12 slot backplane. Several Power Supply modules of any type can be installed on a backplane thus providing redundant and alternative power source configurations.

Fire Risks



A supply voltage outside the specified limits may cause fire.

Electrical Hazards



Only appropriately qualified and trained personnel can install and service this equipment.

Mains Power must be connected in accordance with local national wiring rules and regulations. Building installation shall provide appropriate short-circuit backup protection.

Always remove input mains voltage (by disconnecting power cord from the mains power outlet or by switching off an external circuit breaker, depending on installation) before performing any operation on this product. Failure to do so may cause fire and may result in a serious personnel injury or even death.

Disconnect power cord from the Power Supply Module before wiring, removing or servicing.

Warning



The earth Terminals in the mains power inlet provide only **FUNCTIONAL EARTH** / Ground connection and cannot be relied upon for safety purposes.

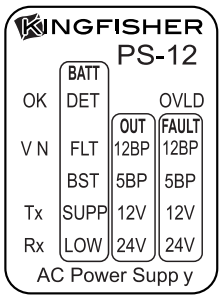
Battery Charging

Whenever the battery begins to draw more than 100 mA out of the power supply (e.g. when the power supply is first turned on or a battery is connected), the power supply assumes that a fully discharged backup battery just has been connected and starts its Boost charge. After Boost charging the battery for the estimated time (3-10 hours, see below for details, **BATT DET** and **BATT BST** LEDs ON), the power supply will switch to Float charging (**BATT DET** and **BATT FLT** LEDs ON).

PS-12 also maintains estimated capacity of the connected Sealed Lead Acid battery and this value is provided to the system Processor Module. For the algorithm to work properly, a correct battery capacity should be provided to the PS-12 via the Toolbox / RTU configuration setup. When battery is initially detected, it is assumed to be fully discharged. Boost charging time mentioned earlier is calculated based on the provided battery capacity value. Estimated battery capacity is increased by integrating measured current flowing into the battery over the time till it reaches the stated battery capacity. When battery current becomes negative (for instance, if Mains power is out and the RTU runs from the battery), this current is integrated over the time and subtracted from the estimated battery capacity till it reaches zero.

Please note that PS-12 cannot distinguish between the real battery connection and the connection of any other (generic) load or power source to the battery terminals, as it detects such connections only by measuring the Battery Current. As a result, all BATT LEDs may exhibit several various combinations depending on kind of load / source connected to the B terminals.

Module LEDs



LED	State	Description
OK	OFF	Module fault (no power)
	Blinking	No communications with RTU Processor Module
	ON	Normal
VIN	OFF	Mains not present / SMPS not running
	ON	SMPS running [1]
TX	OFF	No data being sent to Processor Module
	ON	The PS-12 is sending data to Processor Module via Backplane
RX	OFF	No data being sent by other modules
	ON	Any RTU module sends data via Backplane
BATT DET	OFF	No battery nor load nor DC source connected to B terminals[2]
	ON	Battery or load or DC source connected to B terminals
BATT FLT	OFF	Battery is not in Float Charge mode
	ON	Battery is slow (float) charging
BATT BST	OFF	Battery is not in Boost Charge mode
	ON	Battery is fast (boost) charging
BATT SUPP	OFF	Battery does not supply current to the PS-12
	ON	Battery sources more than 0.1 A[3] current to the PS-12[4]
BATT LOW	OFF	+12V_RAIL voltage has risen above 12.4 V[4]
	ON	+12V_RAIL voltage has fallen below 11.5 V[4]
OUT 12BP	OFF	Backplane power is switched OFF: either start-up or shutdown
	ON	Backplane power is switched ON
OUT 5BP	OFF	Backplane power is switched OFF: either start-up or shutdown
	ON	Backplane power is switched ON
OUT 12AUX	OFF	12VAUX is switched OFF
	ON	12VAUX is switched ON
OUT 24iAUX	OFF	24ViAUX is switched OFF
	ON	24ViAUX is switched ON
OVLD	OFF	PS-12 is not in Overload Mode
	BLINKING	In Overload Mode. Output voltage will be ramped down
FAULT 12BP	OFF	Backplane power is switched OFF or it is ON and 12VBP is above 9 V[4]
	ON	Backplane power is switched ON and 12VBP is below 9 V[4]
FAULT 5BP	OFF	Backplane power is switched OFF or it is ON and 5VBP above 2 V[4]
	ON	Backplane power is switched ON and 5VBP is below 2 V[4]
FAULT 12AUX	OFF	12VAUX is switched OFF or it is ON and above 9 V[4]
	ON	12VAUX is switched ON and it is below 9 V[4]
FAULT 24iAUX	OFF	24ViAUX is switched OFF or it is ON and above 18 V[4]
	ON	24ViAUX is switched ON and it is below 18 V[4]

PS-12 Specifications

<table>
<tr><td>AC Mains Input Rated Voltage Range</td><td>100 - 240 V, 50 - 60 Hz, 1.5 – 0.7 A</td></tr>
<tr><td>DC Mains Input Rated Voltage Range</td><td>96 - 340 VDC, 2.0 – 0.5 A</td></tr>
<tr><td>Safety Isolation: Primary (Mains) to Secondary (Backplane, Field)</td><td>3kV_{peak}
In accordance with IEC 60950</td></tr>
<tr><td>Mains Inlet Connector</td><td>7.62 mm pitch TB Plug (Phoenix PC4/3-ST-7.62) with optional Cable Housing Phoenix KGG-PC 4/3
Note. Phoenix PC4/3-G-7.62 Header mounted on the module’s PCB</td></tr>
<tr><td>Input Supply from B terminals</td><td>12.0-16.0 VDC</td></tr>
<tr><td>Backup Battery</td><td>12 V Sealed Lead-Acid, 26 AH max.
Note: Batteries exceeding 26 AH can be used. However, full charging and estimated battery capacity value cannot be guaranteed.</td></tr>
<tr><td>Power Outputs</td><td>
<table>
<tr><td>Item</td><td>Range</td><td>Max. Current</td><td>Protection</td><td>Switchable from Logic?</td></tr>
<tr><td>12 V Backplane #</td><td>10.5 - 15.6 V</td><td>4.5 A</td><td>Firmware</td><td>No</td></tr>
<tr><td>5 V Backplane</td><td>5 V + 5%</td><td>3.0 A</td><td>Electronic</td><td>No</td></tr>
<tr><td>Battery #</td><td>10.5 - 15.6 V</td><td>4.5 A</td><td>Crowbar over-voltage and reverse polarity protection; Polyfuse</td><td>No</td></tr>
<tr><td>12 V Aux.#</td><td>10.5 - 15.6 V</td><td>2.0 A</td><td>Polyfuse</td><td>Yes</td></tr>
<tr><td>24 V Isolated Aux.</td><td>24 V + 5%</td><td>0.25 A</td><td>Polyfuse</td><td>Yes</td></tr>
</table>
Nominal value is 13.8 V @ 25°C. These voltages are electrically linked and are controlled by the module when charging a battery. They will depend only on backup battery voltage when RTU runs from the battery (e.g. when there is a Mains outage).
</td></tr>
<tr><td>Output Power</td><td>60 W max (Note: This is total power from all outputs)</td></tr>
<tr><td>Filed Connector</td><td>5 mm pitch TB plug (Phoenix MSTB2.5/7-ST or similar)</td></tr>
<tr><td>Monitoring</td><td>
<table>
<tr><td>Item</td><td>Range</td><td>Accuracy</td></tr>
<tr><td>Rail Voltage
(12 VBP, Battery, 12 VAUX)</td><td>9.0 - 15.6 V</td><td>± 2%</td></tr>
<tr><td>Supply Current</td><td>0.0 - 4.0 A</td><td>± 10%</td></tr>
<tr><td>Battery: Supply Current from Battery
Charge Current to Battery</td><td>-4.0 - 0.0 A
0.0 - +4.0 A</td><td>± 10%
± 10%</td></tr>
<tr><td>External Temperature</td><td>-40 - +100 °C</td><td>± 2 °C typ @25 °C</td></tr>
<tr><td>Internal Temperature</td><td>-30 - +100 °C</td><td>± 2 °C typ @25 °C</td></tr>
</table>
</td></tr>
<tr><td>Operating Temperature</td><td>-20 - +70 °C</td></tr>
<tr><td>Storage Temperature</td><td>-40 - +85 °C</td></tr>
<tr><td>Humidity</td><td>5 - 98% RH non-condensing</td></tr>
</table>

Maximum Working Voltage on any contact of the field connector (7-pin TB)	42.4 V_{peak} / 60 VDC relative to system (backplane) ground
Hot Swap	Yes. Module can be swapped while RTU is running, assuming that there is an alternative source for the RTU to be powered during such swap – for instance, another (redundant) PS-xx.

1) May keep switching ON and OFF intermittently at very light or no load.
2) Short periodic flashes indicate that PS-12 is trying to detect connection.
3) Current value given to the Processor Module is negative
4) approximate values

Part Numbers:

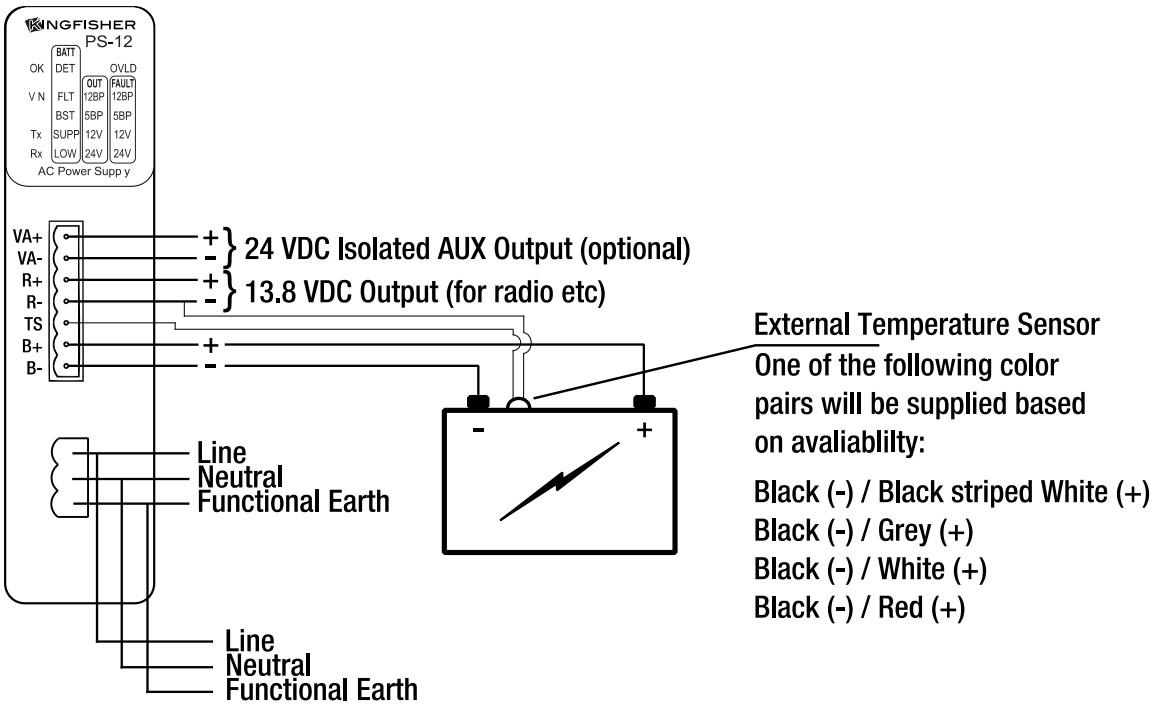
PS-12-C AC input, Auxiliary 24 V converter fitted

PS-12-0 AC input, Auxiliary 24 V converter not fitted

Wiring Diagrams

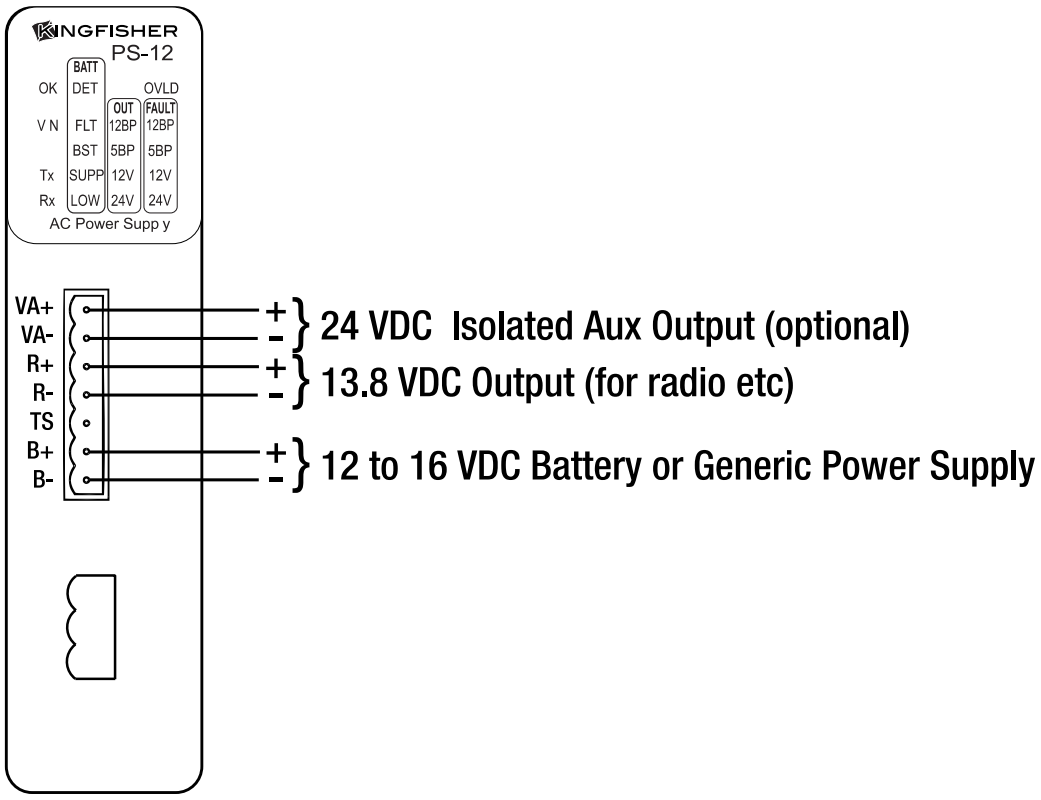
Safety Warning	
	Ensure power cord is un-powered before disconnecting power cord from module. Disconnect power cord from module before wiring, removing or servicing the module. Connect module to Mains supply in accordance with national wiring regulations. Mains connections of PS-12 must comply with all requirements listed in Kingfisher Plus+ Installation Manual

AC/DC Supply with battery backup:



For best results tape or cable-tie the temperature sensor directly to the battery. Connect the black stripped wire to **B-** or **R-**.

12 – 16 VDC Supply:



A battery or other low voltage DC supply can be connected to the **B** terminals to power the PS-12.

3.2. PS-22 Power Supply Module

- **Monitoring of rail voltage, supply & battery currents, and temperature**
- **DC input**
- **Support for redundancy (several supplies per backplane)**
- **Isolated DC Output**
- **Sealed Lead Acid Battery connection with charging/monitoring and low voltage protection**
- **Software controlled power to the Backplane and Aux outputs**

The PS-22 power supply module provides Medium Voltage DC to DC conversion for the backplane, 12V auxiliary output and for an optional 24V isolated auxiliary output. Both auxiliary outputs can be controlled (switched ON or OFF) by the RTU configuration.

The PS-22 is supplied with internal and optional external temperature sensors. When a backup battery is connected, the supplied external sensor should be mounted close to the negative terminal of the battery to ensure correct charging temperature compensated battery charging. If readings from the external sensor are out of range, internal sensor data is used. Please note the charge circuitry is designed for float operation and short term boost of batteries already charged and in good condition. Use of this supply on flat or fully discharged batteries may cause damage to the module.

The Rail Voltage, Supply Current, Battery Current, internal and, optionally, external temperature monitoring circuits enable the RTU to monitor and to control all functions of the PS-22 module. The Processor Module has access to many of these values as analog and digital points in the system.

If the Mains supply fails and the system is powered from the backup battery, the PS-22 enters Low Battery Shutdown when battery voltage drops below 10.6V. All outputs are switched OFF for battery preservation, including Backplane power as well – effectively meaning that the whole RTU will be shut down. PS-22 switches itself to the lowest power consumption mode possible, further preserving the battery from deep discharge. PS-22 checks rail voltage regularly, and the Backplane power will be restored when +12V_RAIL voltage rises above 12.4 V (if no Mains present) or 11.5 V (if Mains present).

Besides various hardware protection features, PS-22 firmware provides additional protection from overload. If output power exceeds its maximum specified power, the SMPS will enter an Overload Mode. Its output voltage will be ramped down and, if overload still exists when it reaches 10.0 V (minimal output voltage), it will switch all outputs off, similar to Low Battery Shutdown. PS-22 will attempt to switch the Backplane ON again regularly. RTU power will be restored permanently when overload condition is removed.

A power supply module can be installed in any I/O slot of a 4, 6 or 12 slot backplane. Several Power Supply modules of any type can be installed on a backplane thus providing redundant and alternative power source configurations

Fire Risks



A supply voltage outside the specified limits may cause fire.

Electrical Hazards



Only appropriately qualified and trained personnel can install and service this equipment.

Mains Power must be connected in accordance with local national wiring rules and regulations. Building installation shall provide appropriate short-circuit backup protection.

Always remove input mains voltage (by disconnecting power cord from the mains power outlet or by switching off an external circuit breaker, depending on installation) before performing any operation on this product. Failure to do so may cause fire and may result in a serious personnel injury or even death.

Disconnect power cord from the Power Supply Module before wiring, removing or servicing.

Warning



The earth Terminals in the mains power inlet provide only **FUNCTIONAL EARTH** / Ground connection and cannot be relied upon for safety purposes.

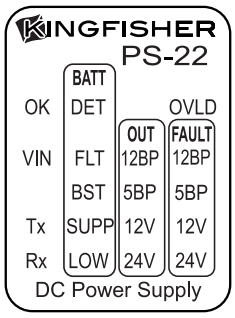
Battery Charging

Whenever the battery begins to draw more than 100 mA out of the power supply (e.g. when the power supply is first turned on or a battery is connected), the power supply assumes that a fully discharged backup battery just has been connected and starts its Boost charge. After Boost charging the battery for the estimated time (3-10 hours, see below for details, **BATT DET** and **BATT BST** LEDs ON), the power supply will switch to Float charging (**BATT DET** and **BATT FLT** LEDs ON). Note: if the battery charging current falls below 100 mA at any stage during Boost or Float charging, the Power Supply will stop charging the battery (**BATT FLT** and **BATT BST** LEDs OFF, **BATT DET** shortly flashes every second indicating that PS-22 is trying to detect battery).

PS-22 also maintains estimated capacity of the connected Sealed Lead Acid battery and this value is provided to the system Processor Module. For the algorithm to work properly, a correct battery capacity should be provided to the PS-22 via the Toolbox / RTU configuration setup. When battery is initially detected, it is assumed to be fully discharged. Boost charging time mentioned earlier is calculated based on the provided battery capacity value. Estimated battery capacity is increased by integrating measured current flowing into the battery over the time till it reaches the stated battery capacity. When battery current becomes negative (for instance, if Mains power is out and the RTU runs from the battery), this current is integrated over the time and subtracted from the estimated battery capacity till it reaches zero.

Please note that PS-22 cannot distinguish between the real battery connection and the connection of any other (generic) load or power source to the battery terminals, as it detects such connections only by measuring the Battery Current. As a result, all BATT LEDs may exhibit several various combinations depending on kind of load / source connected to the B terminals.

PS-22 Module LEDs



LED	State	Description
OK	OFF	Module fault (no power)
	Blinking	No communications with RTU Processor Module
	ON	Normal
VIN	OFF	Mains not present / SMPS not running
	ON	SMPS running [1]
TX	OFF	No data being sent to Processor Module
	ON	The PS-22 is sending data to Processor Module via Backplane
RX	OFF	No data being sent by other modules
	ON	Any RTU module sends data via Backplane
BATT DET	OFF	No battery nor load nor DC source connected to B terminals[2]
	ON	Battery or load or DC source connected to B terminals
BATT FLT	OFF	Battery is not in Float Charge mode
	ON	Battery is slow (float) charging
BATT BST	OFF	Battery is not in Boost Charge mode
	ON	Battery is fast (boost) charging
BATT SUPP	OFF	Battery does not supply current to the PS-22
	ON	Battery sources more than 0.1 A[3] current to the PS-22[4]
BATT LOW	OFF	+12V_RAIL voltage has risen above 12.4 V[4]
	ON	+12V_RAIL voltage has fallen below 11.5 V[4]
OUT 12BP	OFF	Backplane power is switched OFF: either start-up or shutdown
	ON	Backplane power is switched ON
OUT 5BP	OFF	Backplane power is switched OFF: either start-up or shutdown
	ON	Backplane power is switched ON
OUT 12AUX	OFF	12VAUX is switched OFF
	ON	12VAUX is switched ON
OUT 24iAUX	OFF	24ViAUX is switched OFF
	ON	24ViAUX is switched ON
OVLD	OFF	PS-22 is not in Overload Mode
	BLINKING	In Overload Mode. Output voltage will be ramped down
FAULT 12BP	OFF	Backplane power is switched OFF or it is ON and 12VBP is above 9 V[4]
	ON	Backplane power is switched ON and 12VBP is below 9 V[4]
FAULT 5BP	OFF	Backplane power is switched OFF or it is ON and 5VBP above 2 V[4]
	ON	Backplane power is switched ON and 5VBP is below 2 V[4]
FAULT 12AUX	OFF	12VAUX is switched OFF or it is ON and above 9 V[4]
	ON	12VAUX is switched ON and it is below 9 V[4]
FAULT 24iAUX	OFF	24ViAUX is switched OFF or it is ON and above 18 V[4]
	ON	24ViAUX is switched ON and it is below 18 V[4]

PS-22 Specifications

<table>
<tr><td>DC Mains Input Rated Voltage Range</td><td>20 - 60 VDC, 4.0 A</td></tr>
<tr><td>Isolation: Primary to Secondary</td><td>3 kV_{peak}
In accordance with IEC 60950</td></tr>
<tr><td>DC Inlet Connector</td><td>7.62 mm pitch TB Plug (Weidmuller BLZ 7.62/90-3 or Phoenix GMSTBA 2.5/3-G-7.62 or similar)
Note. Weidmuller SL 7.62/90B-3 or Phoenix GMVSTBR 2.5/3-ST-7.62 or similar Header mounted on the module's PCB</td></tr>
<tr><td>Input Supply from B terminals</td><td>12.0-16.0 VDC</td></tr>
<tr><td>Backup Battery</td><td>12 V Sealed Lead-Acid, 26 AH max.
Note: Batteries exceeding 26 AH can be used. However, full charging and estimated battery capacity value cannot be guaranteed.</td></tr>
<tr><td>Power Outputs</td><td>
<table>
<tr><th>Item</th><th>Range</th><th>Max. Current</th><th>Protection</th><th>Switchable from Logic?</th></tr>
<tr><td>12 V Backplane #</td><td>10.5 - 15.6 V</td><td>4.5 A</td><td>Firmware</td><td>No</td></tr>
<tr><td>5 V Backplane #</td><td>5 V + 5%</td><td>3.0 A</td><td>Electronic</td><td>No</td></tr>
<tr><td>Battery #</td><td>10.5 - 15.6 V</td><td>4.5 A</td><td>Crowbar over-voltage and reverse polarity protection; Polyfuse</td><td>No</td></tr>
<tr><td>12 V Aux.#</td><td>10.5 - 15.6 V</td><td>2.0 A</td><td>Polyfuse</td><td>Yes</td></tr>
<tr><td>24 V Isolated Aux.</td><td>24 V + 5%</td><td>0.25 A</td><td>Polyfuse</td><td>Yes</td></tr>
<tr><td colspan="5"># Nominal value is 13.8 V @ 25°C. These voltages are electrically linked and are controlled by the module when charging a battery. They will depend only on backup battery voltage when RTU runs from the battery (e.g. when there is a Mains outage).</td></tr>
</table>
</td></tr>
<tr><td>Output Power</td><td>60 W max (Note this is total power from all outputs)</td></tr>
<tr><td>Filed Connector</td><td>5 mm pitch TB plug (Phoenix MSTB2.5/7-ST or similar)</td></tr>
<tr><td>Monitoring</td><td>
<table>
<tr><th>Item</th><th>Range</th><th>Accuracy</th></tr>
<tr><td>Rail Voltage
(12 VBP, Battery, 12 VAUX)</td><td>9.0 - 15.6 V</td><td>+ 2%</td></tr>
<tr><td>Supply Current</td><td>0.0 - 4.0 A</td><td>+ 10%</td></tr>
<tr><td>Battery: Supply Current from Battery
Charge Current to Battery</td><td>-4.0 - 0.0 A
0.0 - +4.0 A</td><td>+ 10%
+ 10%</td></tr>
<tr><td>External Temperature</td><td>-40 - +100 °C</td><td>+ 2 °C typ @25 °C</td></tr>
<tr><td>Internal Temperature</td><td>-30 - +100 °C</td><td>+ 2 °C typ @25 °C</td></tr>
</table>
</td></tr>
<tr><td>Operating Temperature</td><td>-20 - +70 °C</td></tr>
<tr><td>Storage Temperature</td><td>-40 - +85 °C</td></tr>
<tr><td>Humidity</td><td>5 - 98% RH non-condensing</td></tr>
<tr><td>Maximum Working Voltage on any contact</td><td>42.4 V_{peak} / 60 VDC relative to system (backplane) ground</td></tr>
<tr><td>Hot Swap</td><td>Yes. Module can be swapped while RTU is running, assuming that there is an alternative source for the RTU to be powered during such swap – for instance, another (redundant) PS-xx.</td></tr>
</table>

1) May keep switching ON and OFF intermittently at very light or no load.
2) Short periodic flashes indicate that PS-22 is trying to detect connection.
3) Current value given to the Processor Module is negative
4) approximate values

Part Numbers:

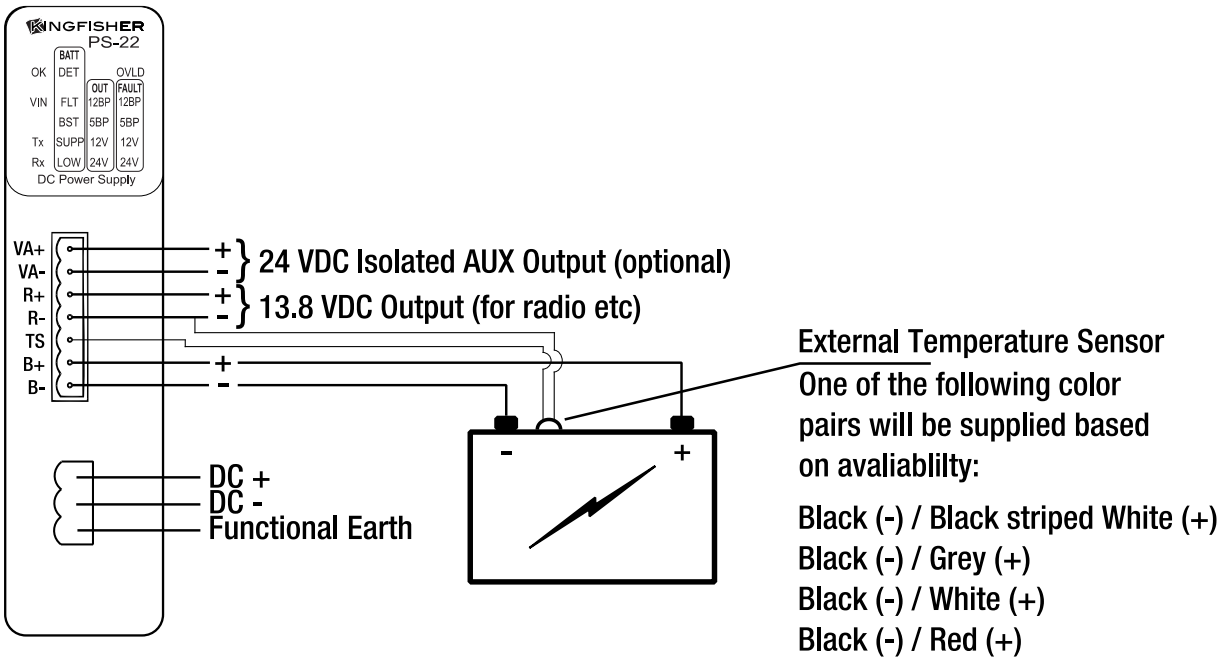
PS-22-C DC input, Auxiliary 24 V converter fitted

PS-22-0 DC input, Auxiliary 24 V converter not fitted

Wiring Diagrams

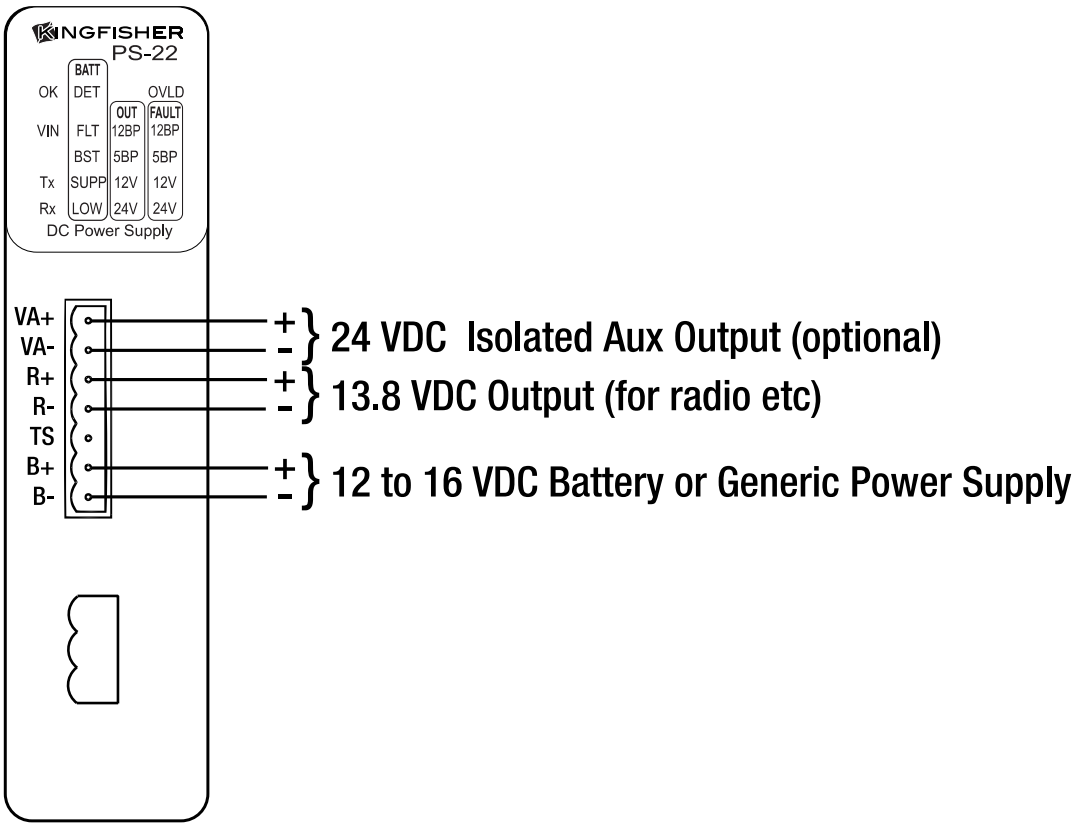
Safety Warning	
	Ensure power cord is un-powered before disconnecting power cord from module. Disconnect power cord from module before wiring, removing or servicing the module. Connect module to Mains supply in accordance with national wiring regulations. Mains connections of PS-22 must comply with all requirements listed in Kingfisher Plus+ Installation Manual

AC/DC Supply with battery backup:



For best results tape or cable-tie the temperature sensor to the negative battery terminal (or as close as possible). Connect the black stripped wire to **B-** or **R-**.

12 – 16 VDC Supply:



A battery or other low voltage DC supply can be connected to the **B** terminals to power the PS-22.

3.3. PSU-3: 40 Watt AC Power Supply Unit

- **AC input supply**
- **40 Watt DC output**

The PSU-3 AC to DC power supply is intended as a standalone unit to provide 13.8 VDC (adjustable) typically for PC-1 based RTUs. The PSU-3 does not have any power monitoring functions. Power monitoring is performed by the PC-1 processor module.

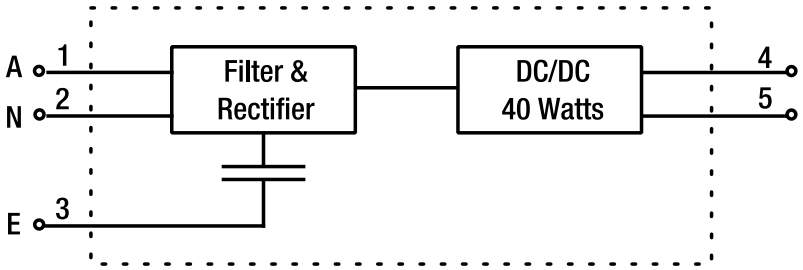
Specifications:

Input Supply	90 to 260 VAC 50/60 Hz
Load Capacity	40 W
Outputs	+13.8 VDC @ 2.8 A
Isolation	2.5 kV AC input/DC output
Supply Fuse	3 A, M205 internal
Monitoring Circuits	Nil
Status Indicators	Nil
Connector	Screw Terminals
Weight	430 gm

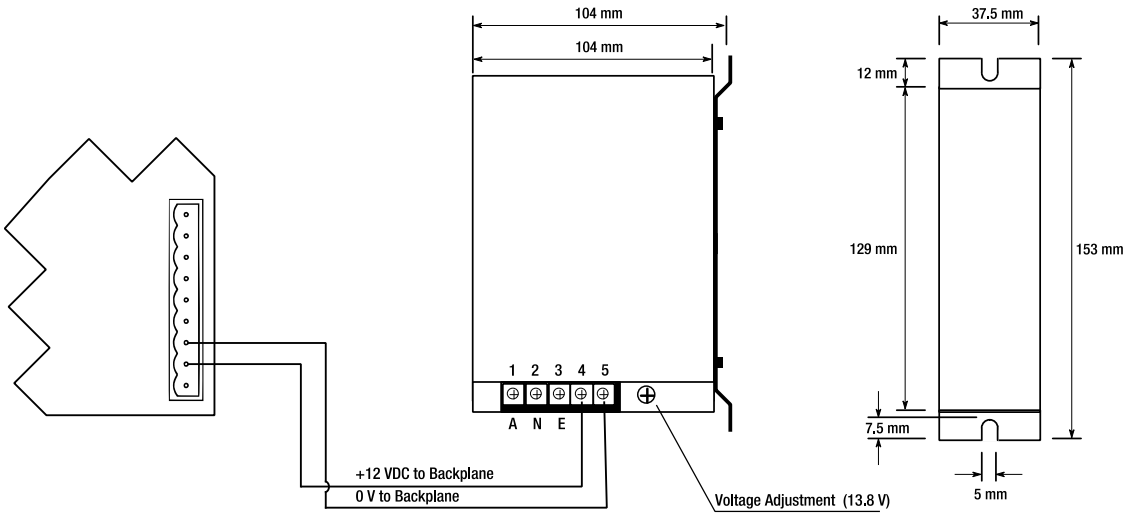
Fire Risks	
	A supply voltage outside the specified limits may cause fire.

Electrical Hazards	
	Only appropriately qualified and trained personnel can install and service this equipment. Disconnect power cord from the Power Supply Module before wiring, removing or servicing.

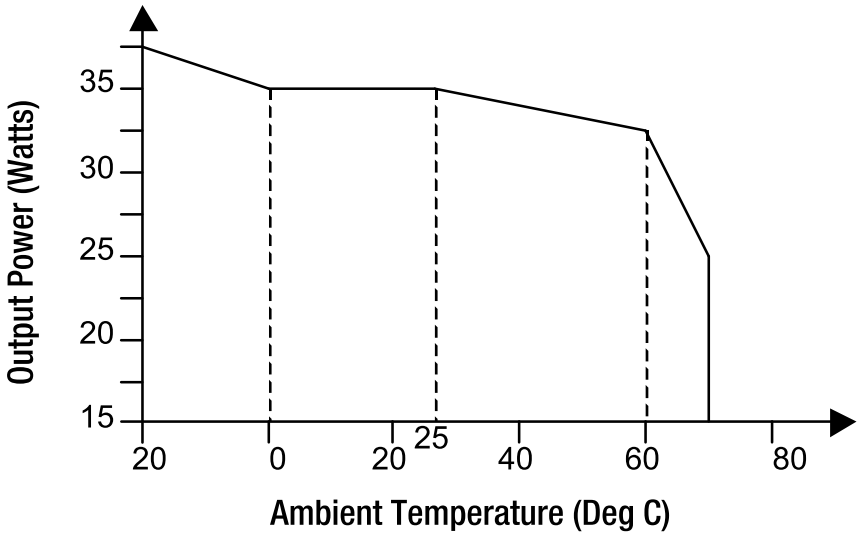
PSU-3 Block Diagram



Mounting and Connections



PSU-3 Output Characteristics



3.4. PSU-4: 60 Watt AC Power Supply Unit

- **AC Input Supply**
- **60 Watt DC Output**

The PSU-4 AC to DC power supply is intended as a standalone unit to provide 13.8 VDC (adjustable) typically for PC-1 based RTUs. The PSU-3 does not have any power monitoring functions. Power monitoring is performed by the PC-1 processor module.

Specifications:

Input Supply	90 to 260 VAC 50/60 Hz
Load Capacity	60 W
Outputs	+13.8 VDC @ 2.8 A
Isolation	2.5 kV AC input/DC output
Supply Fuse	3.15 A, M205 internal
Monitoring Circuits	Nil
Status Indicators	Nil
Connector	Screw Terminals
Weight	480 gm

Fire Risks



A supply voltage outside the specified limits may cause fire.

Electrical Hazards



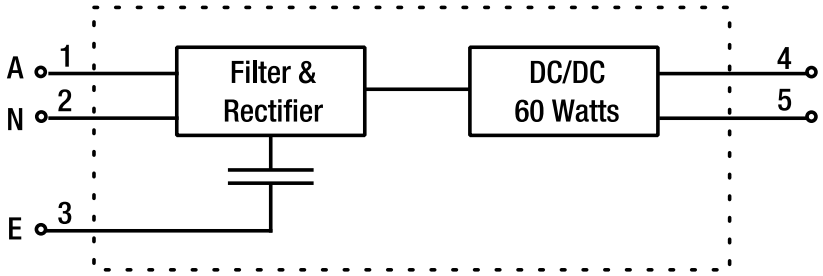
Only appropriately qualified and trained personnel can install and service this equipment.

Mains Power must be connected in accordance with local national wiring rules and regulations. Building installation shall provide appropriate short-circuit backup protection.

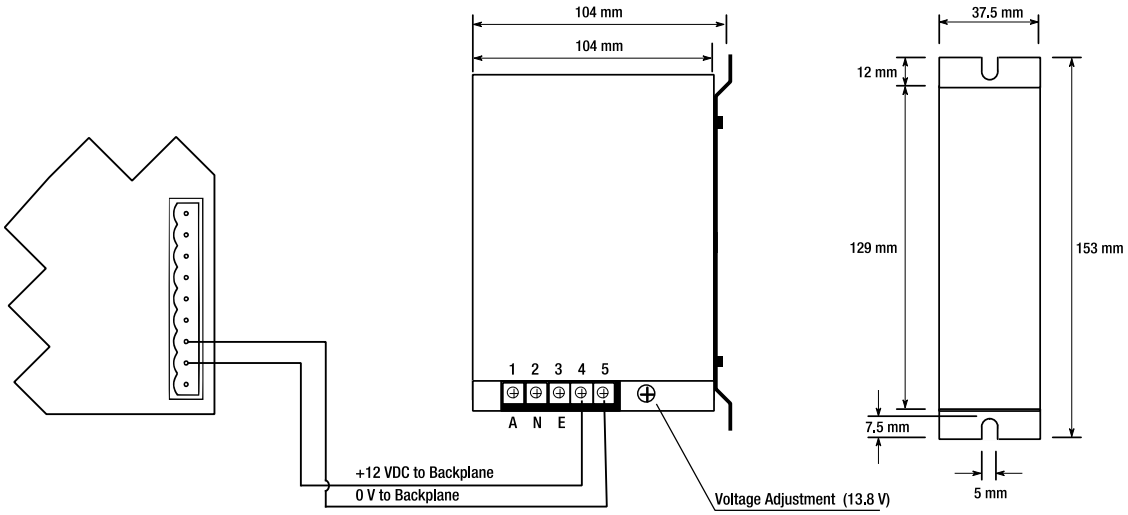
Always remove input mains voltage (by disconnecting power cord from the mains power outlet or by switching off an external circuit breaker, depending on installation) before performing any operation on this product. Failure to do so may cause fire and may result in a serious personnel injury or even death.

Disconnect power cord from the Power Supply Module before wiring, removing or servicing.

PSU-4 Block Diagram



Mounting and Connections



3.5. Calculating Power Requirements

This chapter aims to assist you in selecting an appropriate power supply module/s and backup battery for your RTU. It also allows the power requirements of the RTU to be checked to ensure the power supplies are not overloaded.

Note that there is a spreadsheet available from MyKingfisher (called "Kingfisher RTU Backup Battery and Solar Panel Calculator") that can perform the following calculations automatically.

PS-22 Typical current consumption at various DC voltages (mA)

Input Voltage	20 V	40 V	60 V
Basic Module, no options	34	20	19
24 VDC Aux Converter Installed	49	27	25

PS-12 Typical efficiency at various AC supply voltages

Input Voltage	100 V	170 V	240 V
Efficiency	85%	87%	88%

Note: No DC-DC converter installed

Processor Modules current consumption (mA at 13.8 VDC)

Item	CP-12	CP-30
Basic Module, no options	140	135

PC-1 Typical current consumption (mA at 13.8 VDC)

Bare Module	24 V Aux Converter Installed	Option S Board Installed	Option R Board Installed	Option P Board Installed
54	+53	59	62	59

IO Module typical current consumption (mA at 13.8 VDC)

Part number	24 V Converter OFF	24 V Converter ON	Extra current per Analogue Input ON	Extra current per Analogue Input OFF	Extra current per Digital Input ON	Extra current per Digital Input OFF	Absolute Max current draw
AI-1	11	80	+50 [+0]	-	-	-	480
AI-10	25	185	+62 [+3]	-	-	-	681
AO-3	5	180	-	+50	-	-	380
DI-5	23	-	-	-	+7 [+2]	-	135
DI-10	40	-	-	-	+11 [+5]	-	216
DO-1	7	-	-	-	-	+31	255
DO-2	7	-	-	-	-	+13	215
DO-5/6	3	-	-	-	-	+1	19
IO-2	5	--	-	-	+7 [+3]	+12	157
IO-3	10	53	+46 [-1]	+42	+10 [+1]	+12	367
IO-4	8	44	+44 [-2]	-	+9 [+1]	+12	228
IO-5	TBA	TBA	TBA	TBA	TBA	TBA	TBA

Note: Values shown are for inputs powered by the IO module itself when power is available from the 13.8 VDC supply. Values in square brackets '[ ]' denote current consumption when inputs re powered by an external supply.

Communications Modules current consumption (mA at 13.8 VDC)

Item	MC-12	MC-31
Basic Module, no options	140	135

For Communications Option Boards please refer to the 5 V Rail Overload Check chapter.

Superseded Communications Modules current consumption (mA at 13.8 VDC)

Item	MC-11	MC-30
Basic Module, no options	165	165

Superseded IO Module typical current consumption (mA at 13.8 VDC)

AO-2	11	115	-	+55	-	-	335

3.6. 5 V Rail Overload Check

The PS-12 and PS-22 modules supply 5 VDC to the backplane for powering modules. A maximum of 3 Amps can be drawn on the 5 VDC rail from each power supply module.

Please ensure that this limit us not exceeded by totaling the 5 V current requirements for your RTU.

CP-xx and MC-xx typical 5 V Rail current consumption (mA at 5 VDC)

CP-11	CP-12	CP-21	CP-30	MC-11 / MC-30
310	150	360	290	370

MC-xx CP-xx Option Board typical 5 V Rail consumption (mA at 5 VDC)

Option Board Type	Port label	Consumption
A3 Fibre Optic Ethernet Board	A3	600
Dial (PSTN)	D	165
Fibre Optic Serial	F	40
HART	H	90
Isolated Serial (RS232)	I	70
Private Line or Analogue Radio Interface	L	90
2.4 GHz (50 mW) Spread Spectrum Radio: **Transmitting** **Receiving**	R3	 100 85
900 MHz (1 W) Spread Spectrum Radio: **Transmitting** **Receiving**	R2 / R4	 100 670
T3 Ethernet Option Board	T3	300

IO Module 5 V Rail current consumption (mA at 5 VDC)

Module	All IO inactive	All IO active and powered by module
AI-1	22	27
AI-10	15	66
AO-2	22	28
AO-3	9	30
DI-5	6	40
DI-10	54	85
DO-1	15	27
DO-2	9	39
DO-5/6	48	39
IO-2	10	37
IO-3	26	36
IO-4	23	37
IO-5	TBA	TBA

Superseded Option Boards typical 5 V Rail consumption (mA at 5 VDC)

Option Board Type	Port label	Consumption
CP-12 Ethernet	ENET-T	130
CP-21 Port 2 Only Ethernet	ENET-A	65
CP-30 Ethernet	ENT-T2	20
CP-21 Ethernet	ENET-E	0 idle / 850 max
Serial (RS232)	SER-S	5
Line (original version)	L(1)	120
Image Capture	J	1000

3.7. Total Power Load

The total **Current** load required to power the RTU is as follows:

$$I_{Total\ Current\ Load} = I_{Processor\ Total} + I_{MC-xx\ Total} + I_{IO\ Module\ Total}$$

Total **Power** load is therefore:

$$Total\ Power = \frac{13.8 \times I_{Total\ Load\ Current}}{1000}\ \ Watts$$

Note: If Amps is used in the 'Total Current Load' calculation in place of milliamps, dividing by 1000 can be omitted (1 Amp = 1000 mA).

- The Total Current Load for a PS-12/22 should not exceed 4.5 Amps. Loads greater than 4.5 Amps will require a second PS-12/22 module.
- The Total Current Load for a PC-1 should not exceed 4 Amps. Loads greater than 4 Amps will require a PS-12/22 supply to be installed.
- Users should be mindful of the current draw on the 5 VDC rail. See the Rail Overload Check chapter for more details

3.8. Battery Backup

For maximum battery life, a maximum discharge depth of 50% is normally used. E.g. for a 7 AH battery, there is 3.5 AH of backup power. Therefore the battery can supply 3.5 Amps for 1 hour or 1 Amp for 3.5 hours etc.

The size of the backup battery required depends on how long the RTU needs to be able to run without mains power. In addition to the Total Current Load above, a backup battery will also need to power the PS-11/21 if present (not applicable if using a PC-1 processor).

$$I_{(Total\ RTU\ Consumption)} = I_{(Total\ Current\ Load)} + I_{(PS-22\ Consumption)}$$

$$Minimum\ Backup\ Battery\ (AH) = \frac{I_{(Total\ RTU\ Consumption)}(mA)}{1000 \times Backup\ Time\ (Hours) \times 2\ AH}$$

4. Processor Modules

The amount of memory, speed, and flexibility of an RTU is determined by the processor module selected.

There are three processor modules available in the Kingfisher modular RTU range. These modules are not equipped with any I/O or communications natively and require additional modules to be attached to the backplane.

Processor modules summary

Model Number	CPU Speed	Memory	optional expansions	Part number
PC-1	16 MHz	128 KB Flash 256 KB SRAM	Bare module	
			24 VDC Aux Supply fitted	
			V.23 FSK Radio	
			2-wire line V.23 FSK	
			4-wire line V.23 FSK (obsolete)	
CP-12	40 MHz	512 KB Flash 512 KB NVRAM	See Chapters Communications Options Boards and Compatibility	
CP-30	166 MHz	128 KB SRAM 16 MB Flash 32 MB NVRAM		

Lithium Battery	
	This product contains a lithium battery. Risk of explosion if battery is replaced by an incorrect type. Dispose of used batteries in accordance with local regulations or return to the supplier.

Fire Risks	
	A supply voltage outside the specified limits may cause fire.

4.1. PC-1: Power & Processor Module

- **Monitoring of battery and input supplies**
- **Isolated DC Outputs**
- **16 MHz Processor**
- **DC Input Supply**
- **Up to two Communications Ports**
- **Low Voltage Battery Protection**
- **256 KB SRAM**

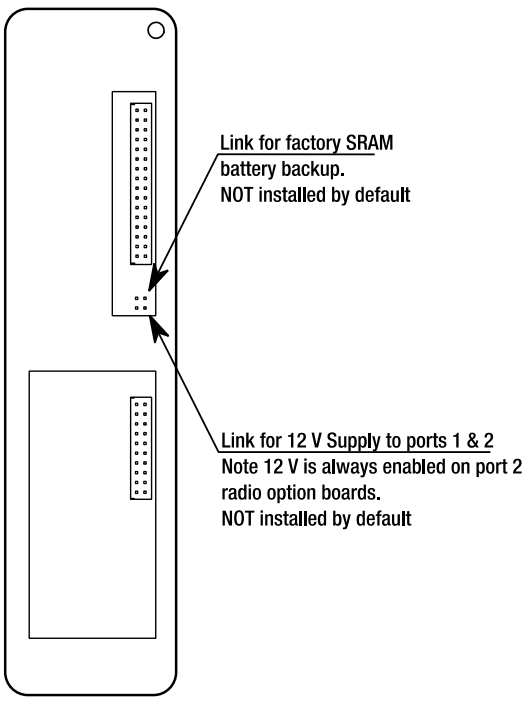
The PC-1 is one of the best supported processors available to a kingfisher RTU. It is well suited to small and mid-size installations as it features an integrated power supply, reduces the system complexity by negating the need for additional power supply modules.

With remote installations in mind the PC-1 was designed to be capable of running from a backup battery, and has a fully isolated low power DC output for external equipment.

To configure the PC1, a PC running the Toolbox32 software is required. The Toolbox32 software allows the user to implement ladder logic.

The PC-1 can only be installed in the first slot of a 4-slot backplane (BA-4) and operates from a nominal +12 VDC supply (typically 13.8 VDC). The module has one fixed RS-232 port and one option port.

A PC-1 has two links that can be accessed from the rear of the module as shown below.



The SRAM battery is enabled at shipping time by the factory. The user can clear the SRAM by removing the SRAM link for five minutes. This will clear the RTU configuration and ladder logic.

Part Numbers

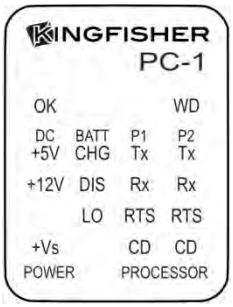
The PC-1 is available with 3 options (A, P, M) as detailed below.

PC -	A	P	M
Device:	24 V 10 W Auxiliary Supply Converter	Port 2 Option Board Type	Memory
Part Number:	0 = Not Fitted C = Fitted	0 = Not Fitted R = Radio, V.23 FSK* P = 2-Wire Line, V.23 FSK S = Serial RS232/RS485	0=128 KB RAM (obsolete) 1=256 KB RAM (standard)

* Radio option boards must be factory modified to suit Trio radios (resistor R15 [150 KΩ] is replaced with a 2K2 resistor). Please add the comment "for Trio radio" when ordering a radio option board for use with a Trio radio.

Example: PC-1-CR1 is a PC-1 with 24 VDC auxiliary converter, radio option port and extra RAM.

PC-1 Module LEDs



Both of the communications ports have Tx, Rx, RTS and CD LEDs in a vertical group as shown above.

PC-1 LED	Description
OK	ON when module is functioning OK
DC +5 V	ON when the internal 5 V supply is OK. This LED should always be on
+12 V	ON when the internal 12 V supply is OK. This LED should always be on (software controlled)
T1	Test LED 1. Flashes during Power Down mode.
+Vs	ON when the Auxiliary 24 V supply is OK (will only display if the 24 V converter is installed).
BATT CHG*	ON when the battery is being charged
DIS*	ON when the battery is being discharged
LO	ON when the battery voltage is low (For a PC-1 this occurs when the supply voltage is less than about 11.2 V)
T2	Test LED 2. Not currently used.
Tx	ON when port is transmitting
Rx	ON when port is receiving
RTS	Request to send. Set ON to begin transmitting
CD	Carrier detect: ON while a communications signal is detected.
WD	Processor Watchdog Timer. Set ON when the processor is reset.

* The battery charging (BATT CHG) and battery discharging (DIS) LEDs will sometimes flicker on and off when the battery is charged to the optimum level or if no battery is connected.

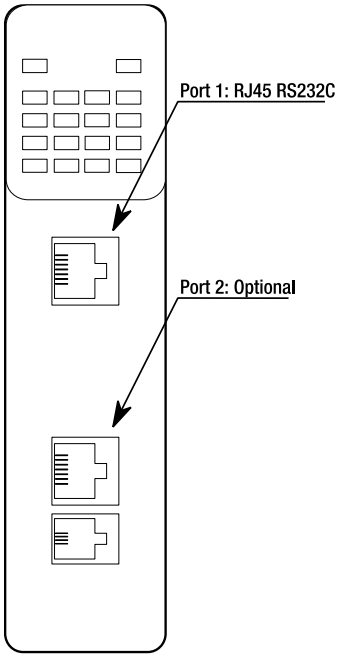
PROCESSOR SPECIFICATIONS	
Processor Type	Intel 80C188
Word Size	16 Bit internal data bus 8 Bit external data bus
Clock Speed	16 MHz
BIOS	Yes
Flash Memory	128 KB Total. 28 KB for firmware drivers.
SRAM	256 KB
Real-time Clock (RTC)	1 minute per month (+/- 20 ppm)
Watchdog Timer	Yes
Status Indication	Yes
Battery Type	Lithium. Not rechargeable.
Battery Life - module unpowered	7 years @ 25°C
Communications Ports	2
Port 1 (RS232)	Serial, 300 to 115200 Baud
Port 2 (Optional)	Serial, Analogue Radio Interface, 2-Wire Line or 4-Wire Line 300 to 115200 Baud (depending on port type)
Modem Port 2 CCITT V23 (Optional)	1200 Baud
Configuration Software	Toolbox 32
Diagnostics Software	Yes
Basic Configuration	Auto on power-up
RTU Address Range	1 – 249
Communications Protocol	Kingfisher, DNP3, Modbus, plus many more…
Analogue Block Processing	Yes
PID Block Processing	Yes
Redundant Power Supplies	Not supported
Redundant Processors	Not supported
Redundant Communications	Yes
Internal Power Consumption	120 mA from +5 VDC
I/O Bus Data Rate	250 Kbps
CM Bus Data Rate	83 Kbps
Cyclic Redundancy	Port 1 and 2
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
Hot Swap	Not supported. Removing the PC-1 will power down the RTU.
PC-1 POWER SUPPLY	

Input Supply to PC-1	11.5-15 VDC @ 4 A Max (60 W) Typically 13.8 VDC if backup battery connected	
Outputs From PC-1	+5 VDC @ 1 A Max (5 W) to Backplane +12 VDC @ 4 A Max to Backplane* +12 VDC @ 2 A Max to Vr* +24 VDC @ 400 mA (10 W) Optional Auxiliary Output (3 kV Isolation) #	
Backup Battery	12 V, 7 AH typical. 26 AH max	
Deep Discharge Protection	RTU Shutdown at 10.6 V RTU Start-up at 11.8 V	
Supply Fuse	7 A (Maximum Current into the PC-1)	
Battery Fuse	7 A (Maximum Current into or out of battery)	
Combined Vr and 24 VDC Fuse	3 A Polyfuse	
Monitoring	Item	Accuracy
	Battery Current PC-1 Supply Voltage PC-1 Supply Current PC-1 Temperature	± 10% ± 5% ± 10% ± 5%

* Note: backplane rail voltages are dependent on power supply to the PC-1. Most PC-1s are powered using the 40 W PSU-3 Power Supply set to 13.8 VDC when using a 12 VDC backup battery.

the +24 V converter is optional and must be ordered with the PC-1.

PC-1 Pinout



Port 1 Pins	Direction	RS-232 Definition
1	OUT	DTR
2	OUT	+12 V low power
3	OUT	RTS
4	IN	DCD
5	COM	GND (0 V)
6	IN	CTS
7	IN	RXD
8	OUT	TXD

Please refer to the PC-1 Option boards for more information regarding port 2 option boards.

4.2. CP-12 Processor Module

- **Support for Processor and Communications Redundancy**
- **Up to 3 communications ports**
- **40 MHz x86 CPU**

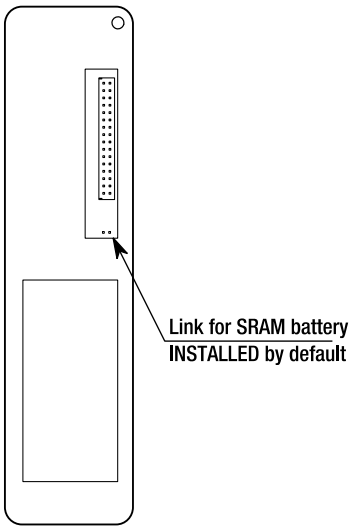
The CP-12 processor module has up to three independent communications ports. Ports 2 and 3 can house option boards while port 1 is a fixed serial port (RS-232).

This processor is targeted at the application space that is too complex for the PC-1 but does not required the additional features made available with a CP-30 based system. The CP-12 has extended functionality over the PC-1 such as redundant processor and communications modules support, and is compatible with Ethernet based boards.

The CP-12 uses the same configuration software as the PC-1 processor, and as such is programmable with ladder logic.

The CP-12 has 512 KB of flash memory for operating code and system parameter storage, and 512 KB of battery backed SRAM for all configuration and event storage data.

CP-12 Reset Procedures



The SRAM battery is enabled from the factory by default. The user can clear the SRAM by removing the SRAM link for five minutes.

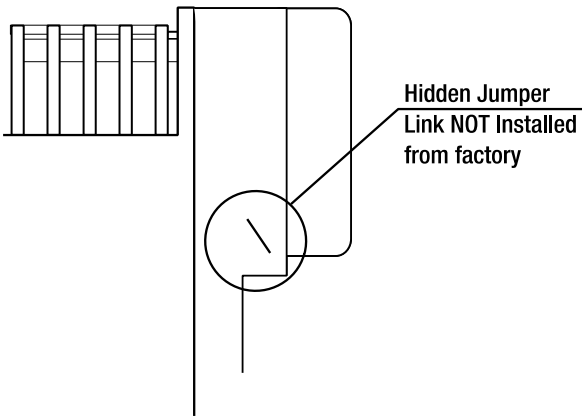
This will clear the RTU configuration and Ladder Logic.

Clearing Configuration with Monitor Mode (Kingfisher Bootloader Self-Test)

Behind the LED lens of the CP-12 there is a diagonally mounted jumper. This is a hardware feature unique to the CP-12 processor.

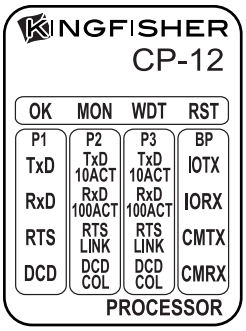
When the jumper pins are shorted while the module is being reset (or power cycled), the processor will enter **Monitor Mode** (the Kingfisher bootloader) and perform a read/write test of the SRAM. This will forcefully remote any configuration and logic in the RTU.

Monitor Mode is a deterministic and efficient way of clearing a Processor as the module does not need to be removed from the Backplane, and as the SRAM is forcibly overwritten.



Note: The RAM test is extremely fast. The CP-12 will clear the RAM nearly instantly. To exit monitor mode, remove the short and power cycle the unit again.

CP-12 Module LEDs

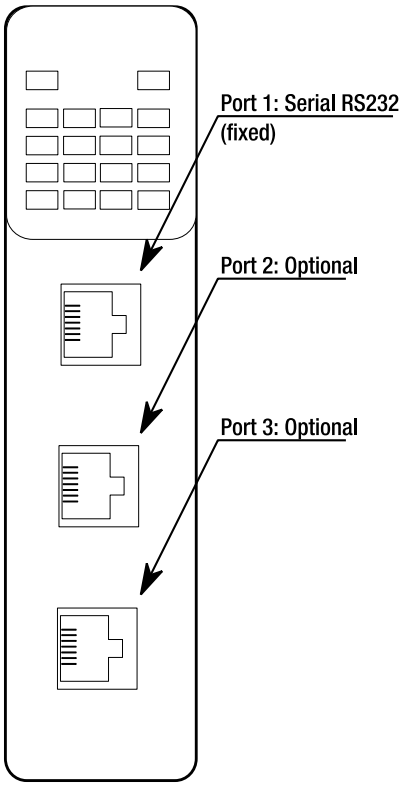


CP-12 LED	Description
OK	ON when Processor is functioning correctly
MON	ON when Processor is in Monitor mode
WDT	ON when Processor watchdog timer is overflows, such as in the event of a software crash.
RST	ON when in reset. Will be lit for 200 ms when cold starting.
TxD	ON when transmitting data on corresponding Port
RxD	ON when receiving data on corresponding Port
RTS	ON when asserting Request To Send on corresponding Port
DCD	ON when Data Carrier Detect affirmed on corresponding Port
10ACT	ON when Ethernet is operating at 10 Mbps on corresponding Port
100ACT	ON when Ethernet is operating at 100 Mbps on corresponding Port
LINK	ON when Ethernet Link is established
COL	ON when Ethernet Collision is detected
IOTX **IORX**	Intensity is proportional to load on backplane IO Bus (this bus is used to poll all IO modules)
CMTX **CMRX**	Intensity is proportional to load on load on backplane Communications Bus (this bus is used for communications modules data transmission)

PROCESSOR SPECIFICATIONS	
Processor	40 MHz x86
Word Size	16 bit data bus
BIOS	Yes
Flash Memory	512 KB
SRAM	512 KB
Battery Type	Lithium Primary (not rechargeable)
Battery Life - module unpowered	7 years @ 25°C
Real-time Clock (RTC)	1 minute per month (+/- 20 ppm)
Watchdog timer	Yes
Status Indication	Yes
Communications Ports	1-3 (1 fixed, 2 option ports)
Port 1 (RS232)	300 to 115200 Baud (factory default 9600 8-N-1)
Ports 2 and 3 (Optional)	For supported port types, please see the Option Boards chapter
Configuration Software	Toolbox 32
RTU Address Range	1 – 249 (expandable to 2000 by using multiple masters)
Communications Protocol	Kingfisher, Modbus + many more
Default Data Format	8 data bits, no parity, 1 stop (8, N, 1)
Analogue Block Processing	Yes
PID Block Processing	Yes
Redundancy	Yes. Two CP-12 modules can be installed in the one RTU. One processor module must be installed in an odd numbered slot and one in an even numbered slot.
Internal Power Consumption	275 mA from +5 VDC bus on backplane
I/O Bus Data Rate	250 Kbps
CM Bus Data Rate	83 Kbps
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
Hot Swap	Yes. When 2 processors are present on the backplane, one processor can be swapped while the RTU is still running. However, a hot swap will cause a Warm Start of the remaining processor. All ports will be re-initialized and ready for communications within 6 seconds. New data received during the changeover may be lost. To preserve data and for more information please see the Redundancy appendix in the Toolbox 32 manual.

CP-12 Ports

The CP-12 has a fixed serial port (RS-232) on port 1. Ports 2 and 3 can house option boards. For more information regarding communications capabilities please refer to the Option Board Chapter.



Port 1 Pins	Direction	RS-232 Definition
1	OUT	DTR
2	-	N/C
3	OUT	RTS
4	IN	DCD
5	COM	GND (0 V)
6	IN	CTS
7	IN	RXD
8	OUT	TXD

4.3. CP-30: High Performance Processor Module

- **Compliant with IEC-61131 programming languages**
- **Up to 3 communications ports**
- **166 MHz ARM 9 CPU**
- **Supports Communications and Processing Redundancy**
- **16 MB Flash**
- **32 MB DRAM**

The CP-30 is a high performance processor module that can provide exceptional speed, memory and functionality to your RTU.

Targeting large RTU Systems, the CP-30 is equipped with a 166 MHz ARM9 CPU, capable of running all IEC-61131-3 certified languages, and utilizes an Ethernet port as the default connection and configuration medium.

To configure the CP-30, a PC with an Ethernet port and the Toolbox PLUS software is required.

Toolbox PLUS features ISaGRAF™ software, which provides logic programming in the IEC-61131 standard languages: Structured Text, Ladder Logic, Function Blocks, Instruction Lists and Sequential Function Charts.

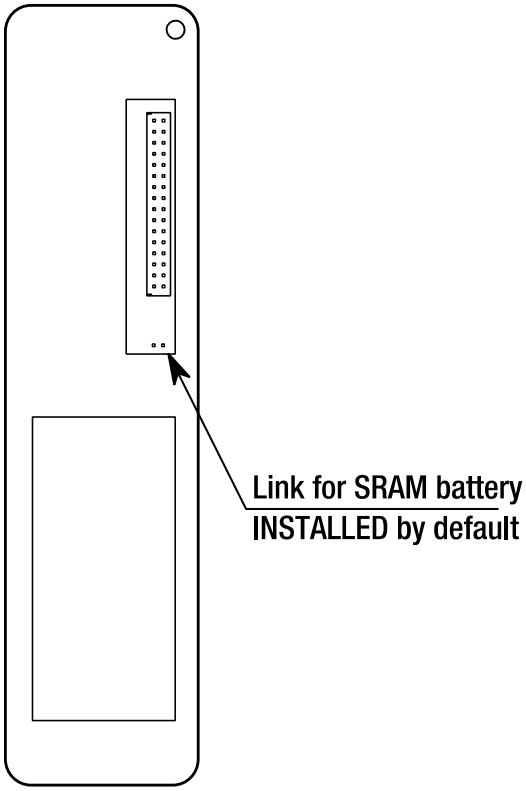
The processor module has up to three independent communications ports. Ports 2 and 3 can use plug-in option boards while port 1 is fixed as Ethernet.

RTUs can use a second CP-30 module to provide processor redundancy. One processor is installed in an odd-numbered backplane slot (the passive processor) and the other in an even-numbered slot (the active processor). The passive standby processor will switch to active mode if communications stop on the backplane for 1500 ms (by default).

This could be caused by:

- Failure, removal or reset of the active processor
- Download of the configuration, logic or firmware to the active processor

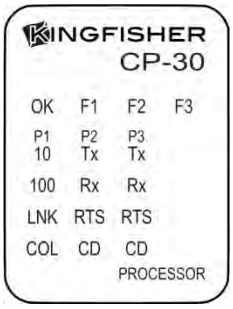
The CP-30 has 16 MB of flash memory for the storage of all operating code, RTU configuration and event logs. It also has 32 MB of SDRAM for program operation and general data storage and 128 KB of battery backed SRAM for non-volatile data such as retained variables.



The SRAM battery is enabled at shipping time by the factory. The user can clear the SRAM by removing the SRAM link for five minutes. Note: this will **not** clear the RTU configuration.

CAUTION: After removing and re-installing the SRAM link, please ensure that the CP-30 is powered up for at least one second. The SRAM battery will then function for the specified life span.

CP-30 Module LEDs

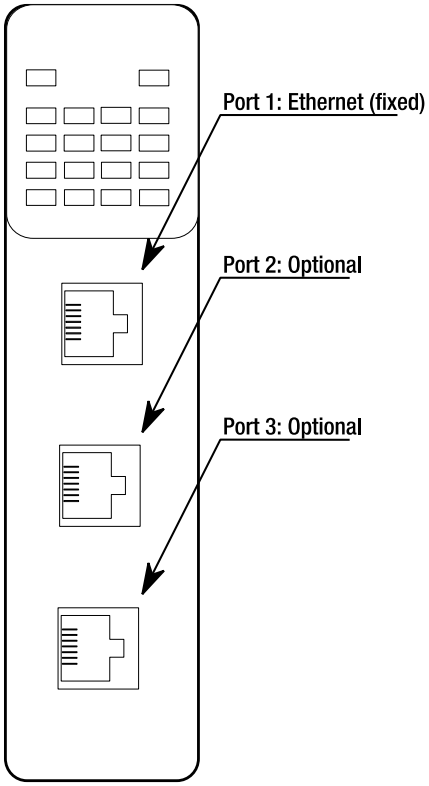


CP-30 LED	Description
OK *	Steady: Operating system Ok. Set ON after start-up checks pass (see F1, F2 and F3 LEDs below). Slow flash: starting operating system after downloading firmware Fast flash: firmware download error
10	Port 1 10 Mbps Ethernet connection. Flashes when communicating otherwise ON continuously
100	Port 1 100 Mbps Ethernet connection. Flashes when communicating otherwise ON continuously
LNK	Port 1 Ethernet link established (port is connected to an Ethernet network)
COL	Port 1 Ethernet collisions detected
Tx	ON when port is transmitting
Rx	ON when port is receiving
RTS	Request to send. RTU Sets RTS ON to begin transmitting
CD	Ports 2, 3: Carrier detect. ON while a communications signal is detected.
F1 *	During start-up: set ON if Firmware running OK. When RTU running: flashes if port 2 configuration error. During firmware download: flashes fast if an error occurs. Reset power to clear.
F2 *	During start-up: set ON if Linux operating system running OK. When RTU running: flashes if port 3 configuration error. During firmware download: flashes fast if an error occurs. Reset power to clear.
F3 *	During start-up: set ON if ISaGRAF™ and RTU configuration running OK. After start-up: remains steady ON if active (or only) processor or flashes at 1 Hz if passive (redundant standby) processor. Note: the F3 LED may be turned off briefly (less than 1 second) during initial synchronization between redundant processors. Flashes quickly if watchdog timer error – return to supplier for repair. During firmware download: flashes fast if an error occurs. Reset power to clear.

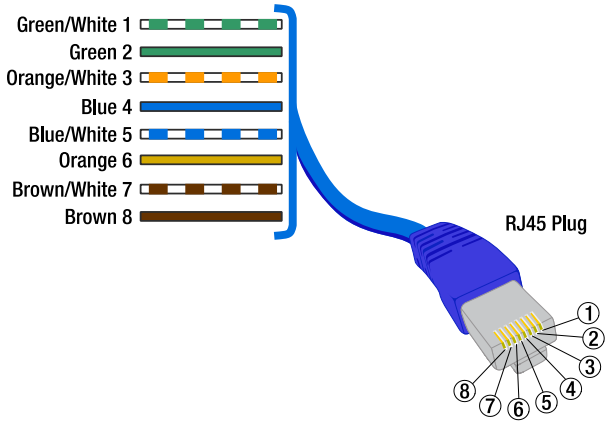
* As the CP30 starts up, the F1, F2 and F3 LEDs are progressively set ON when successful. After a successful start up, F1 and F2 are set OFF, F3 is left ON and the OK LED is set ON

PROCESSOR SPECIFICATIONS	
Processor	Cirrus EP9301 (ARM9) / 166 MHz / 32 bit data bus
BIOS	Yes
SRAM	128 KB (Battery backed)
Flash Memory	16 MB. Permanent memory. Used to store the RTU configuration, logic, retained variables and event logs. If power to the processor is lost, non-retained variables and the current state of execution will be reset.
SDRAM	32 MB
Real-time Clock (RTC)	1 minute per month (+/- 20 ppm)
Watchdog timer	Yes
Status Indication	Yes
Battery Life – module unpowered	7 years @ 25°C
Communications Ports	1-3 (1 fixed, 2 option ports)
Comms Port 1 (Ethernet)	10 or 100 Mbps auto negotiation Default IP address: 192.168.0.1 Isolation: Transient voltage: 1 kV
Comms Ports 2 and 3 (Optional)	For supported port types, please see the Option Boards chapter
Configuration Software	Toolbox PLUS+
Diagnostics Software	Yes
RTU Address Range	1 – 65520
Communications Protocol	Kingfisher, Modbus (RTU, ASCII and TCP), DNP3 and more (see the protocols document for further details)
Default Data Format	8 data bits, no parity, 1 stop (8, N, 1)
Analog Block Processing	Yes
PID Block Processing	Yes
Redundancy	Yes. Two CP-30 modules can be used in the one RTU.
Logic Processing	IEC 61131 Languages: Ladder Logic, Structured Text, Function Block Diagram, Sequential Function Chart, Instruction List and Flowchart
Internal Power Consumption	500 mA from +5 VDC bus on backplane
I/O Bus Data Rate	250 Kbps
CM Bus Data Rate	250 Kbps
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing

CP-30 Pinout



Port 1 Pins	Ethernet Function
1	DTR
2	N/C
3	RTS
4	DCD
5	GND (0 V)
6	CTS
7	RXD
8	TXD



5. Communications Modules

Communications modules can be utilized to add additional ports and multiple protocol capability to your RTU.

Each module is equipped with two expansion ports that can house a wide range of specialized option boards as follows:

Part Number	Option Board Description
I	Isolated Serial Interface, RS232/RS485/RS422
F	Fiber Optic Interface
D	Dialup Modem (PSTN) V34 33.6 Kbps
L	Private Line or Analogue Radio Interface
H	HART / Bell 202 interface
A3	Ethernet MTRJ Fiber Optic Interface
T3	Ethernet RJ54 Copper – 10/100 Mbps
R2	900 MHz Spread Spectrum Radio for Australia
R3	2.4 GHz Spread Spectrum Radio for International
R4	900 MHz Spread Spectrum Radio for USA

For more information regarding option boards and compatibility with superseded hardware, please refer to the chapter Option Boards.

Lithium Battery	
	These products contain a lithium battery. There is a risk of explosion if battery is replaced by an incorrect type. Dispose of used batteries in accordance with local regulations or return to the supplier.

5.1. MC-12 Communications Module

- **Up to three communications ports per module**
- **Supports Communications Redundancy**
- **Wide range of available option boards**
- **Fixed Serial (RS232) port on port 1**

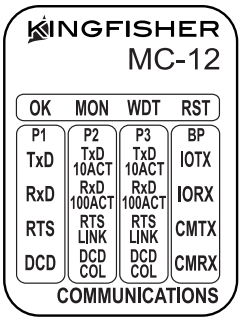
The MC-12 multi-communications module provides up to three additional communications ports. Ports two and three can house option boards while port 1 is fixed as a serial (RS-232) port.

An MC-12 supports a maximum baud rate of 83 Kbps between itself and the RTU processor module. This bandwidth can be split across a maximum of 16 ports. Users should be mindful of this limitation when determining the number of ports used simultaneously in one installation.

The MC-12 is identical to the CP-12 with the exception of labelling, the lens cover, and firmware.

This module consumes power from the +5 VDC bus on the backplane. It also requires +12 VDC. One or more MC-xx modules can be installed in any I/O slot of a 4, 6 or 12 slot backplane.

MC-12 Module LEDs

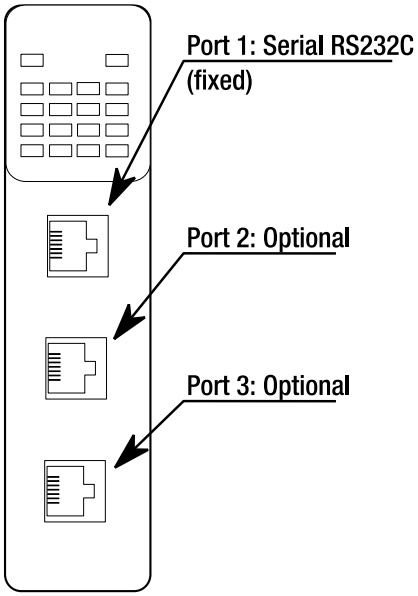


MC-12 LED	Description
OK	ON when Module is functioning correctly
MON	ON when Module is in Monitor mode
WDT	ON when Module watchdog timer is overflows, such as in the event of a software crash.
RST	ON when in reset. Will be lit for 200 ms when cold starting.
TxD	ON when transmitting data on corresponding Port
RxD	ON when receiving data on corresponding Port
RTS	ON when Request To Send on corresponding Port is asserted
DCD	ON when Data Carrier Detect affirmed on corresponding Port
10ACT	ON when Ethernet is operating at 10 Mbps on corresponding Port
100ACT	ON when Ethernet is operating at 100 Mbps on corresponding Port
LINK	ON when Ethernet Link is established
COL	ON when Ethernet Collision is detected
IOTX **IORX**	Brightness of each indicates load on backplane IO Bus (this bus is used to poll all IO modules)
CMTX **CMRX**	Brightness of each indicates load on backplane Communications Bus (this bus is used for communications modules data transmission)

MC-12 COMMUNICATIONS MODULE SPECIFICATIONS	
Processor	40 MHz x86
Word Size	16 bit data bus
BIOS	Yes
Flash Memory	512 KB
SRAM	512 KB (Non-Volatile, Battery Backed)
Battery Type	Lithium Primary (not rechargeable)
Battery Life — module unpowered	7 years @ 25°C
Real-time clock	Yes. Accuracy ± 1 min/month
Watchdog timer	Yes
Status Indication	Yes
Communications Ports	1-3 (1 fixed, 2 option ports)
Port 1 (RS-232)	300 to 115200 Baud (factory default = 9600 bps)
Default Data Format	8 data bits, no parity, 1 stop (8, N, 1)
Ports 2 and 3 (Optional)	For supported port types, please see the Option Boards chapter
Configuration Software	Toolbox 32
RTU Address Range	1 – 249 (expandable to 2000 by using multiple masters)
Communications Protocol	Kingfisher, Modbus + many more
Analogue Block Processing	Yes
Redundancy	Yes. Two CP-12 modules can be installed in the one RTU. One processor module must be installed in an odd numbered slot and one in an even numbered slot.
Internal Power Consumption	275 mA from +5 VDC bus on backplane
I/O Bus Data Rate	250 Kbps
CM Bus Data Rate	83 Kbps
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
Hot Swap	Yes. When 2 processors are present on the backplane, one processor can be swapped while the RTU is still running. However, a hot swap will cause a Warm Start of the remaining processor. All ports will be re-initialized and ready for communications within 6 seconds. New data received during the changeover may be lost. To preserve data and for more information please see the Redundancy appendix in the Toolbox 32 manual.

MC-12 Pinout

The MC-12 has a fixed serial port (RS-232) on port 1. Ports 2 and 3 can house option boards. For more information regarding communications capabilities please refer to the Option Board chapter.



Port 1 Pins	Direction	RS-232 Definition
1	OUT	DTR
2	N/C	N/C
3	OUT	RTS
4	IN	DCD
5	COM	GND (0 V)
6	IN	CTS
7	IN	RXD
8	OUT	TXD

5.2. MC-31 Communications Module

- **Up to three communications ports per module**
- **Supports Communications Redundancy**
- **Wide range of available option boards**
- **Fixed Ethernet port on port 1**
- **128 KB SRAM**
- **16 MB Flash**
- **32 MB DRAM**

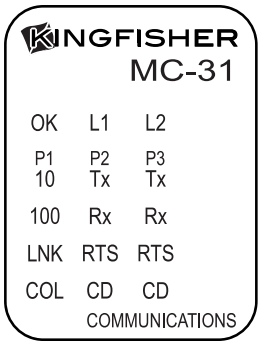
The MC-31 Communications Module provides three additional communications ports. Ports 2 and 3 are optional and house option boards while port 1 is a fixed Ethernet port.

The MC-31 is identical to the CP-30 with the exception of labelling, the lens cover, and firmware.

The MC-31 module is only for use with CP-30 based RTUs.

This module consumes power from the +5 VDC bus on the backplane. It also requires +12 VDC. One or more MC-31 modules can be installed in any I/O slot of a 4, 6 or 12 slot backplane. An RTU can have up to 16 ports.

MC-31 Module LEDs

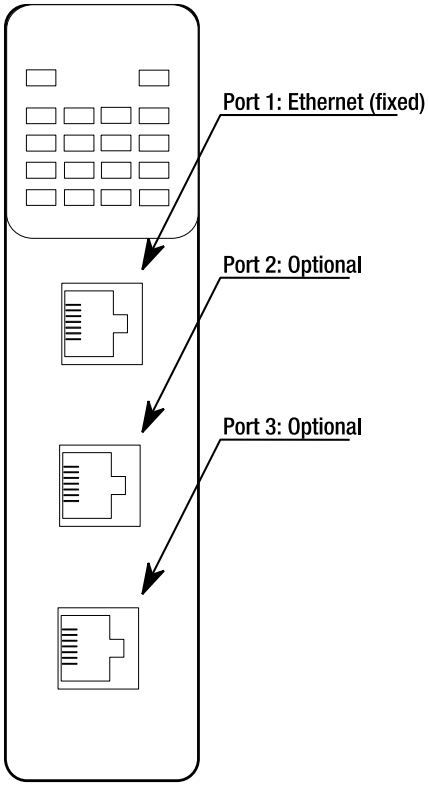


MC-31 LED	Description
OK *	Steady: Operating system Ok. Set ON after start-up checks pass (see F1, F2 and F3 LEDs below). Slow flash: starting operating system after downloading firmware Fast flash: firmware download error
10	Port 1 10 Mbps Ethernet connection. Flashes when communicating otherwise ON continuously
100	Port 1 100 Mbps Ethernet connection. Flashes when communicating otherwise ON continuously
LNK	Port 1 Ethernet link established (port is connected to an Ethernet network)
COL	Port 1 Ethernet collisions detected
Tx	ON when port is transmitting
Rx	ON when port is receiving
RTS	Request to Send. RTU sets RTS ON to begin transmitting
CD	Ports 2, 3: Carrier Detect. ON while a communications signal is detected.
L1 *	During start-up: set ON if Firmware running OK. When RTU running: flashes if port 2 configuration error. During firmware download: flashes fast if an error occurs. Reset power to clear.
L2 *	During start-up: set ON if Linux operating system running OK. When RTU running: flashes if port 3 configuration error. During firmware download: flashes fast if an error occurs. Reset power to clear.

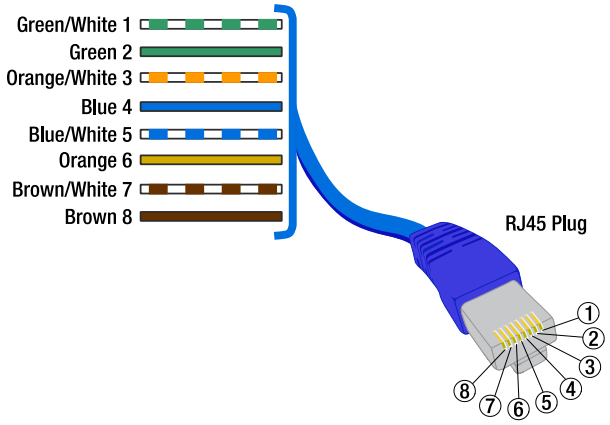
* As the MC-31 starts up, the top row LEDs are progressively set ON when successful. After a successful start up, L1 and L2 are set OFF.

MC-31 COMMUNICATIONS MODULE SPECIFICATIONS	
Processor	Cirrus EP9301 (ARM9) / 166 MHz / 32 bit data bus
SRAM	128 KB (Battery backed)
Flash Memory	16 MB
SRAM	32 MB SDRAM (Non-Volatile, Battery Backed)
Battery Type	Lithium Primary (not rechargeable)
Battery Life — module unpowered	7 years @ 25°C
Status Indication	Front Panel LEDs
Communications Ports	1-3 (1 fixed, 2 option ports)
Port 1 (RS-232)	Fixed Ethernet
Default Data Format	8 data bits, no parity, 1 stop (8, N, 1)
Ports 2 and 3 (Optional)	For supported port types, please see the Option Boards chapter
Communications Protocol	Kingfisher, Modbus (RTU, ASCII and TCP) and DNP3
Default Data Format	8 data bits, no parity, 1 stop (8, N, 1)
MC-30/31 modules per RTU	Maximum of 16 ports per RTU E.g. Can use 5 MCs if each has 3 ports
Internal Power Consumption	500 mA from +5 VDC bus on backplane
Hot Swap	Yes. Module can be swapped while RTU is running.
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing

MC-31 Pinout



Port 1 Pins	Ethernet Function
1	DTR
2	N/C
3	RTS
4	DCD
5	GND (0 V)
6	CTS
7	RXD
8	TXD



6. Communications Option Boards

The following option boards are compatible with the CP-12/30 processor modules and the MC-12/31 communications modules (and the LP-3 stand-alone RTU). For PC-1 option boards please see the following chapter.

These are the currently supported option boards:

Part Number	Option Board Description
I	Isolated Serial
F	Fiber Optic Interface
D	Dialup Modem (PSTN) V34 33.6 Kbps
L	Private Line or Analogue Radio Interface
H	HART / Bell 202 interface
A3	Ethernet MTRJ Fiber Optic Interface
T3	Ethernet RJ54 Copper – 10/100 Mbps
R2	900 MHz Spread Spectrum Radio for Australia
R3	2.4 GHz Spread Spectrum Radio for International
R4	900 MHz Spread Spectrum Radio for USA

For previous generation hardware, please refer to the section Compatibility.

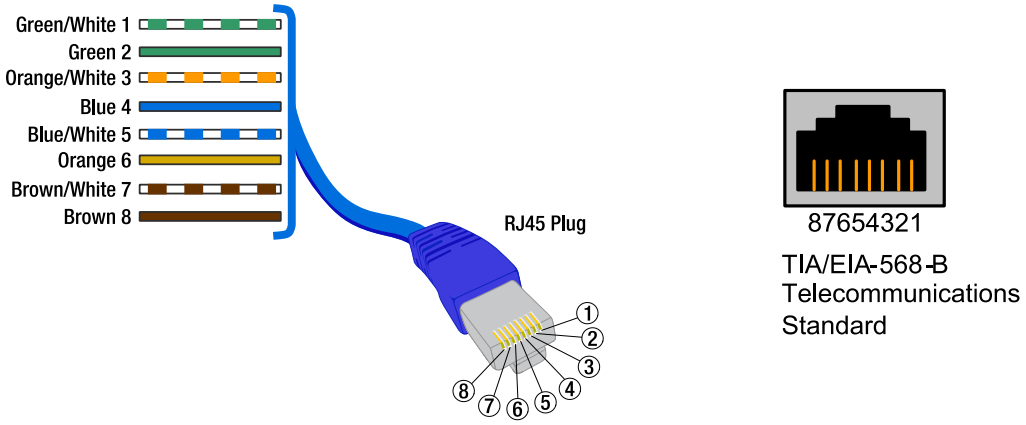
6.1. Option Board I: Isolated serial

The isolated serial option board provides an RS-232, RS485 or an RS422 interface. The port is software configurable for any of these modes. When RS485 is configured for an isolated serial option board, the RTS and CD LEDs are set on and when RS422 is configured the RTS LED is set on (there are no LEDs set on for RS232). RS485 requires a 120 Ω terminating resistor at each end of the transmission line and RS422 requires a 100 Ω terminating resistor at the receiver end of the transmission line only (Please see the wiring diagrams at the end of this section).

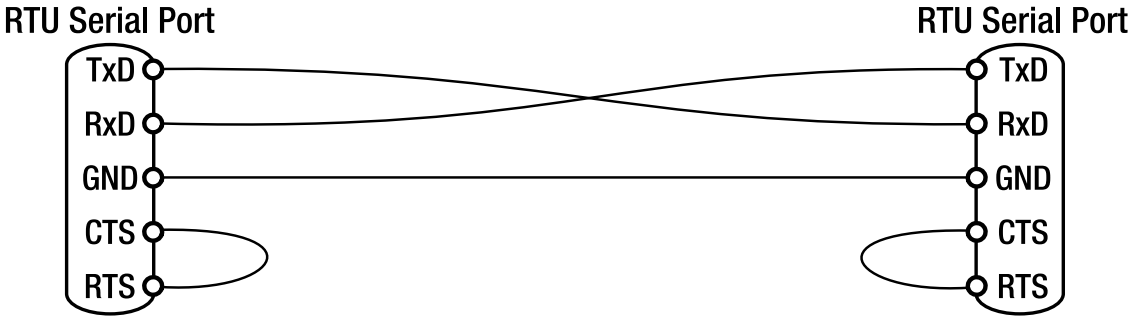
Option Board I Specifications	
Baud rate	300 – 115200 bps
Internal Power Consumption	15 mA from +5 VDC Bus on backplane
Output Power	+4.3 V @ 100 mA max.
RS422 Line drive	10 Receivers
RS485 Line drive	32 Receivers
Communications	8 data bits, no parity, 1 stop (8, N, 1)
Isolation	Transient voltage: 2.5 kV
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
RTU Hardware Required	Can be installed in any of the following ports: CP-10/11/21/30 Port 2 or Port 3 MC-10/11/30/31 Port 2 or Port 3 LP-1/2 Port4 LP-3 Port 3 or Port 4

Serial Option Board Connections

RJ45 Pin	Direction	RS-232	RS422 / RS485
1	OUT	DTR	N/A
2	OUT	4.3 V	N/A
3	OUT	RTS	TX+
4	IN	DCD	N/A
5	Common	GND	GND
6	IN	TCS	RX+
7	IN	RxD	RX-
8	OUT	TxD	TX-

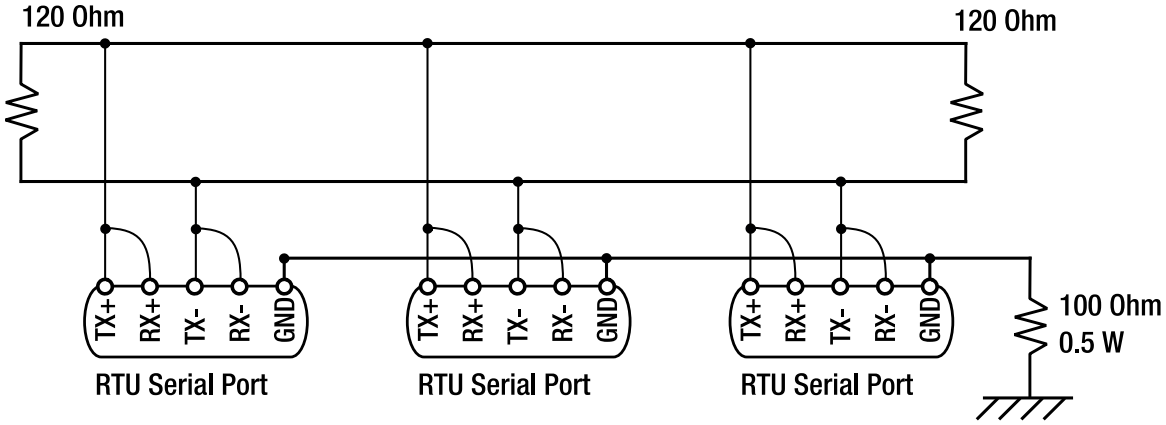


RS232 Wiring Diagram (Null Modem Cable)



Note maximum recommended RS232 length is 15 meters.

RS485 Wiring Diagram

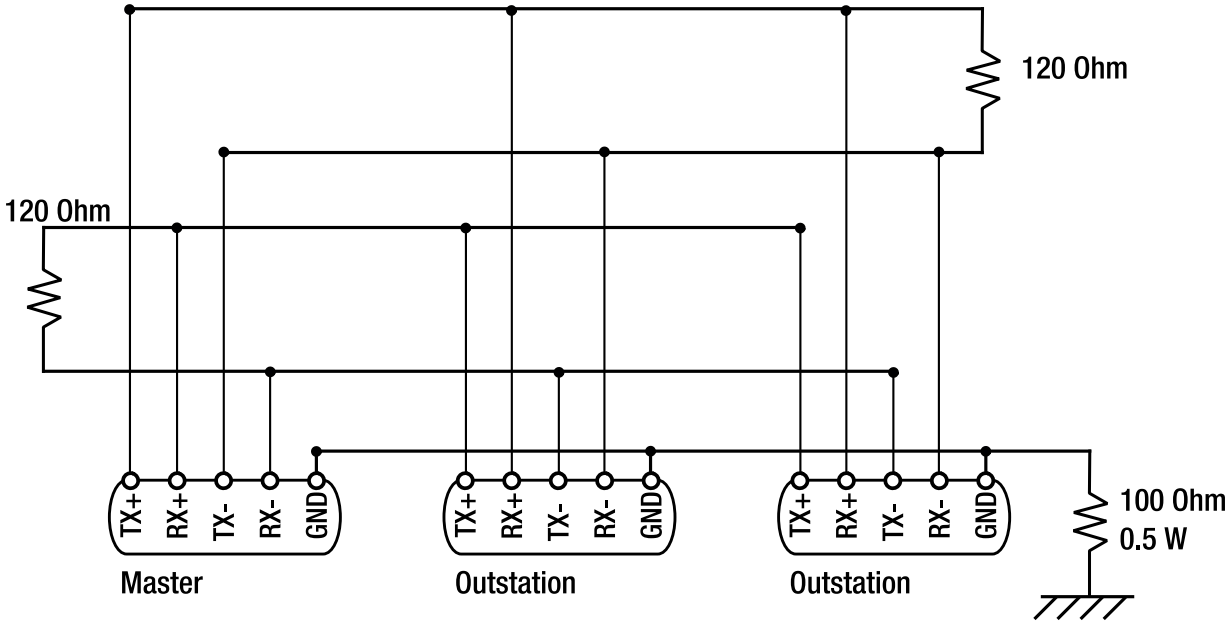


If the ground resistor is not available, each GND terminal can be tied to EARTH locally via 100 Ω 0.5 W resistor.

For short cable runs (less than 5 m) a single 60 Ω terminating resistor can be used at one end of the RS485 cable.

RS422 Wiring Diagram

The master RTU can transmit/receive to any one outstation RTU at any time or each outstation can transmit/receive to the master RTU, one at a time. Note: outstation RTUs cannot communicate with each other. Up to 10 RTUs (or other RS422 devices) can be connected to the RS422 bus. Maximum RS422 Wire Length: 1200 m



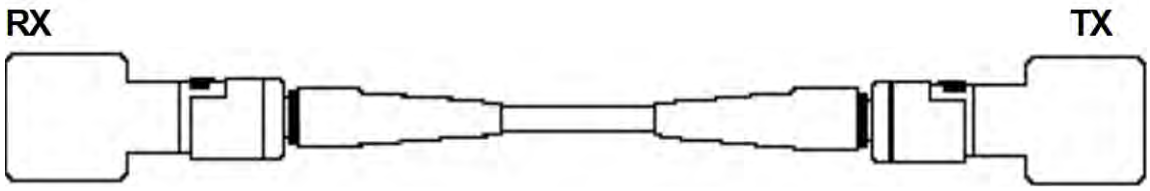
If GND wire is not available, each GND terminal can be earthed locally via 100 Ω 0.5 W resistors.

6.2. Option Board F: Fibre Optic Serial Board

The fibre optic serial option board provides a serial interface via a fibre optic cable. A fibre optic port is treated the same way as a standard serial port except a fibre optic cable is used for the communications medium. A fibre optic link offers excellent electrical isolation and a high data rate. Two fibre optic cables are required for each fibre optic port.

Option Board F Specifications	
Maximum Baud rate	115.2 Kbps (equivalent to RS232 port)
Communications	8 data bits, no parity, 1 stop (8, N, 1)
Maximum Fiber Optic Cable Length	Approx. 4 km (depends on cable and other factors)
Supported Fiber Optic Cables	Multimode 50/125 um, 62.5/125 um, 100/140 um, and 200 um HCS
Option Board Connectors (use male connectors on cable)	Tx: ST female (light grey port) Rx: ST female (dark grey port)
Power Consumption (Tx)	200 mA max. from +5 VDC Bus on backplane
Line drive	1 Receiver (point to point)
Electrical Isolation	15 kV
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
RTU Hardware Required	Can be installed in any of the following ports: CP-10/11/21/30 Port 2 or Port 3 MC-10/11/30/31 Port 2 or Port 3 LP-1/2 Port4 LP-3 Port 3 or Port 4

Cabling

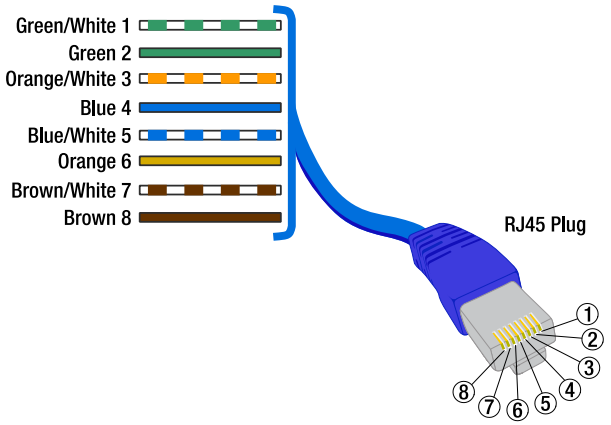


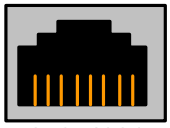
6.3. Option Board D: 33.6 Kbps Dial Option Board

The dial option board provides a **V34 PSTN** interface to the Kingfisher RTU. The port speed is software configurable, and the dial board is designed to be compliant with telecommunications standards worldwide.

Dial Option Board Connections

RJ45 Pin	PSTN Function
1	-
2	-
3	Reserved
4	Line -
5	Line +
6	Reserved
7	-
8	-





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Telecommunication Line Cord



To reduce risk of fire, use only 26 AWG or larger telecommunications line cord.

Dial Option Board Specifications	
PSTN Modem / Data Rate	V.34, 300 to 33600 bps, auto-negotiating
RTU DTE Port Speed	300 – 115200 bps
Line Impedance	600 Ω
Approval	International
Transmit level	-10 dBm
Receive level	-43 dBm to — 9 dBm
Dialling	Pulse or Tone
Internal Power Consumption	175 mA from +5 VDC Bus on backplane
Isolation	Maximum working voltage in respect to system earth/ground must not exceed TNV-2 limits (80 V) Transient voltage: 5 kV
Recommended Initialization String	D Option: AT&FE0V0S0=2&W Original D Option: AT&FE0V0S0=2X0&W (ignores dial tone)
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
Compatibility	Can be installed in any of the following ports: CP-10/11/21/30 Port 2 or Port 3 MC-10/11/30/31 Port 2 or Port 3 LP-1/2 Port4 LP-3 Port 3 or Port 4

6.4. Option Board L: Line/Analogue Radio Interface

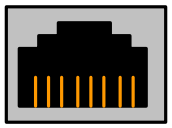


The line option board provides a Private Line or analogue radio interface and is software configurable for either of these modes.

The board is optically isolated, operates at 1200 bps and provides FSK CCITT V.23 modulation.

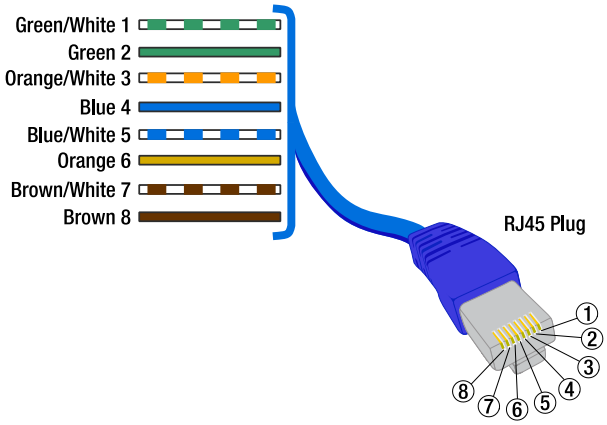
Line Board Connections

RJ45 Pin	Direction	Line / Radio Function
1	OUT	Tx -
2	IN	Rx -
3	OUT	RTS/PTT
4	IN	CD
5	IN	GND (0 V)
6	IN	12 V
7	IN	Rx +
8	OUT	Tx +



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Telecommunications Line Cord



To reduce risk of fire, use only 26 AWG or larger telecommunications line cord.

Connecting a Radio

As the port is isolated it is necessary to use an external voltage source (normally from the RTU 'radio' connection +12 V) to power not only the radio but also the carrier detect circuit.

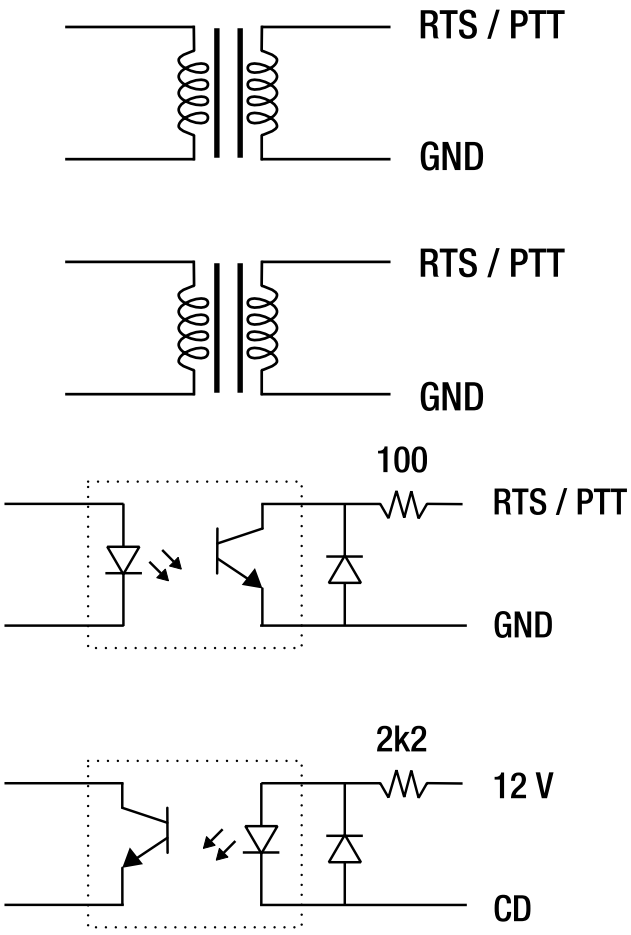
Some radios have a very low audio interface level (TX Audio), e.g. Maxon DM 0530, DM-2850, SD-125 and Tait T2010 / 2015. These radios will most likely require a resistor network external to the port to drop the TX Audio level.

Some radios (e.g. Maxon) have an internal pull up resistor to +5 V on the carrier detect line, if +12 V is used on the carrier detect optocoupler and then run to the carrier detect output on the radio, the optocoupler will always be driven. There are several ways to get around this:

Use a radio without an internal pull up to +5 V (Trio SR, possibly Tait)

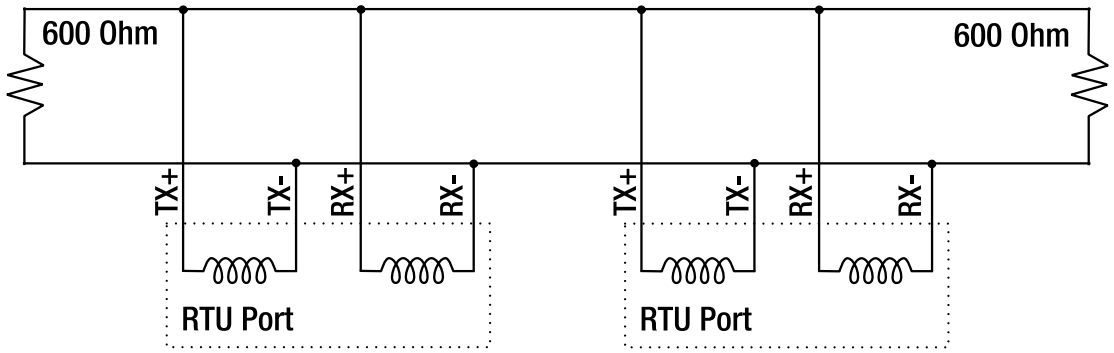
Modify the radio by removing the internal pull up, as per manufacturer's instructions.

Use +5 V to supply the carrier detect optoisolation circuit. (DO NOT USE +5 V FROM THE BACKPLANE UTILUX CONNECTOR AS IT IS NOT ISOLATED)



2-Wire Line, point-to-point

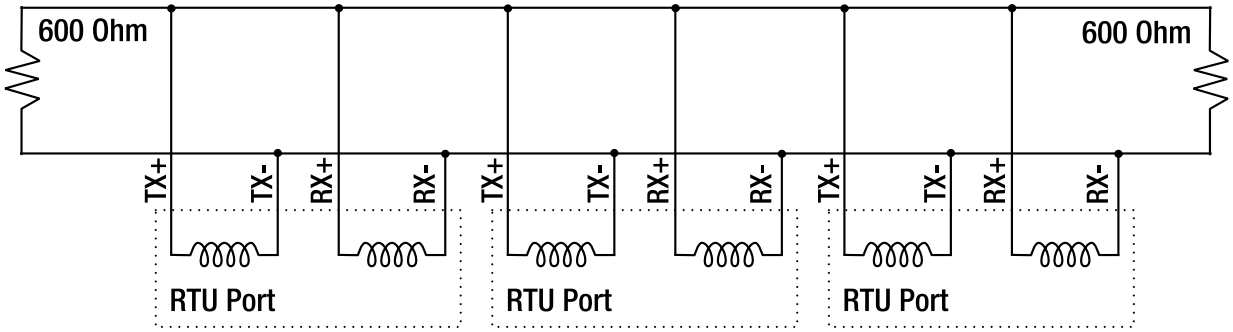
Either RTU can transmit/receive one at a time.



Note line termination is required.

2-Wire Line, multi-drop

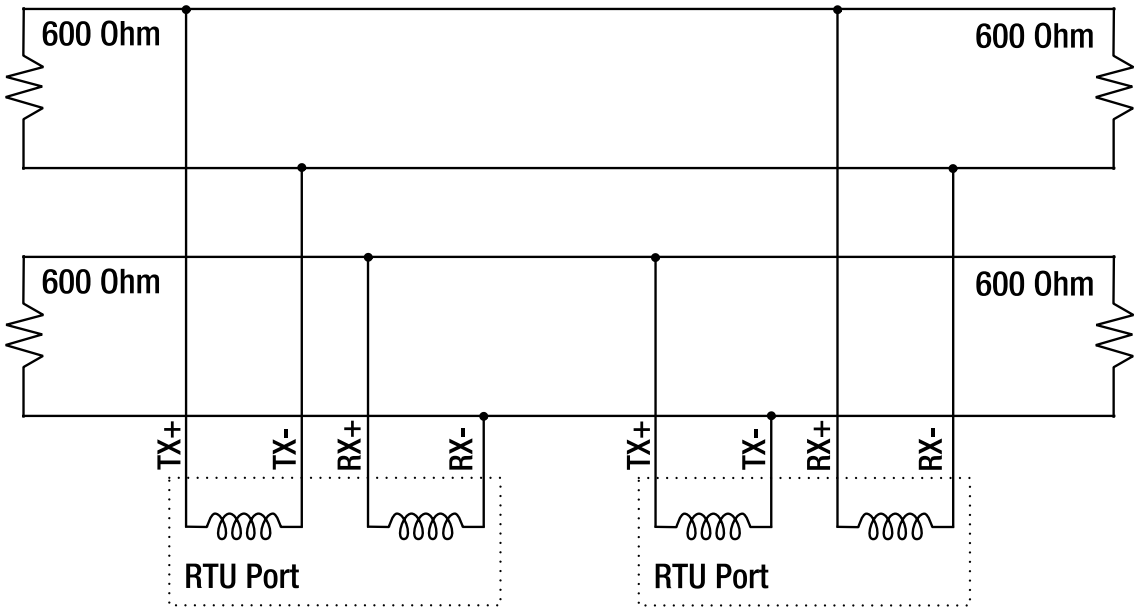
Any RTU can transmit/receive one at a time.



Note line termination is required.

4-Wire Line, point-to-point

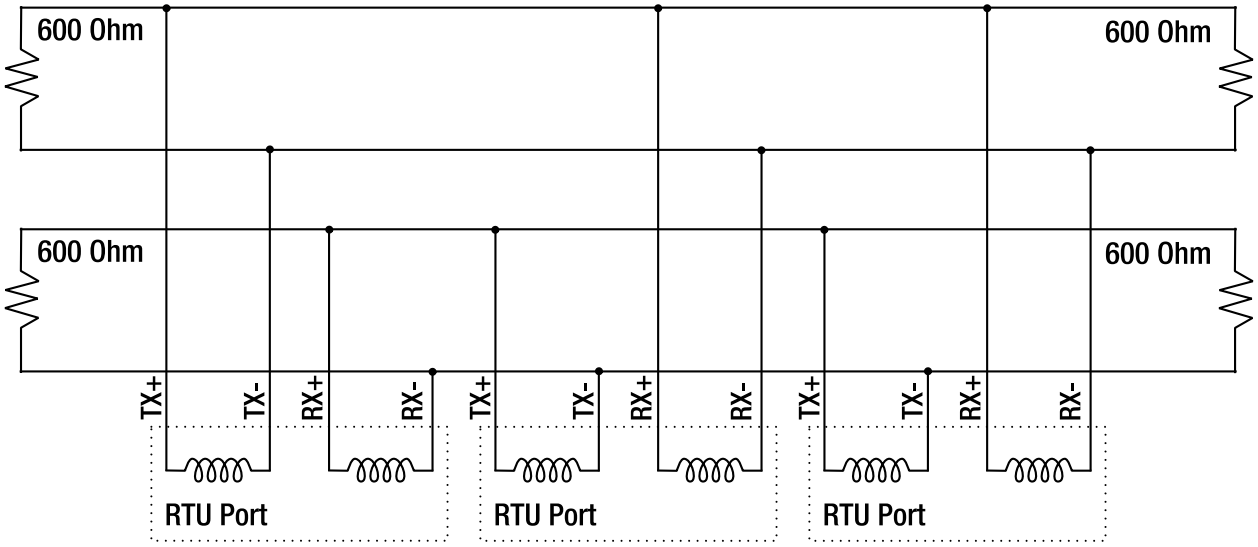
Either RTU can transmit/receive at any time.



4-Wire Line, multi-drop

Master RTU can transmit/receive to any one outstation RTU at any time or each outstation can transmit/receive to master RTU, one at a time.

Note that outstations cannot communicate to each other.



Line/Radio Option Board Specifications	
Baud rate	1200 Baud
Modulation	FSK, CCITT V.23
Carrier detect input	Optical isolation Active low or high Min. input 2 mA (70 VDC max.)
RTS/PTT output	Optical isolation Open collector output Active low 30 VDC max @ 20 mA max. Microwave networks typically use a negative supply rail for the carrier detect circuit. The more positive rail should be connected to pin #6 (RTS/PTT) and the difference between the rails must not exceed 30 VDC.
Output impedance	30 kΩ
Input impedance	30 kΩ
Line termination	600 Ω
Line configuration	2 or 4 wire The port is not full duplex and cannot use the full duplex functionality of a 4-wire configuration. 4-wire configurations eliminate the ability to communicate peer to peer but allow an increased number of drops on one link.
Line drive in multi-drop configuration	10 drops for 2 wire 20 drops for 4 wire
Transmit output level	-6 dBm (LINE-2) -6 to –21 dBm software configurable (LINE-L)
Receive level	-43 dBm to -9 dBm
Internal Power Consumption	85 mA from +5 VDC Bus on backplane
Transmission Distance	Allowing 3dB for background noise and a 10dB fade margin, up to 24dB of cable loss can be tolerated. Therefore, transmission distance = 24 / cable loss per Km (dB). Note: if there are more than 2 RTUs (or other devices) on the line, reduce the allowable cable loss (24) by 1dB per additional RTU or device.
Isolation	Maximum working voltage in respect to system earth/ground must not exceed TNV-2 limits (80 V) Transient voltage: 3.88 kV
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
Compatibility	Can be installed in any of the following ports: CP-10/11/21/30 Port 2 or Port 3 MC-10/11/30/31 Port 2 or Port 3 LP-1/2 Port4 LP-3 Port 3 or Port 4

6.5. Option Board H: HART Interface

The HART option board provides a Bell 202 interface to devices supporting the HART protocol. Each HART option board can communicate with up to 15 Hart devices. Two HART option boards can be installed on the one RTU allowing up to 2 point-to-point circuits or 2 multi-drop circuits.

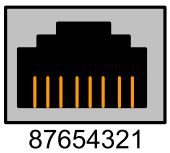
In a point-to-point installation, the loop current can be measured using an RTU analogue input channel. If using two separate point to point circuits and reading the loop current in each, the RTU analogue input channels must be isolated from each other.

In a multi-drop installation, the loop current is not used or measured.

For more information regarding HART configurations please refer to the HART Implementation Guide available on MyKingfisher.

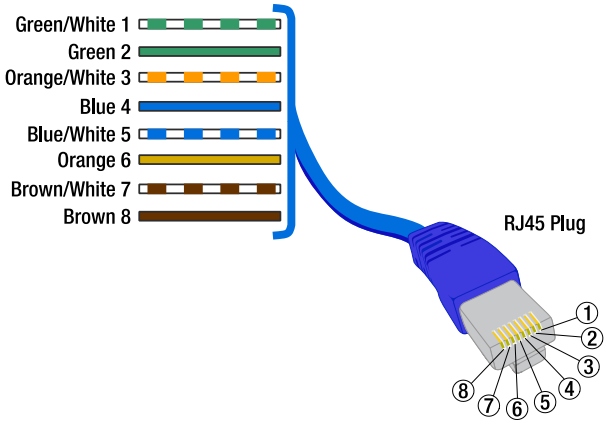
HART Board Connections

RJ45 Pin	HART Function
1	Line +
2 to 8	Not Connected
8	Line -

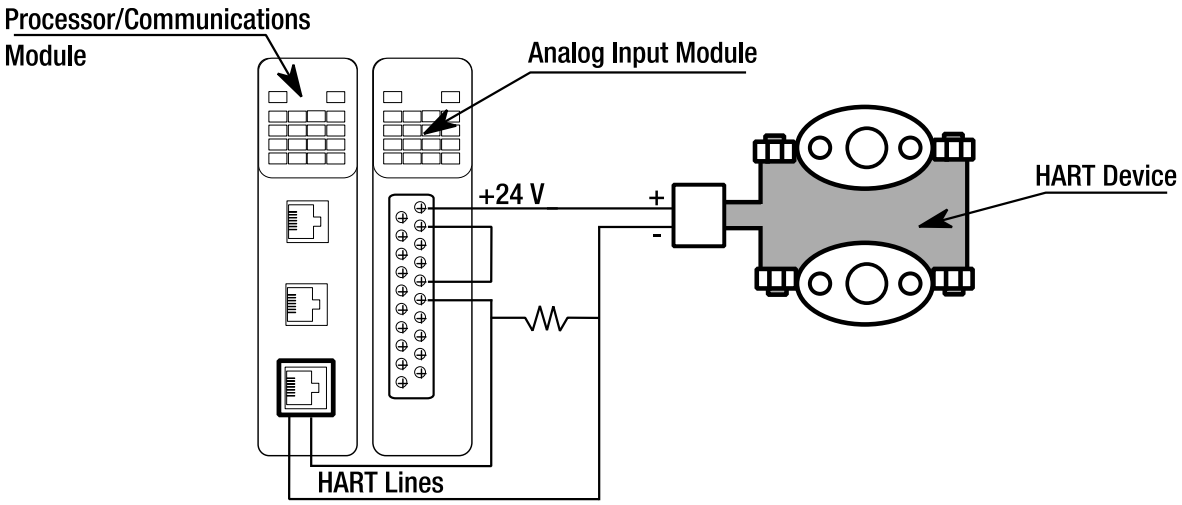


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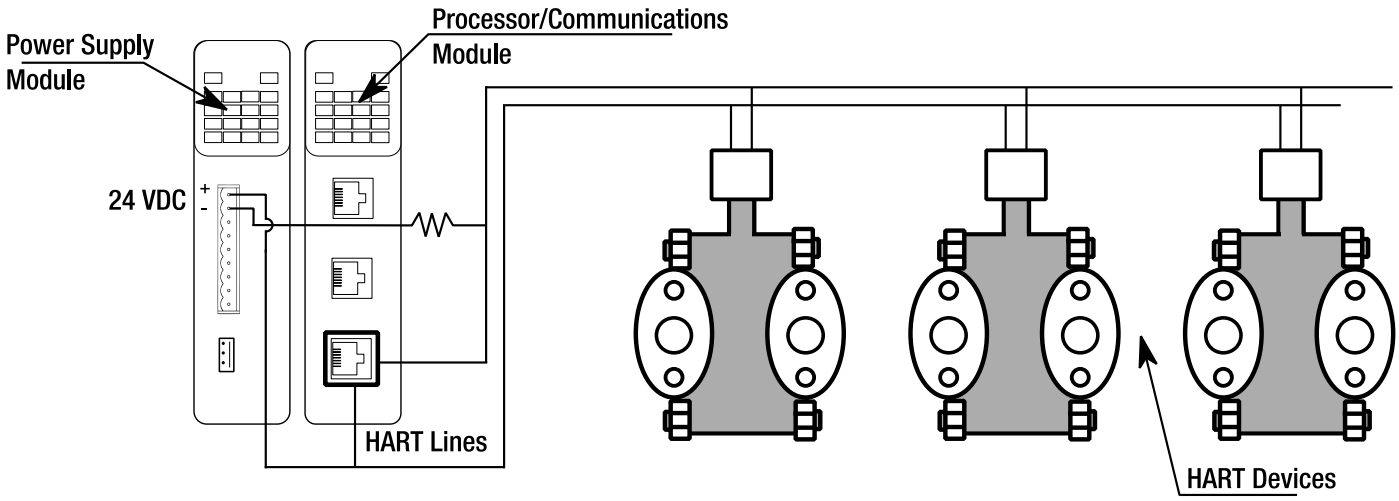


Point-to-point Wiring Configuration (Utilizing Analogue Input)



Note resistor should be approximately 500 Ω.

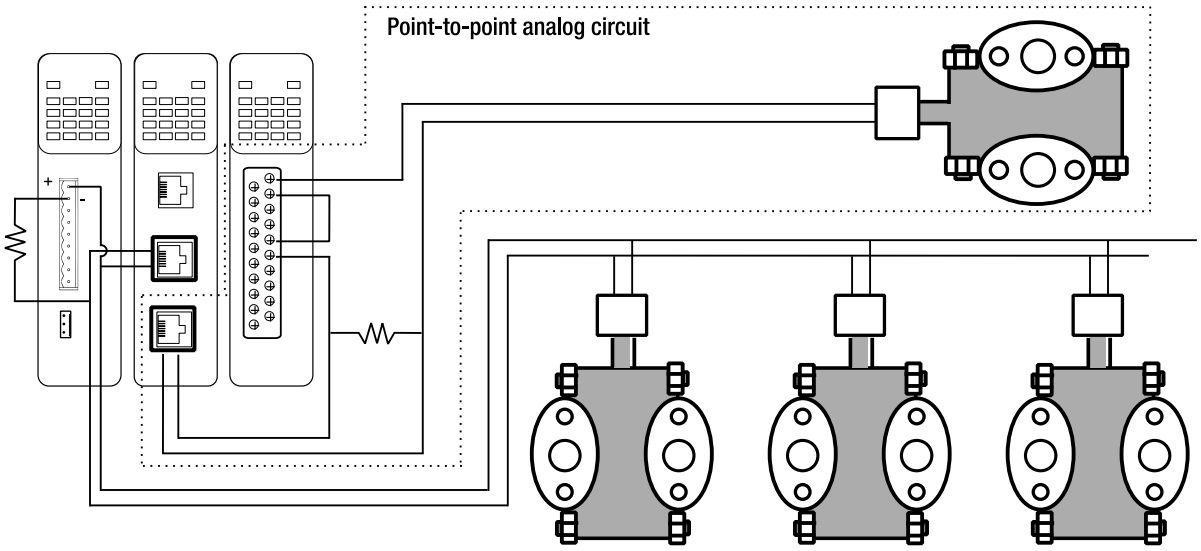
Multi-drop Wiring Configuration



Note the more HART devices connected, the closer the resistor value needs to be to 50 Ω

Hybrid Wiring Configuration

When using multiple HART networks on a single RTU, be sure to isolate the 24 V supplies.



HART Option Board Specifications	
Baud-rate	1200 Baud, Half Duplex
Modulation	Bell 202
Logical Frequencies	1 = 1200 Hz 0 = 2200 Hz
Internal Power Consumption	1 mA from +5 VDC Bus on backplane
Maximum No. HART Devices	15 (multi-drop)
Data Available	HART and loop current for point-to-point HART only for multi-drop
Isolation	Maximum working voltage in respect to system earth/ground must not exceed TNV-2 limits (80 V) Transient voltage: 3.88 kV
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
Compatibility	Can be installed in any of the following ports: CP-10/11/30 Port 2 or Port 3 MC-30/31 Port 2 or Port 3

6.6. Option Board T3: 10/100 Ethernet Controller

The T3 Ethernet Option Board provides Ethernet connectivity via the W5300 chipset allowing full MAC & TCP/IP integration, and simultaneous connection to 8 separate sockets with automatic negotiation.

T3 Ethernet Option Board Specifications	
Connection Speed	10/100 auto negotiated (up to 50 Mbps actual)
Max Simultaneous Sockets	8 (with 0 ~ 64 KByte memory for data allocation)
Connection Durability	Approximately 750 cycles
Operating Temperature	0 to 70 °C
Storage Temperature	-40 to85 °C
Compatibility	Can be installed in any of the following ports: CP-10/11/30 Port 2 or Port 3 MC-30/31 Port 2 or Port 3

6.7. Option Board A3:Fibre Optic Ethernet

The A3 option board provides Ethernet connectivity via fibre optic cable. The A3 is functionally equivalent to a T3 Ethernet board, but fibre optical cabling is used in place of copper cabling allowing for excellent electrical isolation.

A3 Ethernet Option Board Specifications	
Connection Speed	10/100 Mbps
Optical Compliance	Full ATM 100 Mbps physical layer Full 100 Mbps-FX (IEEE802.3u)
Fiber Optic Transceiver	AFBR-5903Z
Supported Fiber Optic Cables	Multimode 50/125 um, 62.5/125 um, 100/140 um, and 200 um HCS
Option Board Connectors (use male connectors on cable)	Tx: ST female (light grey port) Rx: ST female (dark grey port)
Supported Fiber Optic Cables	Multimode 50/125 um, 62.5/125 um, 100/140 um, and 200 um HCS
Option Board Connectors (use male connectors on cable)	MTRJ connector. Available from Semaphore are the MTRJ-SC and MTRJ-ST adaptors.
Compatibility	Can be installed in any of the following ports: CP-10/11/30 Port 2 or Port 3 MC-30/31 Port 2 or Port 3

6.8. Option Board R2: Australian Spread Spectrum Radio



The R2 Spread Spectrum radio option board uses the MaxStream 900 MHz RF module to provide a high speed data link in Australia. This radio uses the public frequency band and does not need to be licensed.

When installed in a Communications or processor, the corresponding port **CD** (Carrier Detect) LED will be lit when the board is functioning correctly (weather antenna is connected or not).

RF Exposure	
	**900 MHz Spread Spectrum Radio** This equipment is approved only for mobile and base station transmitting devices. Antenna(s) used for this transmitter must be installed to provide a **separation distance of at least 30 cm** from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Modifications	
	Use of unauthorised antenna or other changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this product.

R2 Spread Spectrum Radio Board Specifications	
Countries Supported	Australia
Frequency	902-928 MHz
Transmit Power	1-1000 mW configurable
Range Indoors	900 m
Range Outdoors	22 km
Range with Yagi	Up to 32 km
Data rate — RTU to Radio	9600 bps
Data rate — Radio to Radio	115200 or 9600 bps
Power Consumption	3.7W maximum
Spread Spectrum Type	FHSS (Frequency Hopping Spread Spectrum)
Encryption	None #
Antenna Connector	RPSMA (reverse polarity SMA) Male (on radio)
Receiver Sensitivity	-110 dBm @ 9600 bps
Operating Temperature	-20 to 70 °C
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
Compatibility	Can be installed in any of the following ports: CP-10/11/30 Port 2 or Port 3 MC-10/11/30/31 Port 2 or Port 3 LP-1/2 Port4 LP-3 Port 3 or Port 4

6.9. Option Board R3: International Spread Spectrum Radio



The R3 Spread Spectrum radio option board uses the 2.4 GHz RF module to provide a high speed data link anywhere in the world (international). This radio uses the public frequency band and does not need to be licensed.

When installed in a Communications or processor, the corresponding port **CD** (Carrier Detect) LED will be lit when the board is functioning correctly (weather antenna is connected or not).

RF Exposure	
	**2.4 GHz Spread Spectrum Radio** This equipment is approved only for mobile and base station transmitting devices. **Separation distances of (i) 20 centimetres or more for antennas with gains < 6 dBi or (ii) 2 meters or more for antennas with gains > 6 dBi** should be maintained between the antenna of this device and nearby persons during operation. To ensure compliance, operation at distances closer than this is not recommended.

Modifications	
	Use of unauthorised antenna or other changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this product.

R3 Spread Spectrum Radio Board Specifications	
Countries Supported	International
Frequency	2.4000-2.4835 GHz
Transmit Power	50 mW
Range Indoors	180 m
Range Outdoors	5 km
Range with Yagi	Up to 8 km
Data rate — RTU to Radio	19200 bps
Data rate — Radio to Radio	9600 bps
Power Consumption	0.75W maximum
Spread Spectrum Type	FHSS (Frequency Hopping Spread Spectrum)
Encryption	None #
Antenna Connector	RPSMA (reverse polarity SMA) Male (on radio)
Receiver Sensitivity	-105 dBm
Operating Temperature	-20 to 70 °C
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
Compatibility	Can be installed in any of the following ports: CP-10/11/30 Port 3 only MC-10/11/30/31 Port 3 only LP-2 Port4 LP-3 Port 3 or Port 4

Encryption by special request in the USA only.

Please see www.digi.com/products/wireless for more information.

6.10. Option Board R4: US/Canada Spread Spectrum Radio



The R4 Spread Spectrum radio option board uses the MaxStream 900 MHz RF module to provide a high speed data link in the US and Canada. This radio uses the public frequency band and does not need to be licensed.

When installed in a Communications or processor, the corresponding port **CD** (Carrier Detect) LED will be lit when the board is functioning correctly (weather antenna is connected or not).

RF Exposure	
	**900 MHz Spread Spectrum Radio** This equipment is approved only for mobile and base station transmitting devices. Antenna(s) used for this transmitter must be installed to provide a **separation distance of at least 30 cm** from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

Modifications	
	Use of unauthorised antenna or other changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this product.

R4 Spread Spectrum Radio Board Specifications	
Countries Supported	US & Canada
Frequency	902-928 MHz
Transmit Power	1-1000 mW configurable
Range Indoors	900 m
Range Outdoors	22 km
Range with Yagi	Up to 32 km
Data rate — RTU to Radio	9600 bps
Data rate — Radio to Radio	115200 or 9600 bps
Power Consumption	3.7W maximum
Spread Spectrum Type	FHSS (Frequency Hopping Spread Spectrum)
Encryption	None #
Antenna Connector	RPSMA (reverse polarity SMA) Male (on radio)
Receiver Sensitivity	-110 dBm @ 9600 bps
Operating Temperature	-20 to 70 °C
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
Compatibility	Can be installed in any of the following ports: CP-10/11/30 Port 2 or Port 3 MC-10/11/30/31 Port 2 or Port 3 LP-1/2 Port4 LP-3 Port 3 or Port 4

Encryption by special request in the USA only.

Please see www.digi.com/products/wireless for more information.

7. PC-1 Option Boards

The PC-1 hybrid power supply and processor module has an accompanying range of communications option boards. These are not compatible with the CP series boards.

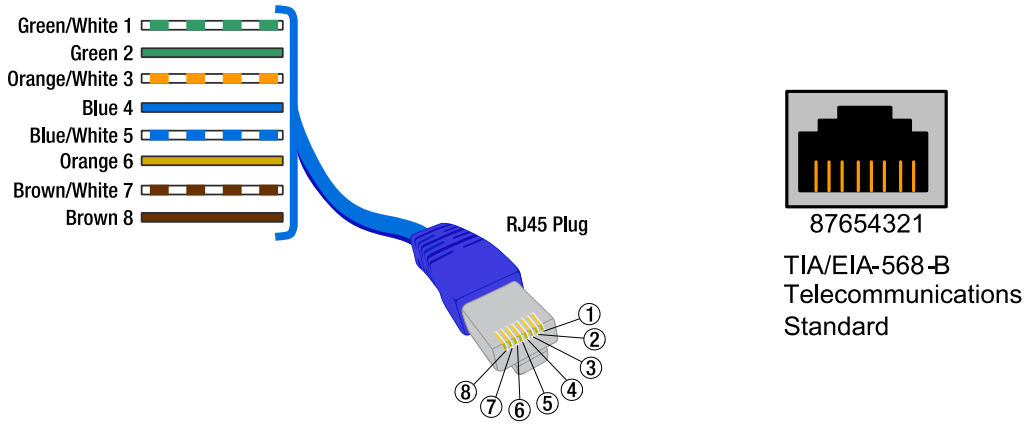
7.1. PC-1 Serial Option Board

The serial option board provides a RS-232 or RS485 interface. The port is software configurable for either of these modes. When RS485 is used, a 120 Ω terminating resistor is required at each end of the transmission line.

PC-1 Serial Board Connections

RJ45 Pin	Direction	RS-232	RS485
1	OUT	DTR	N/A
2	OUT	+12 V low power	N/A
3	OUT	RTS	LINE - *
4	IN	DCD	N/A
5	COM	GND (0 V)	GND (0 V)
6	IN	CTS	N/A
7	IN	RXD	N/A
8	OUT	TXD	LINE + *

* Polarity is opposite to CP-xx



For RS485 wiring diagram please refer to CP-xx/MC-xx serial board RS486 Diagrams

7.2. PC-1 Modem Board PL: Two Wire Line

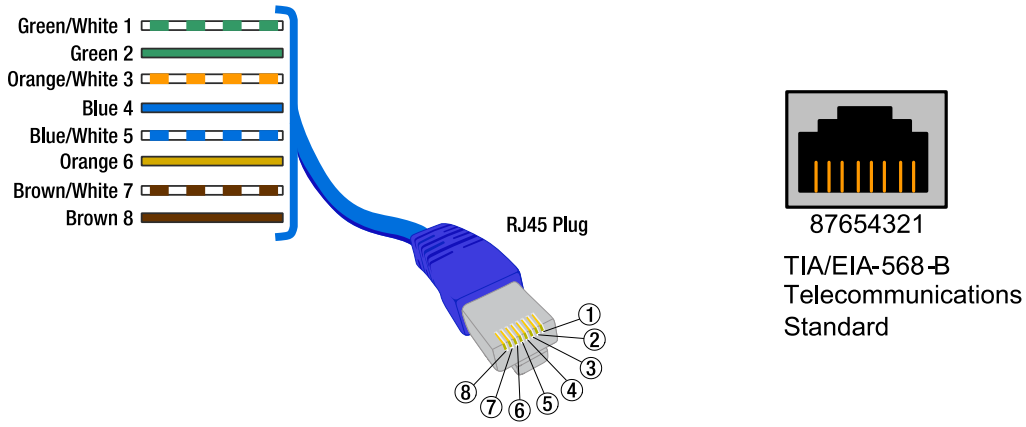
The 2-wire (Private) line option board provides a 2-wire point-to-point connection to another RTU with a line option board.

The board is optically isolated, operates at 1200 bps and utilizes FSK CCITT V.23 modulation.

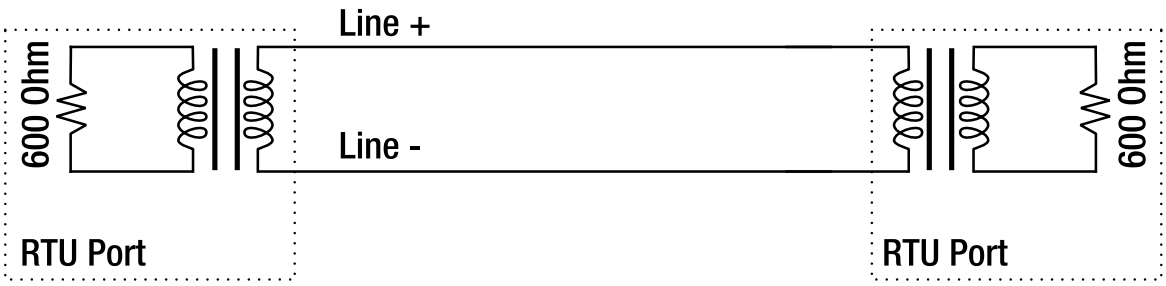
PC-1 Modem Board Connections

RJ45 Pin	Direction	Radio Function
1	OUT	DTR
2	OUT	+12 V low power
3	OUT	RTS
4	IN	DCD
5	COM	GND (0 V)
6	IN	CTS
7	IN	RXA
8	OUT	TXA

* Polarity is opposite to CP-xx



PC-1 2 Wire Line Wiring Diagram (point-to-point)



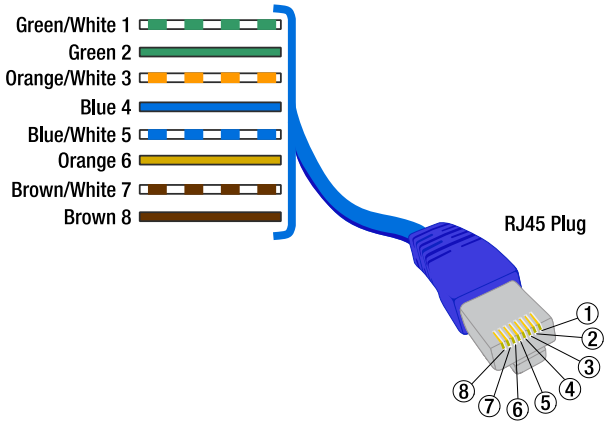
7.3. PC-1 Modem Board: Analogue Radio Interface

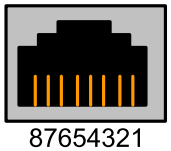


The analogue radio option board provides an FSK interface to external analogue radios (typically Maxon or Trio). When used with a Trio radio, one of the resistors must be factory modified.

PC-1 Analog Radio Board Connections

RJ12 Pin	Direction	Radio Function
1	OUT	DTR
2	OUT	+12 V low power
3	OUT	RTS
4	IN	DCD
5	COM	GND (0 V)
6	IN	CTS
7	IN	RXA
8	OUT	TXA





87654321

TIA/EIA-568-B Telecommunications Standard

8. Compatibility

Not all option boards are universally compatible with all processors and communications modules. The following tables are a selection guide for assuring the hardware you have selected will function as expected.

Communications Option Boards

CPU/Comms Module	A	A3	D	E	F	H	I	J	L	R2	R3	R4	T	T2	T3
CP-30 2676 firmware	✓	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓
MC-31 2676 firmware	✓	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓
MC-30 276 firmware	✗	✗	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	✗	✓	✗
CP-10/11 1.45b firmware	✗	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	✗	✗	✓
CP-10 previous firmware	✓	✗	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	✓	✗	✗
CP-12	✗	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	✗	✗	✓
CP-21	✗	✗	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✗	✗	✗
MC-10/11	✓	✗	✓	✗	✓	✗	✓	✓	✓	✓	✓	✓	✓	✗	✗
MC-11 V160 Firmware	✓	✗	✓	✗	✓	✗	✓	✓	✓	✓	✓	✓	✗	✗	✓
MC-12	✗	✓	✓	✗	✓	✓	✓	✗	✓	✓	✓	✓	✗	✗	✓
PC-1 with MC-10/11	✗	✗	✓	✗	✓	✗	✓	✓	✓	✓	✓	✓	✗	✗	✗
PC-1 with MC-12	✗	✗	✓	✗	✓	✗	✓	✓	✓	✓	✓	✓	✗	✗	✗

Note: The above table was correct at the time of writing. Please refer to MyKingfisher for any recent changes.

9. Analogue Input Modules

Analogue input modules provide analogue inputs to the Kingfisher RTU.

Each module is equipped with a fully isolated 24 VDC power supply for energizing field equipment such as sensor loops.

9.1. AI-1: 8 Channel Analogue Current Input Module

- **12 Bit resolution**
- **1.5 kV Field to Logic Isolation**
- **2 ms scan rate**
- **24 VDC isolated DC output**
- **0 — 20 mA or 4 – 20 mA current inputs**
- **0 – 5 VDC or 1 – 5 VDC Voltage Inputs (requires factory modification)**

The analogue input module provides eight input channels, each capable of converting an analogue input signal to a digital variable for use as required by your application. A link on the rear of the module selects 4-20 mA or 0-20 mA for all 8 channels. The default range is 4 to 20 mA.

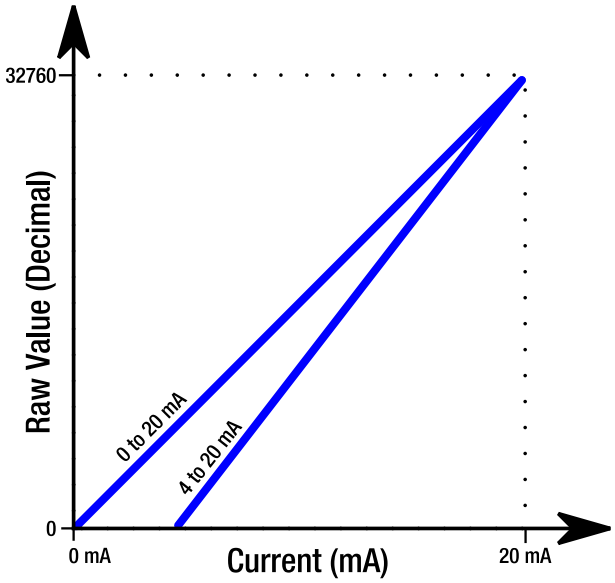
The module can also be factory modified to handle voltage inputs of 0-5 VDC or 1-5 VDC.

Conversion speed for each of the eight channels is 20 μs and this provides a total update rate of two milliseconds for the module. Resolution of the converted signal is 12 bits binary (1 part in 4096) over the range. The placement of the 12 bits from the A/D converter in the #AI data word is as follows:

LSB														MSB
0	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	0	0	0

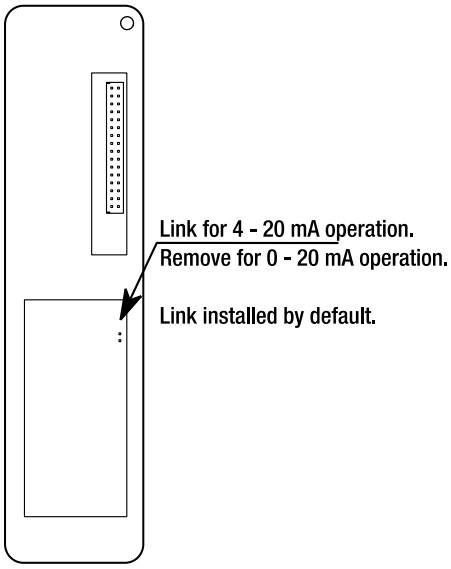
If the current source is reversed into the input, or is less than the low end of the current range, then the module will output a data word corresponding to the low end of the current range (0000H in #AI). If an input that is out of range is entered (i.e. greater than 20 mA), the A/D converter will output up to full scale (corresponding to 7FF8H in #AI).

Scaling of the input is shown below:



Input protection for the module is sufficient to guarantee operation with reduced performance with up to 1500 V common-mode. The module provides electrical isolation of externally generated noise between field wiring and the backplane through the use of optical isolation.

To minimise the capacitive loading and noise, all field connections to the module should be wired using a good grade of twisted, shielded instrumentation cable. The shields can be connected to GND. The GND connection provides access to the backplane (frame ground).



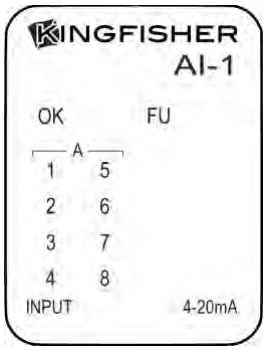
This module can be installed in any I/O slot of a 4, 6 or 12-slot backplane. Up to 10 Analogue Current Input modules can be installed on a single 12-slot backplane.



An insert goes between the inside and outside surface of the hinged door. The surface towards the inside of the module (when the hinged door is closed) has circuit wiring information and circuit identification information can be recorded on the outside surface. The outside left edge of the insert is colour-coded blue to indicate a low-voltage module.

(Image for demonstration purposes only)

AI-1 Module LEDs

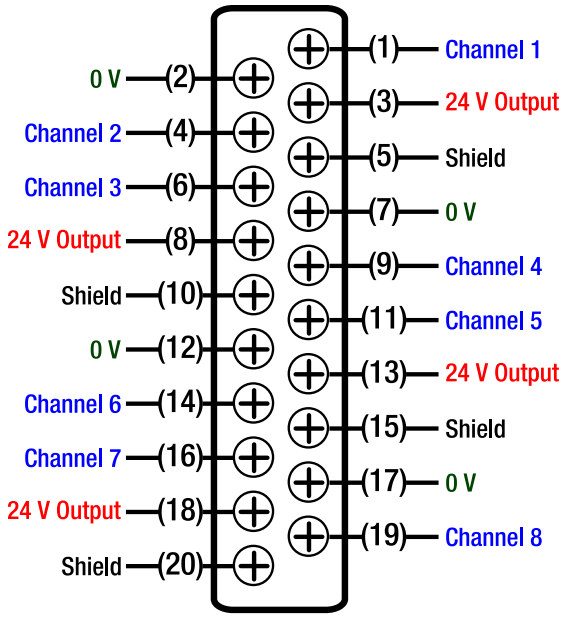


LED	State	Description
OK	OFF	Module fault (no power)
	ON	Normal
FU	OFF	Fuse OK
	ON	Fuse fail
A1-A8	OFF	Channel Input level < 1%
	ON	Channel Input level > 1%

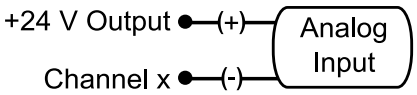
AI-1 Analogue Input Module Specifications	
Input Current Ranges	4-20 mA and 0-20 mA
Input Voltage Ranges	1-5 V and 0-5 V *
Inputs per Module	8
Calibration	Factory calibrated to 5μA
Update Rate	2 ms (all eight channels)
Accuracy	± 0.25% @ 25°C
Resolution	12 bit (no sign bit)
Common Mode Voltage	1500 V
Linearity	< 1 Least Significant Bit
Isolation	1.5 kV between field and logic
Common Mode Rejection	> 70 dB at DC; >70 dB at 60 Hz
Cross-Channel Rejection	> 80 dB from DC to 1 kHz
Input Impedance	250 Ω standard 11 kΩ optional *. The internal load resistors can be factory removed if high impedance voltage inputs are required.
Input Filter Response	2 kHz
Output Power	24 VDC @ 400 mA Isolated (10 W)
Operating Temperature	-20 to 70°C
Storage Temperature	-40 to +85°C
Operating Humidity	5 to 98% RH non-condensing
Hot Swap	Yes. Module can be swapped while RTU is running. Hot swap will not cause a Warm Start. Inputs are cleared in RTU memory while module is removed.

* Analogue inputs can be modified from current inputs to voltage inputs by lifting one leg of the 250 Ω channel resistor. Each channel has its own resistor, so any combination of channels can be converted. It is recommended that modules be returned to Semaphore for factory conversion if required. No responsibility will be taken by Semaphore for damage caused to boards during modification performed by clients. The circuit board resistors to change are: channels 1 — 8 = R9 — R16.

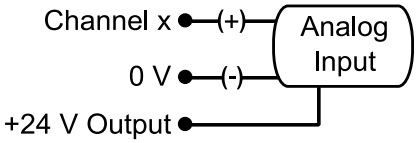
AI-1 Wiring Diagram



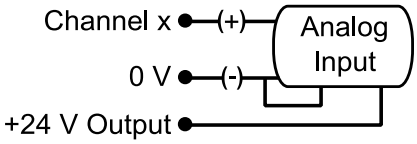
2 wire transmitter (powered by module)



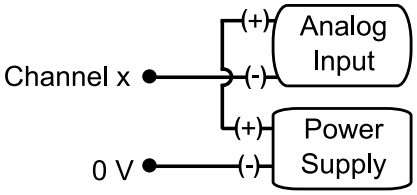
3 wire transmitter (powered by module)



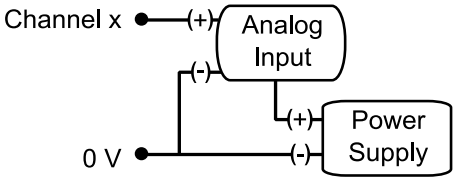
4 wire transmitter (powered by module)



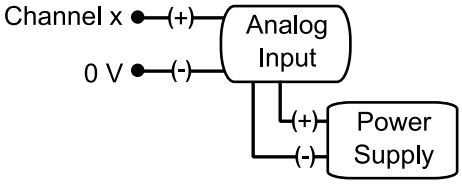
2 wire transmitter (powered externally)



3 wire transmitter (powered externally)



4 wire transmitter (powered externally)



9.2. AI-10: 8 Channel High Impedance Analogue Input Module

- **16 Bit resolution**
- **5 kV field to logic isolation**
- **Channel to channel isolation**
- **24 VDC isolated DC output**
- **AI-10: Current / Low Impedance Inputs**
- **AI-10-V: High Impedance Voltage Inputs**
- **10 ms scan rate**

The AI-10 and AI-10-V modules are identical except the AI-10-V has the 250 Ω sensing resistors removed. This increases the input impedance for each channel to more than 1 MΩ which is suitably high for voltage transducers.

Both modules provide:

- 8 analogue inputs with high electrical isolation between the field terminals and the RTU logic.
- A 24 V isolated output that can be used to power field sensors / transducers
- 16 bit input resolution
- Full compatibility with the AI-1 and AI-4 analogue input modules. However, the resolution has been enhanced to provide a positive raw scale range of 0-32767 (AI-1 and AI-4 use 0-32760)

The AI-10 supports various current and voltage input ranges as follows:

- 4-20 mA / 1-5 V
- 0-20 mA / 0-5 V
- ±10 V
- ±20 mA / ±5 V
- ±10 mA / ±2.5 V

The AI-10-V supports various *voltage* input ranges as follows:

- 1-5 V
- 0-5 V
- ±10 V
- ±5 V
- ±2.5 V

To minimize the capacitive loading and noise, all field connections to the module should be wired using a good grade of twisted, shielded instrumentation cable. The shields can be connected to ground.

This module consumes power from the +5 VDC and +12 VDC RTU rails. A 24 V DC-DC converter mounted within the module is used to provide isolated power to the analogue front-end and to provide power to the field devices as required.

This module can be installed in any I/O slot of a 4, 6 or 12 slot backplane. Up to 11 Analogue Input modules can be installed on each backplane.



An insert goes between the inside and outside surface of the hinged door. The surface towards the inside of the module (when the hinged door is closed) has circuit wiring information and circuit identification information can be recorded on the outside surface. The outside left edge of the insert is colour-coded blue to indicate a low-voltage module.

(Image for demonstration purposes only)

AI-10 Module LEDs



AI-1 LEDs	State	Description
OK *	OFF	Module Fault (no power)
	ON	Module OK
	One second flash*	Module Fault
DC OK	OFF	AI-10 loop power OFF
	ON	AI-10 loop power ON
1-8 (left side)	OFF	Channel Input level < 1%
	ON	Channel Input level > 1%
1-8 (right side)	OFF	Channel Normal
	ON	Channel Fault (under/over range, data invalid)

* Early revision modules used ON (a very fast flash) for module OK and steady ON for module fault.

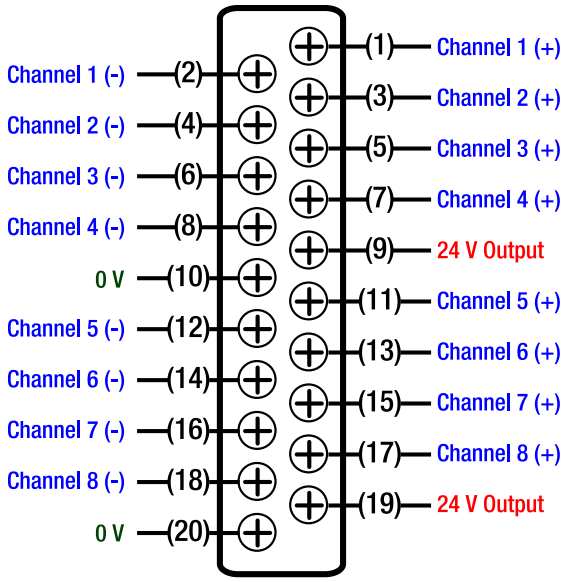
Note: On power up some LED's may come on for a short time.

IA-10 / AI-10-V Analogue Input Module Specifications	
Input Current ranges (AI-10 only)	4-20, 0-20, +10, +20 mA (software selectable)
Input Voltage ranges *	1-5, 0-5, +2.5, +5, +10# VDC (software selectable)
Inputs per Module	8
Sub System Isolation	The analogue subsystem of the AI-10 is fully isolated from the RTU's digital system.
Isolation	3 kV Transient
Input impedance	AI-10: 250 Ω standard, > 1 MΩ optional* AI-10-V: > 1 MΩ
Maximum Input Voltage	+12 V on 10 V range, +7 V on other ranges
Accuracy	± 0.1% @ 25 °C. ± 0.25% @ -20 to 70 °C
Resolution	16 bit (15 data bits and 1 sign bit)
Scanning Rate	10 ms per channel max.
Input Protection	The input multiplexer integrated circuits are designed to withstand pulses of up to 100 V
Output Power	Isolated 24 VDC @ 160 mA
Operating Temperature	-20 to 70°C
Storage Temperature	-40 to +85°C
Operating Humidity	5 to 98% RH non-condensing
Hot Swap	Yes. Module can be swapped while RTU is running. Hot swap will not cause a Warm Start. Inputs are cleared in RTU memory while module is removed.
Compatibility	One range setting for all channels when used with a PC-1 or CP-11/12/21 processor. Individual range setting for each channel when used with a CP-30 processor.

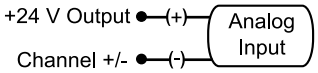
* Analogue Input channels can be modified from low impedance to high impedance by lifting one leg of the 250 Ω channel resistor. Each channel has its own current sensing resistor, so any combination of channels can be converted. It is recommended that modules be returned to Semaphore for factory conversion if required. No responsibility will be taken by Semaphore for damage caused to boards during modification performed by clients. The circuit board resistors to change are: channels 1 to 8 = R64 to R71.

the ±10 V input range can only be used on an AI-10 input channel if the current sensing resistor has been removed. Resistors have already been removed in an AI-10-V.

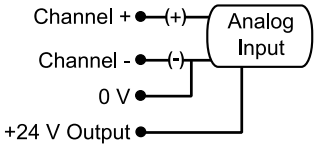
AI-10 / AI-10-V wiring diagram



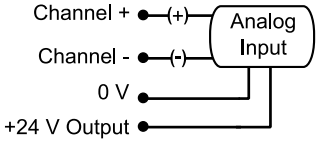
2 wire transmitter (powered by module)



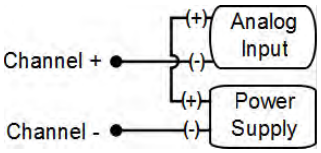
3 wire transmitter (powered by module)



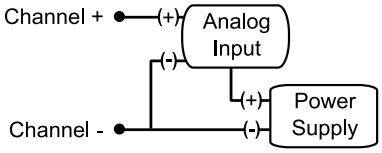
4 wire transmitter (powered by module)



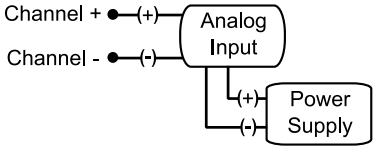
2 wire transmitter (powered externally)



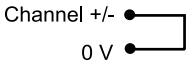
3 wire transmitter (powered externally)



4 wire transmitter (powered externally)



Loop



* When using the +24 V output to power a transducer, the negative input terminal of the analogue input channel (2, 4, 6, 8, 12, 14, 16 or 18) must be wired to the OV terminal (10 or 20). This will complete the current loop due to electrical isolation between the input channel and the module +24 V Output.

Note: Any channels sharing the same power source (e.g. +24 V from module or a field power supply) are no longer isolated from one other.

10. Analogue Output Module

The AO-3 analogue output module provides four 12 bit differential outputs allowing a Kingfisher RTU to drive analogue loads.

10.1. AO-3: Analogue Output Module

- **12 bit resolution**
- **3 kV field to logic isolation**
- **Open loop detection**
- **0 – 20 or 4 – 20 mA outputs**
- **3 kV channel group to channel group isolation**

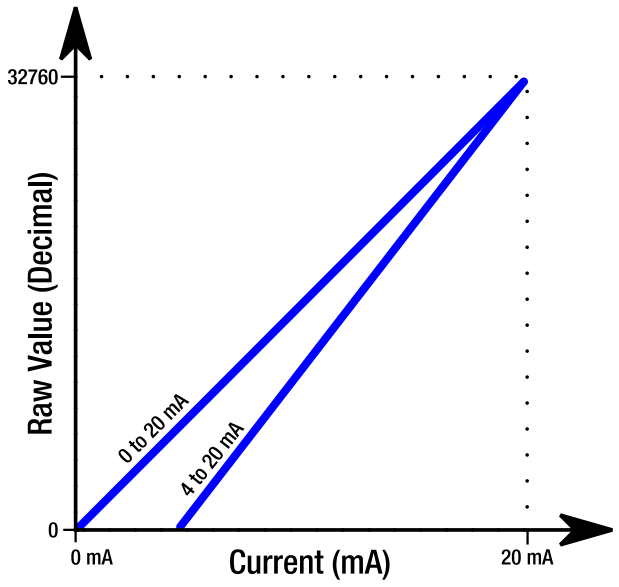
The AO-3 provides four current output channels that use 12-bit digital to analog converters (DAC). The AO-3 also provides open loop detection.

The sign bit is not used in the digital to analog conversion process. The placement of the 12 bits within the data word is as follows:

LSB														MSB
0	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	0	0	0

This module provides two output ranges. The default range is 4 to 20 mA with user data scaled so that a count of 0 corresponds to 4 mA and a count of 32760 corresponds to 20 mA. A range link (on the rear of the module) selects either 4-20 mA or 0-20 mA for all four channels. The default condition is 4-20 mA with the link on. The module provides 12 bits of resolution in either range.

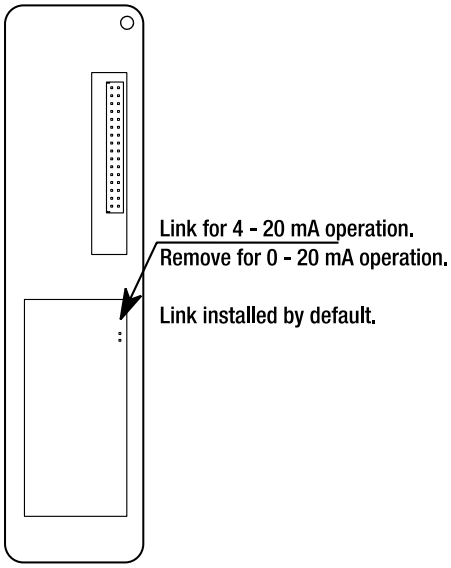
Scaling of the output is as shown below.



Analogue outputs 1 & 2 and analogue outputs 3 & 4 form two groups that are isolated from each other and from the backplane logic. Each group is powered by a separate DC-DC converter module that produces an isolated voltage of +24 V to drive the current loop outputs and analog front-end.

The current loop drivers on the module are source type drivers. To minimize the capacitive loading and noise, all field connections to the module should be wired using a good grade of twisted, shielded instrumentation cable. The shields should be connected to E (Shield) on the user terminal connector block. The E connection provides path to the backplane (frame Earth / Ground) resulting in attenuation of noise caused by the shield drain currents. To further improve noise immunity, direct connection of the analog cable shields to the Earth / Ground rails with metal clamps or similar method is recommended, especially in environments with high electromagnetic noise levels.

This module can be installed in any I/O slot of a 4, 6 or 12 slot backplane in a system.



This module can be installed in any I/O slot of a 4, 6 or 12-slot backplane. Up to 10 Analogue output modules can be installed on a single 12-slot backplane.



An insert goes between the inside and outside surface of the hinged door. The surface towards the inside of the module (when the hinged door is closed) has circuit wiring information and circuit identification information can be recorded on the outside surface. The outside left edge of the insert is colour-coded blue to indicate a low-voltage module.

(Image for demonstration purposes only)

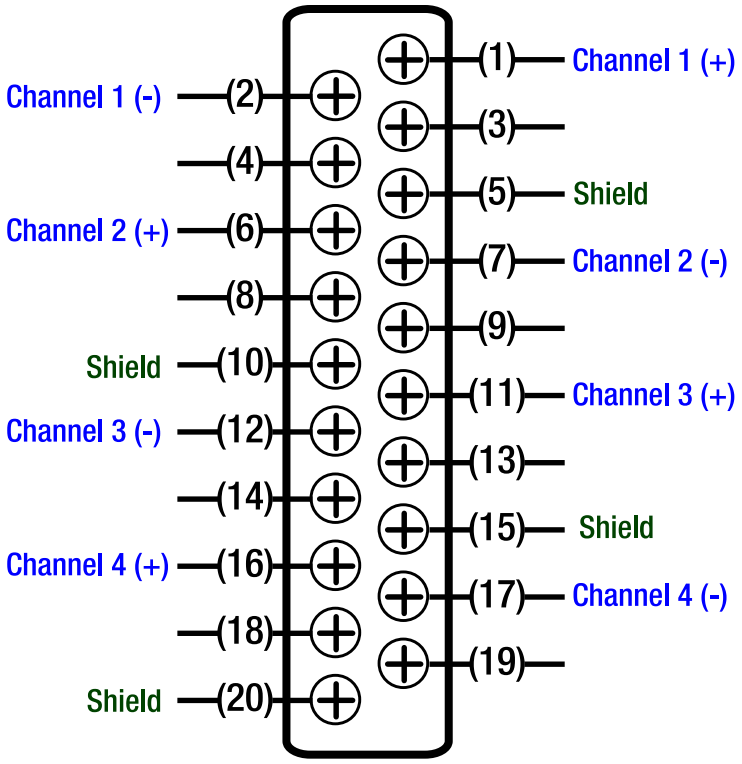
AO-3 Module LEDs



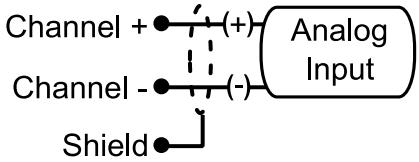
AO-3 LEDs	State	Description
OK	OFF	Module fault / no power
	ON	Normal
RST	OFF	Module running
	ON	Module in Reset (power-on or watchdog)
ANALOG OUT 1-4	OFF	Channel output set to 0%
	ON	Channel output greater than 0%
OPEN LOOP 1-4	OFF	Closed Loop (load detected)
	ON	Open Loop (no load)

AO-3 Analog Output Module Specifications	
Output Current Range	4 to 20 mA [default] or 0 to 20 mA (loop current is supplied by module)
Outputs per Module	4
Output Power	Isolated 24 VDC @ 40 mA for outputs 1 & 2 Isolated 24 VDC @ 40 mA for outputs 3 & 4
Supply Voltage (nominal)	+5 VDC and +12 VDC from backplane
Update Rate	250 ms (all channels) Determined by I/O scan time and is application dependent
Resolution	12 bit (no sign bit)
Accuracy	± 0.2% @ 25 °C ± 0.5% @ -20 to 70 °C
Load Resistance	0 to 850 Ω
Load Capacitance, max	2000 pF
Load Inductance, max	1 H
Isolation	Analog outputs 1 & 2 and analog outputs 3 & 4 form two groups. Each group is isolated from the other group and from the backplane logic. There is no isolation between outputs 1 & 2 and no isolation between outputs 3 & 4. Transient voltage (Group to Group and Group to Logic): 5 kV Maximum working voltage in respect to system earth/ground must not exceed SELV limits (42.4 Vpeak / 60 VDC)
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 90% RH non-condensing
Hot Swap	Yes. Module can be swapped while RTU is running. Hot swap will not cause a Warm Start. Outputs will be restored within 2 seconds once module is replaced.
Open Loop Detection	Yes. Monitors output circuit for failure (e.g. cable breakage) or if the load is disconnected. Note: when using the 0-20 mA range, Open Loop Detection cannot be guaranteed on an output when set below 160 / 0.1 mA / 0.5%.

AO-3 wiring diagram



0 – 20 / 4 – 20 mA Current Loop Receiver



11. Digital Input Modules

The Digital Input Modules allow various level digital signals to be interpreted by your RTU.

All modules provide a minimum of 1 kV field isolation, 16 input channels and can be configured to use counters and input buffers to count incoming pulses.

Summary:

Module	Max input Voltage	Channel group 1 capture speed	Channel group 2 capture speed
DI-5-1	10 to 28 VDC (supports reverse polarity)	Channels 1 and 2 10 kHz max	Channels 3 and 4 255 Hz max
DI-5-1-48	30 to 60 VDC (supports reverse polarity)	Channels 1 and 2 10 kHz max	Channels 3 and 4 255 Hz max
DI-10-1	+10 to +110 VDC 20 – 126 VAC	Channels 1 to 4 10 kHz max	Channels 5 to 16 1 kHz max
DI-10-1-48	35 to 130 VDC 27 – 260 VAC	Channels 1 to 4 10 kHz max	Channels 5 to 16 1 kHz max

11.1. DI-5: DC Input 16 Channel Digital Input Module

- **Pulse counting on channels 1 to 4 (up to 10 kHz)**
- **Positive or Negative Polarity Inputs**
- **Isolated DC Outputs for powering inputs**

The DI-5 provides 16 input channels with one common. As a wide input voltage is accepted a wide range of input devices can be used such as buttons, red switches, line switches, PIR sensors, and proximity sensors. Any combination of inputs powered externally or by the modules own isolated DC supply (+12 V) can be used.

Applying a high input voltage results in logic 1 in the modules status register. Low (or not present) input voltages result in logic 0.

The DI-5 counter can also count pulses in the first 4 digital inputs. It is able to count up to 10 kHz on inputs 1 and 2 and can count up to 255 Hz on inputs 3 and 4. The pulse total and the frequency for each of the first 4 digital inputs are stored.

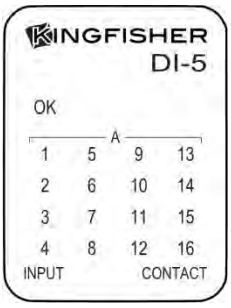
This module can be installed in any I/O slot of a 4, 6 or 12 slot backplane system.



The insert in the hinged cover of the terminal strip has circuit wiring information. Circuit identification information can be recorded on the outside surface of the insert. The outside left edge of the insert is colour-coded red to indicate a high-voltage module.

(Note the DO-5 module differs from the image shown to the left)

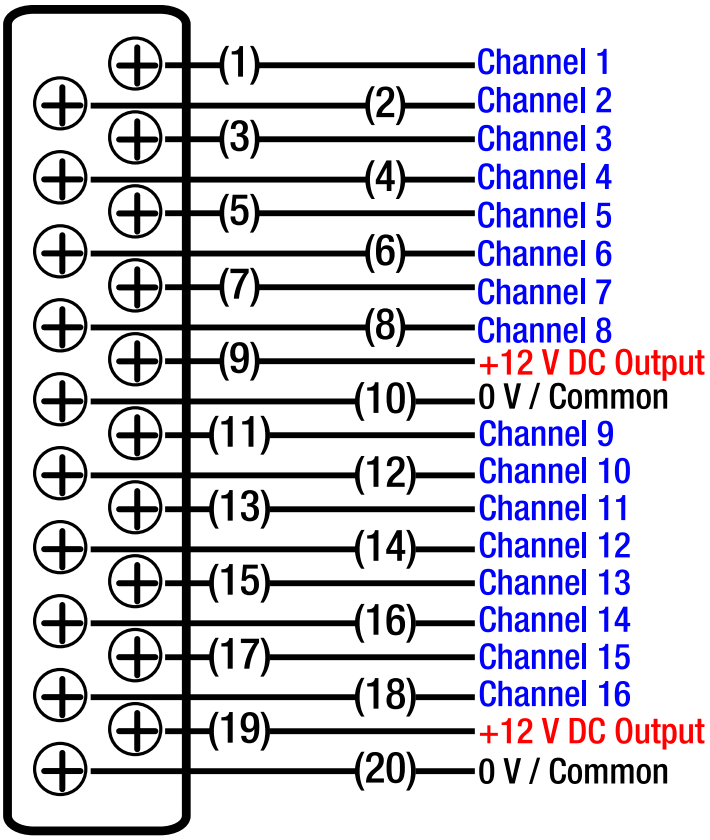
DI-5 Module LEDs



LED	State	Description
OK	OFF	Module fault (no power)
	ON	Normal
1 - 16	OFF	Digital Input OFF
	ON	Digital Input ON

DO-5 Isolated Relay Output Module Specifications		
Rated Voltage	+ 12 to 24 VDC nominal (supports reverse polarity) Note: The DI-5-1-48 High Input Voltage module in the Custom Products chapter supports higher DC input voltages (48 VDC nominal)	
Inputs per Module	16	
Input Characteristics	Impedance	2.7 kΩ
	On-state Voltage	Chs 1&2: 10 to 28 VDC maximum Chs 3-16: 7.5 to 28 VDC maximum
	Off-state Voltage	Chs 1&2: 0 to 3.5 VDC Chs 3-16: 0 to 3.0 VDC
	On-state Current	4.3 mA minimum
	Off-state Current	1 mA maximum
	On response Time	Channels 1 and 2: 50 μs maximum Channels 3 and 4: 500 μs maximum Channels 5 to 16: 10 ms maximum
	Off response Time	Channels 1 and 2: 50 μs maximum Channels 3 and 4: 500 μs maximum Channels 5 to 16: 17 ms maximum
Isolation	5 kV Transient	
Output Power	12 VDC @ 250 mA (3 W) isolated, supplied by module	
Operating Temperature	-20 to 70 °C	
Storage Temperature	-40 to 85 °C	
Operating Humidity	5 to 98% RH non-condensing	
Pulse Tantalization	Channels 1 to 4: 0-65535 Pulses	
Pulse Rates / Frequency	Channels 1 and 2: 10 kHz maximum Channels 3 and 4: 255 Hz maximum	
Hot Swap	Yes. Module can be swapped while RTU is running. Hot swap will not cause a Warm Start. Inputs are cleared in RTU memory while module is removed.	

DI-5 Wiring Diagram



11.2. DI-10: AC or DC Input, 16 Channel

- **Frequency/Pulse/Quadrature counters (on up to 7 input pairs)**
- **Isolated DC Field Output**
- **Software Debounce**
- **AC or DC Inputs**
- **Sequence of event recording**

The DI-10 provides 16 AC or DC input channels allowing it to interface a wide range of input devices to your RTU. Inputs can be powered by the modules own +12 VDC Output Power or from AC or DC field voltages.

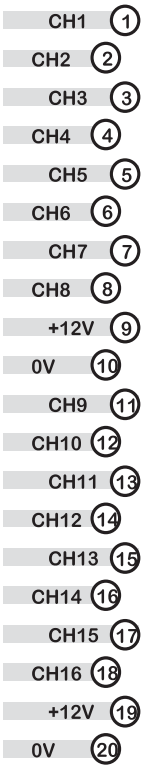
Applying a high input voltage results in a logical 1 in the status register, no or low input voltage results in a logical 0.

The DI-10 features software configurable pre-conditioning of inputs such as debounce filters, channel inversion and sequence-of-event recording selectable on any channel(s).

The DI-10 can also perform frequency or pulse counting for up to 7 pairs of input channels.

The DI-10 module provides all the functionality of the DI-1 and DI-5 modules **except the input voltage cannot be reversed.**

This module can be installed in any I/O slot of a 4, 6 or 12 slot backplane system.





The insert in the hinged cover of the terminal strip has circuit wiring information. Circuit identification information can be recorded on the outside surface of the insert. The outside left edge of the insert is colour-coded red to indicate a high-voltage module.

(Note the DO-10 module differs from the image shown to the left)

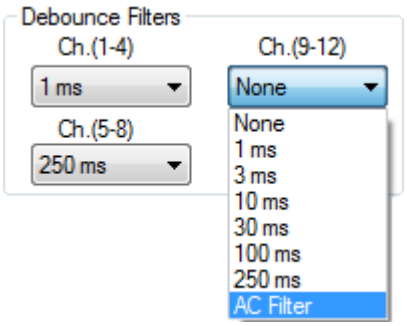
Configurable Functions

The fist 4 channels of the DI-10 are high speed and capable of counting up to 10kHz, while channels 5 to 16 can count up to 1 kHz.

Seven user configurable counter inputs are available which appear as 16-bit unsigned integer values in the analogue input register. Each of these counters can be configured to determine frequency, count pulses, or quadrature counters which work with quadrature inputs or pairs of channels.

Channel inversion can be configured on any input channel. Normally a high voltage level results in a logical HIGH state (1) to be set in the digital input register with the corresponding LED illuminating on the front panel. By enabling channel inversion, a low voltage level applied to an input will result in a logical HIGH (1).

Software debounce can be activated on any input channel. The time constant can be configured from 1 ms to 250 ms. When using software debounce with AC inputs, the input channel must be configured with the debounce filter set to 'AC Filter' as shown below.



Sequence of Events Recording

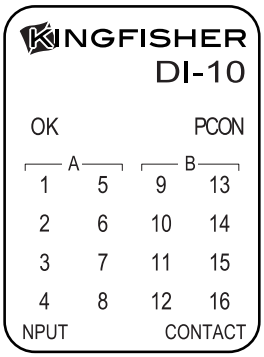
Sequence-of-Event (SoE) recording can be configured for any input channel. When enabled, any change of state (event) on the input is logged to 1 millisecond accuracy.

These events are automatically included in the Event Log of the RTU. The DI-10 module has an internal timer that is synchronized with the Real Time Clock of the processor.

The DI-10 module has a buffer capable of storing 1000 events. This means bursts of up to 1000 events can be recorded at a time. Events are uploaded to the processor module at a maximum rate of 100 events per second.

Please note that SoE recording is not supported when using a PC-1 processor.

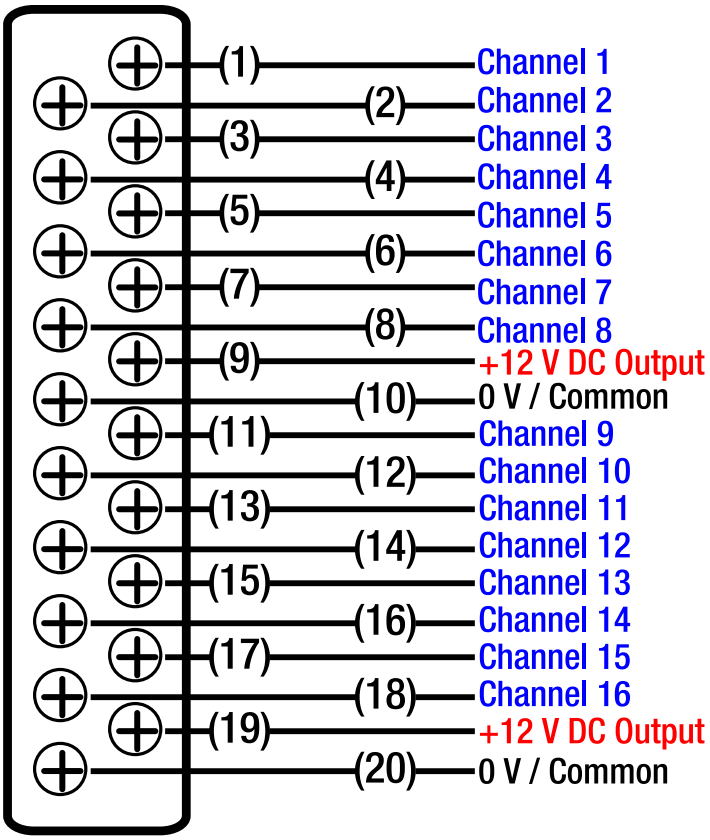
DI-5 Module LEDs



LED	State	Description
OK	OFF	Module fault (no power)
	ON	Normal
PCON	OFF	DI-10 Output Power OFF
	ON	DI-10 Output Power ON
1 - 16	OFF	Digital Input OFF
	ON	Digital Input ON

DI-10: AC or DC Input, 16 Channel		
Rated Voltage	+10 to +110 VDC nominal 20 to 125 VAC	
Inputs per Module	16	
Input Characteristics	Impedance	1.2 kΩ approx.
	On-state Voltage	7.5 to 130 VDC maximum 20 to 125 VAC
	Off-state Voltage	0 to 3.0 VDC
	On-state Current	3.5 mA minimum
	Off-state Current	1 mA maximum
	On response Time	Channels 1 to 4: 50 μs maximum Channels 5 to 16: 500 μs maximum
	Off response Time	Channels 1 to 4: 50 μs maximum (DC) Channels 5 to 16: 500 μs maximum (DC) Channels 1-16: 30 ms (AC)
Isolation	Maximum working voltage in respect to system earth/ground must not exceed 125 VAC or 130 VDC Transient voltage: 3 kV	
Output Power	12 VDC @ 80 mA (1 W) isolated, supplied by module	
Operating Temperature	-20 to 70 °C	
Storage Temperature	-40 to 85 °C	
Operating Humidity	5 to 98% RH non-condensing	
Pulse Rates / Frequency	Channels 1 to 4: 10 kHz maximum * Channels 5 to 16: 1 kHz maximum	
Frequency Counting	1 Hz resolution on any input(s) (7 counters max.)	
Pulse Totalisation	0-65535 Pulses on any input(s) (7 counters max.)	
Quadrature Counting	0-65535 Pulses on any of the following pairs of inputs: 1&2, 3&4, 5&6, 7&8, 9&10, 11&12, 13&14 and 15&16 (7 counters max.)	
Channel Inversion	Selectable on any input(s)	
Debounce Filtering	Time constant 1-250 ms on any input(s) or AC Filter (for AC inputs).	
Sequence of Events	1 ms resolution Buffering for 1000 events, uploaded to CPU at 100 events/second Selectable on any input(s)	
Hot Swap	Yes. Module can be swapped while RTU is running. Hot swap will not cause a Warm Start. Inputs are cleared in RTU memory while module is removed.	

DI-10 Wiring Diagram



12. Digital Output Modules

The digital output modules provide relay and transistor outputs to the Kingfisher series of RTUs.

The DO-1 and DO-2 offer relay outputs, eight and sixteen respectively, while the DO-6 is transistor based.

The DO-6 is compatible with the TEL-REL-00x series of relay output boards to allow for higher current and voltage switching.

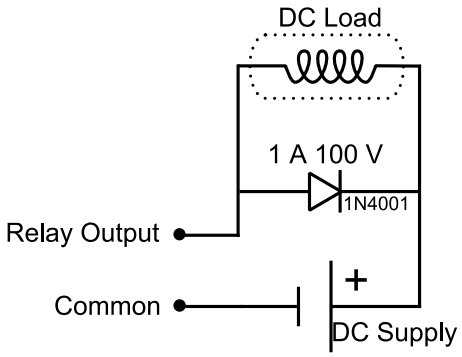
MVTech_LT2003G_Origional.rar

Switching Inductive Loads

When switching inductive loads, users should be mindful of possible reduced relay life due to back-EMF. To mitigate this negative effect, suppression circuits should be used when switching inductive loads.

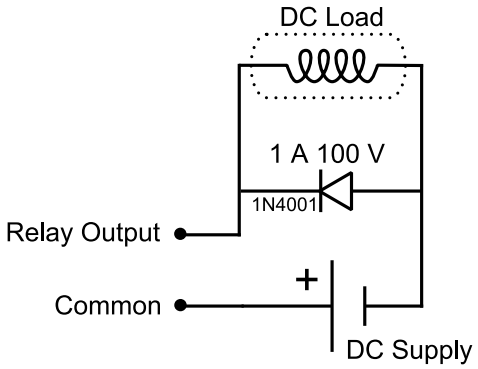
Switching DC Supplied inductive loads

(high switching relay output)



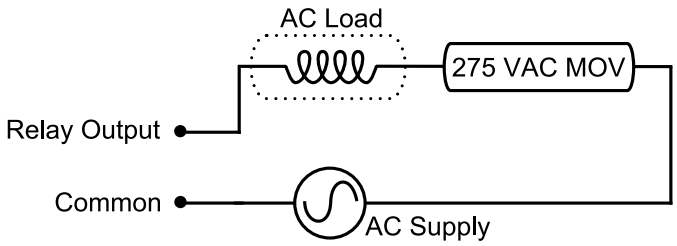
Switching DC Supplied inductive loads

(ground switching relay output)



Switching AC supplied inductive loads

(*MOV = Metal Oxide Varistor)



12.1. DO-1: 8 Channel Isolated Relay Output Module

- **8 SPDT isolated relay outputs**
- **500 V channel pair isolation**
- **One common per channel pair**
- **Can switch AC or DC voltages**
- **3 kV coil to contact isolation**

The DO-1 provides 8 normally open or normally closed relay circuits for controlling output loads. All output channels are isolated from each other and arranged into pairs. Each channel pair shares a separate common terminal (see the wiring in this chapter for clarification).

The relay outputs can control a wide range of user supplied load devices such as motors, starters, solenoids, and indicators. The user is required to supply the AC or DC power to operate the field devices connected to this module. Internal fuses offer protection to the relay contacts should their maximum load be exceeded.

This module can be installed in any I/O slot of a 4, 6 or 12 slot backplane.



The insert in the hinged cover of the terminal strip has circuit wiring information. Circuit identification information can be recorded on the outside surface of the insert. The outside left edge of the insert is colour-coded red to indicate a high-voltage module.

(Note the DO-1 module differs from the image shown to the left)

DO-1 Module LEDs

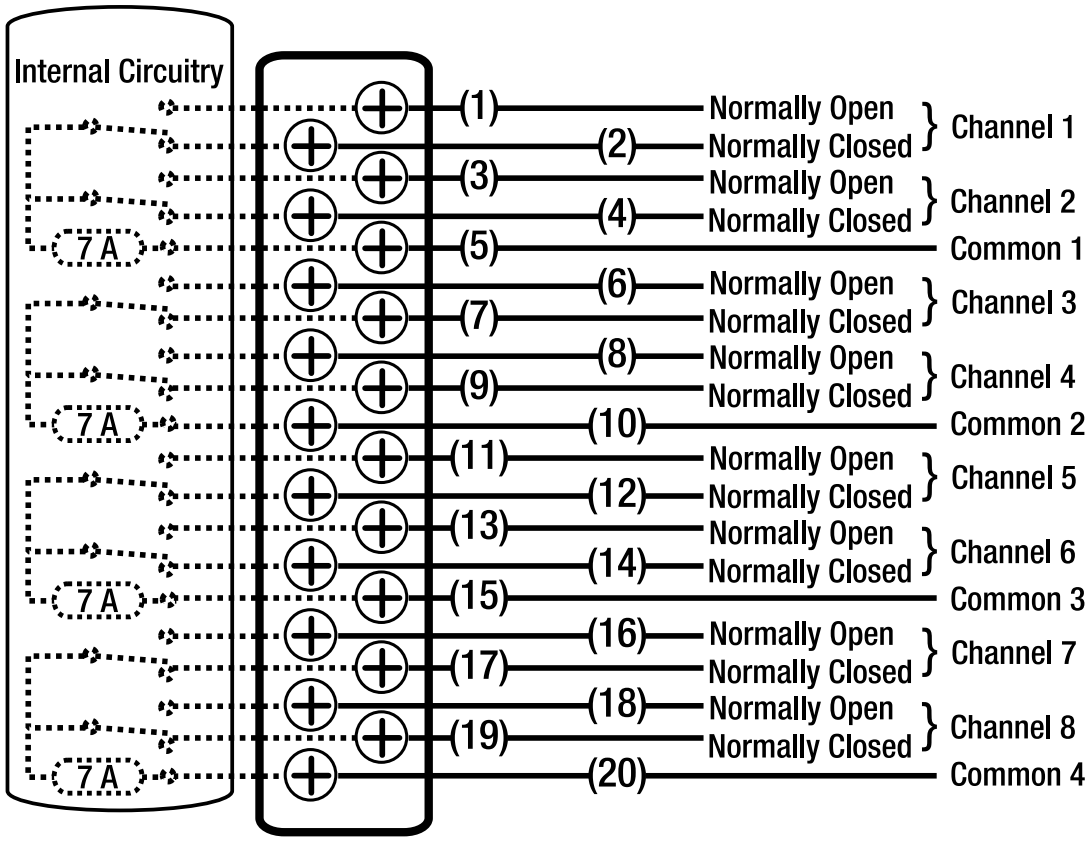


LED	State	Description
OK	OFF	Module fault (no power)
	ON	Normal
FU	OFF	Fuse OK
	ON	Fuse fail
A1, A2 **B3, B4** **C5, C6** **D7, D8**	OFF	Digital output OFF (open)
	ON	Digital output ON (closed)

DO-1 Isolated Relay Output Module Specifications	
Outputs per Module	8
Commons	4 (each common supplies 2 outputs)
Relay Type	SPDT (Single Pole, Double Throw)
Rated Load (per contact)	5 A at 250 VAC Resistive 5 A at 30 VDC Resistive (20 A maximum per DO-1 module)
Maximum Operating Voltage	380 VAC, 125 VDC
Maximum Switching Power - Resistive	1250 VA, 150 W
Maximum Switching Power - Inductive	375 VA, 80 W
Minimum Load	10 mA at 5 VDC
Relay Operations	100,000 minimum at 1800 operations per hour at rated load
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
Isolation	3 kV coil to contacts 500 V between channel groups
Coil Rated Voltage	12 VDC @ 16.7 mA
Coil Resistance	480 Ω @ 12 VDC
Relay Part Number	Omron G6B-2114P-US (G6B datasheet is available from www.europe.omron.com)
Hot Swap	Yes. Module can be swapped while RTU is running. Hot swap will not cause a Warm Start. Outputs will be restored within 2 seconds once module is replaced.

CAUTION! Contacts should be protected with appropriate suppression devices when wired with inductive loads to increase life of relays (please see DO-1 Switching Inductive Loads). Contacts should also be protected with external fusing.

DO-1 Wiring Diagram



12.2. DO-2: 16 Channel Relay Output Module

- **16 SPST relay outputs**
- **One common per 8 channels**
- **3 kV coil to contact isolation**
- **Can switch AC or DC voltages**

The DO-2 provides 16 normally-open relay circuits for controlling output loads provided by the user. The output points are arranged in two groups of eight. Each group shares a common terminal. The relay outputs can be used to control a wide range of devices such as motor starters, solenoids, and indicators.

Internal fuses protect the DO-2 relay contacts should ratings be exceeded.

This module can be installed in any I/O slot of a 4, 6 or 12 slot backplane.



The insert in the hinged cover of the terminal strip has circuit wiring information. Circuit identification information can be recorded on the outside surface of the insert. The outside left edge of the insert is colour-coded red to indicate a high-voltage module.

(Note the DO-2 module differs from the image shown to the left)

DO-2 Module LEDs

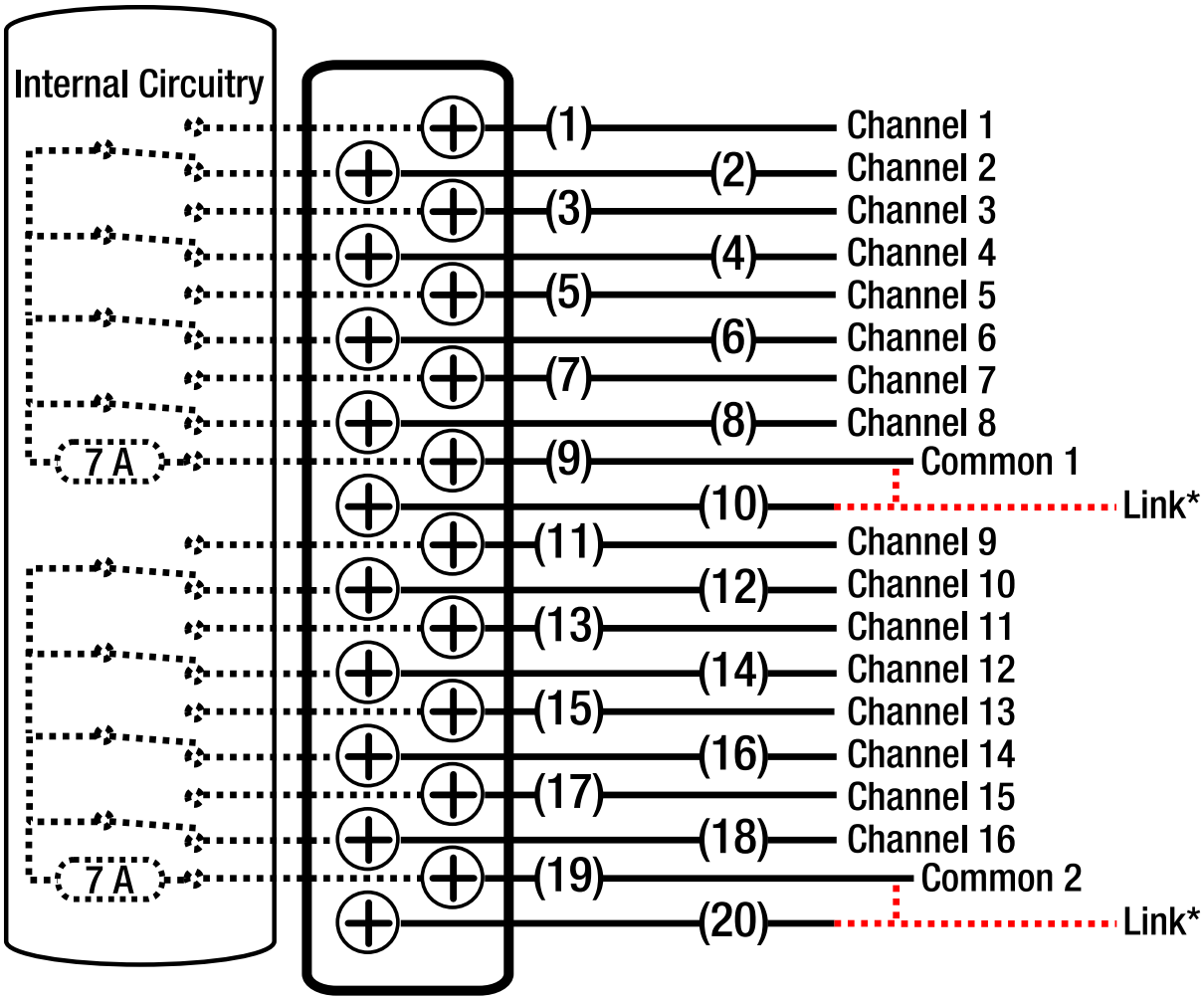


LED	State	Description
OK	OFF	Module fault (no power)
	ON	Normal
FU	OFF	Fuse OK
	ON	Fuse fail
1-16	OFF	Digital output OFF (open)
	ON	Digital output ON (closed)

DO-2 16 Channel Digital Output Module Specifications	
Outputs per Module	16
Commons	2 (each common supplies 8 outputs)
Relay Type	SPST (Single Pole Single Throw, Normally Open)
Maximum Switched Voltage	30 VDC, 250 VAC
Maximum Switched Current	5 A per channel 7 A per common
Minimum Load	10 mA @ 5 VDC (wetting current)
Contact Resistance	100 mΩ maximum
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Operating Humidity	5 to 98% RH non-condensing
Isolation	Maximum working voltage in respect to system earth/ground must not exceed 250 VAC / 130 VDC Transient voltage: 3 kV
Relay Operations	70,000 minimum at 1800 operations per hour at rated load
Fuse Monitor LED	Enabled when the common is wired to pins 10 and 20. CAUTION! When wired, a maximum voltage of 30 V AC or DC can be used to power the common.
Relay Part Number	Omron G6D-1A-12VDC (G6D datasheet is available from http://www.europe.omron.com)
Hot Swap	Yes. Module can be swapped while RTU is running. Hot swap will not cause a Warm Start. Outputs will be restored within 2 seconds once module is replaced.

CAUTION! Contacts should be protected with appropriate suppression devices when wired with inductive loads to increase life of relays (please see the beginning of the chapter Switching Inductive Loads). Contacts should also be protected with external fusing.

DO-2 Wiring Diagram



Note * **Optional Link for DC Supply Only**. Enables the use of fail LED **FU**.

Caution: A maximum of 30 V (AC or DC) can be used to power the common if the link is installed.

12.3. DO-6: 16 Channel Open Drain Output Module

- **16 Open-drain outputs**
- **Designed to operate TELREL 00x relay board**
- **DC Field Output (non-isolated)**

The DO-6 provides 16 open drain NFET outputs for controlling various loads including the TELREL series of relay boards. Power for external loads can be provided from the modules +12 VDC which is sourced from the backplane rail.

The DO-6 output channels are current limited and are protected from high levels of EMI (electro-magnetic interference) that may trigger false outputs.

This module can be installed in any I/O slot of a 4, 6 or 12 slot backplane.



The insert in the hinged cover of the terminal strip has circuit wiring information. Circuit identification information can be recorded on the outside surface of the insert. The outside left edge of the insert is colour-coded red to indicate a high-voltage module.

(Note the DO-6 module differs from the image shown to the left)

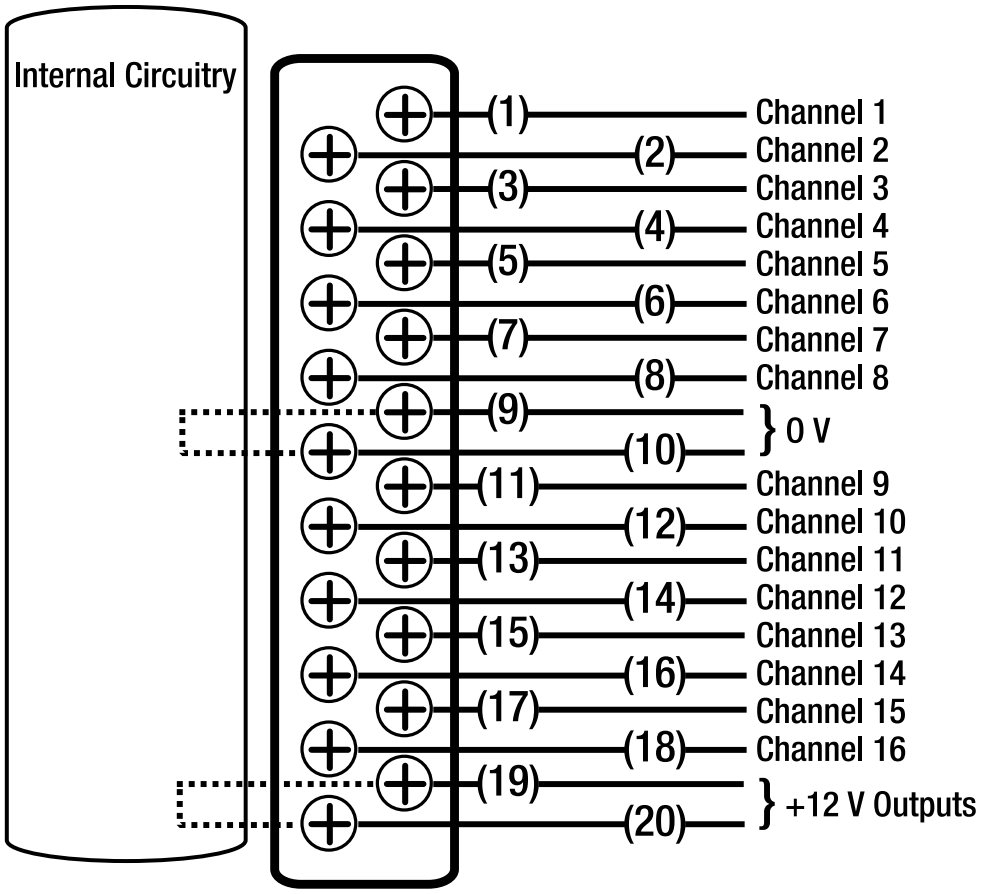
DO-6 Module LEDs



LED	State	Description
OK	OFF	Module fault (no power)
	ON	Normal
A1-A16	OFF	Digital output OFF (open)
	ON	Digital output ON (closed)

DO-6 Channel Open Drain Output Module Specifications	
Outputs per Module	16
Commons	1
Rated Voltage	30 VDC maximum.
Output Type	N-FET, Open Drain
Rated Load	70 mA per channel
Current Limit	90 mA per channel
Output Power	12 VDC @ 1.6 A, non-isolated, supplied by module
On Response Time	15 ms maximum
Off Response Time	15 ms maximum
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to +85 °C
Operating Humidity	5 to 98% RH non-condensing
Hot Swap	Yes. Module can be swapped while RTU is running. Hot swap will not cause a Warm Start. Outputs will be restored within 2 seconds once module is replaced.
Compatibility	The DO-6 is functionally equivalent and pin compatible with the superseded DO-5.

DO-6 Wiring Diagram



Note: The +12 V Output is sourced from the backplane power rail and is not isolated. Users should exercise caution to avoid shorting or overloading this output.

13. Relay Expansion Boards

The Kingfisher Relay Expansion Boards are designed to be used in conjunction to the DO-6 module. The relay boards allow much more flexible use of the DO-6 module due to the wide range of relay types available.

Each relay board has unique internal wiring. Users should be mindful that they are not completely pin-compatible. Please refer to individual wiring diagrams for details.

TEL REL 002	• 16 Channel Isolated Relay SPDT for DO-6-x complete with 1.5m cable • Max Voltage 380VAC, 125VDC, 16 commons, (1 common per channel) • Max Current 16A @ 250VAC resistive, 16A @ 30 VDC resistive, 0.45A @ 125 VDC Inductive. • 5kV isolation (Coil to Contact) • Omron G2R-1-E Relay
TEL REL 003	• Relay Board - 16 Channel Isolated Relay SPST for DO-6-x complete with 1.5m cable • Max Voltage 380VAC, 125VDC, 16 commons, (1 common per channel) • Max Current 8A @ 250VAC resistive, 8A @ 30 VDC resistive 1A @ 125 VDC Inductive • 5kV isolation (Coil to Contact) • Omron G2RG-2A4-DC12 Relay
TEL REL 004	• Relay Board - 16 Channel Isolated Relay DPDT for DO-6-x complete with 1.5m cable • Max Voltage 380VAC, 125VDC, 32 commons, (2 common per channel) • Max Current 5A @ 250VAC resistive, 5A @ 30 VDC resistive • 5kV isolation (Coil to Contact) • Omron G2R-2-12V Relay

13.1. TEL REL 002: SPDT Relay Board

- **16 SPDT Relay Outputs**
- **Common for each channel**
- **5 kV coil to contact isolation**
- **Can switch AC or DC voltages**

The TEL REL 002 is designed to accompany the DO-6 to provide 16 SPDT voltage free output contacts.

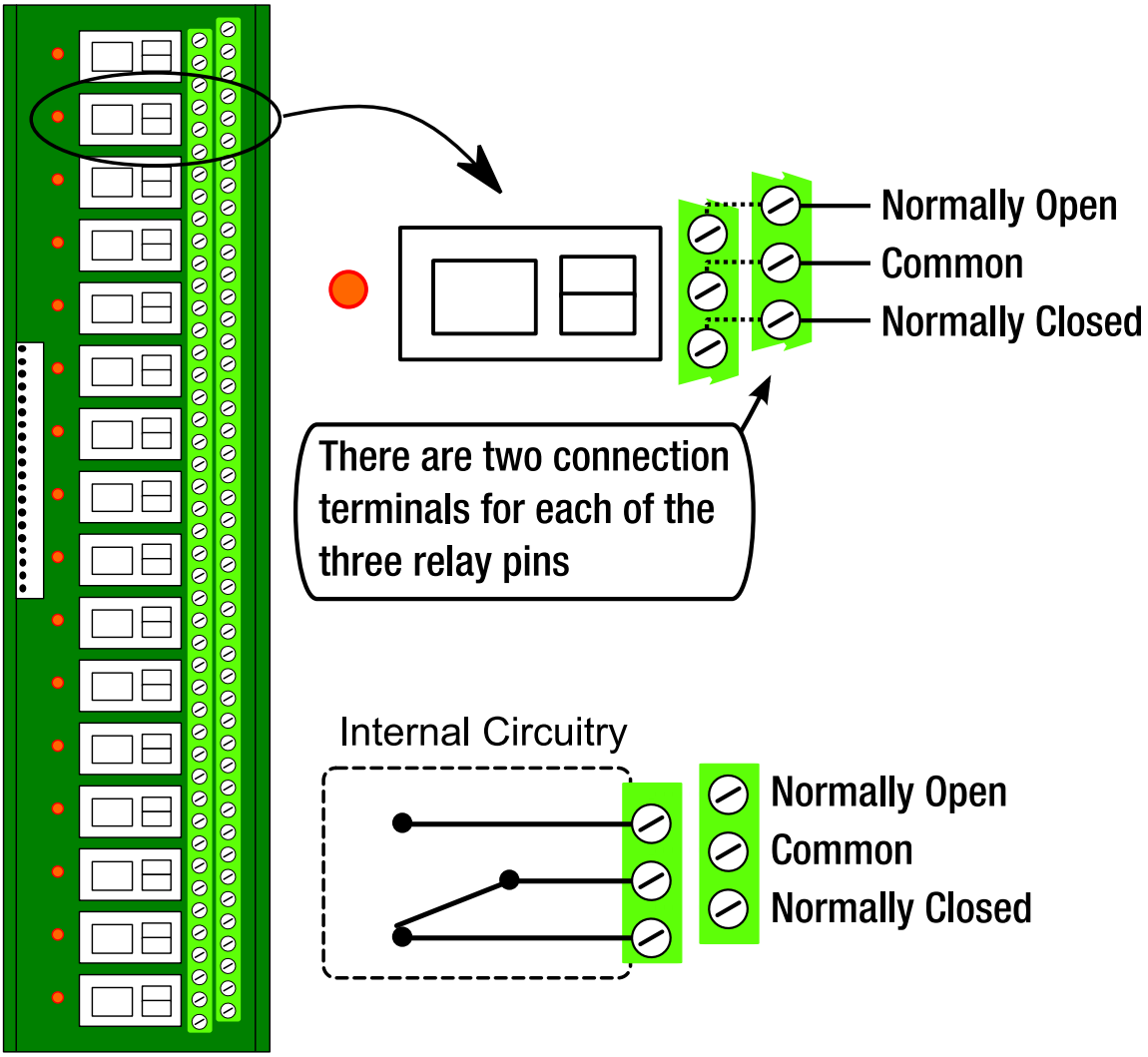
Each relay consumes 43 mA @ +12 VDC from the backplane power supply. An external supply can be connected to a screw terminal on the PCV is available (this is not the case if the standard cable supplied with the DO-6 modules is utilized).

LED indicators are provided for each relay on the relay board. **LED ON = relay active**.

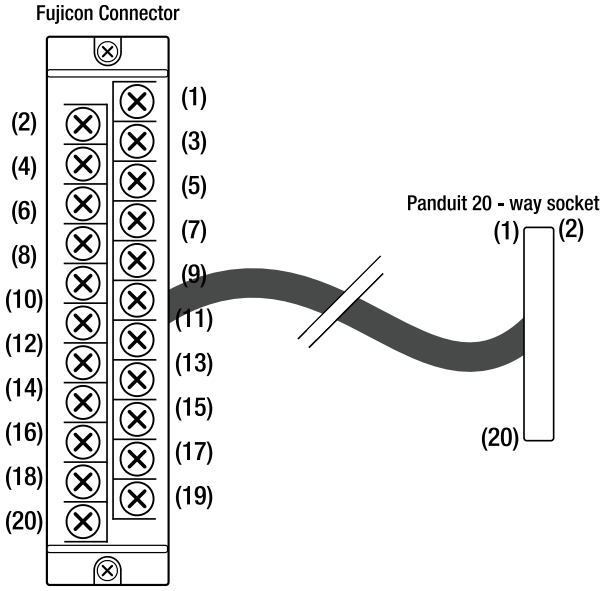
TEL REL 002 SPDT Relay Boards Specifications	
Outputs per Terminal Board	16
Commons	16 (1 common per channel)
Relay Type (per channel)	SPDT (Single Pole, Double Throw)
Rated Load (per contact)	16 A @ 250 VAC Resistive 16 A @ 30 VDC Resistive
Maximum Operating Voltage	380 VAC, 125 VDC
Maximum Switching Power - Resistive	16 A @ 30 VDC 5 A @ 48 VDC 0.6 A @ 125 VDC
Maximum Switching Power - Inductive	16 A @ 12 VDC 8 A @ 30 VDC 0.7 A @ 48 VDC 0.45 A @ 125 VDC
Minimum Load	100 mA at 5 VDC
Contact Resistance	100 mΩ maximum
Relay Operations	100,000 minimum at 1800 operations per hour at rated load
Operating Temperature	-20 to 70 °C (no icing)
Storage Temperature	-40 to +85 °C
Humidity	5 to 98% RH non-condensing
Isolation	5 kV coil to contacts
Coil Rated Voltage	12 VDC @ 43 mA
Coil Resistance	275 Ω @ 12 VDC
Dimensions	253 mm(L) x 90 mm(W) x 70 mm(H) (280 mm long with 2 end clamps)
Mounting	35 mm DIN rail
Interface cable length	1500 mm (for connection to the DO-6 module)
Connection Terminals	Phoenix double height PCB terminal unit arranged in a dual three way terminal (please see wiring diagram). These terminals can take wire sizes up to 4 mm2.
Relay Part Number	Omron G2R-1-E (datasheet is available from www.omroncomponents.eu)

CAUTION! Contacts should be protected with appropriate suppression devices when wired with inductive loads to increase life of relays (please see Switching Inductive Loads). Contacts should also be protected with external fusing.

TEL REL 002 Wiring Diagram



DO-6 to TEL REL 00x Interface Cable



Fujicon DO-6 Pin	DO-6 Outputs	Belden 9431 Cable Color	Panduit 20 way header pins
1	**Channel 1**	Black	1
2	**Channel 2**	White	2
4	**Channel 3**	Red	4
4	**Channel 4**	Green	4
5	**Channel 5**	Orange	5
6	**Channel 6**	Blue	6
7	**Channel 7**	White/Black	7
8	**Channel 8**	Red/Black	8
9	**0 V**	Green/Black	9
10	**0 V**	Orange/Black	10
11	**Channel 9**	Blue/Black	11
12	**Channel 10**	Black/White	12
13	**Channel 11**	Red/White	13
14	**Channel 12**	Green/White	14
15	**Channel 13**	Blue/White	15
16	**Channel 14**	Black/Red	16
17	**Channel 15**	White/Red	17
18	**Channel 16**	Orange/Red	18
19	**+ 12 VDC**	Blue/Red	19
20	**+ 12 VDC**	Green/Red	20

13.2. TEL REL 003: SPST Relay Board

- **16 SPST Relay Outputs**
- **Common for each channel**
- **5 kV coil to contact isolation**
- **Can switch AC or DC voltages**
- **Higher inductive rating than other TEL REL 002 (1 A @ 125 V as opposed to 0.4 A @ 125 V)**

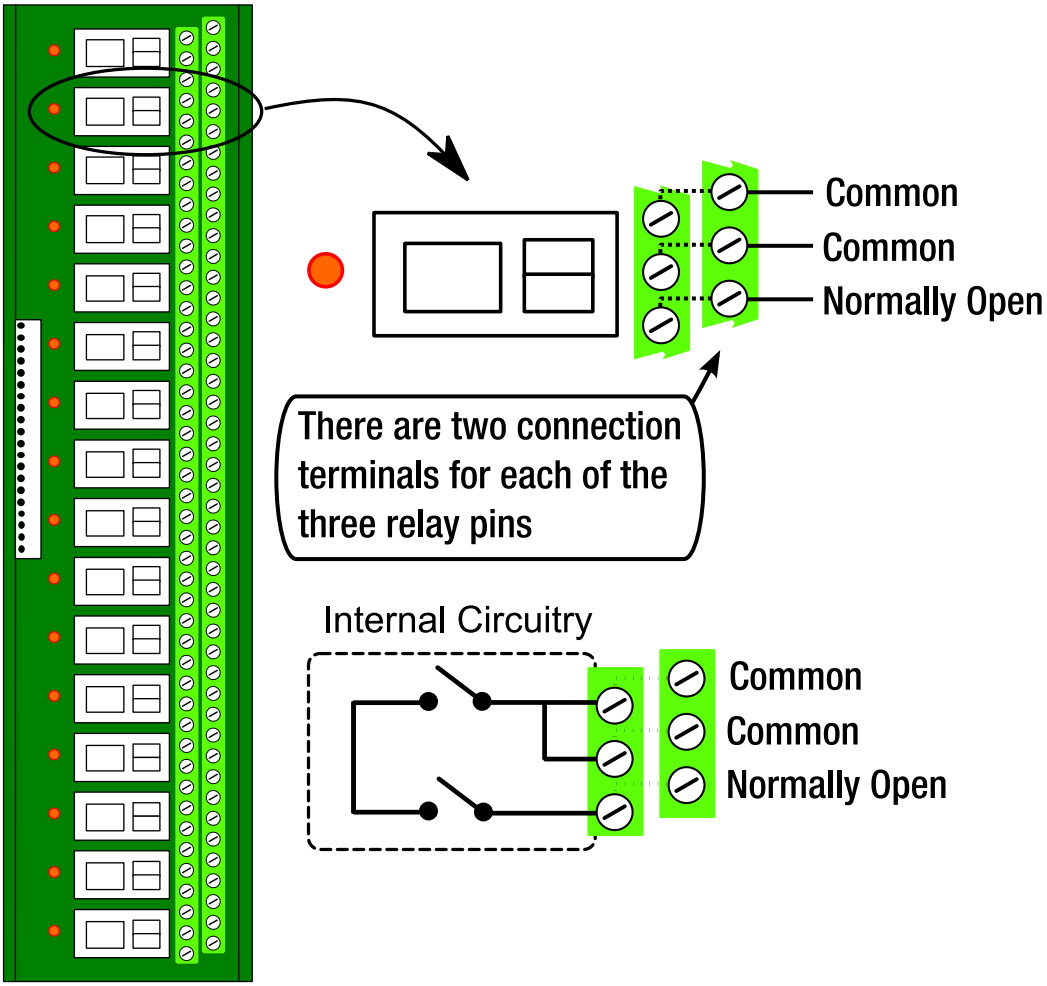
The TEL REL 003 board is designed to be used in conjunction with the DO-6 (or superseded DO-5) and provides superior inductive load rating than the TEL REL 002.

LED indicators are provided for each relay on the relay board. **LED ON = relay active**.

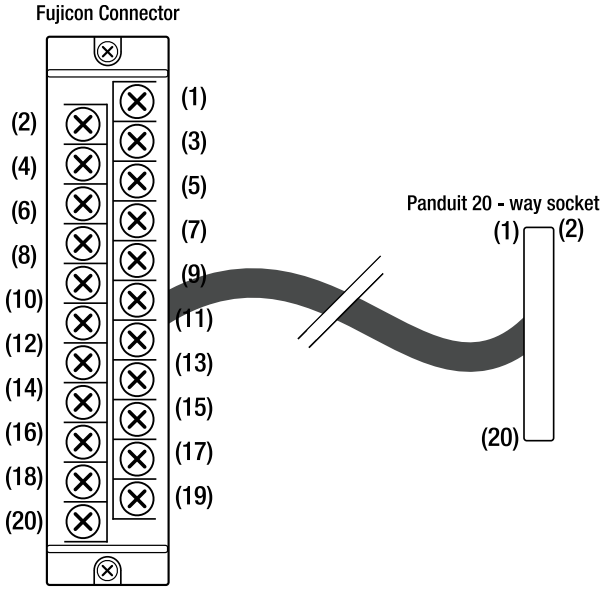
TEL REL 003 SPST Relay Board Specifications	
Outputs per Terminal Board	16
Commons	16 (1 common per channel)
Relay Type (per channel)	SPST (Single Pole, Single Throw)
Rated Load (per contact)	8 A at 250 VAC Resistive 8 A at 30 VDC Resistive 1 A at 125 VDC Inductive
Maximum Operating Voltage	380 VAC, 125 VDC
Maximum Switching Power - Resistive	2000 VA, 240 W
Contact Resistance	100 mΩ maximum
Relay Operations	100,000 minimum at 1800 operations per hour at rated resistive load 50,000 minimum at 360 operations per hour at rated inductive load
Operating Temperature	-20 to 70 °C (no icing)
Humidity	5 to 98% RH non-condensing
Isolation	5 kV coil to contacts
Coil Rated Voltage	12 VDC @ 66 mA
Coil Resistance	180 Ω @ 12 VDC
Dimensions	253 mm(L) x 90 mm(W) x 70 mm(H) (280 mm long with 2 end clamps)
Mounting	35 mm DIN rail
Interface cable length	1.5 m (for connection to the DO-6 module)
Connection Terminals	Weidmuller single height PCB 3-way terminal unit (please see wiring diagram). These terminals can take wire sizes up to 4 mm2.
Relay Part Number	Omron G2RG-2A4-DC12 (datasheet is available from www.omroncomponents.eu)

CAUTION! Contacts should be protected with appropriate suppression devices when wired with inductive loads to increase life of relays (please see DO-1 Switching Inductive Loads). Contacts should also be protected with external fusing.

TEL REL 003 Wiring Diagram



DO-6 to TEL REL 00x Interface Cable



Fujicon DO-6 Pin	DO-6 Outputs	Belden 9431 Cable Color	Panduit 20 way header pins
1	**Channel 1**	Black	1
2	**Channel 2**	White	2
4	**Channel 3**	Red	4
4	**Channel 4**	Green	4
5	**Channel 5**	Orange	5
6	**Channel 6**	Blue	6
7	**Channel 7**	White/Black	7
8	**Channel 8**	Red/Black	8
9	**0 V**	Green/Black	9
10	**0 V**	Orange/Black	10
11	**Channel 9**	Blue/Black	11
12	**Channel 10**	Black/White	12
13	**Channel 11**	Red/White	13
14	**Channel 12**	Green/White	14
15	**Channel 13**	Blue/White	15
16	**Channel 14**	Black/Red	16
17	**Channel 15**	White/Red	17
18	**Channel 16**	Orange/Red	18
19	**+ 12 VDC**	Blue/Red	19
20	**+ 12 VDC**	Green/Red	20

13.3. TEL REL 004: DPDT Relay Board

- **16 DPDT relay outputs**
- **2 commons per channel**
- **5 kV coil to contact isolation**
- **Can switch AC or DC voltages**

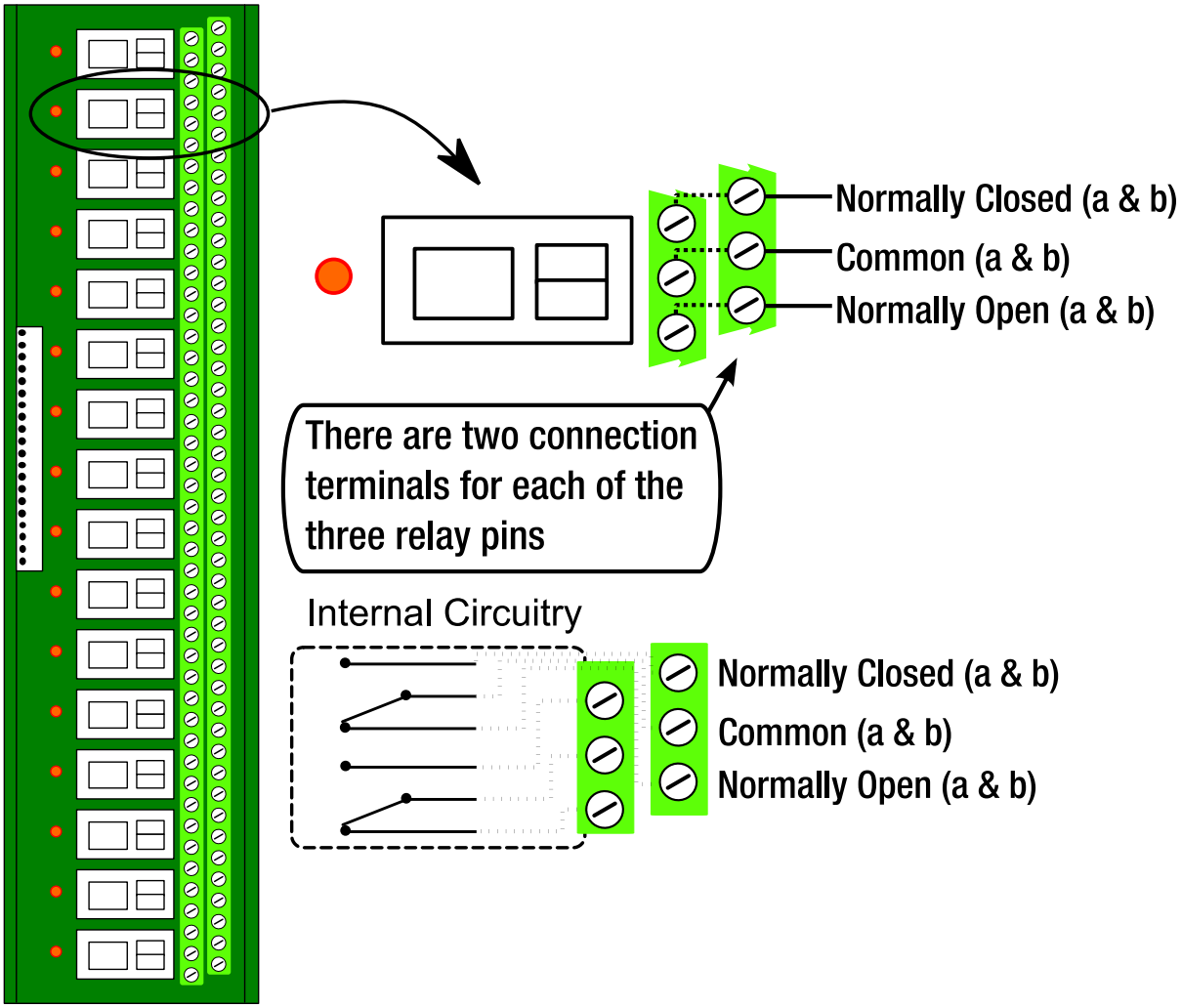
The TEL REL 004 is designed to be used in conjunction with the DO-6 (or superseded DO-5) and provides Double Pole Double Throw (DPDT) relays. This allows the user to utilize both normally open and normally closed relay operation.

LED indicators are provided for each relay on the relay board. **LED ON = relay active**.

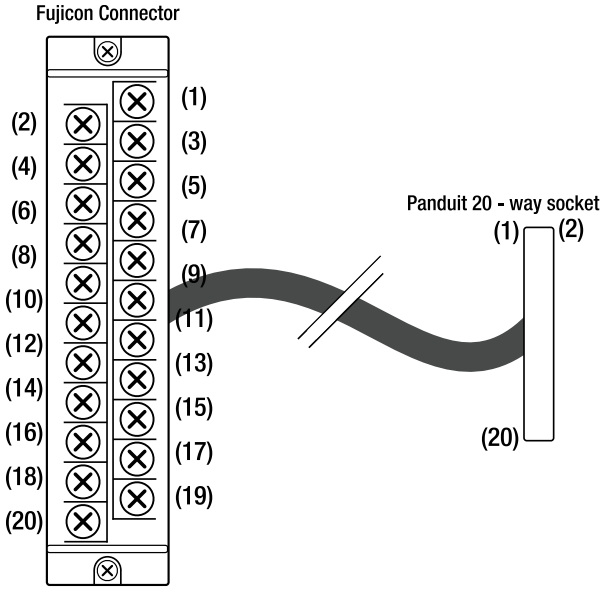
TEL REL 004 DPDT Relay Board Specifications	
Outputs per Terminal Board	16
Commons	32 (2 commons per channel)
Relay Type (per channel)	DPDT (Double Pole, Double Throw)
Rated Load (per contact)	5 A at 250 VAC Resistive 5 A at 30 VDC Resistive
Maximum Current	5 A
Maximum Operating Voltage	380 VAC, 125 VDC (2 A max.)
Maximum Switching Power	750 VA, 90 W Resistive
Minimum Load	10 mA at 5 VDC
Contact Resistance	50 mΩ maximum
Relay Operations	>10,000,000
Operating Temperature	-20 to 70 °C (no icing)
Humidity	5 to 98% RH non-condensing
Isolation	5 kV coil to contacts
Coil Rated Voltage	12 VDC @ 44 mA per coil
Coil Resistance	275 Ω @ 12 VDC
Dimensions	253 mm(L) x 90 mm(W) x 70 mm(H) (280 mm long with 2 end clamps)
Mounting	35 mm DIN rail
Interface cable length	1.5 m (for connection to the DO-5/6 module)
Relay Part Number	Omron G2R-2-12 V (datasheet is available from www.omroncomponents.eu)

CAUTION! Contacts should be protected with appropriate suppression devices when wired with inductive loads to increase life of relays (please see DO-1 Switching Inductive Loads). Contacts should also be protected with external fusing.

TEL REL 004 Wiring Diagram



DO-6 to TEL REL 00x Interface Cable



Fujicon DO-6 Pin	DO-6 Outputs	Belden 9431 Cable Color	Panduit 20 way header pins
1	**Channel 1**	Black	1
2	**Channel 2**	White	2
4	**Channel 3**	Red	4
4	**Channel 4**	Green	4
5	**Channel 5**	Orange	5
6	**Channel 6**	Blue	6
7	**Channel 7**	White/Black	7
8	**Channel 8**	Red/Black	8
9	**0 V**	Green/Black	9
10	**0 V**	Orange/Black	10
11	**Channel 9**	Blue/Black	11
12	**Channel 10**	Black/White	12
13	**Channel 11**	Red/White	13
14	**Channel 12**	Green/White	14
15	**Channel 13**	Blue/White	15
16	**Channel 14**	Black/Red	16
17	**Channel 15**	White/Red	17
18	**Channel 16**	Orange/Red	18
19	**+ 12 VDC**	Blue/Red	19
20	**+ 12 VDC**	Green/Red	20

14. Combination IO Modules

Combinational IO modules provide digital and analogue IO in a single module. They can be installed in any 4, 6, or 12 slot backplane.

14.1. IO-2: Combinational Digital IO Module

- **8 SPST relay outputs**
- **Digital inputs**

This module can be installed in any slot of a 4, 6 or 12 slot backplane.

Digital Inputs

The digital inputs are designed to be powered using an external power supply. A wide range of digital input devices can be used such as push buttons, limit switches and electronic proximity switches. Current through an input (in either direction) results in a logic 1 in the status register. Power to operate the field devices must also be supplied by the user.

Digital Outputs

The output points are arranged in one group of eight points with one common. The output switching capacity of each output is 2 amps. The relay outputs can control a wide range of load devices such as motor starters, solenoids and indicators. Power for the internal relay circuits is provided by the +12 VDC bus on the backplane. The user must supply the AC or DC power to operate the field devices. An internal fuse protects the relay contacts should ratings be exceeded.



An insert goes between the inside and outside surface of the hinged door. The surface towards the inside of the module (when the hinged door is closed) has circuit wiring information and circuit identification information can be recorded on the outside surface. The outside left edge of the insert is colour-coded blue to indicate a low-voltage module.

(Image for demonstration purposes only)

IO-2 Module LEDs

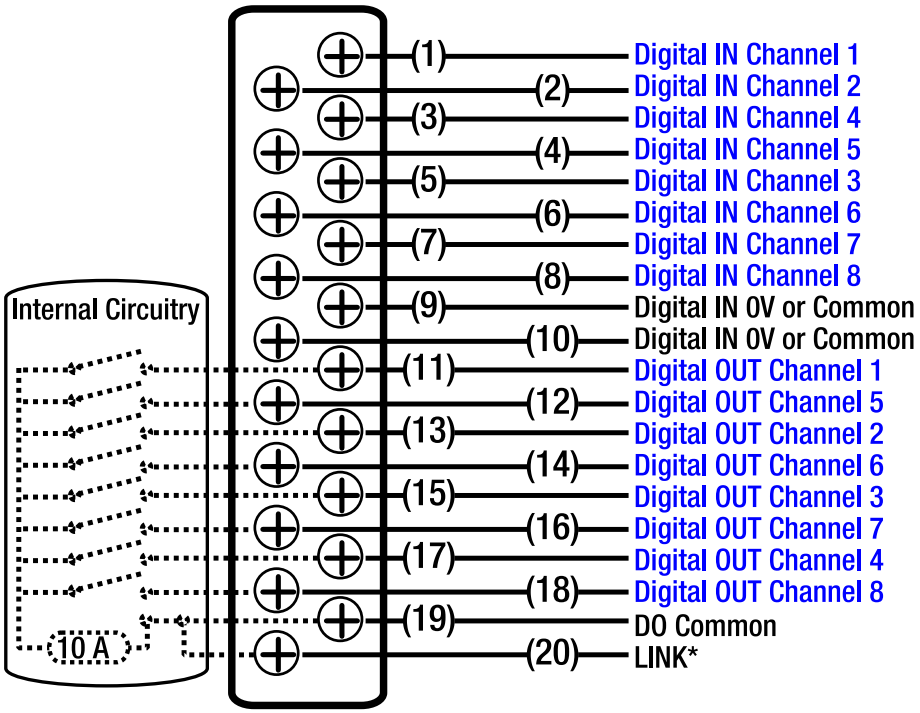


LED	State	Description
OK	OFF	Module fault (no power)
	ON	Normal
FU	OFF	Fuse OK
	ON	Fuse fail
A1-A8	OFF	Digital input OFF
	ON	Digital input ON
B1-B8	OFF	Digital output OFF (open)
	ON	Digital output ON (closed)

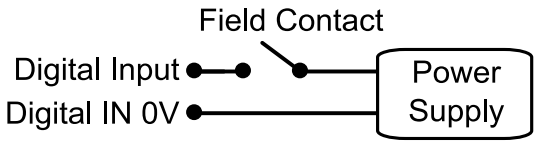
IO-2 Combinational IO Module Specifications		
Operating Temperature	-20 to 70 °C	
Storage Temperature	-40 to 85 °C	
Humidity	5 to 95% RH non-condensing	
Hot Swap	Yes. Module can be swapped while RTU is running. Hot swap will not cause a Warm Start. Outputs will be restored within 2 seconds once module is replaced. Inputs will be cleared while module is removed.	
DIGITAL INPUTS		
Rated Voltage	12 to 24 VAC/DC (can use reverse polarity)	
Inputs per Module	8	
Input Characteristics	On-state Voltage	11.5 to 30 VAC/DC maximum
	Off-state Voltage	0 to +4 VAC/DC
	On-state Current	3.2 mA minimum
	Off-state Current	1 mA maximum
	On response Time	10 ms typical
	Off response Time	17 ms typical
Input Current	4 mA (typical) at rated voltage	
Isolation	3 kV between field and logic	
DIGITAL OUTPUTS		
Outputs per Module	8	
Commons	1 (common supplies all 8 outputs)	
Relay Type	SPST (Single Pole Single Throw)	
Rated Switched Voltage	24 VDC, 120/240 VAC	
Maximum Switched Voltage	30 VDC, 250 VAC	
Maximum Switched Current	5 A per channel 8 A per common	
Isolation	3 kV coil to contacts	
Minimum Load	10 mA @ 5 VDC	
Contact Resistance	100 mΩ maximum	
Relay Operations	70,000 minimum at 1800 operations per hour at rated load	
Relay Part Number	Omron G6D-1A-12 VDC (G6D datasheet is available from www.europe.omron.com)	

CAUTION! Contacts should be protected with appropriate suppression devices when wired with inductive loads to increase life of relays (please see DO-1 Switching Inductive Loads). Contacts should also be protected with external fusing.

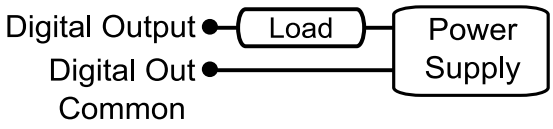
IO-2 Wiring Diagram



Digital Input Example:
(Note polarity can be reversed on power supply)



Digital Output Example:



* Optional link for DC SUPPLY ONLY. Enables fuse fail LED 'FU' on module.
CAUTION: when the link is installed a maximum of 30 V AC or DC can be used to power the common.

Note: DC powered inputs and low voltage AC inputs can both be used on the same module.

14.2. IO-3: Combinational Analog/Digital IO Module

- **4 SPST relay outputs**
- **4 analog inputs**
- **4 digital inputs**
- **1 analog output**

This module can be installed in any slot of a 4, 6 or 12 slot backplane.

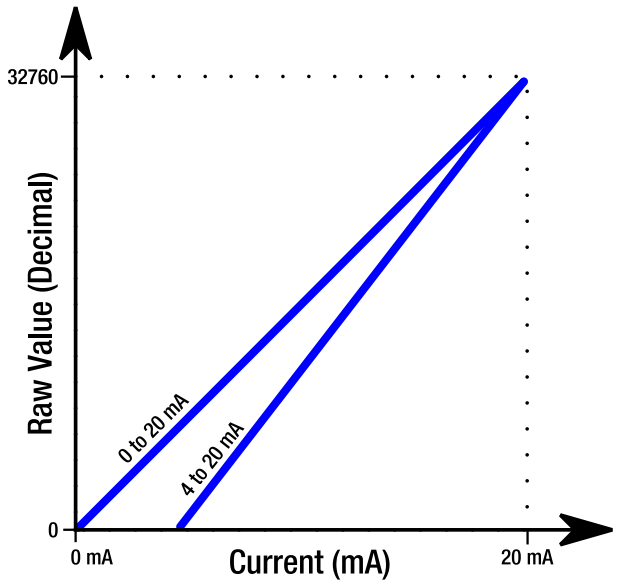
Analogue IO

The IO-3 provides two signal ranges, 0 to 20 mA and 4 to 20 mA. The default range is 4 - 20 mA. A link on the rear of the module selects 4 - 20 mA (link installed) or 0 - 20 mA I/O for all channels.

Resolution of the converted signals is 12 bits binary (1 part in 4096). The sign bit is not used in the conversion process. All channels are updated four times per second (250 ms refresh time). The placement of the bits within the data word is shown below.

LSB														MSB
0	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	0	0	0

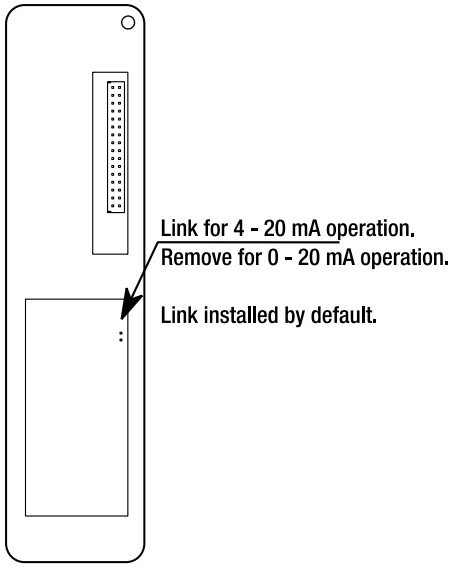
Scaling of the input is shown below:



All inputs share a single common and all outputs share a separate common at the zero volt rail.

Input protection for the module is sufficient to guarantee operation with reduced performance with up to 1500 V common-mode. The module provides electrical isolation of externally generated noise between field wiring and the backplane through the use of optical isolation.

To minimise the capacitive loading and noise, all field connections to the module should be wired using a good grade of twisted, shielded instrumentation cable. The shields can be connected to E. The E connection provides access to the backplane (frame ground).



Digital IO

Input characteristics are compatible with a wide range of user supplied input devices, such as push buttons, limit switches and electronic proximity switches, whilst outputs can control a wide range of user supplied load devices such as: motor starters, solenoids and indicators. Power for the internal relay circuits is provided by the +12 VDC bus on the backplane. The user must supply the AC or DC power to operate field devices. An internal fuse protects the relay contacts should ratings be exceeded.



An insert goes between the inside and outside surface of the hinged door. The surface towards the inside of the module (when the hinged door is closed) has circuit wiring information and circuit identification information can be recorded on the outside surface. The outside left edge of the insert is colour-coded blue to indicate a low-voltage module.

(Image for demonstration purposes only)

IO-3 Module LEDs



LED	State	Description
OK	OFF	Module fault (no power)
	ON	Normal
FU	OFF	Fuse OK
	ON	Fuse fail
A1-A4	-	Not used
B1	-	Not used
C1-C4	OFF	Digital input OFF
	ON	Digital input ON
D1-D4	OFF	Digital output OFF (open)
	ON	Digital output ON (closed)

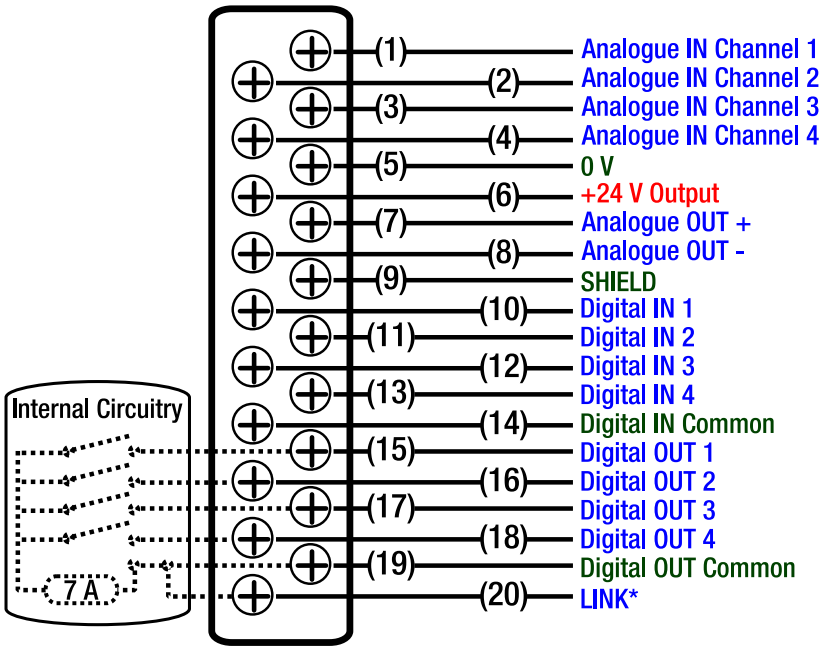
IO-3 Analogue/Digital Combinational IO Module Specifications	
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to +85 °C
Humidity	5 to 95% RH non-condensing
Output Power	24 VDC @ 125 mA (3 W) Isolated
Hot Swap	Yes. Module can be swapped while RTU is running. Hot swap will not cause a Warm Start. Outputs will be restored within 2 seconds once module is replaced. Inputs will be cleared while module is removed.
ANALOG INPUTS	
Input Current Ranges	4 to 20 mA or 0 to 20 mA
Input Voltage Ranges *	1 to 5 V and 0 to 5 V *
Inputs per Module	4
Calibration	Factory calibrated to 5 μA
Update Rate	2 ms (all four channels)
Accuracy	+ 0.25% @ 25 °C
Resolution	12 bit (no sign bit)
Linearity	<1 Least Significant Bit
Isolation	Transient voltage: 1 kV
Common Mode Rejection	> 70 dB at DC; >70 dB at 60 Hz
Cross-Channel Rejection	> 80 dB from DC to 1 kHz
Input Impedance	250 Ω standard 15 kΩ optional *. The internal load resistors can be factory removed if high impedance voltage inputs are required.
Input Filter Response	325 Hz

ANALOG OUTPUT		
Output Current Range	4 to 20 mA or 0 to 20 mA	
Outputs per Module	1	
Calibration	Factory calibrated to 68 μ□A per count	
Supply Voltage (nominal)	+5 VDC and +12 VDC from backplane	
Update Rate	250 ms (all channels) Determined by I/O scan time and is application dependent	
Accuracy	+ 0.25% @ 25 °C	
Resolution	12 bit (no sign bit)	
User Load	0 to 850 Ω	
Output Load Capacitance	2000 pF	
Output Load Inductance	1 H	
Isolation	5 kV Transient	
DIGITAL INPUTS		
Rated Voltage	12 to 24 VAC/DC (can use reverse polarity)	
Inputs per Module	4	
Input Characteristics	On-state Voltage	11.5 to 30 VAC/DC maximum
	Off-state Voltage	0 to +4 VAC/DC
	On-state Current	3.2 mA minimum
	Off-state Current	1 mA maximum
	On response Time	10 ms typical
	Off response Time	17 ms typical
Input Current	4 mA (typical) at rated voltage	
Isolation	5 kV Transient	
DIGITAL OUTPUTS		
Outputs per Module	4	
Commons	1 (common supplies all 4 outputs)	
Relay Type	SPNO (Single Pole, Normally Open)	
Maximum Switched Voltage	30 VDC, 250 VAC	
Maximum Switched Current	4 A per channel 5 A per common	
Isolation	5 kV Transient	
Minimum Load	10 mA @ 5 VDC (wetting current)	
Contact Resistance	100 mΩ maximum	
Relay Operations	70,000 minimum at 1800 operations per hour at rated load	
Relay Part Number	Omron G6D-1A-12VDC (G6D datasheet is available from www.europe.omron.com)	

CAUTION! Contacts should be protected with appropriate suppression devices when wired with inductive loads to increase life of relays (please see DO-1 Switching Inductive Loads). Contacts should also be protected with external fusing.

* Analogue inputs can be modified from current inputs to voltage inputs by lifting one leg of the 250 Ω channel resistor. Each channel has its own resistor, so any combination of channels can be converted. It is recommended that modules be returned to Semaphore for factory conversion if required. No responsibility will be taken by Semaphore for damage caused to boards during modification performed by clients. The circuit board resistors to change are: channels 1 - 4 = R 39, R41, R43 and R45

IO-3 Wiring Diagram

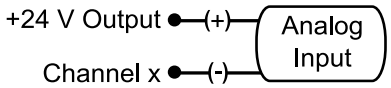


* Optional link for DC SUPPLY ONLY. Enables fuse fail LED 'FU' on module.
CAUTION: when the link is installed a maximum of 30 V AC or DC can be used to power the common.

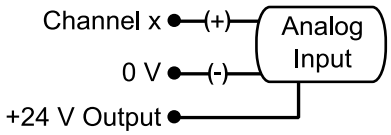
Note: DC powered inputs are low voltage AC inputs can both be used on the same module.

Analogue Input Examples:

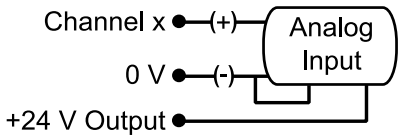
2 wire transmitter (powered by module)



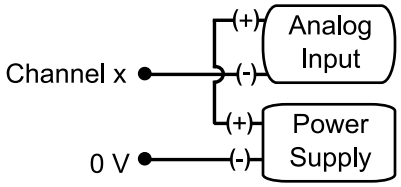
3 wire transmitter (powered by module)



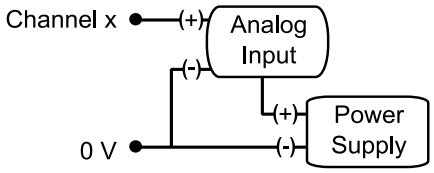
4 wire transmitter (powered by module)



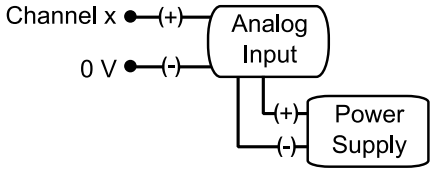
2 wire transmitter (powered externally)



3 wire transmitter (powered externally)

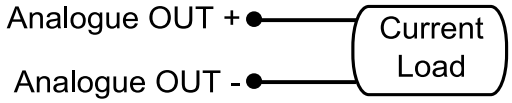


4 wire transmitter (powered externally)



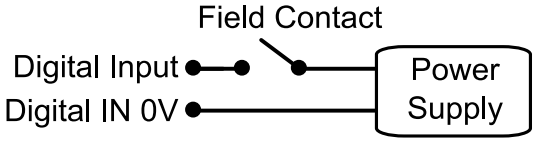
Analogue Output Example:

Analogue load



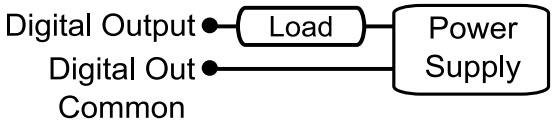
Digital Input Examples:

Sensing the output form a field contact



Digital Output Examples:

Driving external load from digital output



14.3. IO-4: Combinational Analogue / Digital IO Module

- **2 SPST relay outputs**
- **2 analogue inputs**
- **8 digital inputs**

This module can be installed in any I/O slot of a 4, 6 or 12 slot backplane.

Analogue IO

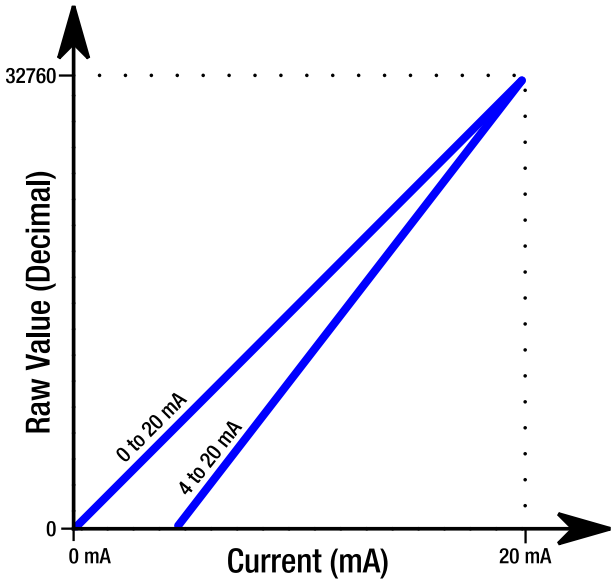
The IO-3 provides two signal ranges, 0 to 20 mA and 4 to 20 mA. The default range is 4 - 20 mA. A link on the rear of the module selects 4 - 20 mA (link installed) or 0 - 20 mA I/O for all channels.

Channel 1 can be utilized for a strain gauge input of range approximately 50 mV. 5 V excitation voltage is supplied from this module (please refer to the wiring diagram for further information).

Resolution of the converted signals is 12 bits binary (1 part in 4096). The sign bit is not used in the conversion process. The placement of the bits within the data word is shown below.

LSB														MSB
0	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	0	0	0

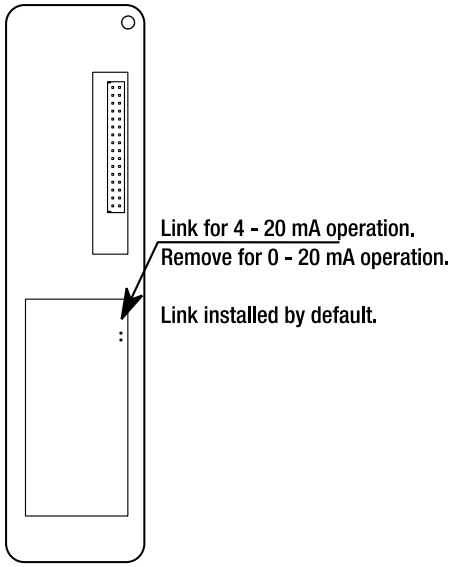
Scaling of the input is shown below:



All inputs share a single common and all outputs share a separate common at the zero volt rail.

Input protection for the module is sufficient to guarantee operation with reduced performance with up to 1500 V common-mode. The module provides electrical isolation of externally generated noise between field wiring and the backplane through the use of optical isolation.

To minimise the capacitive loading and noise, all field connections to the module should be wired using a good grade of twisted, shielded instrumentation cable. The shields can be connected to E. The E connection provides access to the backplane (frame ground).



Digital IO

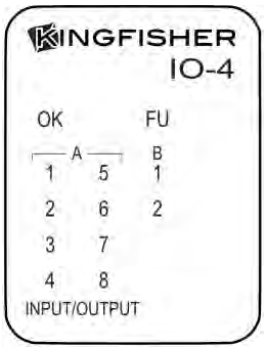
Input characteristics are compatible with a wide range of user supplied input devices, such as push buttons, limit switches and electronic proximity switches, whilst outputs can control a wide range of user supplied load devices such as: motor starters, solenoids and indicators. Power for the internal relay circuits is provided by the +12 VDC bus on the backplane. The user must supply the AC or DC power to operate field devices. An internal fuse protects the relay contacts should ratings be exceeded.



An insert goes between the inside and outside surface of the hinged door. The surface towards the inside of the module (when the hinged door is closed) has circuit wiring information and circuit identification information can be recorded on the outside surface. The outside left edge of the insert is colour-coded blue to indicate a low-voltage module.

(Image for demonstration purposes only)

IO-4 Module LEDs



LED	State	Description
OK	OFF	Module fault (no power)
	ON	Normal
FU	OFF	Fuse OK
	ON	Fuse fail
A1-A8	OFF	Digital input OFF
	ON	Digital input ON
B1-B2	OFF	Digital output OFF (open)
	ON	Digital output ON (closed)

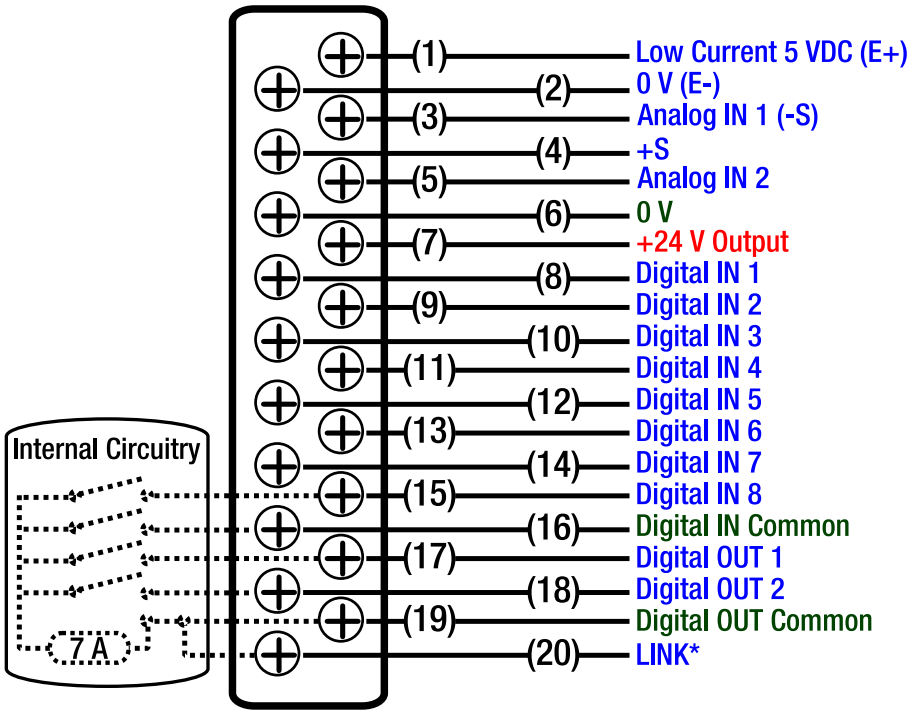
IO-4 Analogue / Digital Combinational Module Specifications	
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to +85 °C
Humidity	5 to 95% RH non-condensing
Output Power	24 VDC @ 125 mA (3 W) Isolated
Hot Swap	Yes. Module can be swapped while RTU is running. Hot swap will not cause a Warm Start. Outputs will be restored within 2 seconds once module is replaced. Inputs will be cleared while module is removed.
ANALOG INPUTS	
Input Current Ranges	4-20 mA and 0-20 mA
Input Voltage Ranges *	1-5 V and 0-5 V *
Inputs per Module	2
Calibration	Factory calibrated to 5 μA
Update Rate	2 ms (all four channels)
Accuracy	+ 0.25% @ 25 °C
Resolution	12 bit (no sign bit)
Common Mode Voltage	1500 V
Linearity	<1 Least Significant Bit
Isolation	1000 VRMS between field and logic
Common Mode Rejection	>70 dB at DC; >70 dB at 60 Hz
Cross-Channel Rejection	>80 dB from DC to 1 kHz
Input Impedance	250 Ω standard 15 kΩ optional *. The internal load resistors can be factory removed if high impedance voltage inputs are required.
Input Filter Response	325 Hz

DIGITAL INPUTS		
Rated Voltage	12 to 24 VAC/DC (can use reverse polarity)	
Inputs per Module	8	
Input Characteristics	On-state Voltage	11.5 to 30 VAC/DC maximum
	Off-state Voltage	0 to +4 VAC/DC
	On-state Current	3.2 mA minimum
	Off-state Current	1 mA maximum
	On response Time	10 ms typical
	Off response Time	17 ms typical
Input Current	4 mA (typical) at rated voltage	
Isolation	1000 Vrms between field and logic	
DIGITAL OUTPUTS		
Outputs per Module	2	
Commons	1 (common supplies both outputs)	
Relay Type	SPST (Single Pole Single Throw)	
Maximum Switched Voltage	30 VDC, 250 VAC	
Maximum Switched Current	5 A per channel 8 A per common	
Isolation	3 kV coil to contacts	
Minimum Load	10 mA @ 5 VDC	
Contact Resistance	100 mΩ maximum	
Relay Operations	70,000 minimum at 1800 operations per hour at rated load	
Relay Part Number	Omron G6D-1A-12 VDC (G6D datasheet is available from www.europe.omron.com)	

CAUTION! Contacts should be protected with appropriate suppression devices when wired with inductive loads to increase life of relays (please see DO-1 Switching Inductive Loads). Contacts should also be protected with external fusing.

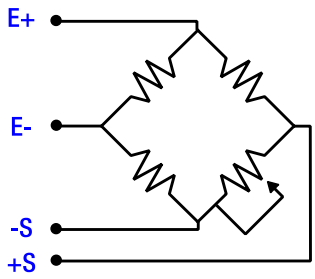
* Analogue inputs can be modified from current inputs to voltage inputs by lifting one leg of the 250 Ω channel resistor. Each channel has its own resistor, so any combination of channels can be converted. It is recommended that modules be returned to Semaphore for factory conversion if required. No responsibility will be taken by Semaphore for damage caused to boards during modification performed by clients. The circuit board resistors to change are: channels 1 - 2 = R85 & R41

IO-4 Wiring Diagram

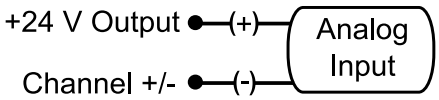


* Optional link for DC SUPPLY ONLY. Enables fuse fail LED 'FU' on module. CAUTION! When link is installed, a maximum voltage of 30 V AC or DC can be used to power the common

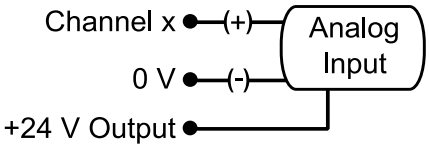
Strain gauge input
(4 wire Wheatstone bridge)



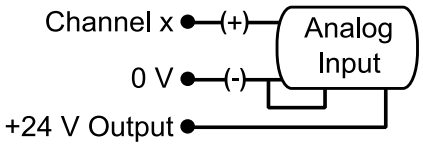
2 wire transmitter
(powered by module)



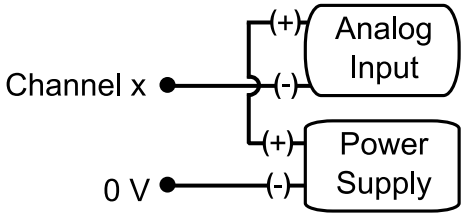
3 wire transmitter
(powered by module)



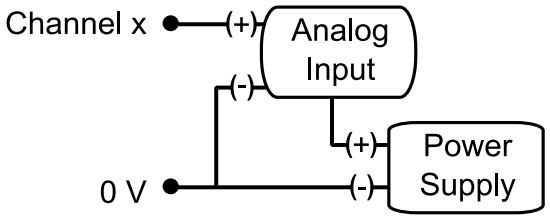
4 wire transmitter
(powered by module)



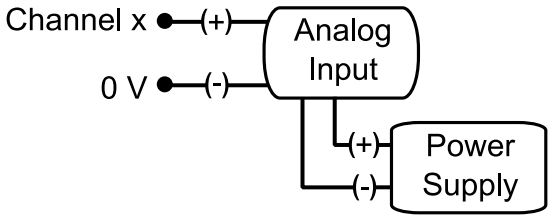
2 wire transmitter
(externally powered)



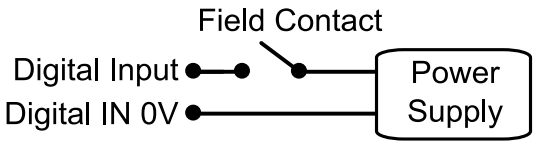
3 wire transmitter
(externally powered)



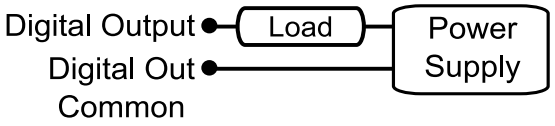
4 wire transmitter
(externally powered)



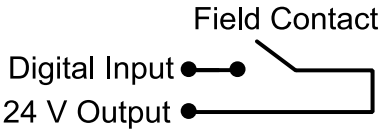
Field contact input
(externally powered)



Driving digital load
(externally powered)



Passive field contact
(powered by module)



14.4. IO-5: Combinational Analogue / Digital IO Module

- **4 sinking solid state outputs**
- **4 analog inputs**
- **4 digital inputs**
- **1 analog output with open line detection**

This module can be installed in any I/O slot of a 4, 6 or 12 slot backplane.

Analogue IO

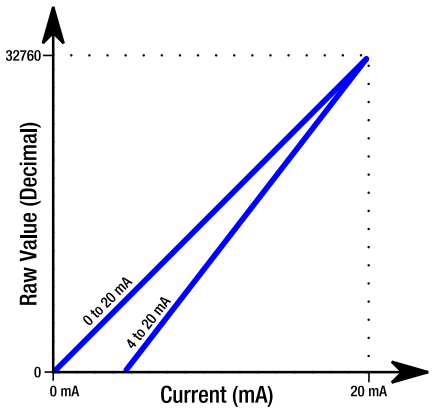
Input protection for the module is sufficient to guarantee operation with reduced performance with up to 1500 V common-mode. The module provides electrical isolation of externally generated noise between field wiring and the backplane through the use of optical isolation.

To minimise the capacitive loading and noise, all field connections to the module should be wired using a good grade of twisted, shielded instrumentation cable. The shields can be connected to E. The E connection provides access to the backplane (frame ground).

Resolution of the converted signals is 12 bits binary (1 part in 4096). The sign bit is not used in the conversion process. The placement of the bits within the data word is shown below.

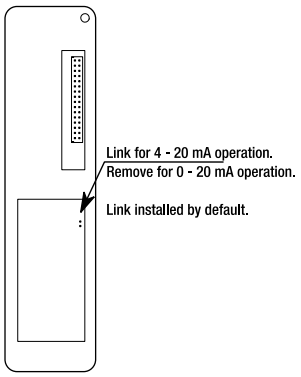
LSB														MSB
0	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	0	0	0

Scaling of the input is shown below:



All inputs share a single common and all outputs share a separate common at the zero volt rail.

For analogue outputs, an **Open Line Detection** circuit will indicate whether current loop is open or closed. Please note that open line detection circuit performance cannot be guaranteed when AO value is set to less than 1% (328 decimal) of full scale in the 0-20 mA range.



The IO-3 provides two signal ranges, 0 to 20 mA and 4 to 20 mA. The default range is 4 - 20 mA. A link on the rear of the module selects 4 - 20 mA (link installed) or 0 - 20 mA I/O for all channels.

Digital Inputs

For high speed isolated digital inputs are provided on the module. All four digital inputs share on one common rail.

All channels can be configured as pulse counters that appear 16 bit unsigned integer values in the analogue input registers of the RTU processor module. Because of processor module limitations, only channels 1 and 2 can be configured as pulse counters when used with the CP-11/12/21 and PC-1 processors (Toolbox32). All four channels can be used as pulse counters when used with CP-30 processor module (Toolbox PLUS+).

Input characteristics are compatible with a wide range of user supplied input devices, such as push buttons, limit switches, Hall sensors, proximity switches, etc.

Digital Outputs

Input characteristics are compatible with a wide range of user supplied input devices, such as push buttons, limit switches and electronic proximity switches, whilst outputs can control a wide range of user supplied load devices such as: motor starters, solenoids and indicators. Power for the internal relay circuits is provided by the +12 VDC bus on the backplane. The user must supply the AC or DC power to operate field devices. An internal fuse protects the relay contacts should ratings be exceeded.



An insert goes between the inside and outside surface of the hinged door. The surface towards the inside of the module (when the hinged door is closed) has circuit wiring information and circuit identification information can be recorded on the outside surface. The outside left edge of the insert is colour-coded blue to indicate a low-voltage module.

(Image for demonstration purposes only)

IO-5 Module LEDs



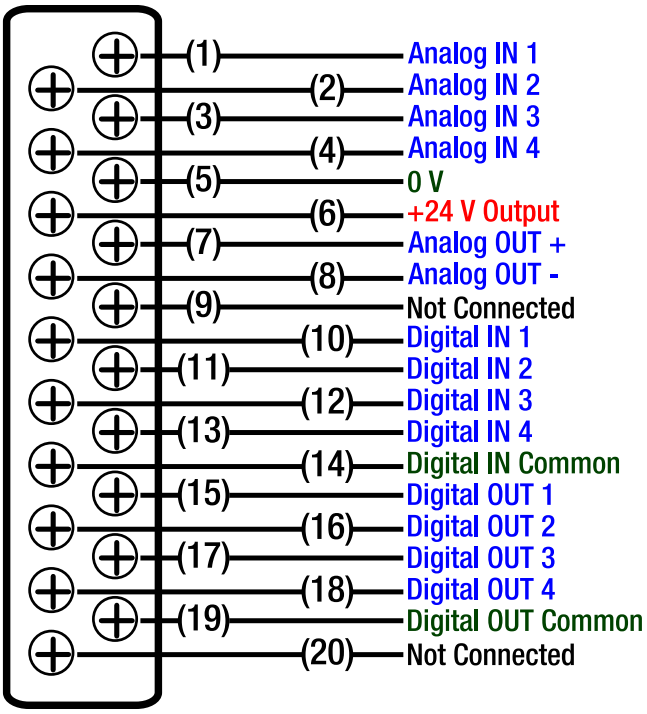
LED	State	Description
OK	OFF	Module fault (no power)
	ON	Normal
RST	OFF	
	ON	Module Reset in progress
24Va	OFF	Field Power disabled
	ON	Field Power enabled
AI 1-4	OFF	Analogue input is less or equal to 1% of range
	ON	Analogue input is greater than 1% of range
AO1	OFF	Analogue output is set to less or equal to 1% of range
	ON	Analogue output is set to greater than 1% of range
OL	OFF	Analogue output line is closed (loaded)
	ON	Analogue output line is open / loop current equal to zero
DI 1-4	OFF	Digital input OFF
	ON	Digital input ON
DO 1-4	OFF	Digital output OFF (Output switch does not conduct)
	ON	Digital output ON (Output switch conducts)

IO-5 Analogue / Digital Combinational Module Specifications	
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to +85 °C
Humidity	5 to 95% RH non-condensing
Maximum Working Voltage on any contact of the field connector	42.4 Vpeak / 60 VDC relative to system (backplane) ground
Hot Swap	Yes. Module can be swapped while RTU is running. Hot swap will not cause a Warm Start.
ANALOG INPUTS	
Input Current Ranges	4 - 20 mA or 0 - 20 mA
Input Voltage Ranges *	1 - 5 V or 0 - 5 V *
Inputs per Module	4
Resolution	Unsigned 12 bit
Accuracy (includes Gain, Linearity and Offset errors)	± 0.25% @ 25 °C ± 0.50% @ -20 to 70 °C
Update Rate	120 ms
Cross-Channel Rejection	> 115 dB from DC to 1 kHz
Input Impedance	250 Ω standard 1 MΩ optional *. The internal load resistors can be factory removed if high impedance voltage inputs are required.
Input Filter Bandwidth (-3 dB cut-off)	7 Hz
AC noise attenuation	16 dB @ 50 Hz 18 dB @ 60 Hz
Output Field Power	24 VDC @ 80 mA Isolated
Isolation	5 kV Transient

ANALOG OUTPUT	
Output Current Range	4 - 20 mA or 0 - 20 mA
Outputs per Module	1
Output Type	Isolated, Sourcing
Resolution	Unsigned 12 bit
Update Rate	250 ms Determined by I/O scan time and is application dependent
Accuracy (includes Gain, Linearity and Offset errors)	± 0.25% @ 25°C ± 0.50% @ -20 to 70 °C
User Load	0 to 850 Ω
Isolation	5 kV Transient
DIGITAL INPUTS	
Inputs per Module	4 with one common
Input Type	Optically isolated, Sinking
Max Input Voltage	30 VDC
Guaranteed On-state Voltage	10 VDC min
Guaranteed Off-state Voltage	4.0 VDC max
Counters Type	Pulse, Unsigned 16-bit (all channels)
Maximum Counters Speed	10 kHz
Input Current	Approx. (Vin / 4.7) mA: 2 mA @ 9.4 V in; 6.4 mA @ 30 V in
Isolation	5 kV Transient
DIGITAL OUTPUTS	
Outputs per Module	4 with one common
Output Type	Optically isolated, Solid State, Sinking
Maximum Switched Voltage	30 VDC
Maximum Switched Current	2 A per channel
Isolation	5 kV Transient

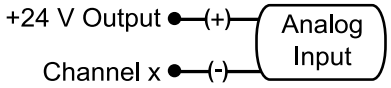
* Analogue inputs can be modified from current inputs to voltage inputs by lifting one leg or by the complete removal of the 250 Ω channel resistor from the board. Each channel has its own resistor, so any combination of channels can be converted. It is recommended that modules be returned to Semaphore for factory conversion if required. No responsibility will be taken by Semaphore for damage caused to boards during modification performed by clients. The circuit board resistors to change are:
Ch.1: R81 (or R85+R86);
Ch.2: R82 (or R87+R88);
Ch.3: R83 (or R89+R90);
Ch.1: R84 (or R91+R92).

IO-5 Wiring Diagram

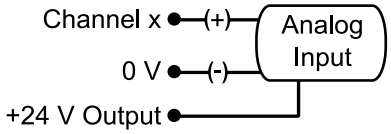


Analogue Input Examples:

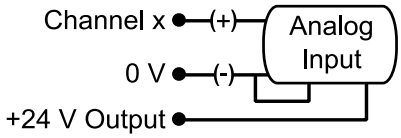
2 wire transmitter (powered by module)



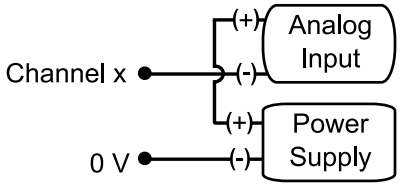
3 wire transmitter (powered by module)



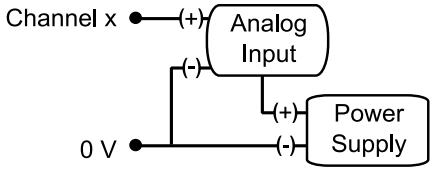
4 wire transmitter (powered by module)



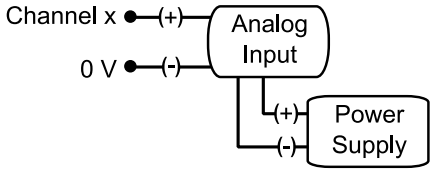
2 wire transmitter (powered externally)



3 wire transmitter (powered externally)

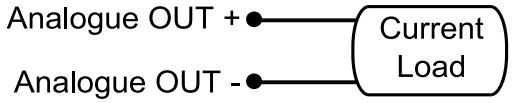


4 wire transmitter
(powered externally)



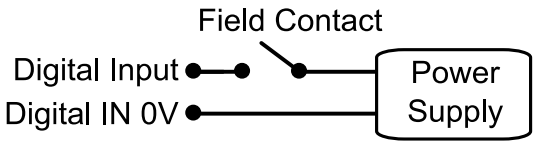
Analogue Output Example:

Analogue load



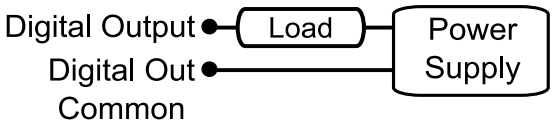
Digital Input Examples:

Sensing the output form a field contact



Digital Output Examples:

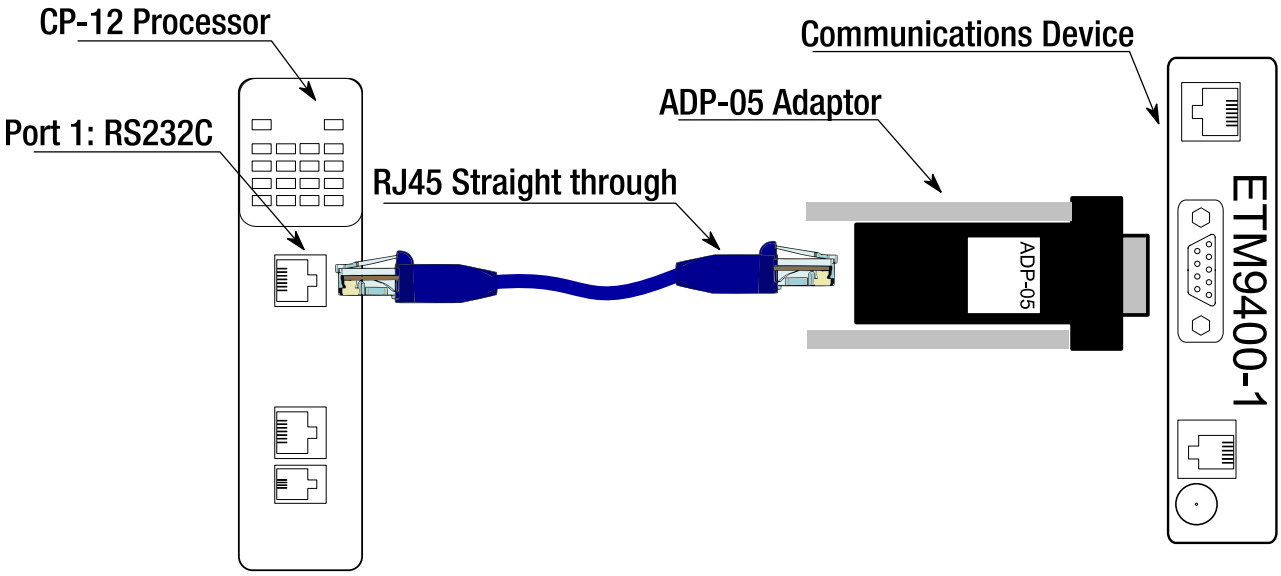
Driving external load from digital output



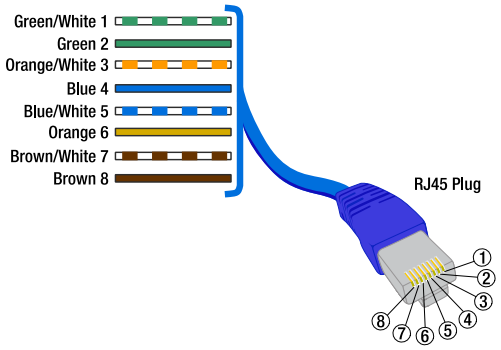
15. Adaptors and Cables

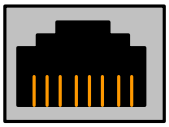
A range of adaptor and cable accessories are available for the Kingfisher range to allow for communications interfacing. The adaptor plugs universally adapt to RJ45 to allow standard CAT5/6 cabling to be used between RTUs, PLCs and communications devices.

Connectivity Example



Reference





87654321

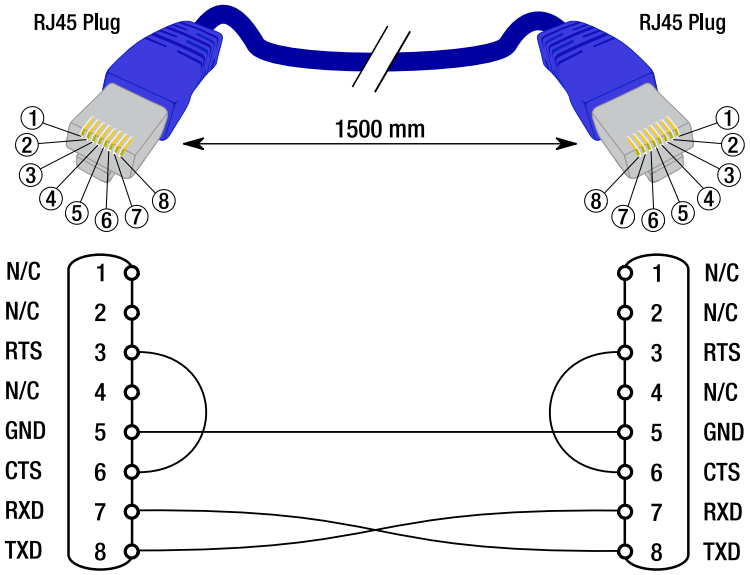
TIA/EIA-568-B Telecommunications Standard

Summary of available adaptors

Part Number	Description
ADP-04	Maxon and Tait radios (DB9F to RJ45 Adaptor) for 'R' option
ADP-05	PC Serial Port (DB9F to RJ45 Adaptor) for 'I' & 'S' options
ADP-N	DB9 port saver. Used with ADP-05 for concealed PC serial ports (E.g. Current HP Notebooks)
ADP-05-N	PC Serial Port (DB9F to RJ45 Adaptor) for 'I' & 'S' options DB9 port saver.
ADP-07	PSTN modem external 25 pin (DB25M to RJ45 Adaptor) for 'S' options, confirm PSTN pin-outs
ADP-08	RJ45 to DB9 Female Converter (Straight Connect)
ADP-08 M	RJ45 to DB9 Male Converter (Straight Connect) for Serial Port to MaxStream External Spread Spectrum Radio
ADP-16	Trio "D" and "E" Series Radio (DB9M to RJ45 Adapter) for 'S' options
ADP-25	Uni-Op Display Model - MD02R-04-00A5 (DB15M to RJ45 Adapter) for 'S' options
ADP-28	Trio "H" series Spread Spectrum Radio (DB9M to RJ45 Adapter) for 'S' options
ADP-29	Trio "M" series Radio (Modem fitted) (DB9M to RJ45 Adapter) for 'S' options
ADP-31	Trio "M" series Radio (DB9M to RJ45 Adapter) for PC-1 'R' option
RJC-05	Cable RJ45 Plug both ends "1:1" - 0.5 meters
RJC-10	Cable RJ45 Plug both ends "1:1" - 1.0 meter
RJC-20	Cable RJ45 Plug both ends "1:1" - 2.0 meters
RJC-30	Cable RJ45 Plug both ends "1:1" - 3.0 meters
RJC-50	Cable RJ45 Plug both ends "1:1" - 5.0 meters
RJC-100	Cable RJ45 Plug both ends "1:1" - 10.0 meters
RJC-ADP-22B	Wavecom GSM Cable (RJ45 to HD15) for 'S' options, to suit Fastrack Xtend FXT009, and superseded 1205-1306, Supreme 10
RJC-ADP-26	Maxon MM-6280IND 3G Cable (RJ45 to DB15) for 'S' options
RJC-ADP-27	Motorola Satellite Series 9522 L-Band Cable (RJ45 to DB25) for 'S' options
RJC-ADP-30	Trio "M" series radio Cable (RJ45 to DB15) for 'L' option
RJC-45/12	RJ45 to RJ12 Phone Lead - 2.0m
RJC-X-OVER	Serial RJ45 to RJ45 cross over cable - 1.5 meters (useful for testing/commissioning)
RJC-ETHER-X-OVER	Ethernet RJ45 to RJ45 cross over cable - 2.0 meters
CAB-OPTION-J	Image Capture Option cable - SMB to BNC female - 2.5m
CAB-IO-1	External I/O cable - 1m
CAB-IO-2	External I/O cable - 2m
CAB-IO-5	External I/O cable - 5m
CAB-ACR-00	Cable PSO-ACR Power Supply 2.5M (Flying leads)
CAB-ACR-AU	Cable PSO-ACR Power Supply 2.5M (3 Pin 240V AU-NZ Plug)
CAB-ACR-EU	Cable PSO-ACR Power Supply 2.5M (3 Pin 240V EU Plug)
CAB-ACR-IN	Cable PSO-ACR Power Supply 2.5M (3 Pin BA546A 240V Plug)
CAB-ACR-UK	Cable PSO-ACR Power Supply 2.5M (3 Pin 240V UK Plug)
CAB-ACR-US	Cable PSO-ACR Power Supply 2.5M (3 Pin 240V UK Plug)
CAB-FO-PATCH-1	Patch Cable for A3 Ethernet Option Board (MTRJ to ST)
CAB-FO-PATCH-2	Patch Cable for A3 Ethernet Option Board (MTRJ to SC)

15.1. RTU Test Cables

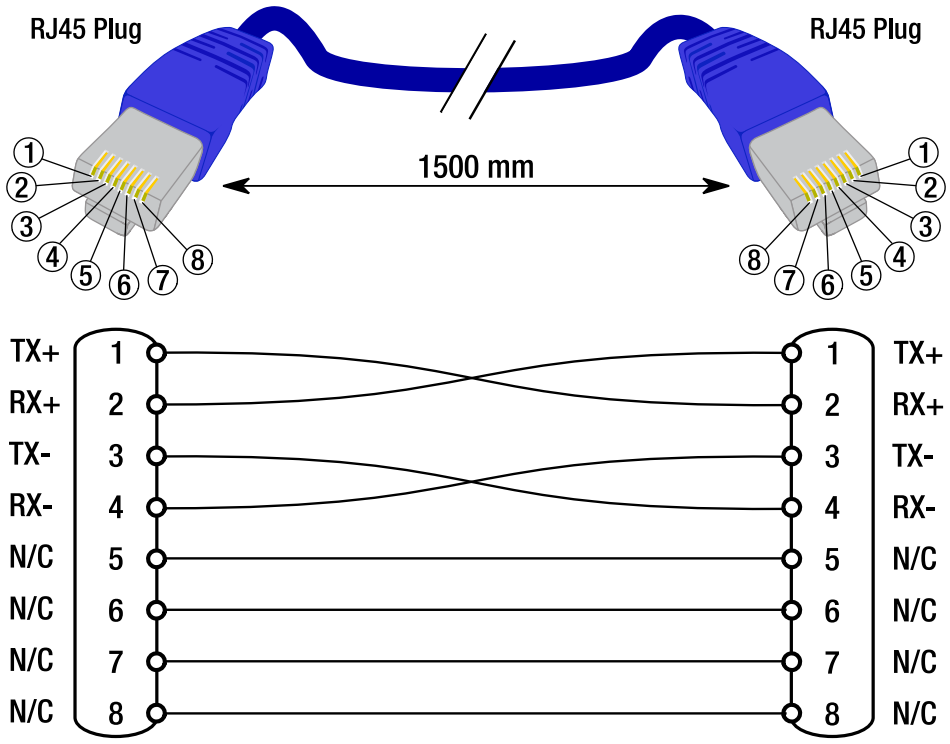
RJC-X-Over: Kingfisher PLUS RJ45 to RH45 RS232 Null Modem Cable (serial crossover)



RJ45 to Kingfisher RTU Serial Port

RJ45 to Kingfisher RTU Serial Port

RJC-X-Over-E: Kingfisher PLUS+ RJ45 to RJ45 Ethernet Crossover Cable

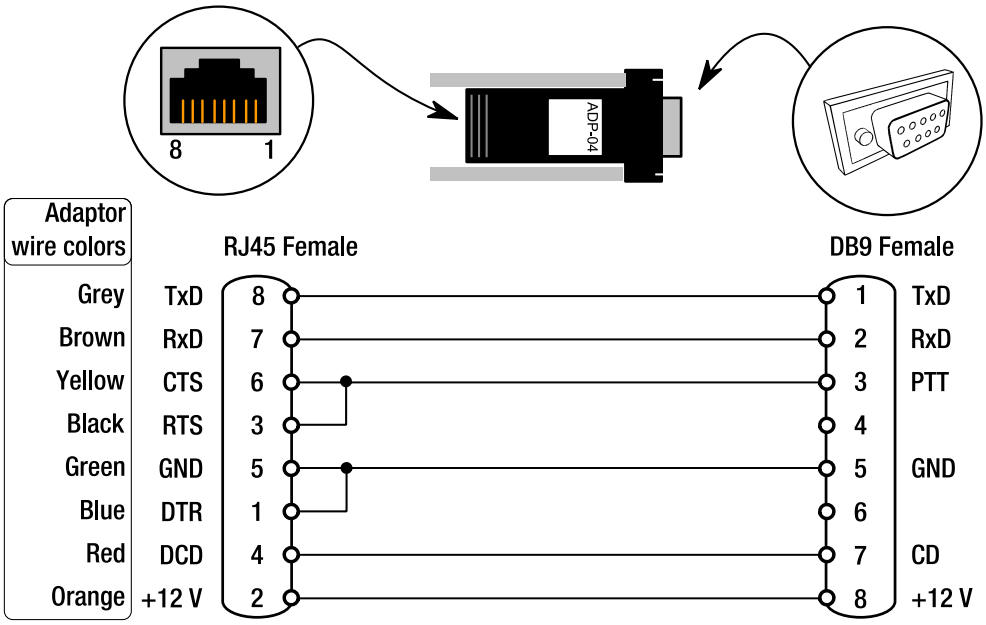


RJ45 to Kingfisher RTU Ethernet Port

RJ45 to Kingfisher RTU Ethernet Port

15.2. Device Cables and Adaptors

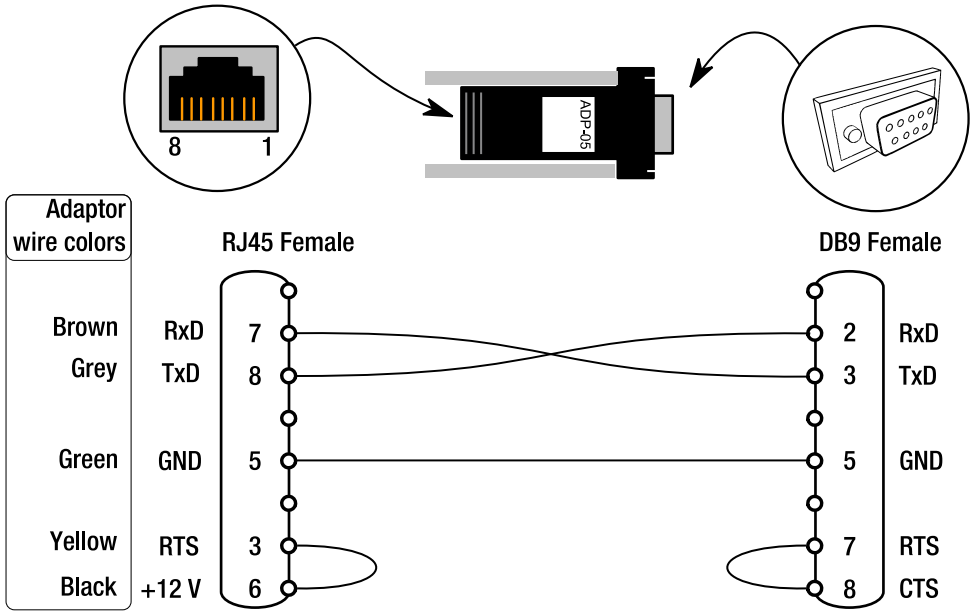
ADP-04: PC-1/MC-1 Radio Port to Tait T2010 or Maxon RDM-01 Radio (SD125)



RJ45 to Kingfisher RTU Radio Port

To Tait 2010 or Maxon RDM-01 radio

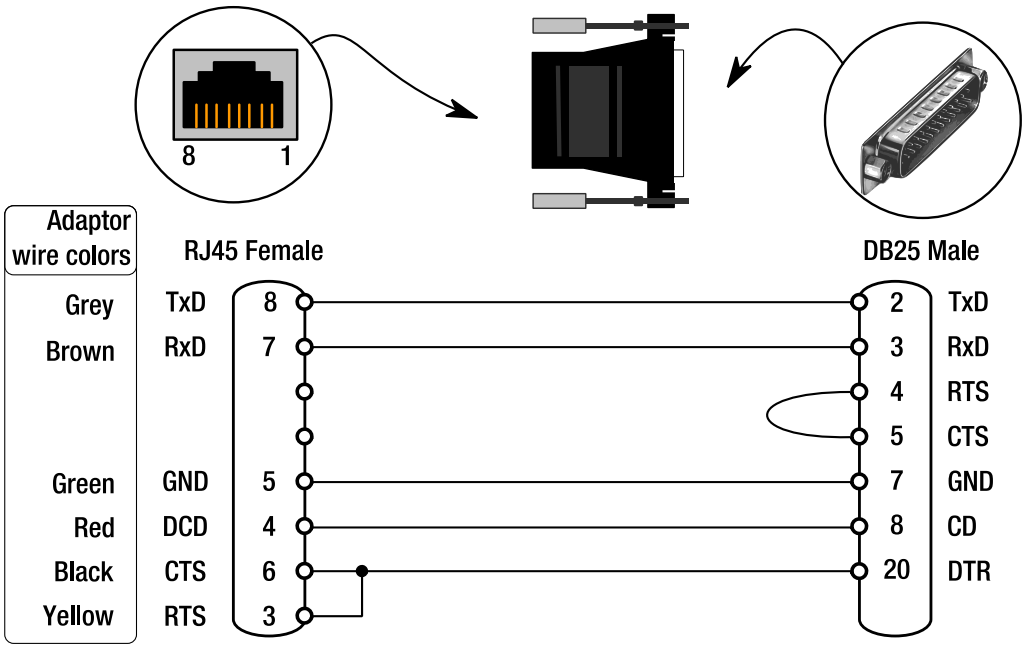
ADP-05: RTU Serial Port to PC Serial Port (Creates a null modem cable)



To Kingfisher Serial Port

To PC Serial Port

ADP-07: RTU Serial Port to External PSTN Modem

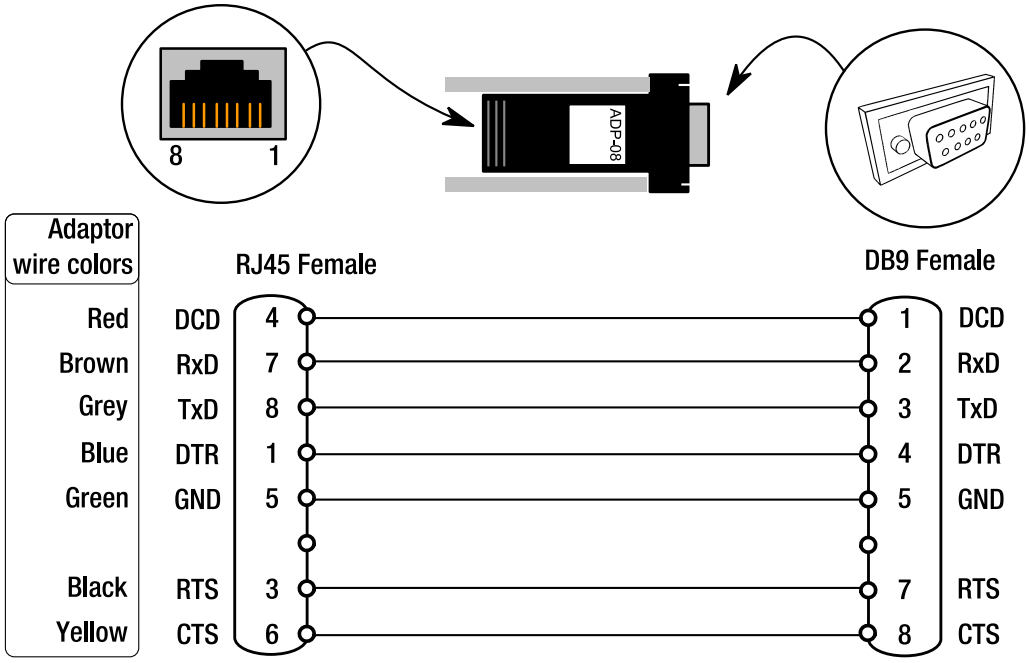


To Kingfisher Serial Port

To PSTN Modem

ADP-08: RJ45 to DB9 Female Converter (Straight Connect)

(Note: when coupled with an ADP-05 forms a null modem cable DB9 female to DB9 female)

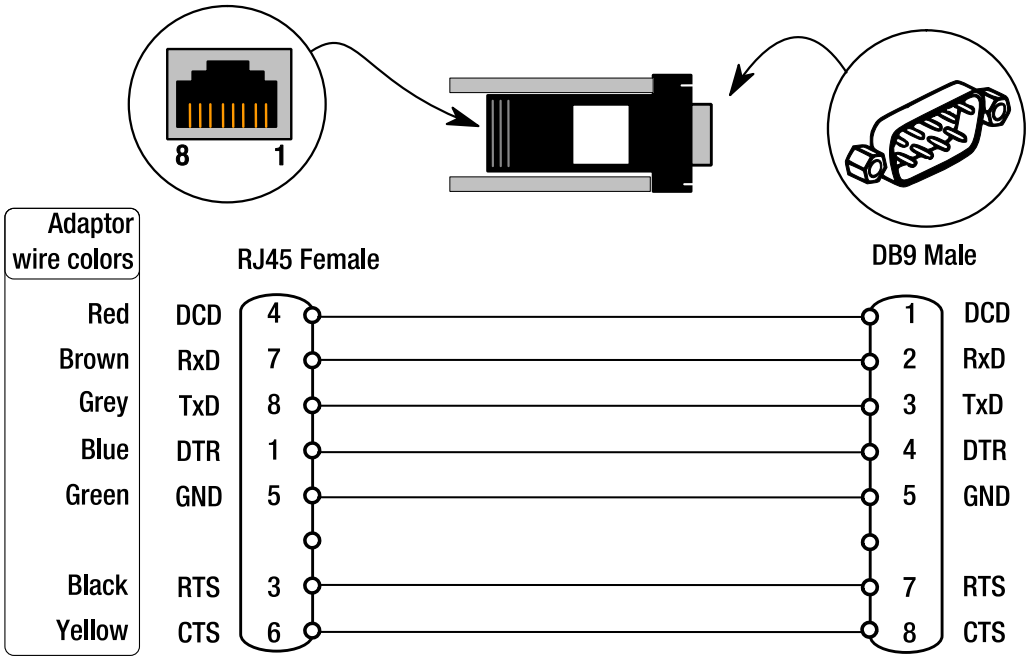


To Kingfisher Serial Port

To External Device

ADP-08-M: Serial Port to Digi External Spread Spectrum Radio

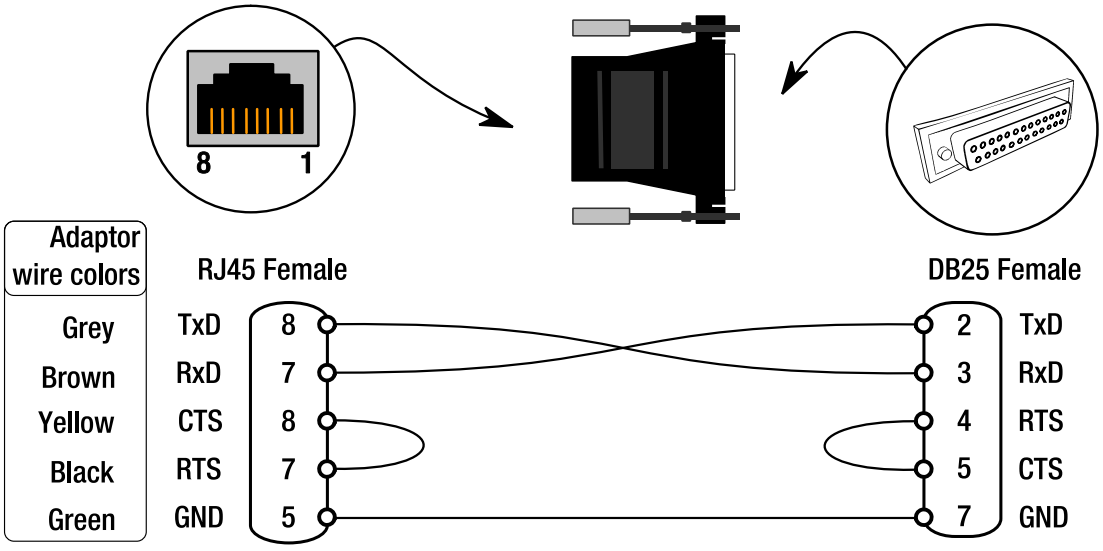
For Digi XTend-PKG or XStream-PKG, and other 3rd party radios.



To Kingfisher Serial Port

To External Radio

ADP-09: Serial Port to HITECH or Nematron Display Panel

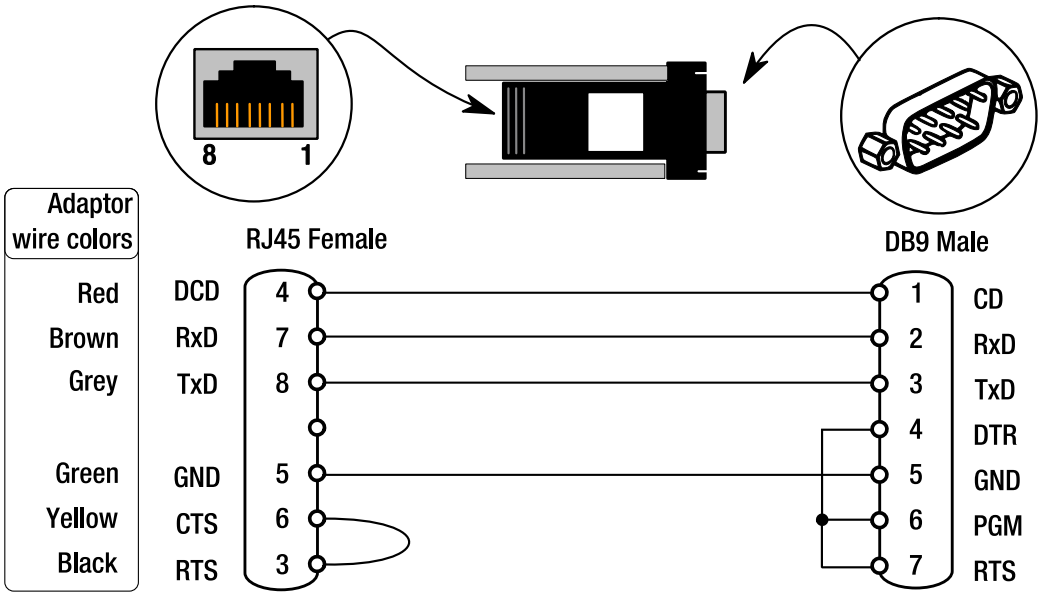


To Kingfisher Serial Port

To Operators Panel

ADP-16: Serial Port to Trio D-Series Radio or Trio E Series Radio

For example TC-450ER or TC-900DR.

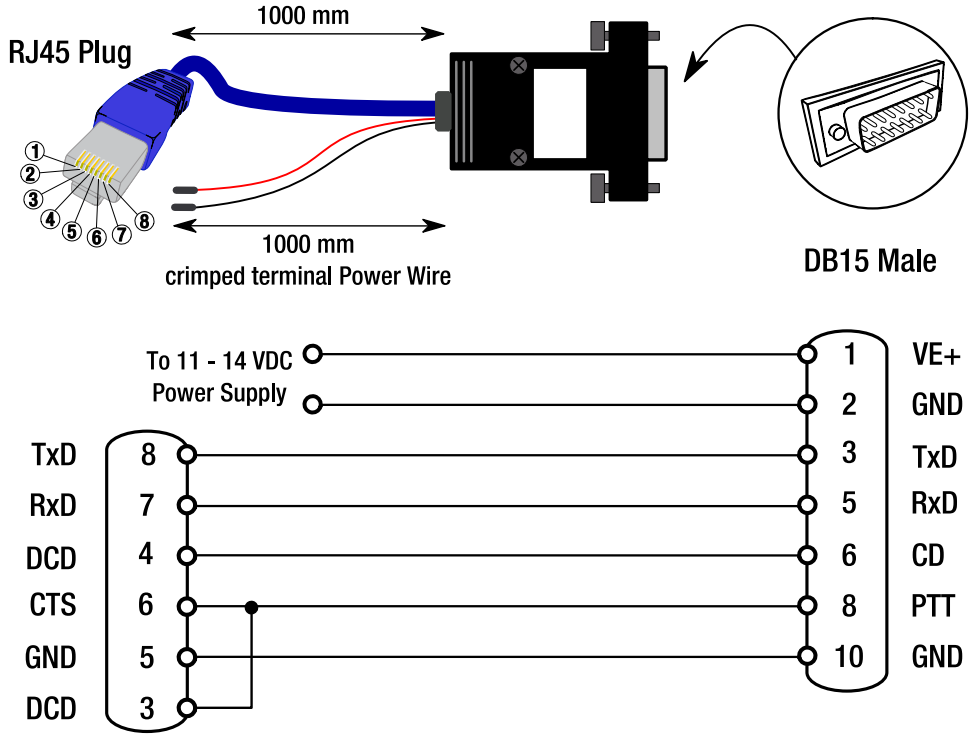


To Kingfisher Serial Port

To Trio Radio

RJC-ADP-17: PC-1/MC-1 Radio Port to Trio S- Series Radio

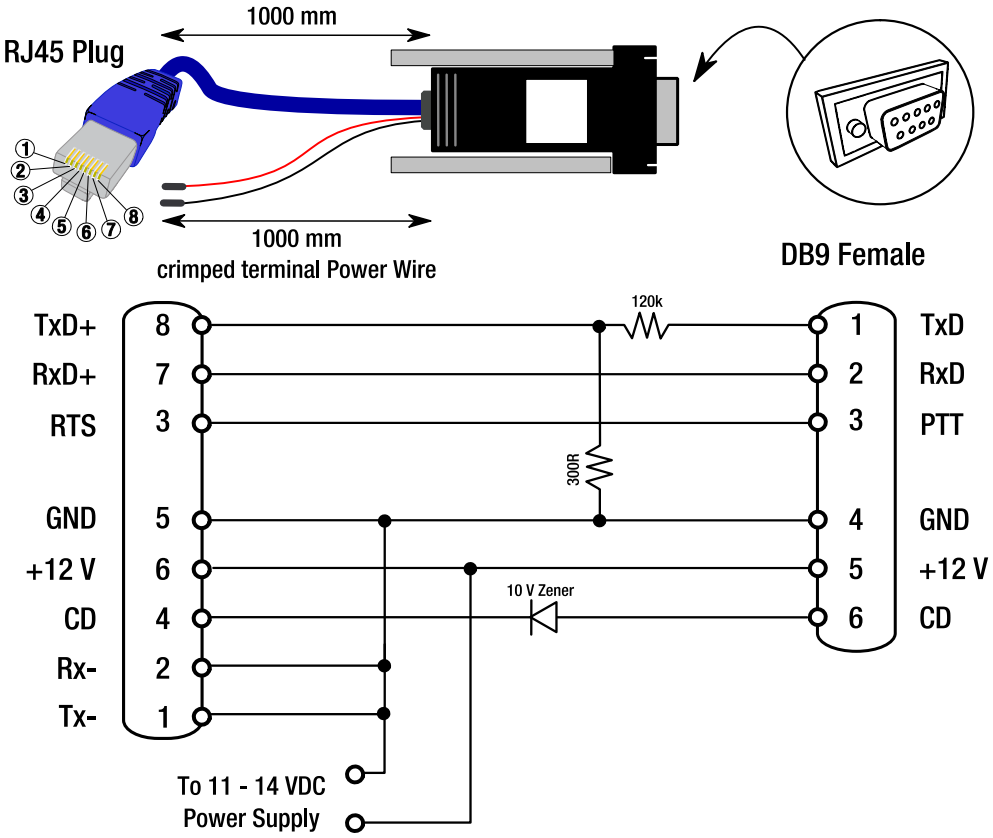
For TC-450SR, TC-900SR or RTU Serial Port to Trio S-Series Radio with 24/48SR modem.



To Kingfisher Serial Port

To Trio Radio

RJC-ADP-18: CP-xx Line Option Board to Maxon Analogue Radio (Maxon SD-125)

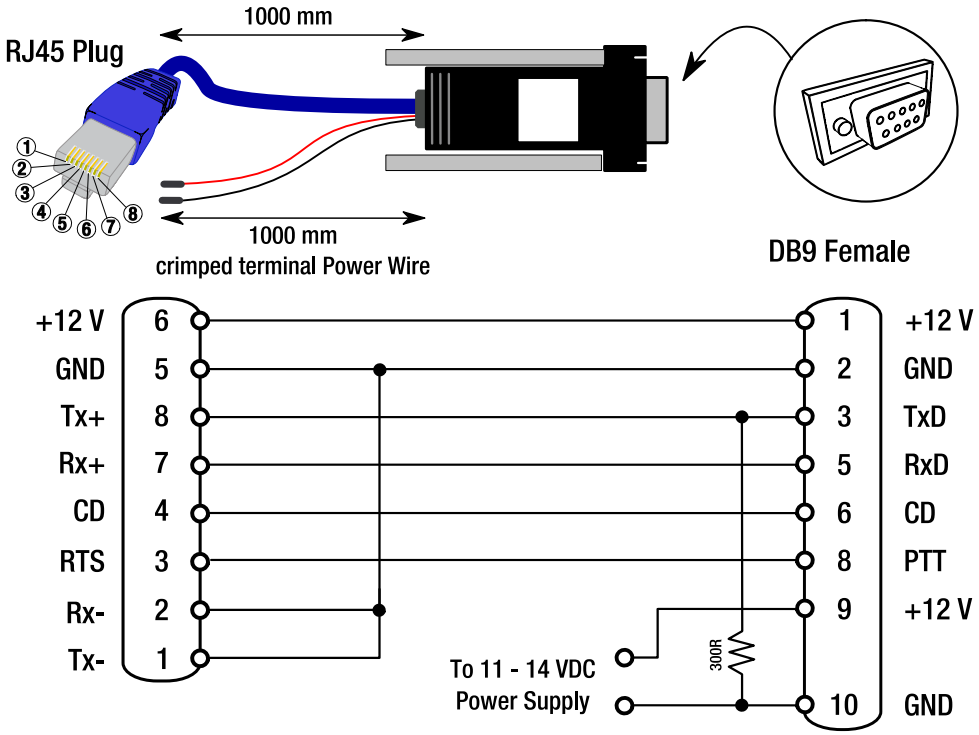


To Kingfisher Serial Port

To Maxon Radio

RJC-ADP-20: CP-xx Line Option Board to Trio S Series Analogue Radio

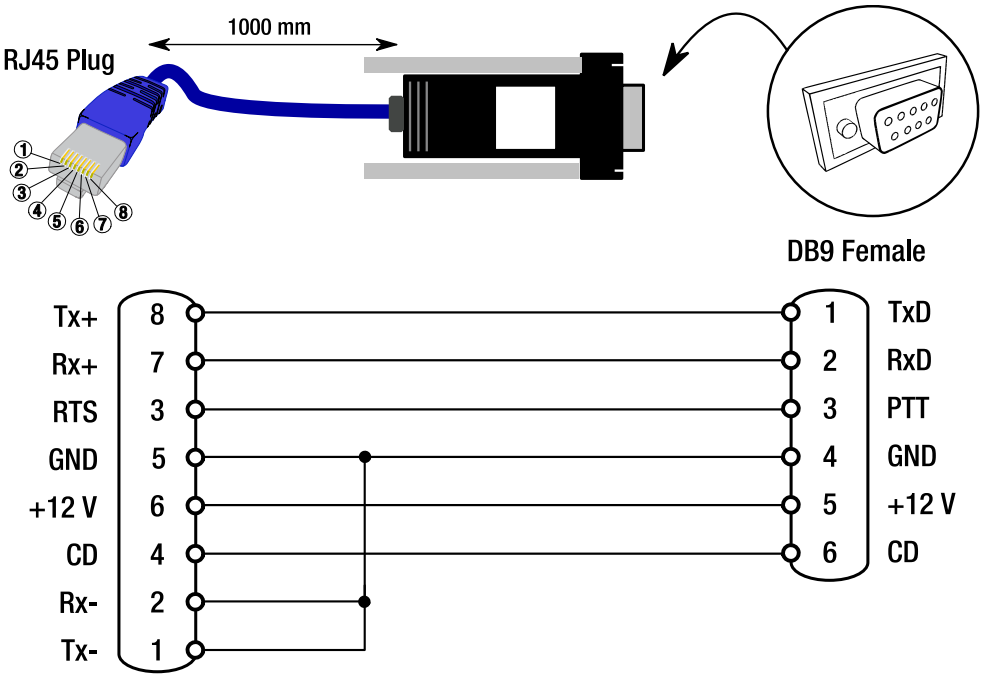
For use with TC-450SR or TC-900SR.



To Kingfisher Serial Port

To Maxon Radio

RJC-ADP-21: CP-xx Line Option Board to Tait T2010 Analogue Radio



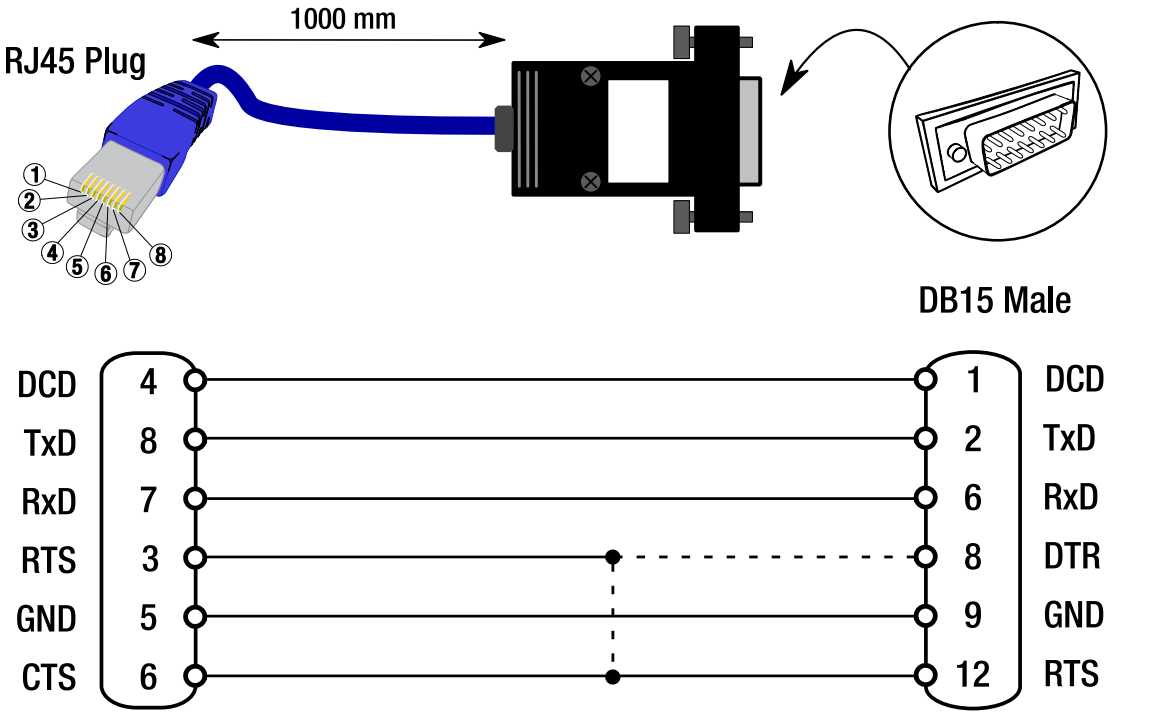
To Kingfisher Serial Port

To Tait Radio

RJC-ADP-22B: Serial Port to Wavecom GSM

For use with the WM02-G900, Fastrack, Fastrack Supreme, or Fastrack Xtend.

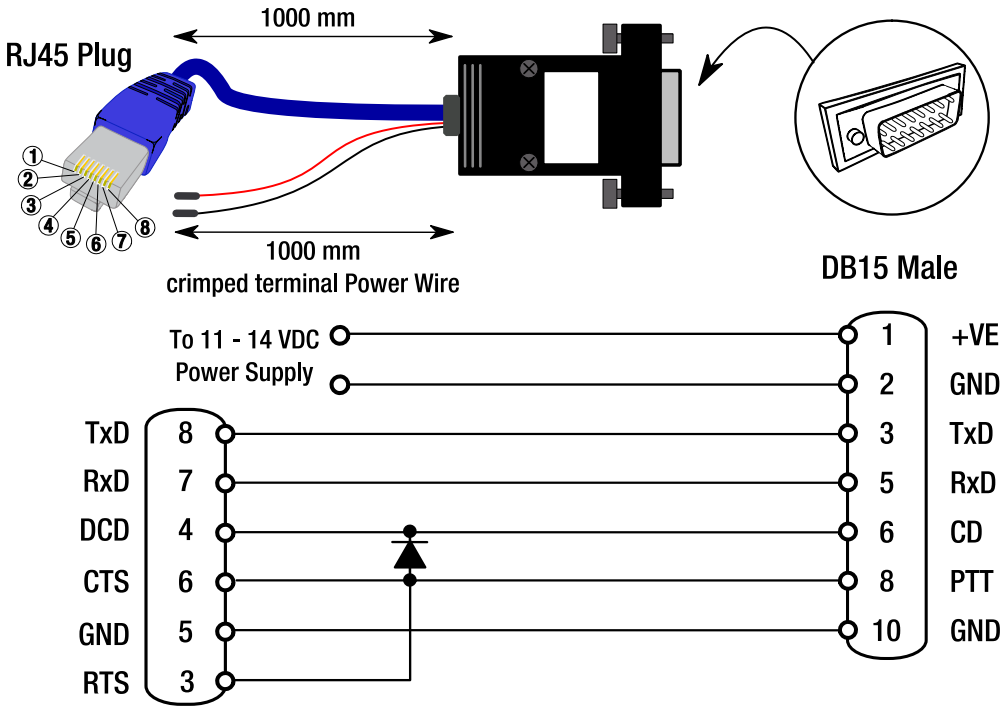
Note: Adds a RTS/DTR link to the previous RJC-ADP-22 cable. Link required for Fastrack Supreme. Link will also work with the older WM02-G900 and Fastrack modems.



To Kingfisher Serial Port

To GSM or GPRS Modem

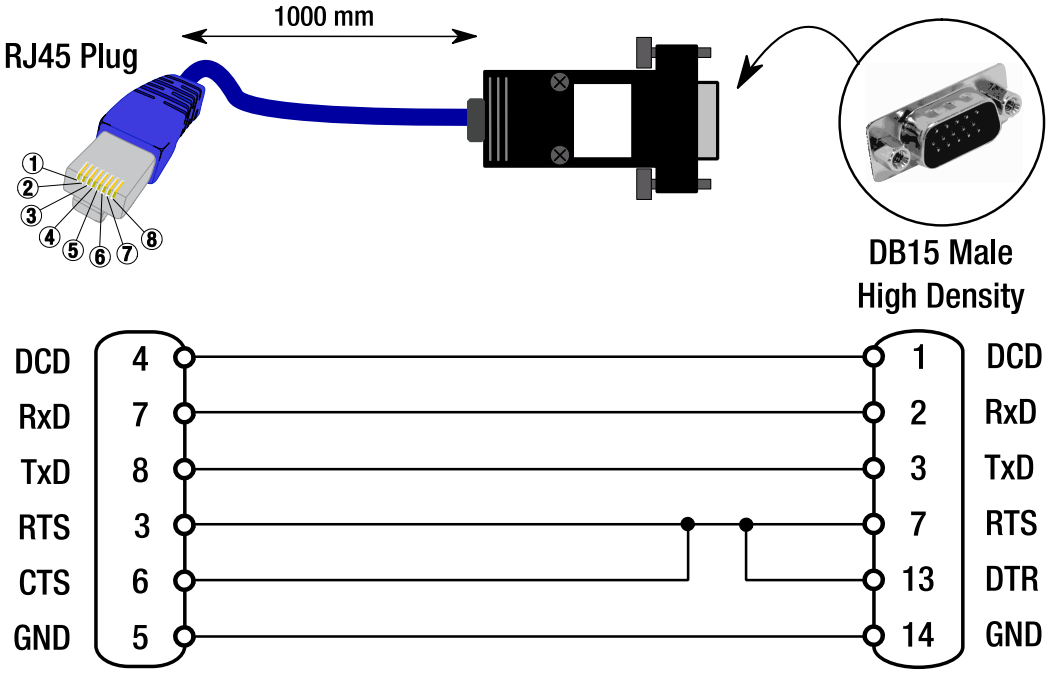
RJC-ADP-23: PC-1/MC-1 Radio Port/Serial Port to Trio S- Series (SB) Repeater



To Kingfisher Serial Port

To GSM or GPRS Modem

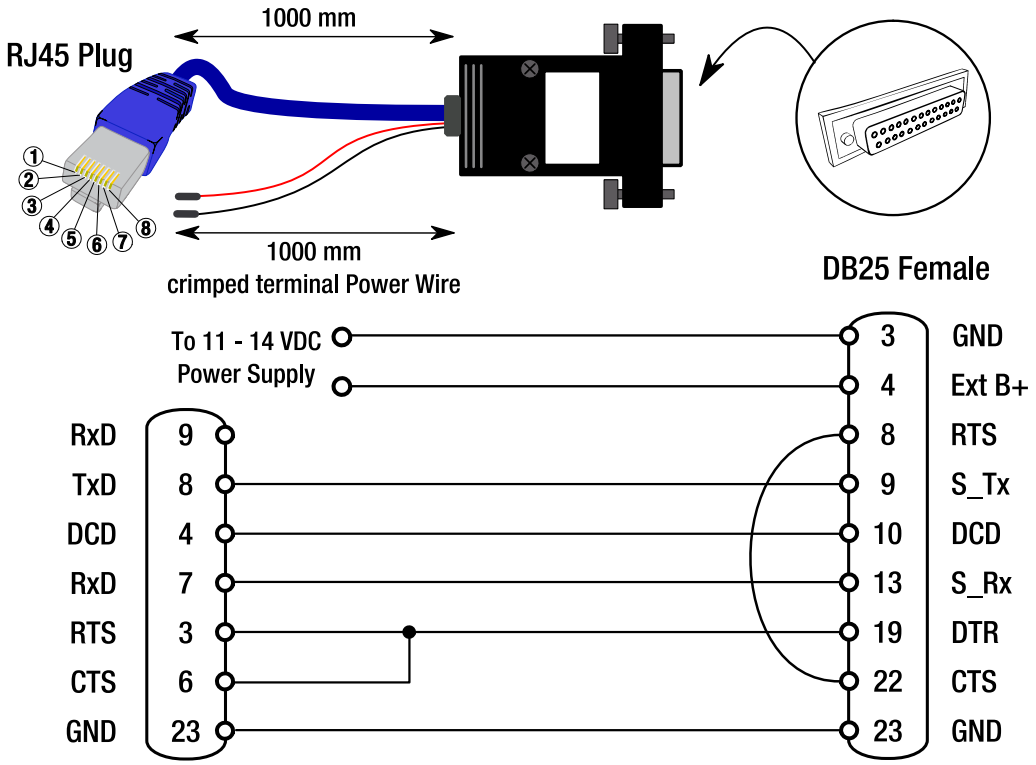
RJC-ADP-26: Serial Port to Maxon MM-6280IND 3G Data Modem (previously used for the Maxon MM-5100 CDMA Modem)



To Kingfisher Serial Port

To 3G Data Modem

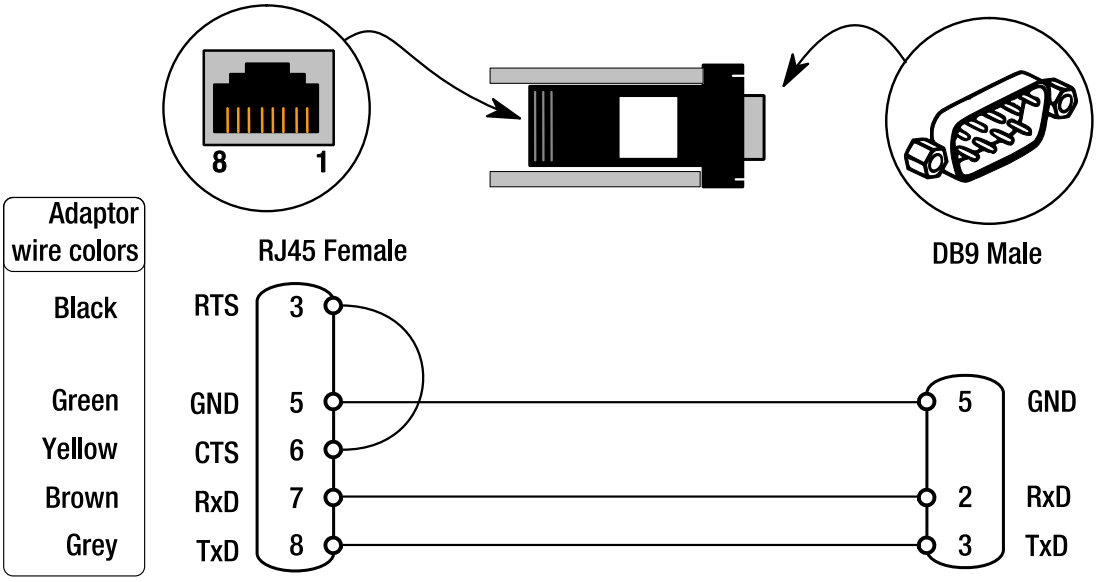
RJC-ADP-27: RTU Serial Port to Motorola 9522 Satellite Transceiver



To Kingfisher Serial Port

To Satellite Transceiver

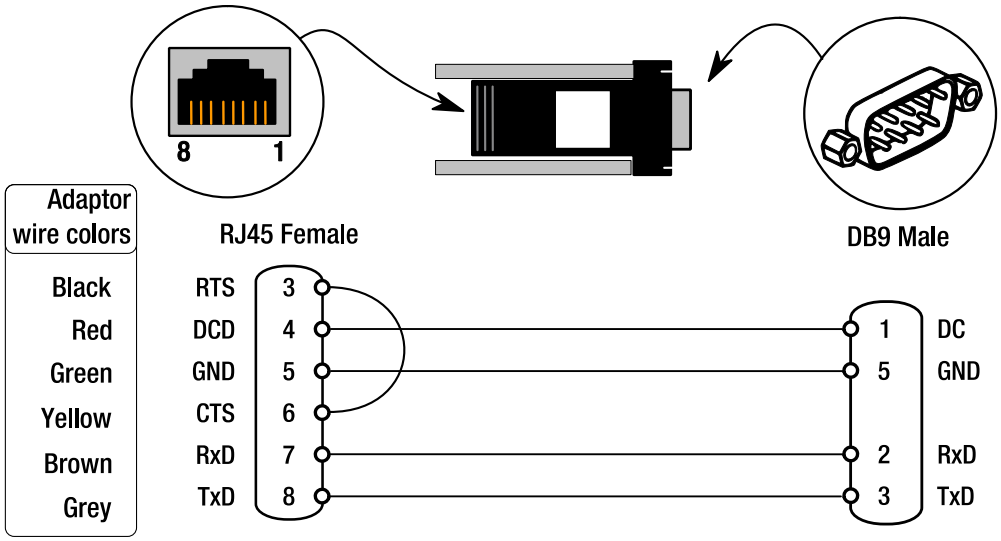
ADP-28: RTU Serial Port to Trio H–Series Spread Spectrum Radio



To Kingfisher Serial Port

To Trio Radio

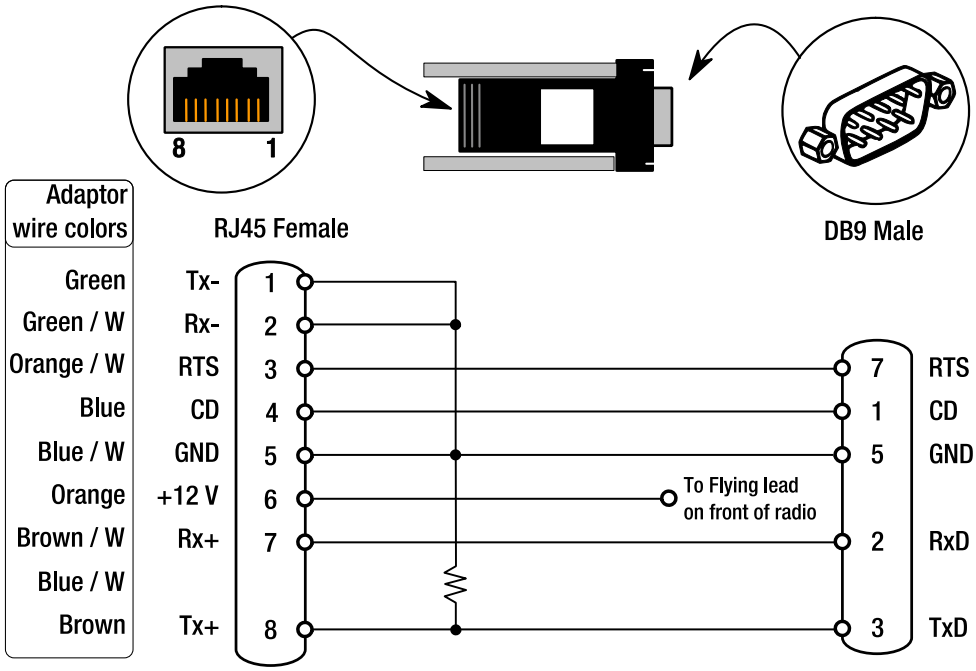
ADP-29: Serial Port to Trio M Series Radio (with modem fitted) E.g. MR540



To Kingfisher Serial Port

To Trio Radio

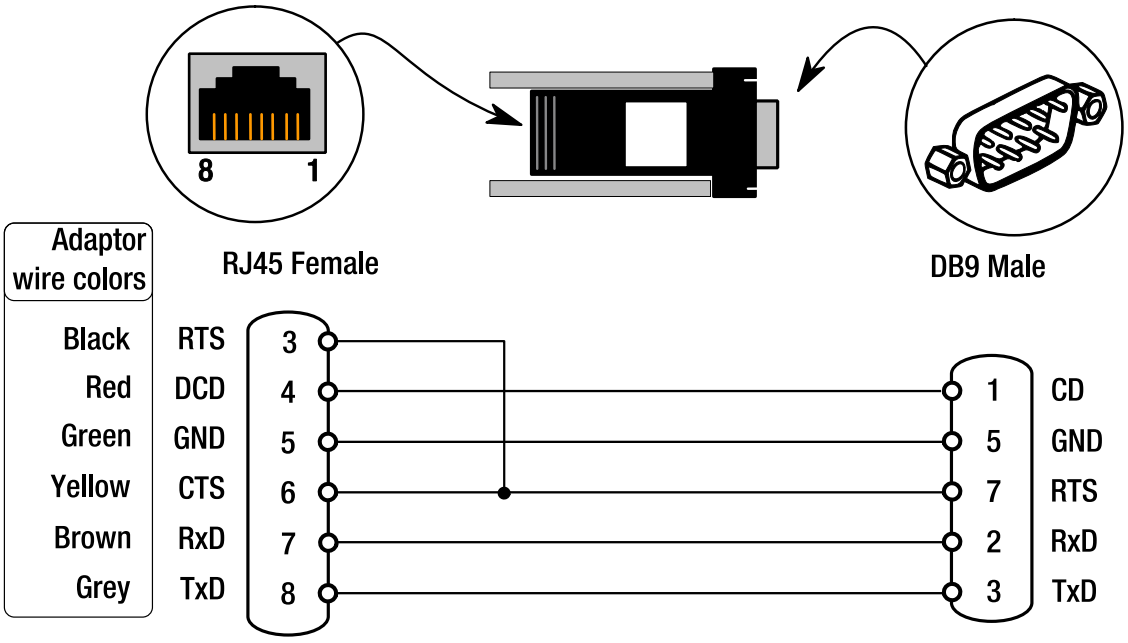
RJC-ADP-30: CP-xx Line Option Board to Trio M Series Analogue Radio (no modem fitted) E.g. MR540



To Kingfisher Serial Port

To Trio Radio

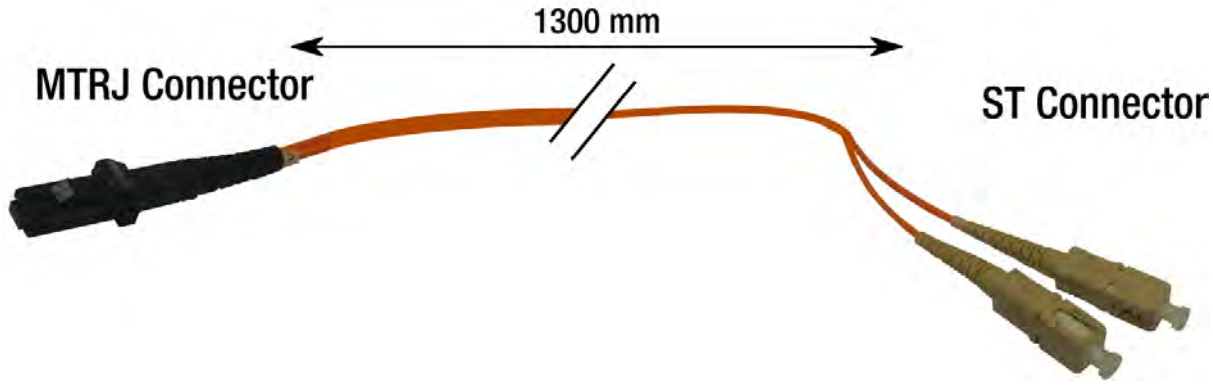
ADP-31: PC-1/MC-1 Radio Port to Trio M Series Analogue Radio (no modem fitted) E.g. MR540



To Kingfisher Serial Port

To Trio Radio

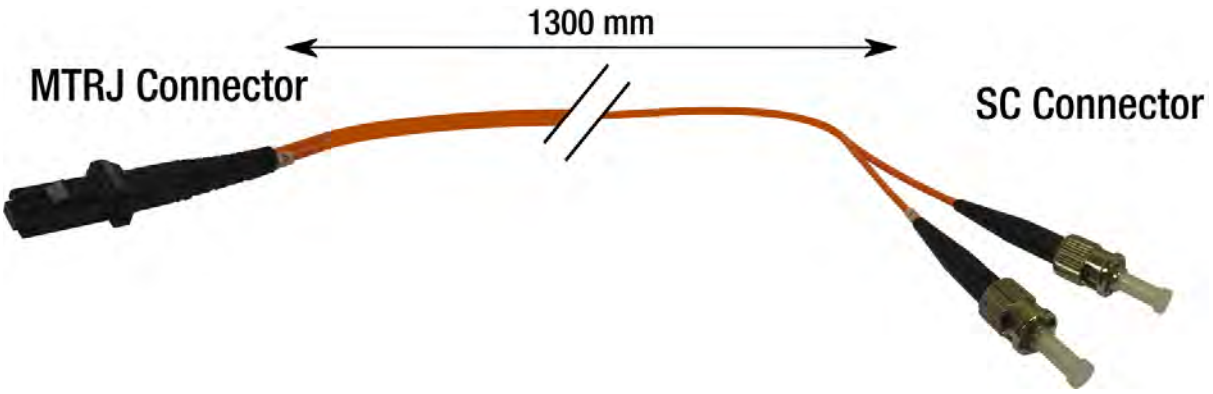
CAB-FO-PATCH-1: A3 Ethernet MTRJ Fibre Optic to 2 × ST adaptor cable



To Kingfisher A3 Option Board

To external Device

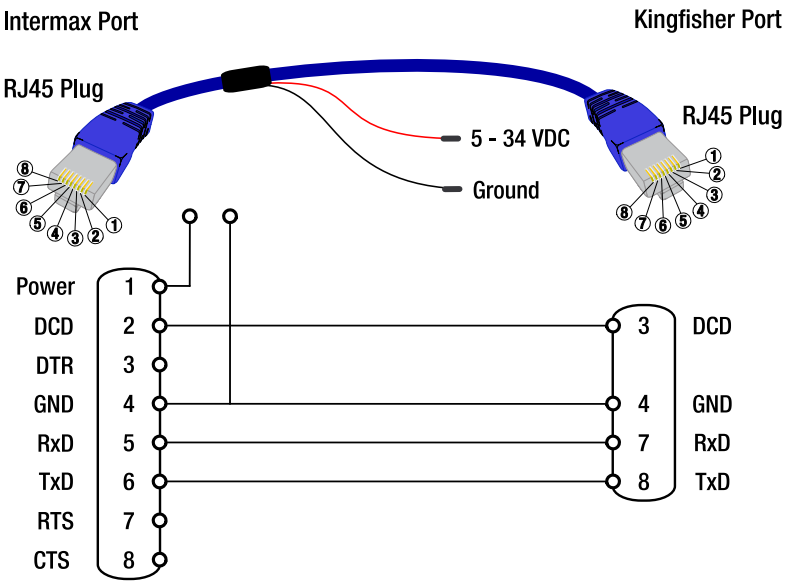
CAB-FO-PATCH-2: A3 Ethernet MTRJ Fibre Optic to 2 × SC adaptor cable



To Kingfisher A3 Option Board

To external Device

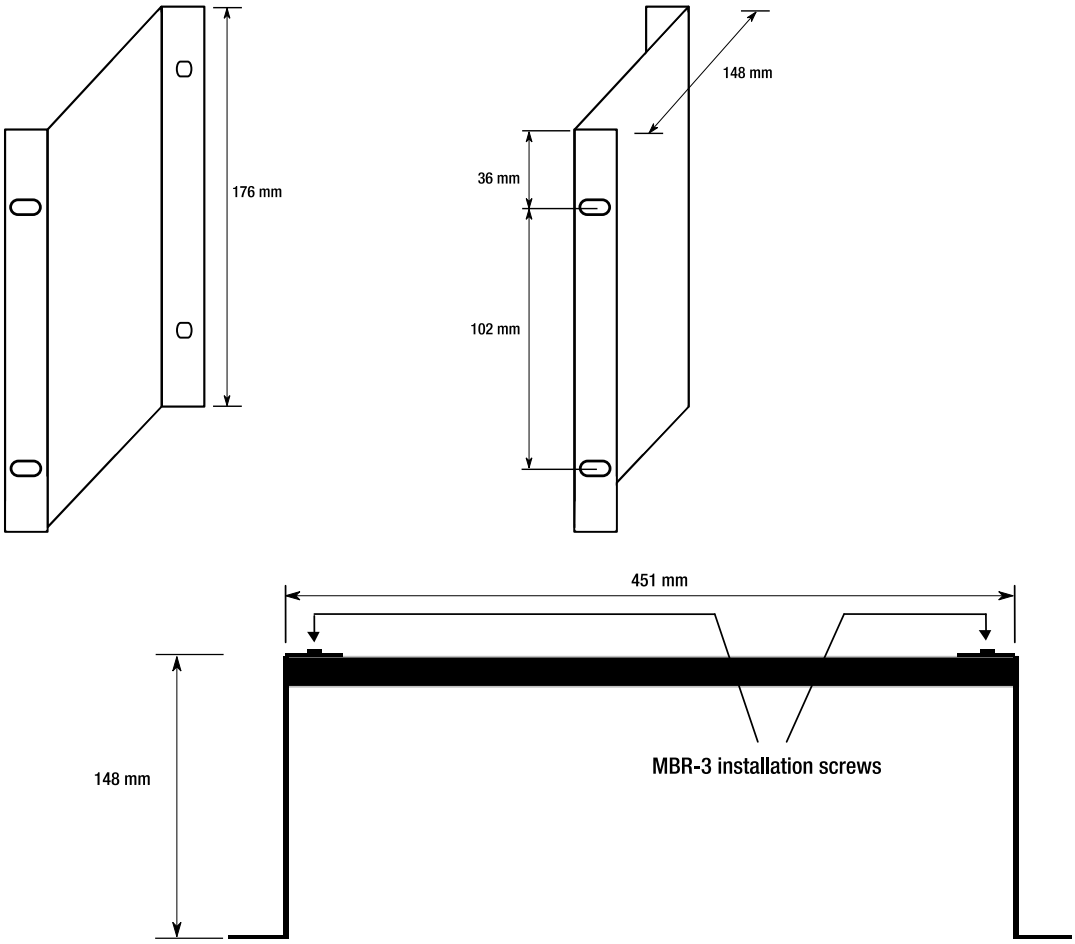
Maxon Intermax Serial Modem to Kingfisher Serial Port



16. Accessories

Accessories are available that can ease the installation of your RTU. These include rack mounting hardware and battery carrier mounts.

MBR-3: 19" Rack Mounting for BA-12

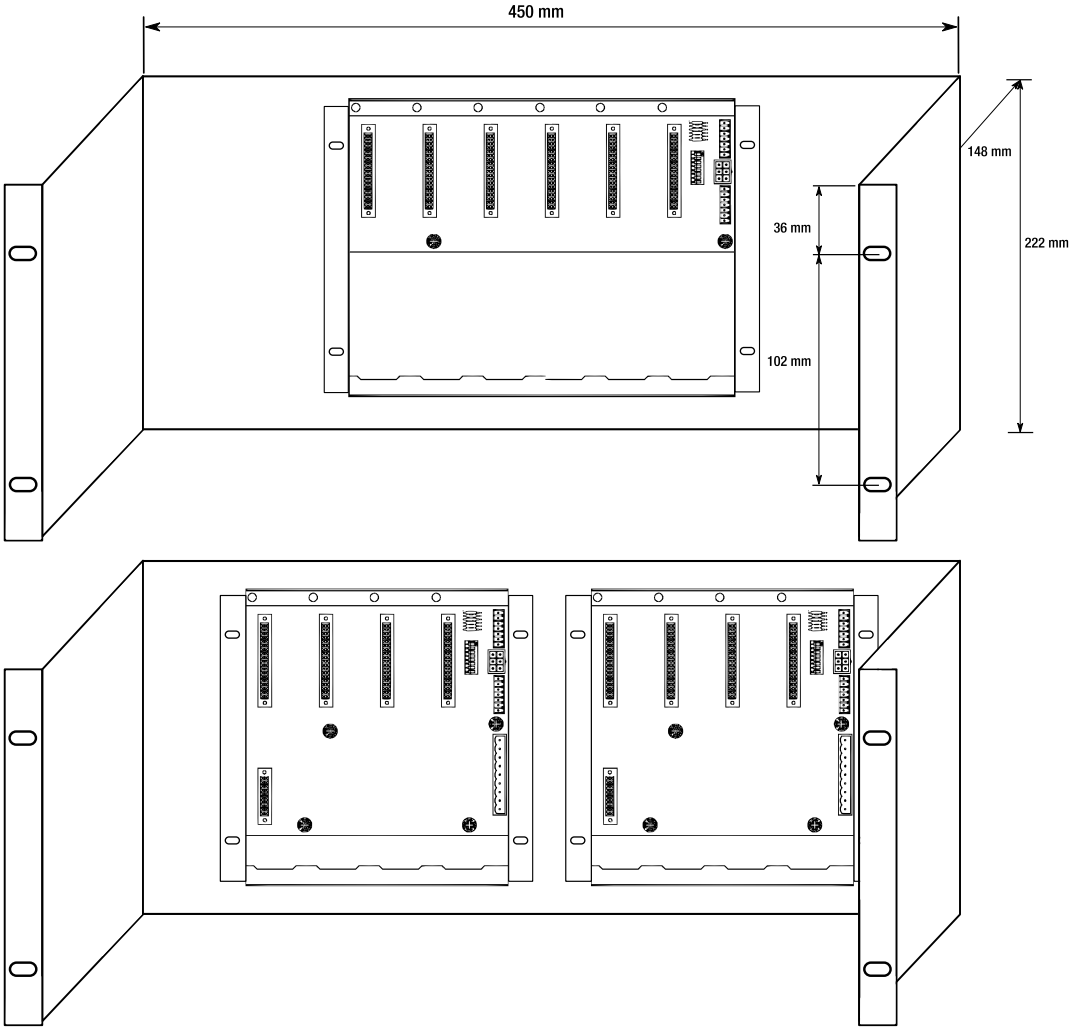


A 12 slot backplane (BA-12) is mounted in a 19 inch rack using two MBR-3 mounting brackets. The MBR-3 brackets replace the surface mount brackets supplied with BA-12 backplanes. Each pair of MBR-3 brackets is supplied with four M4 x 6 mm pan head screws.

Installation Note: The holes in the MBR-3 brackets that are used to attach the brackets to the back of the backplane are drilled oversize to accommodate slight variances in racking equipment. By loosening these screws, pushing the brackets toward the centre of the backplane and then re-tightening the screws, the unit will fit freely into any correctly sized 19-inch rack.

TEL-RAK-002: 19” Rack Mounting for BA-3/6/40

A four slot backplane (BA-4 or BA-40) or a six slot backplane (BA-6) is mounted in a 19 inch rack using a TEL-RAK-002 mounting bracket. One BA-6 or two BA-4/BA-40 backplanes can be attached to the TEL-RAK-002 using the surface mount brackets supplied with each backplane. The TEL-RAK-002 is supplied with eight M3 x 5 mm screws for attaching the backplane(s).



Battery Bracket: 7 AH: 7 AH Battery Mounting Bracket

When using a 7 AH backup battery, a standard battery holder is available for mounting on an enclosure gear plate. The bracket supports the battery and allows a General Power Outlet (GPO) to be mounted on the front using M3 x 10 mm pan head screws. The battery holder also allows an ISB50LN lightning arrestor to be mounted underneath.



17. Glossary

AI, AO, DI, DO	Analogue Input, Analogue Output, Digital Input and Digital Output respectively
Byte	A group of 8 bits. Each bit can be a 0 (off) or a 1 (on) allowing up to 256 combinations.
Comms	Communications
Current Sinking	Current is supplied into the RTU's IO terminal.
IO	Input, Output
IP	Internet Protocol. Used for Ethernet communications.
Port	A physical connection or socket on an RTU used for communications
Processor Module	Processor module containing a CPU (central processing unit)
Protocol	Refers to the format of messages that may be passed to, from and through an RTU in communication with local and remote devices. Communications may use one or more RTU ports. Examples of protocols used within telemetry include Kingfisher, Modbus and DNP3.
RTU	Acronym for Remote Terminal Unit. Describes a group of processor, communications and IO modules that comprise a device for monitoring and control of equipment in remote locations.
TCP/IP	Transfer Control Protocol / Internet Protocol. Commonly used for Ethernet communications.
UDP	User Datagram Protocol.

18. Appendix

Superseded items are not present in this hardware manual.

For information regarding any modules not present in this document please refer to the **Superseded Hardware Manual** available on MyKingfisher.

Technical Support

Explanatory Notes

Lightning Protection



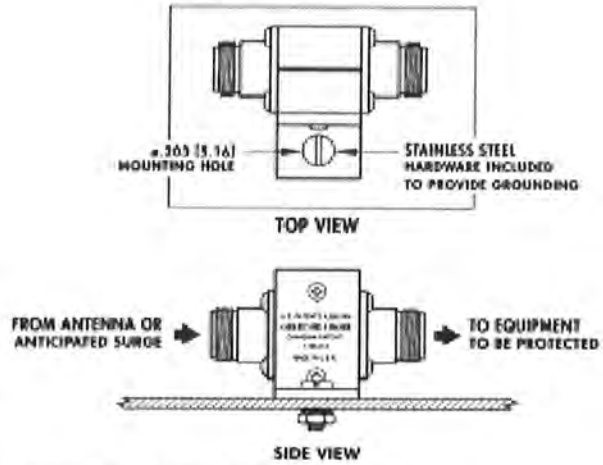
Lightning damages equipment at radio communications sites every day. Although lightning is a DC pulse, the time from zero current to peak current can be very fast. When lightning energy travels through a coaxial cable, there is a slight propagation delay that occurs due to the unbalanced inductances of the shield and centre conductor, and the centre conductor's capacitive relationship through the dielectric to the shield. The higher-frequency shield energy will arrive at the equipment first, followed by the centre conductor energy. Since the pulse energy arrives at different times, a differential voltage occurs. A properly designed coaxial protector equalises this potential difference, which prevents current flow and therefore damage to the site's equipment.

However, the choice of a standard gas tube type coaxial protector without DC blocking may not offer the user complete protection. The fast rise-time lightning pulse can produce over 1000 Volts across the gas tube before the gas can ionise and become conductive. Since there is no DC blocking mechanism, this high voltage is applied directly to the equipment input before the gas tube turns on.

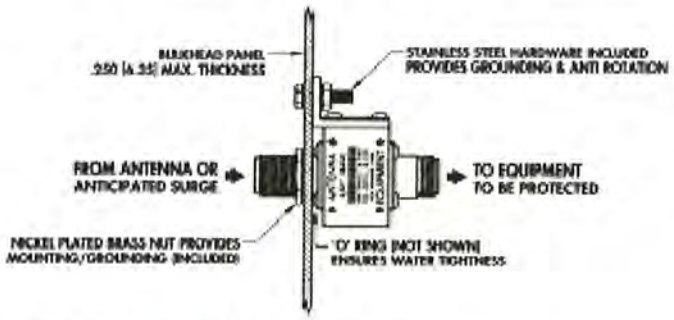
A quarter wave stub coaxial protector creates a band-pass filter, at a frequency determined by the length of the quarter wave coaxial section from the horizontal centre conductor to the grounded base. However, if the equipment input is DC-shorted, the quarter wave stub can allow significant divided DC and low frequency energy to flow towards the equipment input.

A "DC blocking mechanism" inside the protector (no DC continuity through the protector) will prevent harmful levels of throughput energy from reaching the equipment. RFI stocks and distributes the patented PolyPhaser DC-blocked coaxial protector line, which has the lowest throughput specifications in the industry. There is also a series of PolyPhaser coaxial protectors that block DC in the RF path to the equipment, and either inject, pass through, or pick off a specified DC voltage on the feeder's coaxial cable centre conductor. This series of protectors is particularly suited to applications requiring DC to be passed up the coaxial feeder cable to power tower-top amplifier electronics.

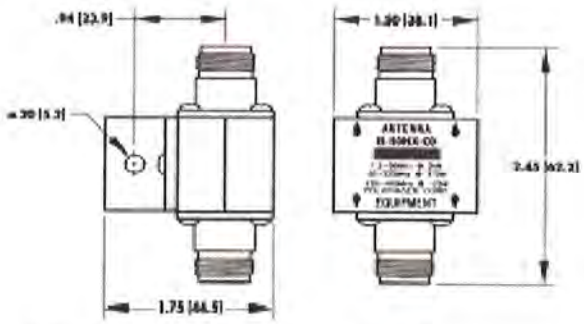
Remember that no matter how good your lightning protector is, it's not a fuse. It still needs to be correctly installed and connected to a suitable grounding system. RFI offers a complete range of products to protect your system, including the coaxial protector, grounding rods, copper strapping and grounding kits for the feeder cables.



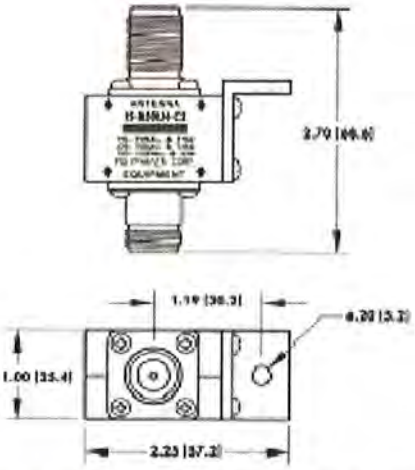
Mounting Configuration, flange mount models



Mounting Configuration, bulkhead mount models



Product Dimensions, IS-50NX-CO, flange mount



Product Dimensions, IS-B50NX-C2, bulkhead mount

IS-B5OHN-CO
Throughput Energy: ≤20mJ* (N Connector/ Bulkhead)
Frequency Range: 1.5 MHz to 400 MHz
Max Power: HF 3kW, VHF 500W, UHF 250W

IS-B5OLN-C1
Throughput Energy: ≤600µJ* (N Connector/ Bulkhead)
Frequency Range: 50MHz to 700MHz
Max Power: VHF 375W, UHF 125W

IS-B5OHN-C1
Throughput Energy: ≤1mJ* (N Connector/ Bulkhead)
Frequency Range: 50 MHz to 700 MHz
Max. Power: VHF 500W, UHF 250W

IS-B50LN-C2
Throughput Energy ≤220µJ* (N Connector/ Bulkhead)
Frequency Range: 125MHz to 1000MHz
Max. Power VHF 375W, UHF (low) 125W
900MHz to 1GHz 50W

IS-B50HN-C2
Throughput Energy: ≤800µJ* (N Connector/ Bulkhead)
Frequency Range: 125MHz to 1000MHz
Max. Power: VHF 500W, UHF (low) 250W
800MHz to 1GHz 125W

IS-B50UX-CO
Throughput Energy: ≤10mJ* (UHF Connector/ Surface)
Frequency Range: 1.5MHz to 400MHz
Max. Power: HF 2kW, VHF 375W, UHF 125W

IS-50UX-C1
Throughput Energy: ≤600µJ* (UHF Connector/ Surface)
Frequency Range: 50 MHz to 700 MHz
Max Power: VHF 375W, UHF 125W

IS-50NX-CO
Throughput Energy: ≤10mJ* (N Connector/ Surface)
Frequency Range: 1.5MHz to 400MHz
Max Power: HF 2kW, VHF 375W, UHF 125W

IS-B50NX-C1
Throughput Energy: ≤600µJ* (N Connector/ Surface)
Frequency Range: 50 MHz to 700 MHz
Max. Power: VHF 375W, UHF 125W

IS-B5ONX-C2
Throughput Energy ≤220µJ* (N Connector/ Surface)
Frequency Range: 125MHz to 1000MHz
Max. Power VHF 375W, UHF (low) 125W
800MHz to 1GHz 50W

IS-75F-C1
Throughput Energy: ≤1mJ* (F Connector/ Surface)
Frequency Range: 4MHz to 900MHz VSWR ≤1.2:1
Max. Power: HF 100W, VHF 100W, UHF 25W

Add suffix - MA for male antenna port connector
Add suffix - ME for female antenna port connector

DOC REF:PB36328-1

miri technologies | AD2006 Telemetry Module

AD2006 TELEMETRY MODULE
QUICKSTART MANUAL



This manual is intended to provide sufficient information for the correct installation of your AD2006 telemetry module. In most cases, your AD2006 module will be delivered pre-configured to your project requirements. For programming information please refer to the MiriMap 2000+ Software on-line help.

PLEASE ENSURE THAT YOU HAVE THE CORRECT POWER SUPPLY VOLTAGE BEFORE POWERING UP THE MODULE.

Rev. August 2009

AD2006 Ordering Information

There are many variations of the AD2006 telemetry modules available. The following shows the ordering code and details for modules with and without internal data radios. For other radio or modem options please contact Miri Technologies directly.

The following options are not fitted as factory standard and need to be requested when ordering : -

4 Channel Analog Ouput option
Ethernet Port option

If you are ordering a module to add to an existing system, please be sure to specify the project when ordering the new module.

ORDERING

Part No. AD2006Tx-aaabb-xx-xx

Add 'T' for Ethernet Option
Otherwise leave blank

12 - for 12VDC supply.
24 - for 24VDC supply.

N - for no analog output option.
A - for analog output option fitted.

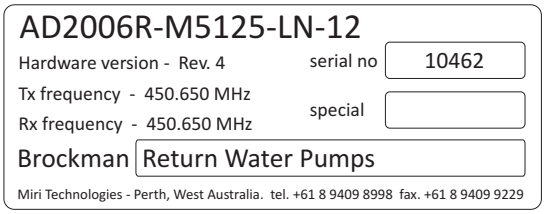
L - for low voltage digital inputs 10 - 35V
H - for hi voltage digital inputs 70 - 130V

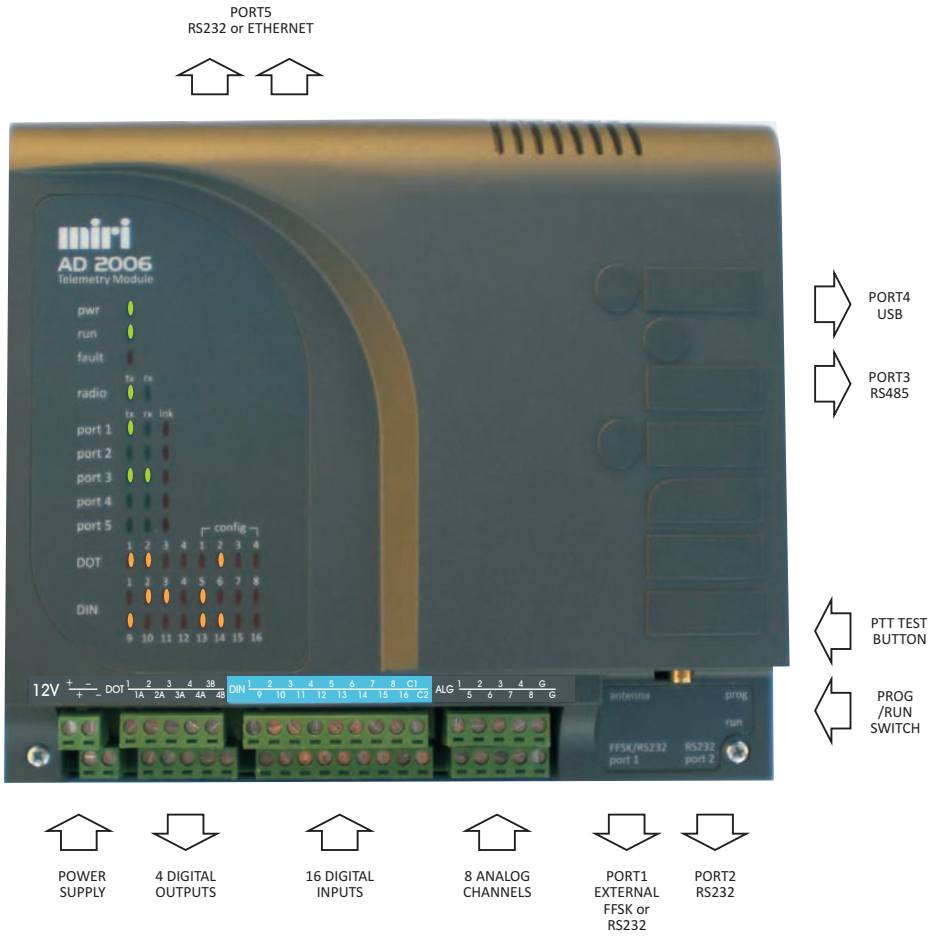
12 - 12.5kHz Channel
25 - 25kHz Channel
SS - Spread Spectrum

Radio Type :
J02 VHF 138 - 174MHz (12.5KHz only)
J51 UHF 450 - 470MHz (12.5KHz only)
M50 UHF 395 - 465MHz
M51 UHF 450 - 520MHz
90 900MHz Spread Spectrum
24 2.4GHz Spread Spectrum

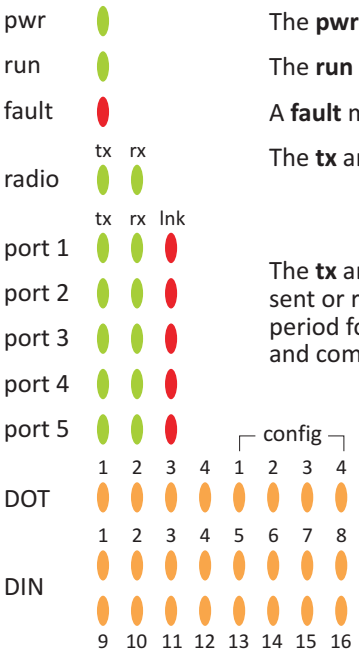
R - with inbuilt radio
E - for external radio

The AD2006 part number is displayed on the rear of each unit together with other relevant information.





DISPLAY PANEL



The **pwr** LED should be on at all times when the unit is powered up.

The **run** LED should flash at 2Hz when the unit is in RUN mode and 4Hz in PROG mode.

A **fault** means that the module has received a bad reply to a message.

The **tx** and **rx** LEDs reflect the PTT and CD status of the internal radio.

The **tx** and **rx** LEDs for each port indicate that a valid system message has been sent or received on that port. A **link** indication means that the slave time-out period for that port has lapsed or the programmed number of retries have failed and communications have been lost.

The first four LEDs indicate that the physical outputs are active. The second four LEDs are programmable status indications.

These LEDs indicate that a particular input is active.

miri technologies | AD2006 Digital I/O

DIGITAL INPUTS

There are two different versions of the AD2006 module with respect to Digital Inputs. There is a low voltage version for nominally 12 or 24 volt inputs, and a high voltage version specifically for 110 volt inputs.

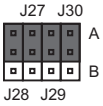
AD2006L - Lo Voltage	10-35VDC/AC	4k7 Impedance
AD2006H - Hi Voltage	70-130VAC/DC	27k Impedance

This is not an on-board selectable option so please ensure that you have the correct version of hardware for your application. The digital input voltage is marked on the terminal strip label with the Lo voltage inputs being highlighted in blue and the Hi voltage inputs being highlighted in orange.
The digital inputs are supplied in two blocks of 8 inputs each with a separate common terminal. The inputs will accept an AC input voltage or a DC voltage of either polarity .

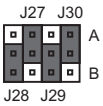
PULSE COUNTERS

Each Digital Input may be used as a pulse counter up to 5Hz. The first two inputs can be configured as high speed pulse counters up to 5KHz equal (mark space ratio). Where the inputs are used as slow counters (to 5Hz.) the inputs are usually referred to the digital input common. Where the fast pulse counters are used, the inputs are referred to the module 0V supply (ground). They will then accept inputs from common emitter transistors, FETs or reed switches etc. as shown below.
The factory default setting is for all inputs to be configured as digital inputs/slow counters. The following jumper settings apply where inputs 1 and 2 are required to be fast counters.

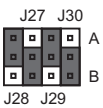
All inputs DINs (factory default)

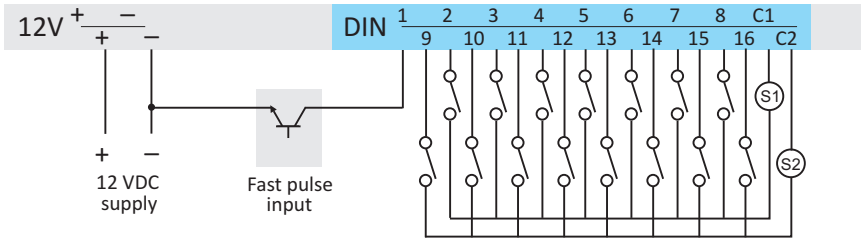


DIN1 - Fast Pulse



DIN2 - Fast Pulse

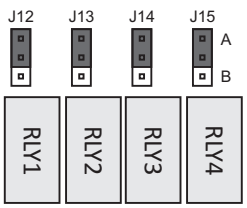


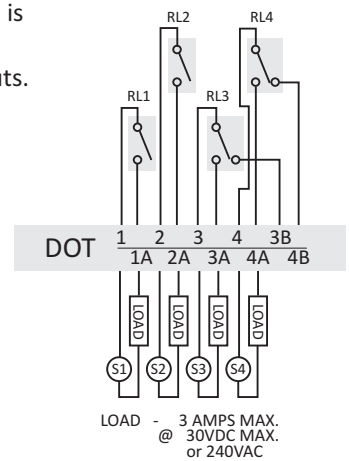


DIGITAL OUTPUTS

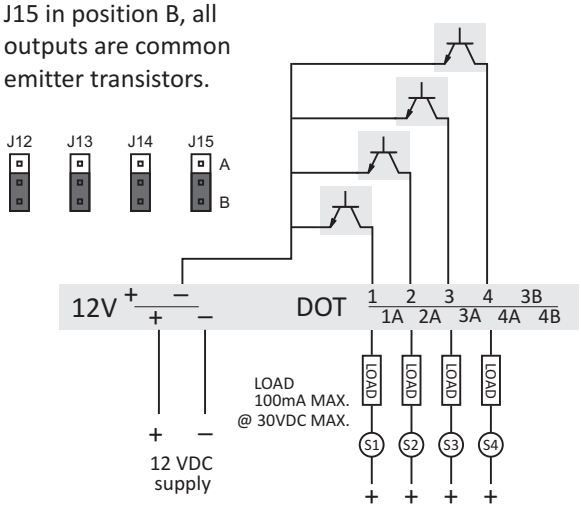
Each Digital Output may be individually configured as an isolated relay or common emitter transistor.

With all jumpers J12 - J15 in position A the module is configured for 2 form A and 2 form C relay outputs. (factory default)





With all jumpers J12 - J15 in position B, all outputs are common emitter transistors.



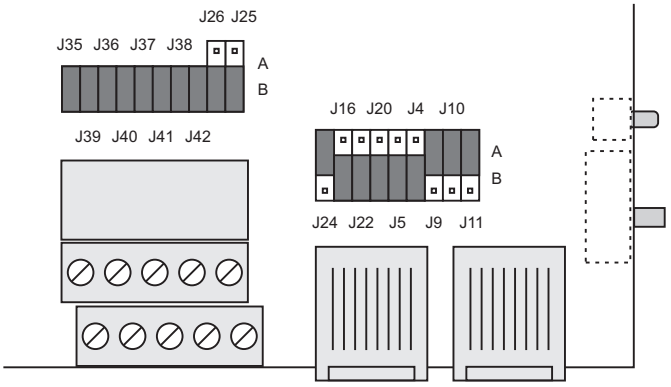
AD2006 Analog Options

The AD2006 module has 8 analog input channels as standard. These are configured from the factory as 4-20mA/1-5V. The following options are available by jumper selection :-

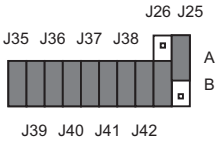
A. 0-20mA/0-5V
B. 4-20mA/1-5V
C. 0-1V

Whichever option is selected determines the configuration of **ALL** analog input channels. Channels 1 to 8 are configured for current or voltage inputs via jumpers J35 to J42 respectively. If a jumper is installed in the appropriate location then that channel will operate as a current input. If no jumper is installed, it will operate as a voltage input.

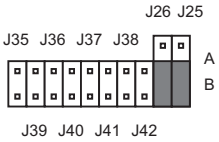
FACTORY DEFAULTS - All channels set to 4-20mA



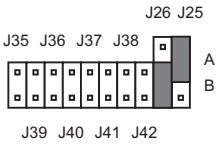
All input channels 0-20mA



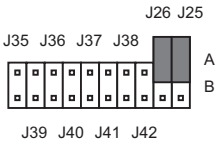
All input channels 1-5V



All input channels 0-5V



All input channels 0-1V



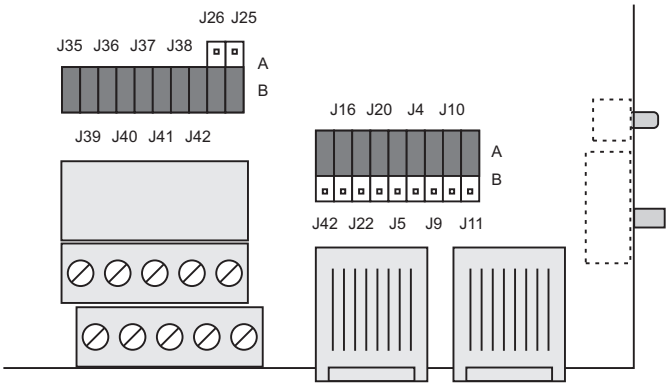
OTHER OPTIONS

POWER SUPPLY MONITOR - Analog Input channel 8 is set by factory default to monitor the supply voltage to the telemetry module. This is particularly useful in solar powered installations. If channel 8 is required as a normal analog input channel then J24 is moved from position A to position B.

VOLTAGE SOURCE FOR FIELD SENSORS - Analog input channel 8 can be configured as a 5V source to power field sensors to a maximum current supply of 20mA. To select this option, install jumpers in J16 position B and J22 position A.

ANALOG OUTPUT OPTION - An analog output board must be installed to utilise this option. This is a factory fitted option. When the analog output option is installed, any of the last four channels can be configured as 4-20mA outputs.

ANALOG OUTPUTS - Channels 5-8 configured as outputs



Channels 5 to 8 are selected as 4-20mA outputs by way of locating jumpers in position A as follows :-

Ch.5 J4
Ch.6 J5
Ch.7 J20
Ch.8 J22 and J16

Note - If channel 8 is configured as an analog output, analog input 8 will still operate as a supply voltage monitor, provided that J24 is selected in position A.

Note - J9, J10 and J11 are not relevant to the analog channel options.

miri technologies | AD2006 Serial Ports

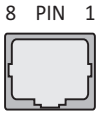
PORT 1 - EXTERNAL RADIO - FFSK or RS232

Port 1 is intended for connection to an external data radio and provides either FFSK or RS232 options.
The FFSK is configurable to 4800 baud. The RS232 option can operate up to 115,200 baud.
The on-board selectable options are detailed on the following page of this manual.

External Radio Port
Pin assignment

1.	n/c
2.	RTS
3.	TX data
4.	PTT
5.	GND
6.	RX data
7.	CTS
8.	CD

View looking into ext. radio port.



PORT 2 & PORT 5 - RS232

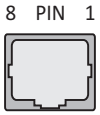
Port 2 and Port 5 can both be used for connection to third party devices via RS232.
Each port can operate up to 115,200 baud.
The on-board selectable options are detailed in the following page of this manual.

NOTE : Port 5 cannot be used as an RS232 port if the Ethernet connection is being used.

External RS232 ports
Pin assignment

1.	DTR
2.	RTS
3.	TX data
4.	PTT
5.	GND
6.	RX data
7.	CTS
8.	DSR

View looking into RS232 ports.



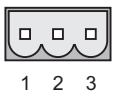
PORT 3 - RS485

Port 3 is an RS485 port intended for use as a multidrop serial connection for I/O expansion modules or third party devices. It can run either Miri protocol or Modbus.

External RS485 port
Pin assignment

1.	DATA B
2.	DATA A
3.	GND

View looking into RS485 port.



PORT 4 - USB-B

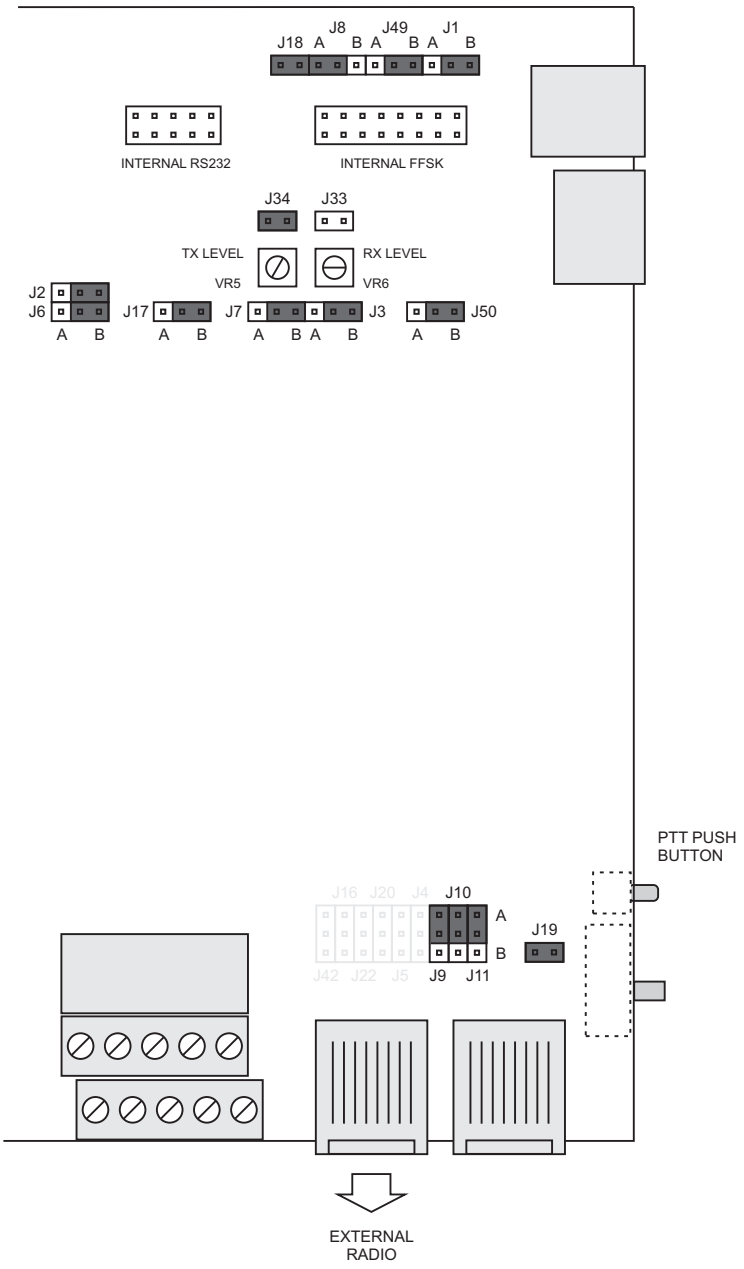
This port is intended for use as a programming port.

PORT 5 - Ethernet Option

The Ethernet port is a factory fitted 10/100T option which can run either Modbus TCP or Miri protocols.
Note that where the Ethernet port is used, Port 5 cannot be used as an RS232 port.

miri technologies | AD2006 Radio Communications Options

FACTORY DEFAULTS - Internal radio - 2400 baud.

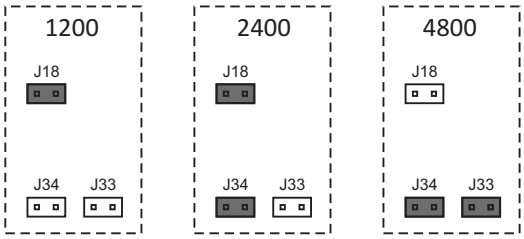


There are a number of radio options available for the AD2006 modules. Some of these use audio (FFSK) modulation, whereas others have an RS232 interface. The above jumper configuration is applicable to both VHF and UHF internal radios. If an audio (FFSK) external radio is to be used with the module, this is implemented using Port1. Ports 2 and 5 are available for RS232 connections.

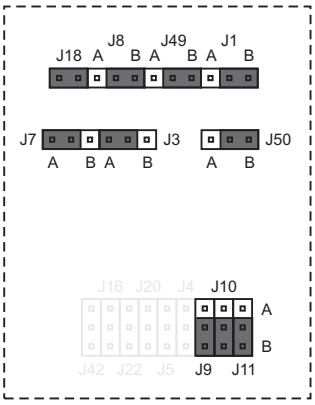
There is a PTT push button located under the bottom right hand corner of the module. This is intended to be used to check the SWR of antenna installations during commissioning.

FFSK BAUD RATE OPTIONS - The jumper arrangement shown is the factory default configuration for an internal radio operating at 2400 baud.

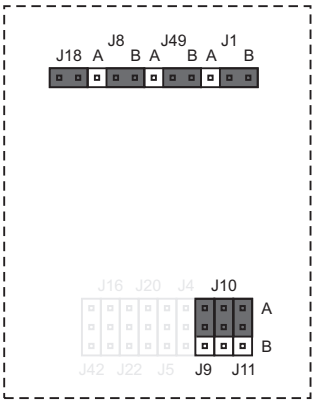
Other options are achieved by implementing the following changes to J18, J33, J34.



FFSK EXTERNAL RADIO - To configure the module for an external audio radio, make the following changes to J1, J3, J7, J8, and J9, J10, J11.



RS232 EXTERNAL RADIO CONNECTION - To configure the module for an external RS232 radio port, jumpers J1, J9, J10, J11 should be set up as follows :-



NOTE - The above configuration is the factory default configuration and so it may not be necessary to move any jumpers to implement this mode.

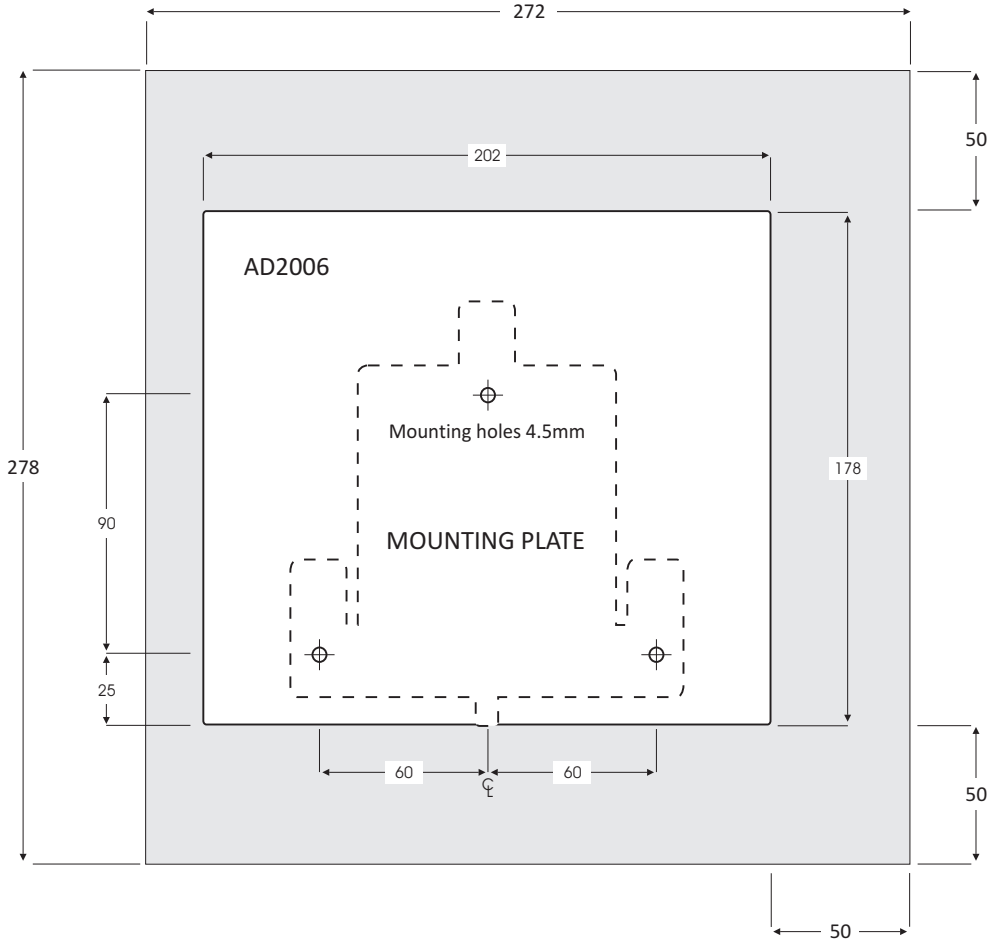
AD2006 Mounting Detail

The AD2006 module is installed by means of the clip in stainless steel mounting bracket supplied with the unit.

Please ensure when mounting the telemetry module that sufficient clearance is left for wiring to and from the unit. Recommended minimum clearances are shown here.

The module is removed by depressing the small tongue at the bottom of the mounting bracket and sliding the unit upwards.

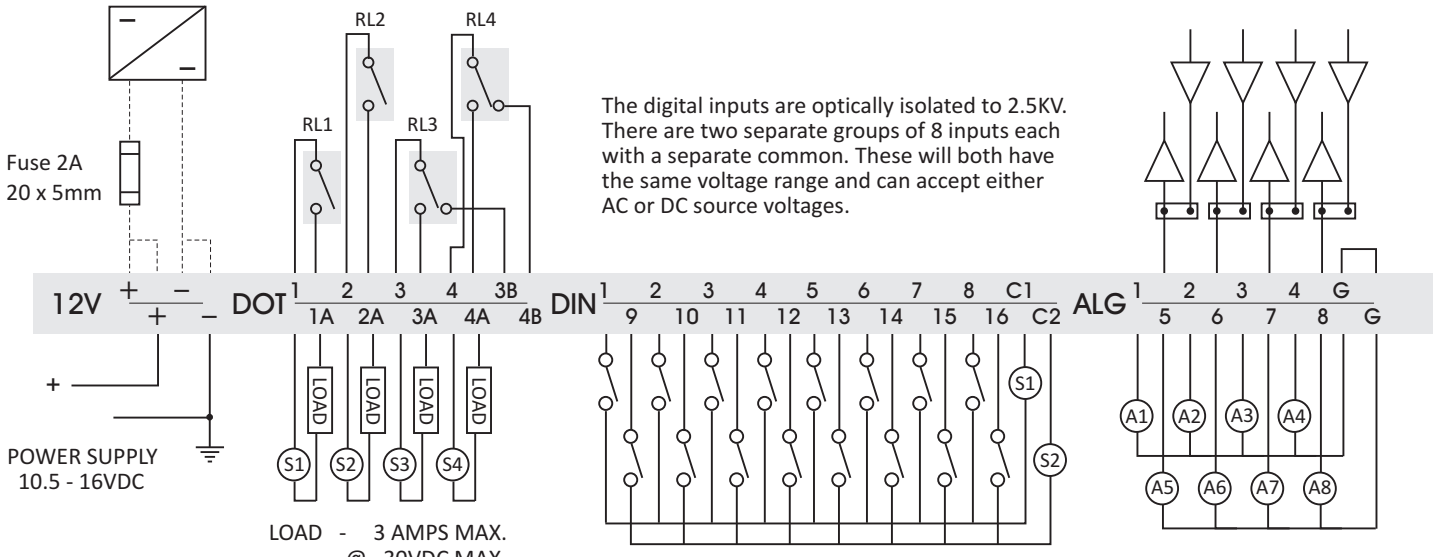
The terminal blocks are removable such that the I/O wiring need not be disturbed when replacing a module in the field.



AD2006 Wiring Diagram

The digital outputs are configurable for relay or solid state format as described in this manual.
The relay format is shown here.
The relays are isolated - 2 form A , 2 form C.

There are 8 Analog input channels which share a common ground. Channels 5 - 8 may be configured as 4-20mA analog outputs by way of a factory installed analog output option.



The digital inputs are optically isolated to 2.5KV. There are two separate groups of 8 inputs each with a separate common. These will both have the same voltage range and can accept either AC or DC source voltages.

LOAD - 3 AMPS MAX.
@ 30VDC MAX.
or 250VAC MAX.

DIGITAL INPUTS : AD2006 'L' 10 - 35VAC/DC
AD2006 'H' 70 - 130VAC/DC

The analog input channels are configurable as 4-20ma /1-5V, 0-20mA / 0-5V or 0-1V.

NEGATIVE SUPPLY & COAXIAL CONNECTION MUST BE GROUNDED

PLEASE ENSURE THAT YOU HAVE THE CORRECT INPUT VOLTAGE BEFORE CONNECTION !

Cellular Transit Antenna

890-960 MHz
1710-1880 MHz

TLA2000
TLA3000

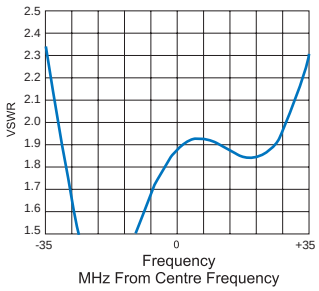


TLA2000/3000

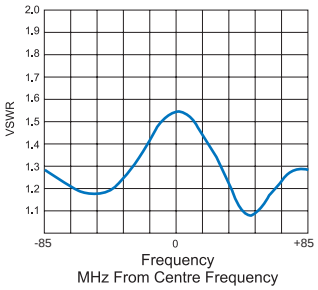
The TLA2000 is an ideal antenna solution for GSM data applications in both fixed and mobile situations. Designed to offer true dual band performance the TLA2000 is ready for use with the latest GSM (GPRS) modems. With a high impact resistant vacuum formed ABS radome and neoprene mounting gasket, the TLA2000 can be used for indoor or outdoor applications.

- Applications include public vending machines, ATM kiosks and industrial automotive use
- Designed for use on conductive or nonconductive surfaces
- TLA3000 model incorporates integrated GPS antenna

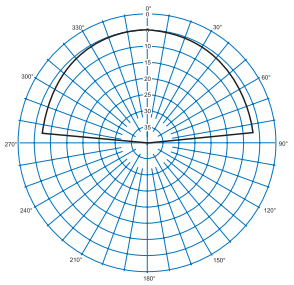
Typical VSWR response GSM900



Typical VSWR response GSM1800



Typical E-Plane response @ 890MHz



Electrical

Model No.	TLA2000/3000
Gain *dBi*	2
Frequency *MHz*	890 - 960 / 1710 - 1880
Power *W*	10
Tuned Bandwidth	Entire specified band @<2.5:1 VSWR
Tuning	Pre-tuned

Mechanical

Model No.	TLA2000	TLA3000
Construction	White Geloy ASA radome	
Diameter *mm*	135	
Height *mm*	61 (including gasket)	
Mounting	M4 hardware (not included)	
Cable and Connector	500mm low loss 9014 RG58 type	Cellular: 5m 9014 RG58 type - FME connector GPS: 5m low loss RG174 type - MCX connector

GPS Specifications

Fo	1575.42 MHz
Operation Temperature	-40 to +85°C
Storage Temperature	-40 to +100°C
System Gain at Fo	28dBi including cable and filter losses
Impedance	50 Ohm
Polarization	RHCP
VSWR at Fo	1.5:1
Noise Figure at Fo	<1.8 dB max.
Power Input	+2.5Vdc to +12Vdc input, Auto Switching
Power Consumption	11mA to 13mA (max)
Power Input	Reverse Polarity Short Circuit Shutdown
Over-Current	Thermal over-current shutdown >+150°C

Data Sheet

NP SERIES - **NP7-12**

Reliability is your Security

Utilizing the latest advance design Oxygen Recombination Technology, Yuasa have applied their 80 years of experience in the lead acid battery field to produce the optimum design of Sealed Lead Acid batteries.



FEATURES

- Superb recovery from deep discharge.
- Electrolyte suspension system.
- Gas Recombination.
- Multipurpose: Float or Cyclic use.
- Usable in any orientation
- Superior energy density.
- Lead calcium grids for extended life.
- Manufactured World wide.
- Application specific designs.

Technical Features

Sealed Construction

Yuasa's unique construction and sealing technique ensures no electrolyte leakage from case or terminals.

Electrolyte Suspension System

All NP batteries utilize Yuasa's unique electrolyte suspension system incorporating a microfine glass mat to retain the maximum amount of electrolyte in the cells. The electrolyte is retained in the separator material and there is no free electrolyte to escape from the cells. No gels or other contaminants are added.

Control of Gas Generation

The design of Yuasa's NP batteries incorporates the very latest oxygen recombination technology to effectively control the generation of gas during normal use.

Low Maintenance Operation

Due to the perfectly sealed construction and the recombination of gasses within the cell, the battery is almost maintenance free.

Terminals

NP batteries are manufactured using a range of terminals which vary in size and type. Please refer to details as shown.

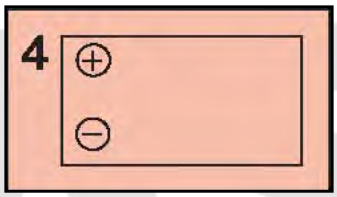
Operation in any Orientation

The combination of sealed construction and Yuasa's unique electrolyte suspension system allows operation in any orientation, with no loss of performance or fear of electrolyte leakage.

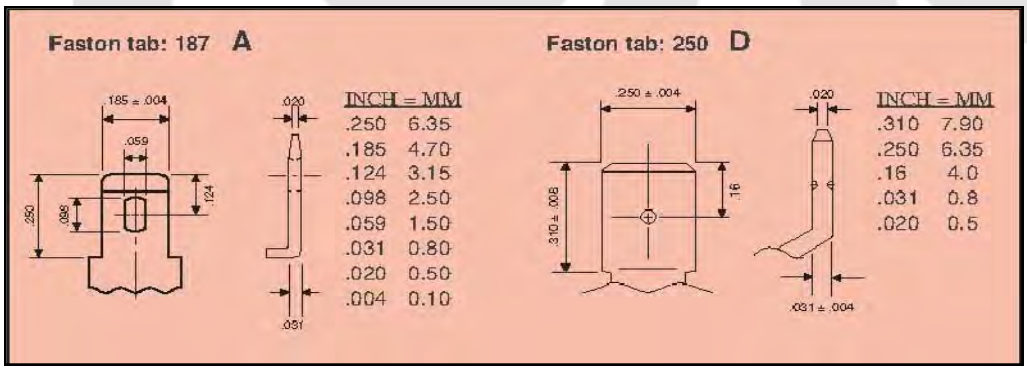
Valve Regulated Design

The batteries are equipped with a simple, safe low pressure venting system which releases excess gas and automatically reseals should there be a build up of gas within the battery due to severe overcharge. Note. On no account should the battery be charged in a sealed container.

Layout



Terminals



General Specifications

Nominal Capacity (Ah)	NP7-12
20hr to 1 .75vpc 30ºC	7
1 0hr to 1 .75vpc 20ºC	6.4
5hr to 1.70vpc 20ºC	5.9
1 hr to 1 .60vpc 20ºC	4.2
Voltage	12
Energy Density (Wh.L.20hr)	91
Specific Energy (Wh.kg.20hr)	32
Int. Resistance (m.Ohms)	25
Maximum discharge (A)	40/75
Short Circuit current (A)	210
Dimensions (mm)	
Length	151
Width	65
Height overall	97.5
Weight (Kg)	2.65
Terminal	A/D
Layout	4
Terminal Torque Nm	-

Data Sheet

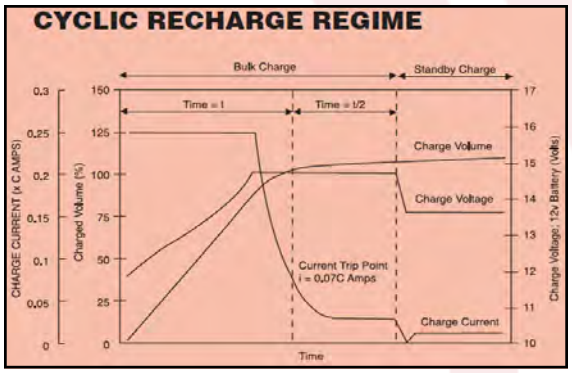
NP SERIES - **NP7-12**

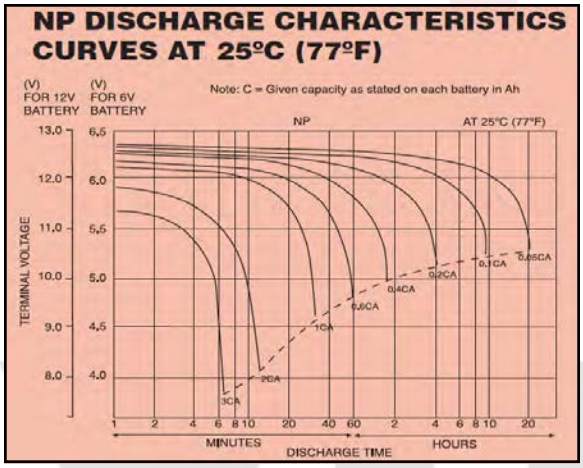
Lead Calcium Grids
The heavy duty lead calcium alloy grids provide an extra margin of performance and life in both cyclic and float applications and give unparalleled recovery from deep discharge.

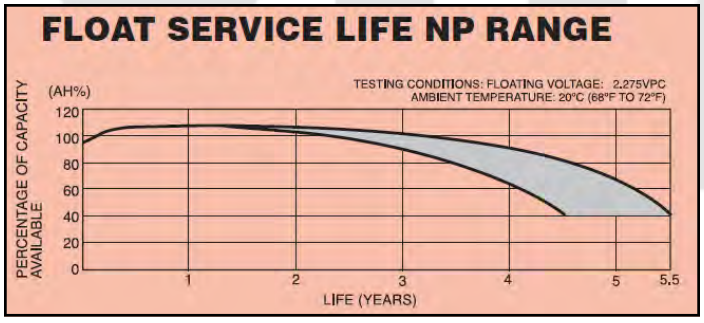
Long Cycle Service Life
Depending upon the average depth of discharge, over a thousand discharge/charge cycles can be expected.

Float Service Life
The expected service life is five years in float standby applications.

Separators
The use of the special separator material provides a very efficient insulation between plates preventing inter-plate short circuits and prohibiting the shedding of active materials.



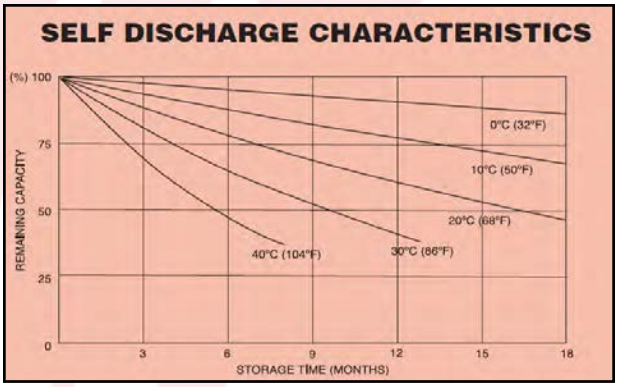


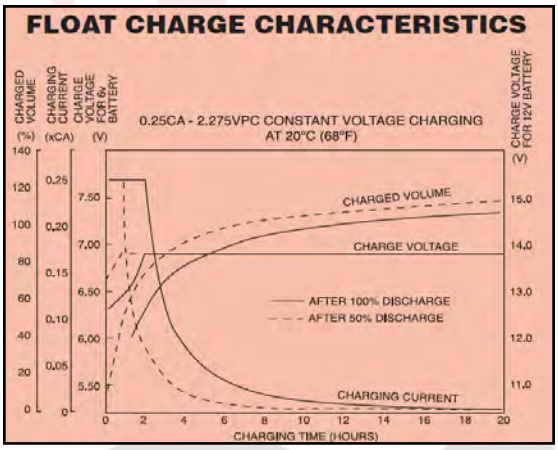


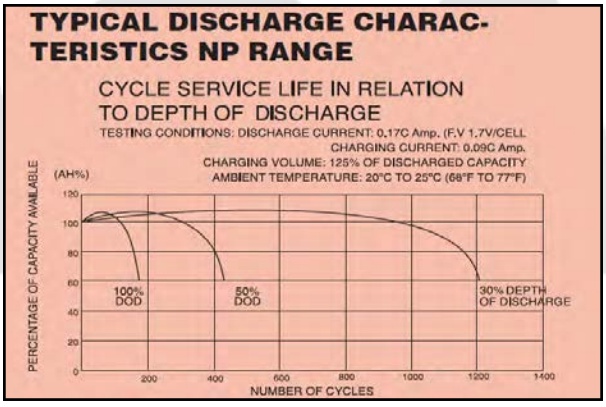
Long shelf Life
The extremely low self discharge rate allows the battery to be stored for extended periods up to one year at normal ambient temperatures with no permanent loss of capacity.

Operating Temperature Range
The batteries can be used over a broad temperature range permitting considerable flexibility in system design and location.

Charge – 15°C to 50°C
Discharge – 20°C to 60°C
Storage – 20°C to 50°C (fully charged battery)







Yuasa Battery Inc.
2901 Montrose Ave
Laureldale, PA 19605
www.yuasabatteries.com

Registered number 1548820

Distributed by

wavecom
Make it wireless

Fastrack Supreme User Guide
WA_DEV_Fastrk_UGD_001

Plug and Play Wireless CPU®

FASTRACK Supreme User Guide

Reference: WA_DEV_Fastrk_UGD_001
Revision: 001e
Date: 5 june, 2007



OPEN AT

Supports Open AT® embedded ANSI C applications

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Document History

Revision	Date	List of revisions	
001	9 February, 07	First Issue	
001a	23 February, 2007	Update DC cable GPIO mapping, add AutoShutDown	
001b	21 May, 07	Add detail of IES, RTC and serial port autoshutdown	
001c	1 Jun, 07	Change to Quad Band	
001d	4 Jun, 07	Update label/packaging photo	
001e	5 Jun, 07	Comment	

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Overview

The FASTRACK Supreme 10 and FASTRACK Supreme 20 are discrete, rugged cellular Plug & Play Wireless CPU® offering state-of-the-art GSM/GPRS (and EGPRS for FASTRACK Supreme 20) connectivity for machine to machine applications.

Proven for reliable, stable performance on wireless networks worldwide, Wavecom's latest generation of FASTRACK Supreme continues to deliver rapid time to market and painless integration.

Having comparable size with the previous M1306B generation, and updated with new features, the FASTRACK Supreme offers an Internal Expansion Socket (IES) interface accessible for customer use. Expanding application features is easy without voiding the warrantee of the FASTRACK Supreme by simply plugging in of an Internal Expansion Socket Module (IESM) board.

Fully certified, the quad band 850/900/1800/1900 MHz FASTRACK Supreme 10 offers GPRS Class 10 capability and FASTRACK Supreme 20 offers GPRS/EGPRS Class 10 capability. Both support a powerful open software platform (Open AT®). Open AT® is the world's most comprehensive cellular development environment, which allows embedded standard ANSI C applications to be natively executed directly on the Wireless CPU®.

FASTRACK Supreme is controlled by firmware through a set of AT commands.

This document describes the FASTRACK Supreme and gives information on the following topics:

- general presentation,
- functional description,
- basic services available,
- technical characteristics,
- installing and using the FASTRACK Supreme,
- user-level troubleshooting.
- recommended accessories to be used with the product.

Note:

This document covers the FASTRACK Supreme Plug & Play alone and does not include

- The programmable capabilities provided via the use of Open AT® Software Suites.
- The development guide for IESM for expanding the application feature through the IES interface.

For detailed, please refer to the documents shown in the "Reference documents" section.

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RoHS Directive

The FASTRACK Supreme is now compliant with RoHS Directive 2002/95/EC, which sets limits for the use of certain restricted hazardous substances. This directive states that "from 1st July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE)".

Plug & Plays which are compliant with this directive are identified by the RoHS logo on their label.



Disposing of the product

This electronic product is subject to the EU Directive 2002/96/EC for Waste Electrical and Electronic Equipment (WEEE). As such, this product must not be disposed off at a municipal waste collection point. Please refer to local regulations for directions on how to dispose off this product in an environmental friendly manner.



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Cautions

Information furnished herein by WAVECOM is accurate and reliable. However, no responsibility is assumed for its use. Please read carefully the safety recommendations given in Section 9 for an application based on FASTRACK Supreme Plug & Play.

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Web Site Support

General information about Wavecom and its range of products:	www.wavecom.com
Specific support is available for the FASTRACK Supreme Plug & Play Wireless CPU®:	TBD
Open AT® Introduction:	www.wavecom.com/OpenAT
Developer community for software and hardware:	www.wavecom.com/forum

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Contents

DOCUMENT HISTORY **2**

OVERVIEW **3**

CAUTIONS **5**

TRADEMARKS **5**

COPYRIGHT **5**

WEB SITE SUPPORT **6**

CONTENTS **7**

LIST OF FIGURES **11**

LIST OF TABLES **12**

1 REFERENCES **13**

1.1 Reference Documents 13
1.1.1 Open AT® Software Documentation 13
1.1.2 AT Software Documentation 13
1.1.3 Firmware Upgrade Documents 13
1.1.4 Delta between M1306B Documents 13
1.1.5 IESM Related Documents 13
1.2 Abbreviations 14

2 PACKAGING **17**

2.1 Contents 17
2.2 Packaging Box 18
2.3 Production Labelling 19

3 GENERAL PRESENTATION **20**

3.1 Description 20
3.2 External Connections 22
3.2.1 Connectors 22
3.2.1.1 Antenna Connector 22
3.2.1.2 Power Supply Connector 22
3.2.1.3 Sub HD 15-pin Connector 23

This document is the sole and exclusive property of WAVECOM. Not to be distributed or divulged without prior written agreement.

3.2.1.4 IES Connector....25
3.2.2 Power supply cable....29

4 FEATURES AND SERVICES....31

4.1 Basic Features and Services....31

4.2 Additional NEW Features....34
4.2.1 Support Additional GSM850/PCS1900 Bands....34
4.2.2 IES Interface for Easy Expansion of Application Features....34
4.2.3 Serial Port Auto Shut Down or Improving Power Consumption....34
4.2.4 Real Time Clock (RTC) for Saving Date and Time....34
4.2.5 SIM Card Lock Feature....35

5 USING THE FASTRACK SUPREME PLUG & PLAY....36

5.1 Getting Started....36
5.1.1 Mount the FASTRACK Supreme....36
5.1.2 Set up the FASTRACK Supreme....36
5.1.3 Check the communication with the FASTRACK Supreme....37
5.1.4 Reset the FASTRACK Supreme....37

5.2 Specific Recommendations when Using the FASTRACK Supreme on Trucks....38
5.2.1 Recommended Power Supply Connection on Trucks....38
5.2.2 Technical Constraints on Trucks....38

5.3 FASTRACK Supreme Operational Status....39

5.4 Echo Function Disabled....40

5.5 Verify the Received Signal Strength....41

5.6 Check the Pin Code Status....41

5.7 Switch between EU/US Band(s)....41

5.8 Check the Band(s) Selection....42

5.9 Verify the FASTRACK Supreme Network Registration....43

5.10 Main AT Commands for the Plug & Play....44

5.11 Firmware Upgrade Procedure....45

6 TROUBLESHOOTING....46

6.1 No Communication with the FASTRACK Supreme through the Serial Link....46

6.2 Receiving "ERROR" Message....46

6.3 Receiving "NO CARRIER" Message....47

7 FUNCTIONAL DESCRIPTION....50

7.1 Architecture....50

7.2 EU and US Bands....51
7.2.1 General Presentation....51
7.2.2 AT COMMAND for Bands Switch....51

7.3 Power Supply....51

This document is the sole and exclusive property of WAVECOM. Not to be distributed or divulged without prior written agreement.

7.3.1 General Presentation....51
7.3.2 Protections....51
7.4 RS232 Serial Link....51
7.4.1 General Presentation....51
7.4.2 Autobauding Mode....52
7.4.3 Pin Description....53
7.4.4 Serial Port Auto shut down Feature....53
7.5 General Purpose Input/Output (GPIO)....54
7.6 BOOT....54
7.7 RESET....54
7.7.1 General presentation....54
7.7.2 Reset Sequence....55
7.8 Audio....56
7.8.1 Microphone Inputs....56
7.8.2 Speaker Outputs....57
7.9 Real Time Clock (RTC)....58
7.10 FLASH LED 58
8 TECHNICAL CHARACTERISTICS....59
8.1 Mechanical Characteristics....59
8.2 Electrical Characteristics....61
8.2.1 Power Supply....61
8.2.2 Power Consumption....62
8.2.3 Audio Interface....65
8.2.4 General Purpose Input/Output....66
8.2.5 SIM Interface....66
8.2.6 RESET Signal....66
8.2.7 RF Characteristics....67
8.2.7.1 Frequency Ranges....67
8.2.7.2 RF Performances....68
8.2.7.3 External Antenna....69
8.3 Environmental Characteristics....69
8.4 Conformity....72
8.5 Protections....72
8.5.1 Power Supply....72
8.5.2 Overvoltage....73
8.5.3 Electrostatic Discharge....73
8.5.4 Miscellaneous....73
9 SAFETY RECOMMENDATIONS....74
9.1 General Safety....74
9.2 Vehicle Safety....74
9.3 Care and Maintenance....75
9.4 Your Responsibility....75

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10 RECOMMENDED ACCESSORIES.....76

11 ONLINE SUPPORT.....77

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List of Figures

Figure 1: Complete package contents....17
Figure 2: Packaging box....18
Figure 3: Production Label....19
Figure 4: FASTRACK Supreme general description....20
Figure 5: FASTRACK Supreme holding bridles....21
Figure 6: SMA connector for antenna connection....22
Figure 7: Power supply connector....23
Figure 8: Sub HD 15-pin connector....24
Figure 9: IES connector for feature expansion....26
Figure 10: Power supply cable....29
Figure 11: SIM card lock feature....35
Figure 12: FASTRACK Supreme mounting....36
Figure 13: Recommended power supply connection on trucks....38
Figure 14: Example of electrical connection which may dramatically damage the FASTRACK Supreme....39
Figure 15: Functional architecture....50
Figure 16: RS232 Serial Link signals....52
Figure 17: Reset sequence diagram....56
Figure 18: Dimensioning diagram....60

This document is the sole and exclusive property of WAVECOM. Not to be distributed or divulged without prior written agreement.

List of Tables

.

Table 1: Power supply connector pin description 23
Table 2: Sub HD 15-pin connector description 24
Table 3: IES Connector Description 27
Table 4: Basic features of the FASTRACK Supreme 31
Table 5: FASTRACK Supreme operational status 40
Table 6: Values of received signal strength 41
Table 7: AT+CPIN Responses 41
Table 8: AT+WMBS Band Selection 42
Table 9: AT+WMBS Responses 42
Table 10: Values of network registration 43
Table 11: Main usual AT commands for the Plug & Play 44
Table 12: Solutions for no connection with FASTRACK Supreme through serial link 46
Table 13: Solutions for "NO CARRIER" message 48
Table 14: Interpretation of extended error code 49
Table 15: Mechanical characteristics 59
Table 16: Electrical characteristics 61
Table 17: Effects of power supply defect 61
Table 18: Power consumption (1*) 62
Table 19: Audio parameters caracteristics 65
Table 20: Microphone inputs internal audio filter characteristics 65
Table 21: Recommended characteristics for the microphone: 65
Table 22: Recommended characteristics for the speaker: 66
Table 23: Operating conditions 66
Table 24: SIM card characteristics 66
Table 25: Electrical characteristics 66
Table 26: Operating conditions 67
Table 27: Frequency ranges 67
Table 28: Receiver and transmitter RF performances 68
Table 29: External antenna characteristics 69
Table 30: Ranges of temperature 69
Table 31: Environmental standard constraints 70
Table 32: List of recommended accessories 76

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1 References

1.1 Reference Documents

For more details, several reference documents may be consulted. The Wavecom reference documents are provided in the Wavecom documents package contrary to the general reference documents, which are not Wavecom owned.

1.1.1 Open AT® Software Documentation

[1] Getting started with Open AT® (Ref.WM_ASW_OAT_CTI_001)

[2] Open AT® Tutorial (Ref.WM_ASW_OAT_UGD_001)

[3] Tools Manual (Ref. WM_ASW_OAT_UGD_003)

[4] Open AT® Programming Guide (Ref. TBD)

[5] Open AT® Customer Release Note (Ref. WM_ASW_OAT_DVD_00062)

Remark: The document above is for Open AT3.12 and FASTRACK Supreme will use new release of Open AT4.21. Reference document not yet available and TBC.

1.1.2 AT Software Documentation

[6] AT commands interface Guide for X51 (Ref. WM_ASW_OAT_UGD_00016)

[7] Customer Release Note X51 (Ref. WM_ASW_OAT_DVD_00120)

Remark: The document above is for X51 and FASTRACK Supreme will use new release of FW6.63. Reference document not yet available and TBC.

1.1.3 Firmware Upgrade Documents

[8] Firmware upgrade procedure (Ref. WM_SW_GEN_UGD_001)

1.1.4 Delta between M1306B Documents

[9] Delta between M1306B and FASTRACK Supreme (Ref. WA_DEV_Fastrk_UGD_004)

1.1.5 IESM Related Documents

[10] IESM Product Technical Specification (Ref. WA_DEV_Fastrk_PTS_001)

[11] IESM-GPS+USB User Guide (Ref. WA_DEV_Fastrk_UGD_002)

[12] IESM-GPS+USB Installation Guide (Ref. WA_DEV_Fastrk_UGD_003)

[13] IESM-IO+USB Installation Guide (Ref. WA_DEV_Fastrk_UGD_005)

[14] IESM-IO+USB User Guide (Ref. WA_DEV_Fastrk_UGD_006)

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Note:

New versions of software may be available. Wavecom recommends customers to check the web site for the latest documentation.

1.2 Abbreviations

Abbreviation	Definition
AC	**A**lternating **C**urrent
ACM	**A**ccumulated **C**all **M**eter
AMR	**A**daptive **M**ulti-**R**ate
AT	**AT**tention (prefix for Wireless CPU® commands)
CLK	**CL**oc**K**
CMOS	**C**omplementary **M**etal **O**xide **S**emiconductor
CS	**C**oding **S**cheme
CTS	**C**lear **T**o **S**end
dB	**D**eci**b**el
dBc	**D**eci**b**el relative to the **C**arrier power
dBi	**D**eci**b**el relative to an **I**sotropic radiator
dBm	**D**eci**b**el relative to one **m**illiwatt
DC	**D**irect **C**urrent
DCD	**D**ata **C**arrier **D**etect
DCE	**D**ata **C**ommunication **E**quipment
DCS	**D**igital **C**ellular **S**ystem
DSR	**D**ata **S**et **R**eady
DTE	**D**ata **T**erminal **E**quipment
DTMF	**D**ual **T**one **M**ulti-**F**requency
DTR	**D**ata **T**erminal **R**eady
EEPROM	**E**lectrically **E**rasable **P**rogrammable **R**ead-**O**nly **M**emory
EFR	**E**nhanced **F**ull **R**ate
E-GSM	**E**xtended **GSM**
EMC	**E**lectro**M**agnetic **C**ompatibility
EMI	**E**lectro**M**agnetic **I**nterference
ESD	**E**lectro**S**tatic **D**ischarges
ETSI	**E**uropean **T**elecommunications **S**tandards **I**nstitute
FIT	**Series of connectors (micro-FIT)**
FR	**F**ull **R**ate

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Abbreviation	Definition
FTA	**F**ull **T**ype **A**pproval
GCF	**G**lobal **C**ertification **F**orum
GND	**G**rou**ND**
GPIO	**G**eneral **P**urpose **I**nput **O**utput
GPRS	**G**eneral **P**acket **R**adio **S**ervice
GSM	**G**lobal **S**ystem for **M**obile communications
HR	**H**alf **R**ate
I	**I**nput
IEC	**I**nternational **E**lectrotechnical **C**ommission
IES	**I**nternal **E**xpansion **S**ocket
IESM	**I**nternal **E**xpansion **S**ocket **M**odule
IMEI	**I**nternational **M**obile **E**quipment **I**dentification
I/O	**I**nput / **O**utput
LED	**L**ight **E**mitting **D**iode
MAX	**MAX**imum
ME	**M**obile **E**quipment
MIC	**MIC**rophone
Micro-Fit	**Family of connectors from Molex**
MIN	**MIN**imum
MNP	**M**icrocom **N**etworking **P**rotocol
MO	**M**obile **O**riginated
MS	**M**obile **S**tation
MT	**M**obile **T**erminated
NOM	**NOM**inal
O	**O**utput
Pa	**Pa**scal (for speaker sound pressure measurements)
PBCCH	**P**acket **B**roadcast **C**ontrol **CH**annel
PC	**P**ersonal **C**omputer
PCL	**P**ower **C**ontrol **L**evel
PDP	**P**acket **D**ata **P**rotocol
PIN	**P**ersonal **I**dentity **N**umber
PLMN	**P**ublic **L**and **M**obile **N**etwork
PUK	**P**ersonal **U**nblocking **K**ey
RF	**R**adio **F**requency

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Abbreviation	Definition
RFI	**R**adio **F**requency **I**nterference
RI	**R**ing **I**ndicator
RMS	**R**oot **M**ean **S**quare
RTS	**R**equest **T**o **S**end
RX	**R**eceive
SIM	**S**ubscriber **I**dentification **M**odule
SMA	**S**ub**M**iniature version **A** RF connector
SMS	**S**hort **M**essage **S**ervice
SNR	**S**ignal-to-**N**oise **R**atio
SPL	**S**ound **P**ressure **L**evel
SPK	**Sp**ea**K**er
SRAM	**S**tatic **RAM**
TCP/IP	**T**ransmission **C**ontrol **P**rotocol / **I**nternet **P**rotocol
TDMA	**T**ime **D**ivision **M**ultiple **A**ccess
TU	**T**ypical **U**rban fading profile
TUHigh	**T**ypical **U**rban, **High** speed fading profile
TX	**T**ransmit
TYP	**TYP**ical
VSWR	**V**oltage **S**tationary **W**ave **R**atio

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2 Packaging

2.1 Contents

The complete package content of the FASTRACK Supreme consists of (see):

- one packaging box (**A**),
- one FASTRACK Supreme (**B**),
- two holding bridles (**C**),
- one power supply cable with fuse integrated (**D**)
- a mini notice (**E**) with:
    - a summary of the main technical features,
    - safety recommendations,
    - EC declaration of conformity.

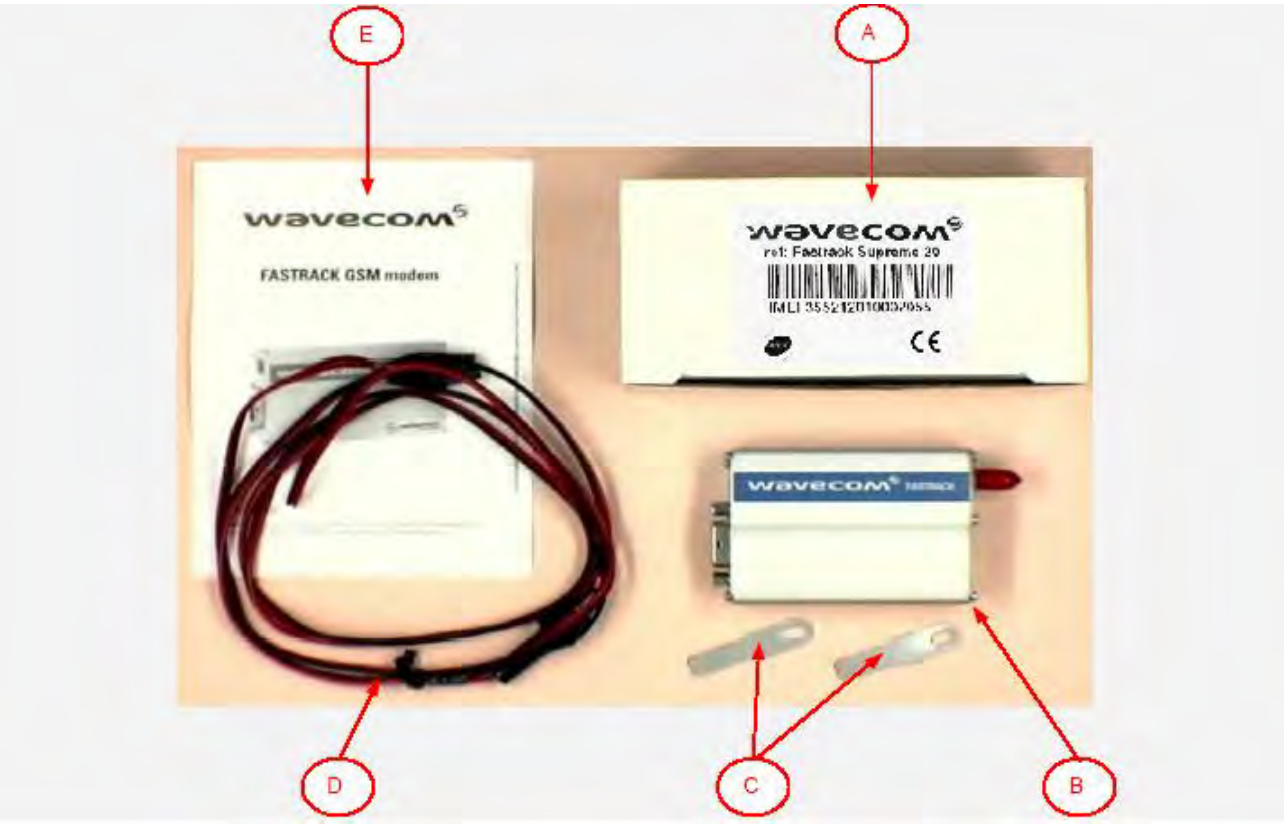


Figure 1: Complete package contents

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2.2 Packaging Box

The packaging box is a carton box (see) with the following external dimensions:

- width: 54.5 mm,
- height: 68 mm,
- length: 108 mm.

A packaging label is slicked on the packaging box cover and supports the:

- WAVECOM logo,
- Product reference (Supreme),
- CE marking
- 15-digit IMEI code
- Open AT® Logo
- RoHS logo
- WEEE logo



Figure 2: Packaging box

The packaging label dimensions are:

- height: 40 mm,
- length: 65 mm.

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2.3 Production Labelling

A production label (see Figure 3) located at the FASTRACK Supreme back side gives the following information:

- product reference (**FASTRACK Supreme 10** or **FASTRACK Supreme 20**),
- part number (WM19183),
- CE marking,
- 15-digit IMEI code,
- OpenAT® logo



Figure 3: Production Label

3 General Presentation

3.1 Description

The FASTRACK Supreme description is given in the Figure 4 below.

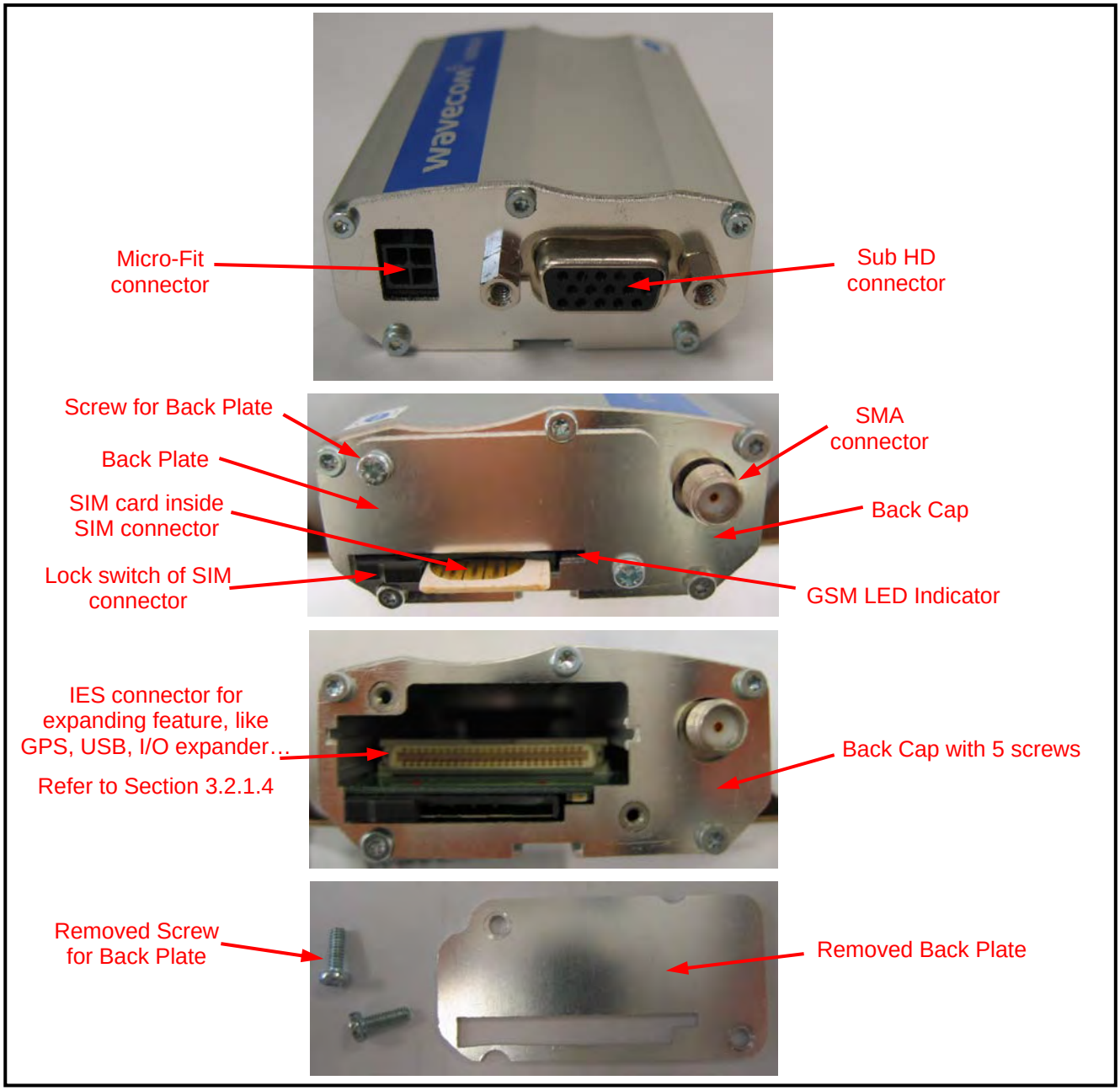


Figure 4: FASTRACK Supreme general description

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CAUTION: Users are free to remove the back plate for IESM board plug in/unplug without voiding the warrantee of the FASTRACK Supreme. **However, the warrantee will be voided if unscrewing any screw of the back cap.**

In addition, two holding bridles are provided to tighten the FASTRACK Supreme on a support.

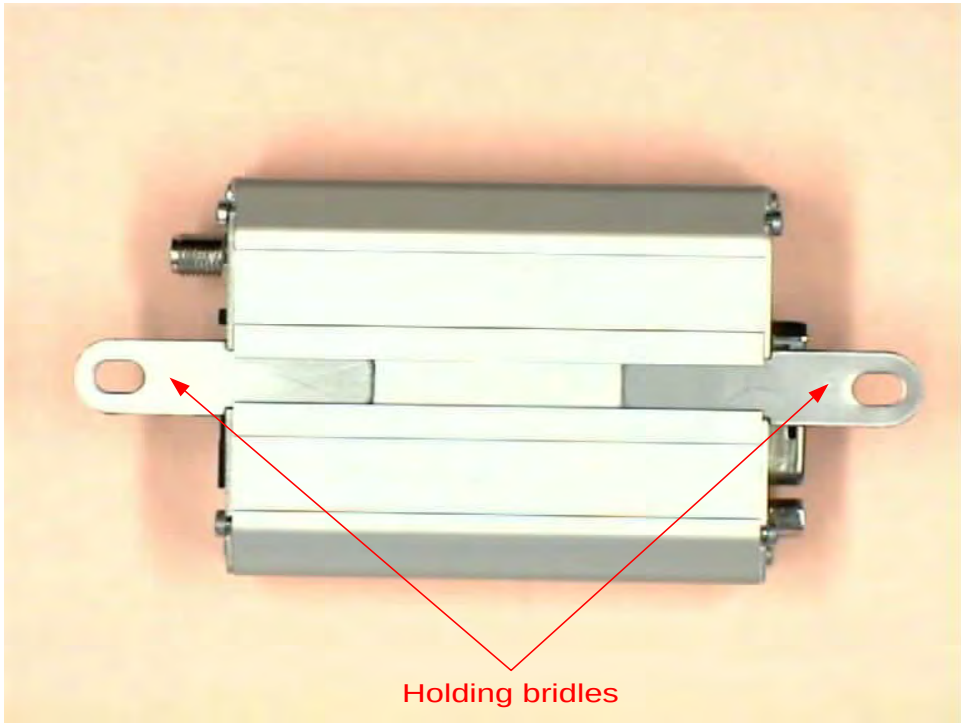


Figure 5: FASTRACK Supreme holding bridles

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3.2 External Connections

3.2.1 Connectors

3.2.1.1 Antenna Connector

The antenna connector is a SMA type connector for a 50 Ω RF connection.

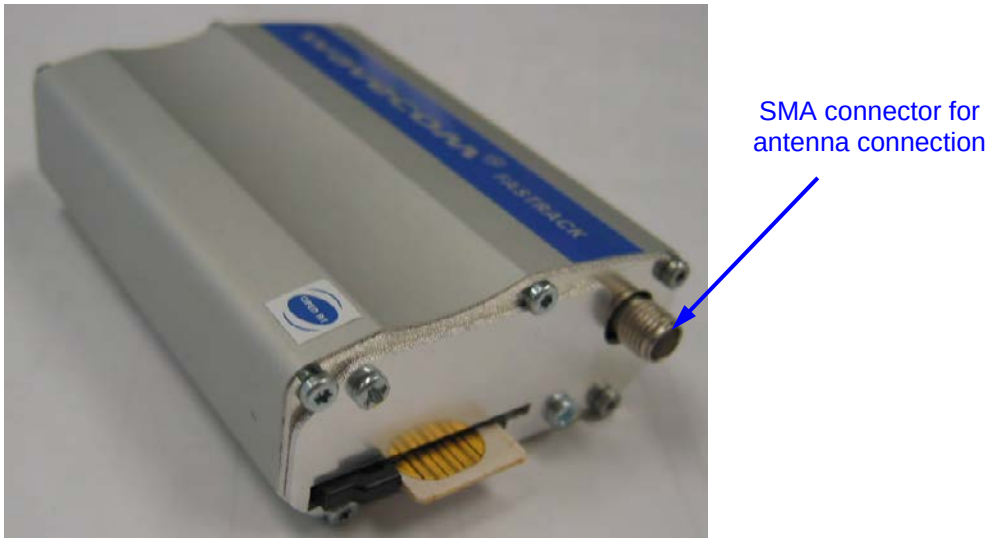


Figure 6: SMA connector for antenna connection

3.2.1.2 Power Supply Connector

The power supply connector is a 4-pin Micro FIT connector for:

- external DC Power Supply connection,
- GPIOs connection (two General Purpose Input/Output signals available).

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Figure 7: Power supply connector

Table 1: Power supply connector pin description

Pin #	Signal	I/O	I/O type	Description	Reset State	Comment
1	V+BATTERY	I	Power supply	Battery voltage input: ▪ 5.5 V Min. ▪ 13.2 V Typ. ▪ 32 V Max.		High current
2	GND		Power supply	Ground		
3	GPIO21	I/O	2V8	General Purpose Input/output	Undefined	Not mux
4	GPIO25	I/O	2V8	General Purpose Input/output	Z	Multiplex with INT1

Warning:

Both pin 3 and pin 4 are used by GPIO interface. It is strictly prohibited to connect them to any power supply at the risk of damage to the FASTRACK Supreme.

3.2.1.3 Sub HD 15-pin Connector

The Sub D high density 15-pin connector is used for:

- RS232 serial link connection,
- Audio lines (microphone and speaker) connection,
- BOOT and RESET signal connection.

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Figure 8: Sub HD 15-pin connector

Table 2: Sub HD 15-pin connector description

Pin #	Signal (CCITT / EIA)	I/O	I/O type	Description	Comment
1	CDCD/CT109	O	STANDARD RS232	RS232 Data Carrier Detect	
2	CTXD/CT103	I	STANDARD RS232	RS232 Transmit serial data	
3	BOOT	I	CMOS	Boot	This signal must not be connected. Its use is strictly reserved to Wavecom or competent retailers.
4	CMIC2P	I	Analog	Microphone positive line	
5	CMIC2N	I	Analog	Microphone negative line	
6	CRXD/CT104	O	STANDARD RS232	RS232 Receive serial data	
7	CDSR/CT107	O	STANDARD RS232	RS232 Data Set Ready	
8	CDTR/CT108-2	I	STANDARD RS232	RS232 Data Terminal Ready	
9	GND	-	GND	Ground	

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Pin #	Signal (CCITT / EIA)	I/O	I/O type	Description	Comment
10	CSPK2P	O	Analog	Speaker positive line	
11	CCTS/CT106	O	STANDARD RS232	RS232 Clear To Send	
12	CRTS/CT105	I	STANDARD RS232	RS232 Request To Send	
13	CRI/CT125	O	STANDARD RS232	RS232 Ring Indicator	
14	RESET	I/O	Schmitt	Supreme Plug & Play reset	Active low
15	CSPK2N	O	Analog	Speaker negative line	

3.2.1.4 IES Connector

The IES connector is a 50 pins board-to-board connector for expanding application features like GPS, USB, I/O expander… Currently there are already 3 IESM boards available for customer to expand the FASTRACK Supreme features immediately. They are:

- IESM-GPS+USB+I/O
- IESM-GPS+USB
- IESM-USB+I/O

For detail, please refer to Document in Section 1.1.5.

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For sales and support, please contact Wavecom sales/FAE or your distributor.

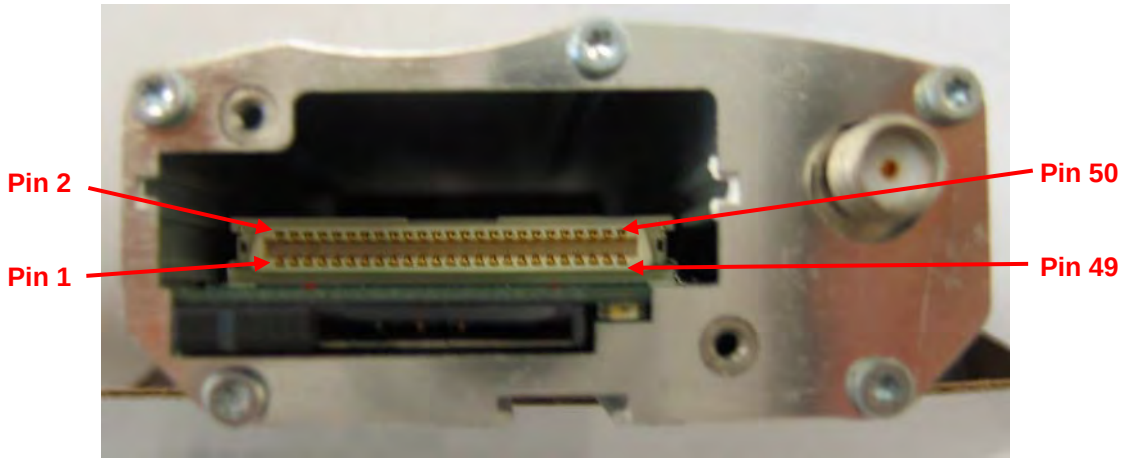


Figure 9: IES connector for feature expansion

Table 3: IES Connector Description

Pin Number	Signal Name		I/O type	Voltage	I/O*	Reset State	Description	Dealing with unused pins
	Nominal	Mux						
1	GND						Ground	
2	GND						Ground	
3	GPIO4	COL0	C8	GSM-1V8	I/O	Pull-up	Keypad column 0	NC
4	GPIO5	COL1	C8	GSM-1V8	I/O	Pull-up	Keypad column 1	NC
5	GPIO6	COL2	C8	GSM-1V8	I/O	Pull-up	Keypad column 2	NC
6	GPIO7	COL3	C8	GSM-1V8	I/O	Pull-up	Keypad column 3	NC
7	VPAD-USB			VPAD-USB	I		USB Power supply input	NC
8	USB-DP			VPAD-USB	I/O		USB Data	NC
9	USB-DM			VPAD-USB	I/O		USB Data	NC
10	GSM-1V8*			GSM-1V8	O		1.8V Supply Output (for GPIO pull-up only)	NC
11	GSM-2V8*			GSM-1V8	O		2.8V Supply Output (for GPIO pull-up only)	NC
12	BOOT			GSM-1V8	I		Not Used	Add a test point / a jumper/ a switch to VCC_1V8 (Pin 10) in case Download Specific mode is used (See product specification for details)
13	~RESET		C4	GSM-1V8	I/O		RESET Input	NC or add a test point
14	AUX-ADC		A2	Analog	I		Analog to Digital Input	Pull to GND
15	~SPI1-CS	GPIO31	C1	GSM-2V8	O	Z	SPI1 Chip Select	NC
16	SPI1-CLK	GPIO32	C1	GSM-2V8	O	Z	SPI1 Clock	NC
17	SPI1-I	GPIO30	C1	GSM-2V8	I	Z	SPI1 Data Input	NC
18	SPI1-IO	GPIO29	C1	GSM-2V8	I/O	Z	SPI1 Data Input / Output	NC
19	SPI2-CLK	GPIO32	C1	GSM-2V8	O	Z	SPI2 Clock	NC
20	SPI2-IO	GPIO33	C1	GSM-2V8	I/O	Z	SPI2 Data Input / Output	NC
21	~SPI2-CS	GPIO35	C1	GSM-2V8	O	Z	SPI2 Chip Select	NC
22	SPI2-I	GPIO34	C1	GSM-2V8	I	Z	SPI2 Data Input	NC
23	CT104-RXD2	GPIO15	C1	GSM-1V8	O	Z	Auxiliary RS232 Receive	Add a test point for firmware upgrade
24	CT103-TXD2	GPIO14	C1	GSM-1V8	I	Z	Auxiliary RS232 Transmit	(TXD2) Pull-up to VCC_1V8 with 100kΩ and add a test point for firmware update
25	~CT106-CTS2	GPIO16	C1	GSM-1V8	O	Z	Auxiliary RS232 Clear To Send	(CTS2) Add a test point for firmware update
26	~CT105-RTS2	GPIO17	C1	GSM-1V8	I	Z	Auxiliary RS232 Request To Send	(RTS2) Pull-up to VCC_1V8 with 100kΩ and add a test point for

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Pin Number	Signal Name		I/O type	Voltage	I/O*	Reset State	Description	Dealing with unused pins
	Nominal	Mux						
								firmware update
27	GPIO8	COL4	C8	GSM-1V8	I/O	Pull-up	Keypad column 4	NC
28	GPIO26	SCL	A1	Open Drain	O	Z	I²C Clock	NC
29	GPIO19		C1	GSM-2V8	I/O	Z		NC
30	GPIO27	SDA	A1	Open Drain	I/O	Z	I²C Data	NC
31	GPIO20		C1	GSM-2V8	I/O	Undefined		NC
32	INT0	GPIO3	C1	GSM-1V8	I	Z	Interruption 0 Input	If INT0 is not used, it should be configured as GPIO
33	GPIO23	**	C1	GSM-2V8	I/O	Z		NC
34	GPIO22	**	C1	GSM-2V8	I/O	Z		NC
35	~CT108-2-DTR1	GPIO41	C1	GSM-2V8	I	Z	Main RS232 Data Terminal Ready	(DTR1) Pull-up to VCC_2V8 with 100kΩ
36	PCM-SYNC			GSM-1V8	O	Pull-down	PCM Frame Synchro	NC
37	PCM-IN		C5	GSM-1V8	I	Pull-up	PCM Data Input	NC
38	PCM-CLK			GSM-1V8	O	Pull-down	PCM Clock	NC
39	PCM-OUT			GSM-1V8	O	Pull-up	PCM Data Output	NC
40	AUX-DAC			Analog	O		Digital to Analog Output	NC
41	VCC-2V8			VCC_2V8	O		LDO 2.8V Supply Output	NC
42	GND						Ground	
43	DC-IN			DC-IN from 5.5V~32VDC	O		DC voltage input through Micro-Fit connector	NC
44	DC-IN			DC-IN from 5.5V~32VDC	O		DC voltage input through Micro-Fit connector	NC
45	GND						Ground	
46	4V			4V	O		4V DC/DC converter Output	NC
47	4V			4V	O		4V DC/DC converter Output	NC
48	GND						Ground	
49	GND						Ground	
50	GND						Ground	

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3.2.2 Power supply cable

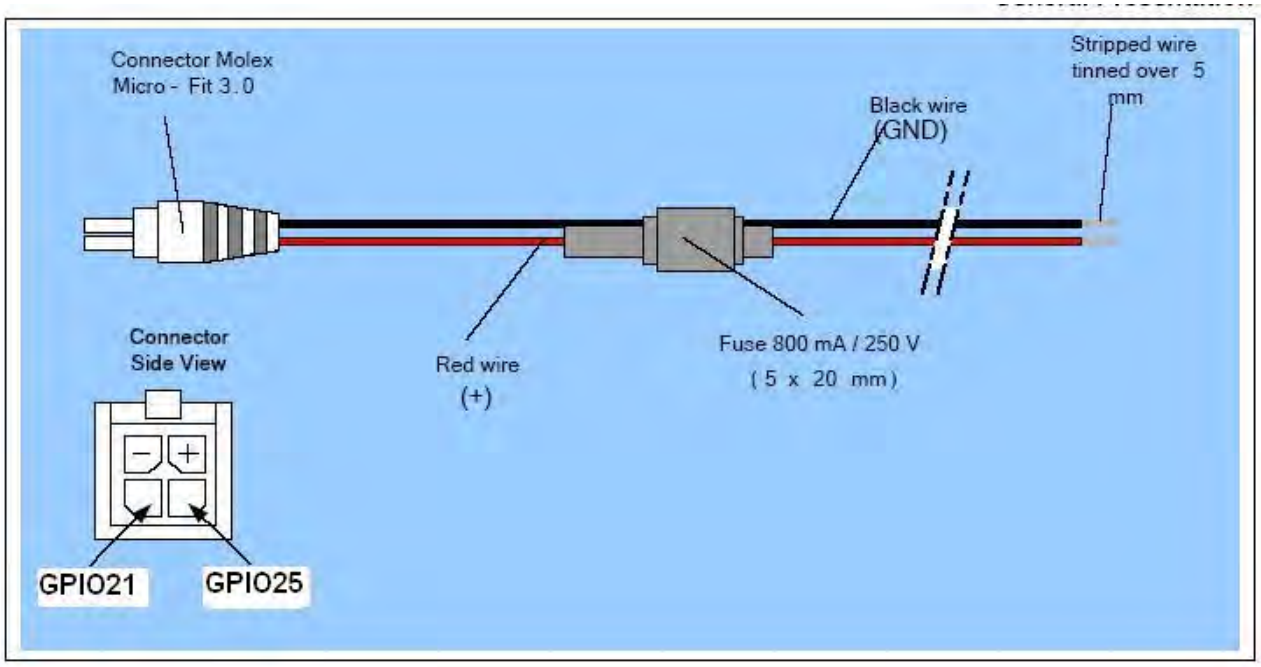


Figure 10: Power supply cable

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Component	Characteristics
Micro-Fit connector 4-pin	Part number: MOLEX 43025-0400
Cable	Cable length: ~1.5 m
Wire	Core: tinned copper 24 x 0.2 mm
	Section: 0.75 mm^2

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4 Features and Services

4.1 Basic Features and Services

Basic features of the FASTRACK Supreme and available services are summarized in the table below.

Table 4: Basic features of the FASTRACK Supreme

Features	GSM850 / GSM900	DCS1800 / PCS1900
Open AT®	Open AT® programmable: Native execution of embedded standard ANSI C applications, Custom AT command creation, Custom application library creation, Standalone operation.	
Standard	850MHz / 900 MHz. E-GSM compliant. Output power: class 4 (2W). Fully compliant with ETSI GSM phase 2 + small MS.	1800 MHz / 1900MHz Output power: class 1 (1W). Fully compliant with ETSI GSM phase 2 + small MS.
GPRS	Class 10. PBCCH support. Coding schemes: CS1 to CS4. Compliant with SMG31bis. Embedded TCP/IP stack.	
EGPRS **(for FASTRACK Supreme 20 only)**	Output power: 0.5W	Output power: 0.4W
	Class 10. PBCCH support. Coding schemes: MCS1 to MCS9. Compliant with SMG31bis. Embedded TCP/IP stack.	

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Features	GSM850 / GSM900	DCS1800 / PCS1900
Interfaces	RS232 (V.24/V.28) Serial interface supporting: ▪ Baud rate (bits/s): 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800 and 921600. ▪ Autobauding (bits/s): from 1200 to 921600. 2 General Purpose Input/Output gates (GPIOs) available. 1.8 V / 3 V SIM interface. AT command set based on V.25ter and GSM 07.05 & 07.07. Open AT® interface for embedded application. Open AT® Plug-In Compatible.	
SMS	Text & PDU. Point to point (MT/MO). Cell broadcast.	
Data	Data circuit asynchronous. Transparent and Non Transparent modes. Up to 14.400 bits/s. MNP Class 2 error correction. V42.bis data compression.	
Fax	Automatic fax group 3 (class 1 and Class 2).	
Audio	Echo cancellation Noise reduction Telephony. Emergency calls. Full Rate, Enhanced Full Rate, Half Rate operation and Adaptive Multi-Rate (FR/EFR/HR/AMR). Dual Tone Multi Frequency function (DTMF).	

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Features	GSM850 / GSM900	DCS1800 / PCS1900
GSM supplement services	Call forwarding. Call barring. Multiparty. Call waiting and call hold. Calling line identity. Advice of charge. USSD	
Other	DC power supply Real Time Clock with calendar Complete shielding	

For other detailed technical characteristics, refer to Section 8.

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4.2 Additional NEW Features

4.2.1 Support Additional GSM850/PCS1900 Bands

Apart from GSM900/DCS1800, the FASTRACK Supreme Plug & Play now supports also the GSM850/PCS1900 bands. FASTRACK Supreme is fully compliant to PTCRB and FCC also.

4.2.2 IES Interface for Easy Expansion of Application Features

The FASTRACK Supreme Plug & Play offers a 50 pin Internal Expansion Socket (IES) Interface accessible for customer use. It is the additional interface which is easy for customers to expand their application features without voiding the warrantee of the FASTRACK Supreme, by simply plugging in an Internal Expansion Socket Module (IESM) board through the matting connector of the IES interface.

Thanks to the flexible IES interface, customers are ready to expand the application features by plugging in the corresponding Internal Expansion Socket Module (IESM) of GPS, I/O expander…, etc.

For brief description of the interface, please refer to Section 3.2.1.4.

For technical detail, please refer to Document [11] or contact your Wavecom distributor or Wavecom FAE.

4.2.3 Serial Port Auto Shut Down or Improving Power Consumption

In order to save power consumption when there is no data communication between the Plug & Play and the DTE, FASTRACK Supreme has now implement the Serial Port Auto Shut Down feature. User can activate or deactivate the Serial Port Auto Shut Down mode by simple AT-command.

For detail, please refer to Section 7.3.4.

4.2.4 Real Time Clock (RTC) for Saving Date and Time

The FASTRACK Supreme has now implemented the Real Time Clock for saving date and time when the Plug & Play is unplugged from the DC power supply through the DC power cable.

For detail, please refer to Section 7.8.

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4.2.5 SIM Card Lock Feature

The FASTRACK Supreme has now implemented a SIM connector having a carrier with lock. This helps ensuring the user to have proper SIM card insertion and locked before proper use of GSM network.

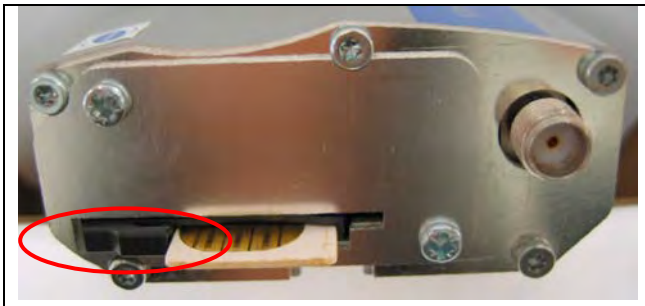
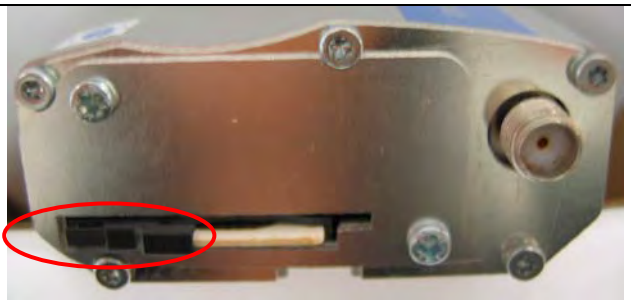
	
SIM card is inserted but not locked. GSM network is not ready for use. Only emergency call 112 is possible.	SIM card is inserted and being locked properly. GSM network is ready for use.

Figure 11: SIM card lock feature

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5 Using the FASTRACK Supreme Plug & Play

5.1 Getting Started

5.1.1 Mount the FASTRACK Supreme

To mount the FASTRACK Supreme on its support, bind it using the holding bridles as shown in the Figure 12 below.

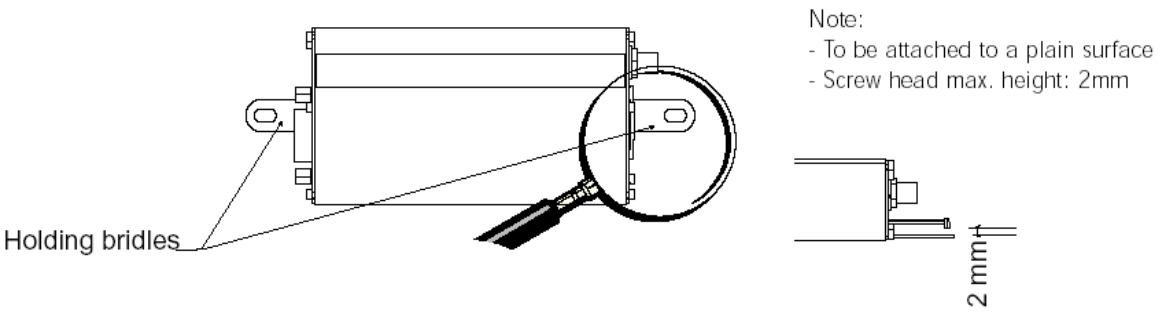


Figure 12: FASTRACK Supreme mounting

For the drill template, refer to Figure 18.

5.1.2 Set up the FASTRACK Supreme

To set up the FASTRACK Supreme, perform the following operations:

- Insert the SIM card into the SIM card holder of the FASTRACK Supreme.
- Lock the SIM card by sliding the lever towards the SIM card.
- Connect the antenna to the SMA connector.
- Connect both sides of the serial and control cable (15-pin Sub HD connector on the FASTRACK Supreme side).
- Connect the power supply cable to the external power supply source.

Note:

For automotive application, it is recommended to connect the V+BATTERY line of the FASTRACK Supreme directly to the battery positive terminal.

- Plug the power supply cable into the FASTRACK Supreme and switch on the external power supply source.
- The FASTRACK Supreme is ready to work. Refer to Section 5.10 for the description of AT commands used to configure the FASTRACK Supreme.

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5.1.3 Check the communication with the FASTRACK Supreme

To check the communication with the FASTRACK Supreme, do the following operations:

- Connect the RS232 link between the DTE (port COM) and the FASTRACK Supreme (DCE).
- Configure the RS232 port of the DTE as follows:
  - Bits per second: **115.200 bps**,
  - Data bits: **8**,
  - Parity: **None**,
  - Stop bits: **1**,
  - Flow control: **hardware**.
- Using a communication software such as a HyperTerminal, enter the **AT↵** command. The response of the FASTRACK Supreme must be **OK** displayed in the HyperTerminal window.
- If the communication cannot be established with the FASTRACK Supreme, do the following:
  - Check the RS232 connection between the DTE and the FASTRACK Supreme (DCE),
  - Check the configuration of the port COM used on the DTE.
- Example of AT commands which can be used after getting started the FASTRACK Supreme:
  - **AT+CGMI**: FASTRACK Supreme answer is "WAVECOM MODEM" when serial link is OK.
  - **AT+CPIN=xxxx**: to enter a PIN code xxxx (if activated).
  - **AT+CSQ**: to verify the received signal strength.
  - **AT+CREG?**: to verify the registration of the FASTRACK Supreme Plug & Play on the network.
  - **ATD<phone number>;**: to initiate a voice call.
  - **ATH**: to hang up (end of call).

For further information on these AT commands and their associated parameters, refer to "AT Commands Interface Guide" [6].

5.1.4 Reset the FASTRACK Supreme

To reset the FASTRACK Supreme, a hardware reset signal is available on pin 14 of the Sub HD 15-pin connector (RESET).

The FASTRACK Supreme reset is carried out when this pin is low for at least 200 µs.

Warning This signal has to be considered as an emergency reset only. For further details on the FASTRACK Supreme reset, refer to Section 7.7.

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5.2 Specific Recommendations when Using the FASTRACK Supreme on Trucks

Warning: The power supply connection of the FASTRACK Supreme must NEVER be directly connected to the truck battery.

5.2.1 Recommended Power Supply Connection on Trucks

All trucks have a circuit breaker on the exterior of the cabin. The circuit breaker is used for safety reasons: if a fire blazes in the trucks, (for example, on the wiring trunk) the driver may cut the current source to avoid any damage (explosion). The circuit breaker is connected to the truck ground, most often associated with the fuse box.

Most of truck circuit breakers do not cut the Positive Supply line of the battery, but cut the ground line of the later.

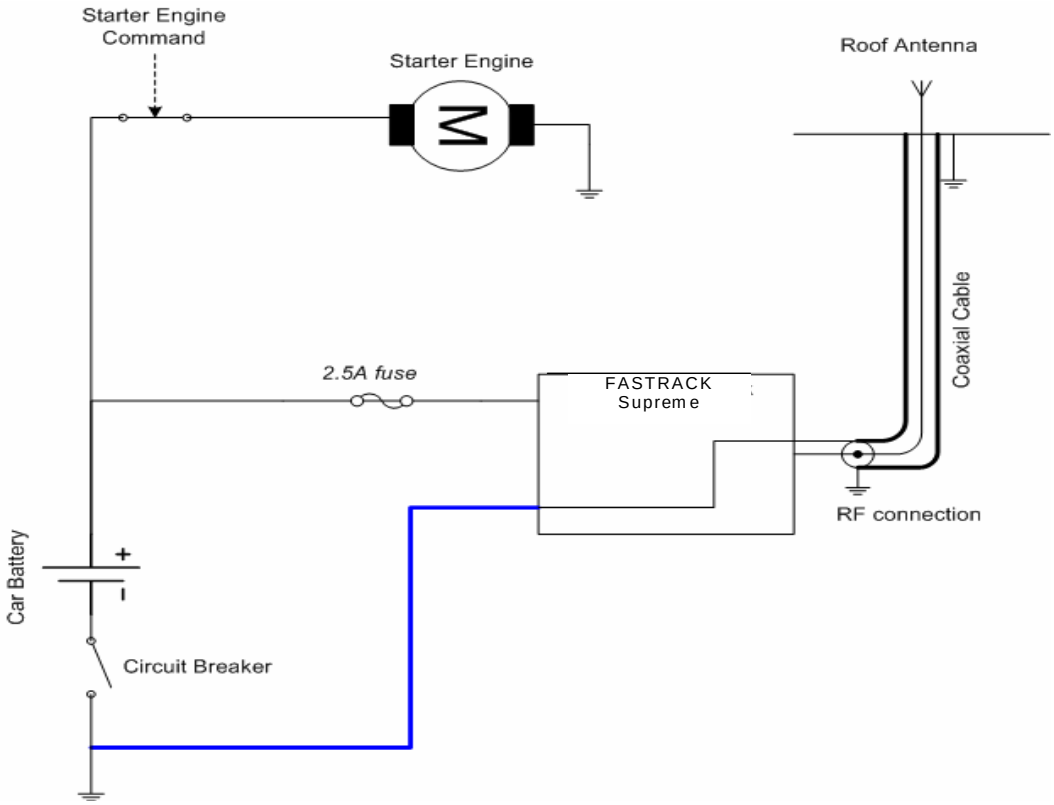


Figure 13: Recommended power supply connection on trucks

Figure 13 gives the recommended power supply connection where the ground connection of the FASTRACK Supreme is not directly connected to the battery but is connected after the Circuit Breaker (on the truck ground or the fuse box).

5.2.2 Technical Constraints on Trucks

It is highly not recommended to connect directly the power supply on the battery rather than on the circuit breaker. The FASTRACK Supreme may be damaged when starting the truck if the circuit breaker is switched OFF (in this case, the truck ground and the battery ground will be connected through the FASTRACK Supreme as shown in the figure below).

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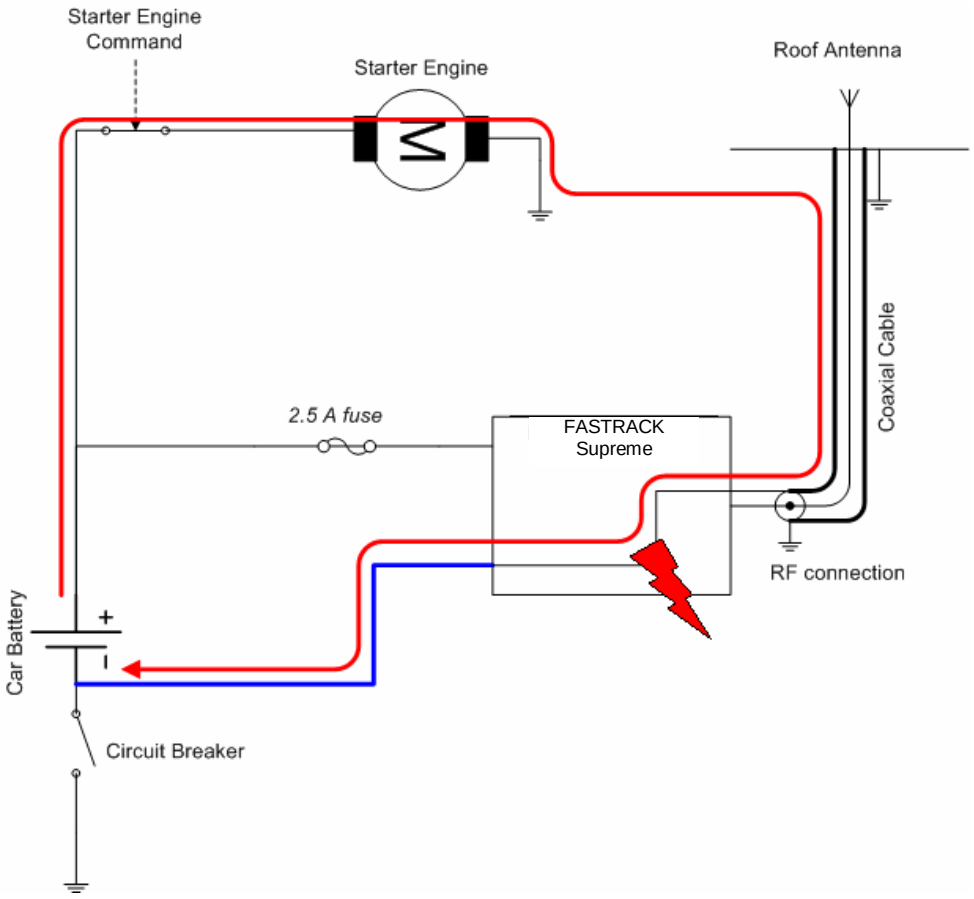


Figure 14: Example of electrical connection which may dramatically damage the FASTRACK Supreme

Figure 14 gives an example of electrical connection which may dramatically damage the FASTRACK Supreme when its ground connection is directly connected to the battery ground.

In this example, when the circuit breaker is switched OFF, the current flows through the FASTRACK Supreme and powers the electrical circuit of the truck (for example, dashboard).

Furthermore, when the Starter Engine command will be used, it will destroy the cables or the FASTRACK Supreme.

Since the internal tracks are not designed to support high current (up to 60 A when starting the truck), they will be destroyed.

5.3 FASTRACK Supreme Operational Status

The FASTRACK Supreme operational status is given by the red LED status located next to the SIM connector on the FASTRACK Supreme panel.

The Table 5 below gives the meaning of the various statuses available.

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Table 5: FASTRACK Supreme operational status

LED Status	LED light activity	FASTRACK Supreme Plug & Play status
ON	LED ON permanent	FASTRACK Supreme is switched ON but not registered on the network
	LED Flashing slowly	FASTRACK Supreme is switched ON and registered on the network, but no communication is in progress (Idle mode)
	LED Flashing rapidly	FASTRACK Supreme is switched ON and registered on the network, and a communication is in progress
OFF	LED OFF	FASTRACK Supreme is switched OFF, or Flash LED is disabled* by the user.

* : Flash LED can be disabled by user when in Slow Standby mode in order to save power consumption. For detail, please refer to Section 7.9.

5.4 Echo Function Disabled

If no echo is displayed when entering an AT command, that means:

- The "local echo" parameter of your communication software (such as HyperTerminal) is disabled.
- The FASTRACK Supreme echo function is disabled.

To enable the FASTRACK Supreme echo function, enter the **ATE1**.

When sending AT commands to the FASTRACK Supreme by using a communication software, it is recommended:

- to disable the "local echo" parameter of your communication software (such as HyperTerminal),
- to enable the FASTRACK Supreme echo function (**ATE1** command).

In a Machine To Machine communication with the FASTRACK Supreme, it is recommended to disable the FASTRACK Supreme echo function (**ATE0** command) in order to avoid useless CPU processing.

For further information on **ATE0** and **ATE1** commands, refer to "AT Commands Interface Guide" [6].

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5.5 Verify the Received Signal Strength

The FASTRACK Supreme establishes a call only if the received signal is sufficiently strong.

To verify the received signal strength, do the following operations:

- Using a communication software such as HyperTerminal, enter the AT command **AT+CSQ.**
  The response returned has the following format:
  +CSQ: <rssi>,<ber> with:
  - **<rssi>** = received signal strength indication,
  - **<ber>** = channel bit error rate.
- Verify the **<rssi>** value returned using the Table 6 below.

Table 6: Values of received signal strength

Value of received signal strength indication (<rssi>)	Interpretation of the received signal strength
0 - 10	Insufficient(*)
11 - 31	Sufficient(*)
32 - 98	Not defined
99	No measure available

(*) Based on general observations.

For further information on AT commands, refer to "AT Commands Interface Guide" [6].

5.6 Check the Pin Code Status

To check that the pin code has been entered, use a communication software such as a HyperTerminal, then enter **AT+CPIN?** command.

The table below gives the main responses returned:

Table 7: AT+CPIN Responses

AT+CPIN response (*)	Interpretation
+CPIN: READY	Code PIN has been entered
+CPIN: SIM PIN	Code PIN has not been entered

(*)For further information on the other possible responses and their meaning, refer to "AT Commands Interface Guide" [6].

5.7 Switch between EU/US Band(s)

To switch between EU/US band(s) for the FASTRACK Supreme, use a communication software such as a HyperTerminal, then enter **AT+WMBS=<band>[,<param>]** command.

The table below gives the commands for various band(s) selection:

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Table 8: AT+WMBS Band Selection

AT+WMBS response (*)	Interpretation
AT+WMBS=0,x	Select mono band mode 850MHz.
AT+WMBS=1,x	Select mono band mode extended 900MHz
AT+WMBS=2,x	Select mono band mode 1800MHz
AT+WMBS=3,x	Select mono band mode 1900MHz
AT+WMBS=4,x	Select dual band mode 850/1900MHz
AT+WMBS=5,x	Select dual band mode extended 900MHz/1800MHz
AT+WMBS=6,x	Select dual band mode extended 900MHz/1900MHz

(*)For further information on the other possible responses and their meaning, refer to "AT Commands Interface Guide" [6].

Remark:

x=0 : The Plug & Play will have to be reset to start on specified band(s).

x=1 : The change is effective immediately. This mode is forbidden while in communication and during Plug & Play initialization.

Refer to "AT Commands Interface Guide" [6] for further information on AT commands.

5.8 Check the Band(s) Selection

To check the band selection for the FASTRACK Supreme, use a communication software such as a HyperTerminal, then enter **AT+WMBS?** command.

The table below gives the main responses returned:

Table 9: AT+WMBS Responses

AT+WMBS response (*)	Interpretation
+WMBS: 0,x	Mono band mode 850MHz is selected
+WMBS: 1,x	Mono band mode extended 900MHz is selected
+WMBS: 2,x	Mono band mode 1800MHz is selected
+WMBS: 3,x	Mono band mode 1900MHz is selected
+WMBS: 4,x	Dual band mode 850/1900MHz are selected
+WMBS: 5,x	Dual band mode extended 900MHz/1800MHz are selected
+WMBS: 6,x	Dual band mode extended 900MHz/1900MHz are selected

(*)For further information on the other possible responses and their meaning, refer to "AT Commands Interface Guide" [6].

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5.9 Verify the FASTRACK Supreme Network Registration

1. Make sure a valid SIM card has been previously inserted and locked in the FASTRACK Supreme SIM card holder.
2. Using a communication software such as a HyperTerminal, enter the following AT commands:
   a. **AT+CPIN=xxxx** to enter PIN code xxxx.
   b. **AT+WMBS?** To check the current band setting in the Plug & Play
   c. **AT+WMBS=<Band>[,<param>]** To switch band/mode when needed
   d. **AT+CREG?.** To ascertain the registration status.

      The format of the returned response is as follows:

      +CREG: <mode>,<stat> with:

   - ***<mode>*** = unsolicited registration message configuration,
   - ***<stat>*** = registration state.
3. Verify the state of registration according the returned value given in the table below.

Table 10: Values of network registration

Returned Value (*) <mode>,<stat>	Network registration
+CREG: 0,0	No (not registered)
+CREG: 0,1	Yes (registered, home network)
+CREG: 0,5	Yes (registered, roaming)

(*)For further information on the other returned values and their meaning, refer to "AT Commands Interface Guide" [6].

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If the FASTRACK Supreme is not registered, perform the following procedure:

- Check the connection between the FASTRACK Supreme and the antenna.
- Verify the signal strength to determine the received signal strength (refer to Section 5.5).

Note: For information on AT command relating to the network registration in GPRS mode, and in particular: CGREG, CGCLASS, CGATT, refer to "AT Commands Interface Guide" [6].

5.10 Main AT Commands for the Plug & Play

The table below lists the main AT commands required for starting the Plug & Play.

For other AT commands available or further information on the AT commands, refer to "AT Commands Interface Guide" [6].

Table 11: Main usual AT commands for the Plug & Play

Description	AT commands	FASTRACK Supreme Plug & Play response	Comment
Check for selected band(s)	AT+WMBS?	+WMBS:<Band>,<ResetFlag> OK	Current selected band mode is return
Band(s) switch	AT+WMBS=<Band>	OK	Band switch is accepted, Plug & Play has to be reset for change to be effective
	AT+WMBS=<Band>,0	OK	Band switch is accepted, Plug & Play has to be reset for change to be effective
	AT+WMBS=<Band>,1	OK	Band switch is accepted and GSMS stack restarted
	AT+WMBS=<Band>	+CME ERROR: 3	Band not allowed
Enter PIN Code	AT+CPIN=xxxx (xxxx = PIN code)	OK	PIN Code accepted.
		+CME ERROR: 16	Incorrect PIN Code (with +CMEE = 1 mode) (1*)
		+CME ERROR: 3	PIN code already entered (with +CMEE = 1 mode) (1*)
Network registration checking	AT+CREG?	+CREG: 0,1	FASTRACK Supreme Plug & Play registered on the network.
		+CREG: 0,2	FASTRACK Supreme Plug & Play not registered on the network, registration attempt.

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Description	AT commands	FASTRACK Supreme Plug & Play response	Comment
		+CREG: 0,0	FASTRACK Supreme Plug & Play not registered on the network, no registration attempt.
Receiving an incoming call	ATA	OK	Answer the call.
Initiate a call	ATD<phone number>; (Don't forget the « ; » at the end for « voice » call)	OK	Communication established.
		+CME ERROR: 11	PIN code not entered (with +CMEE = 1 mode).
		+CME ERROR: 3	AOC credit exceeded or a communication is already established.
Initiate an emergency call	ATD112; (Don't forget the « ; » at the end for « voice » call)	OK	Communication established.
Communication loss		NO CARRIER	
Hang up	ATH	OK	
Store the parameters in EEPROM	AT&W	OK	The configuration settings are stored in EEPROM.

(1*) The command "AT+CMEE=1" switch to a mode enabling more complete error diagnostics.

5.11 Firmware Upgrade Procedure

The firmware upgrade procedure is used to update the firmware embedded into the FASTRACK Supreme.

That procedure consists in downloading the firmware into internal memories through the RS232 serial link available on the SUB-D 15-pin connector.

Refer to "Firmware upgrade procedure" [8] for a detailed description of this procedure.

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6 Troubleshooting

This section of the document describes possible problems encountered when using the FASTRACK Supreme and their solutions.

To review other troubleshooting information, refer the 'FAQs' (Frequently Asked Questions) page at www.wavecom.com or use the following link:
http://www.wavecom.com/support/faqs.php

6.1 No Communication with the FASTRACK Supreme through the Serial Link

If the FASTRACK Supreme does not answer to AT commands through the serial link, refer to the table below for possible causes and solutions.

Table 12: Solutions for no connection with FASTRACK Supreme through serial link

If the Supreme returns	then ask	Action
Nothing	Is the FASTRACK Supreme powered correctly?	Make sure the external power supply is connected to the FASTRACK Supreme and provides a voltage in the range of 5.5 V to 32 V.
	Is the serial cable connected at both sides?	Check the serial cable connection
	Does the serial cable follow correctly pin assignment shown in paragraph 3.2.1.2.	Connect the cable by following pin assignment given in paragraph 3.2.1.1.
Nothing or non-significant characters	Is the communication program properly configured on PC?	Ensure the setting of the communication program is fit to setting of FASTRACK Supreme. FASTRACK Supreme factory setting is: Data bits = 8 Parity = none Stop bits = 1 Baud = 115 200 bps. Flow control = hardware
	Is there another program interfering with the communication program (i.e. Conflict on communication port access)	Close the interfering program.

6.2 Receiving "ERROR" Message

The FASTRACK Supreme returns an "**ERROR**" message (in reply to an AT command) in the following cases:

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- AT command syntax is incorrect: check the command syntax (refer to "AT Commands Interface Guide" [6]),
- AT command syntax is correct, but transmitted with wrong parameters:
- Enter the **AT+CMEE=1** command in order to change the error report method to the verbose method, which includes the error codes.
- Enter again the AT command which previously caused the reception of "ERROR" message in order to get the Mobile Equipment error code.

When the verbose error report method is enabled, the response of the FASTRACK Supreme in case of error is as follows:

- Either +CME ERROR: <error result code>,
- Or +CMS ERROR: <error result code>.

Refer to "AT Commands Interface Guide" [6] for error result code description and further details on the **AT +CMEE** command.

Note: It is strongly recommended to always enable the verbose error report method to get the Mobile Equipment error code (enter **AT +CMEE=1** command).

6.3 Receiving "NO CARRIER" Message

If the FASTRACK Supreme returns a **"NO CARRIER"** message upon an attempted call (voice or data), then refer to the table below for possible causes and solutions.

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Table 13: Solutions for "NO CARRIER" message

If the Supreme returns…	Then ask…	Action…
"**NO CARRIER**"	Is the received signal strong enough?	Refer to section 5.5 to verify the strength of the received signal.
	Is the FASTRACK Supreme registered on the network?	Refer to section 5.9 to verify the registration.
	Is the antenna properly connected?	Refer to section 8.2.7.3 for antenna requirements.
	Is the band selection correction?	Refer to Section 7.2 for band switch
"**NO CARRIER**" (when trying to issue a voice communication)	Is the semicolon (;) entered immediately after the phone number in the AT command?	Ensure that the semicolon (;) is entered immediately after the phone number in the AT command. e.g. **ATD######;**
"**NO CARRIER**" (when trying to issue a data communication)	Is the SIM card configured for data / fax calls?	Configure the SIM card for data / fax calls (Ask your network provider if necessary).
	Is the selected bearer type supported by the called party?	Ensure that the selected bearer type is supported by the called party.
	Is the selected bearer type supported by the network?	Ensure that the selected bearer type is supported by the network. If no success, try bearer selection type by AT command: AT+CBST=0,0,3

If the FASTRACK Supreme returns a "**NO CARRIER"** message, you may have the **extended error code** by using AT command **AT+CEER**. Refer to the table below for interpretation of **extended error code**.

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Table 14: Interpretation of extended error code

Error Code	Diagnostic	Hint
1	Unallocated phone number	
16	Normal call clearing	
17	User busy	
18	No user responding	
19	User alerting, no answer	
21	Call rejected	
22	Number changed	
31	Normal, unspecified	
50	Requested facility not subscribed	Check your subscription (data subscription available?).
68	ACM equal or greater than ACMmax	Credit of your pre-paid SIM card expired.
252	Call barring on outgoing calls	
253	Call barring on incoming calls	
3, 6, 8, 29, 34, 38, 41, 42, 43, 44, 47, 49, 57, 58, 63, 65, 69, 70, 79, 254	Network causes	See "AT Commands Interface Guide" [6] for further details or call network provider.

Note: For all other codes, and/or details, see AT commands documentation [6].

7 Functional Description

7.1 Architecture

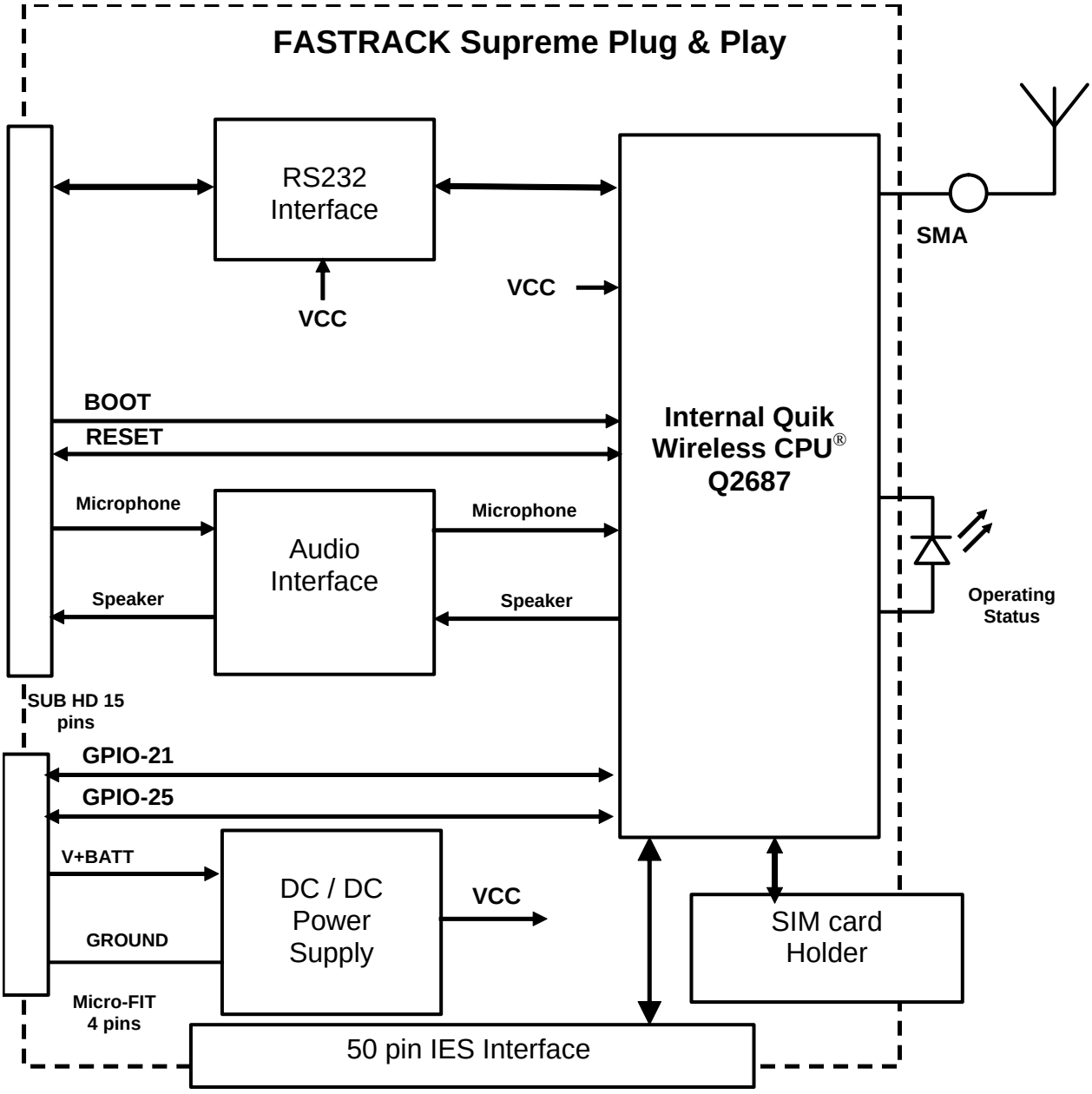


Figure 15: Functional architecture

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7.2 EU and US Bands

7.2.1 General Presentation

The FASTRACK Supreme is a quad band Plug & Play. It supports either EU bands (EGSM900/DCS1800) or US bands (GSM850/ PCS1900), depending on the band setting within the Plug & Play. Users are free to switch between EU bands and US bands by simple AT commands when the selected bands are supported.

7.2.2 AT COMMAND for Bands Switch

EU/US band is easily switched/checked by AT command **AT+WMBS**.

For detail, please refer to Section 5.7 and 5.8.

7.3 Power Supply

7.3.1 General Presentation

The FASTRACK Supreme is supplied by an external DC voltage (V+BATTERY) from +5.5 V to +32 V at 2.2 A.

Main regulation is made with an internal DC/DC converter in order to supply all the internal functions with a DC voltage.

Correct operation of the FASTRACK Supreme in communication mode is not guaranteed if input voltage (V+BATTERY) falls below 5.5 V.

Note: The minimum input voltage specified here is at the FASTRACK Supreme input. Be careful of the input voltage decrease caused by the power cable. See paragraph 8.2.1 for more information.

7.3.2 Protections

The FASTRACK Supreme is protected by a 800 mA / 250 V fuse directly bonded on the power supply cable.

The FASTRACK Supreme is also protected against voltage over +32 V.

Filtering guarantees:

- EMI/RFI protection in input and output,
- Signal smoothing.

7.4 RS232 Serial Link

7.4.1 General Presentation

The RS232 interface performs the voltage level adaptation (V24/CMOS ⇔ V24/V28) between the internal FASTRACK Supreme Plug & Play (DCE) and the external world (DTE).

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The RS232 interface is internally protected (by ESD protection) against electrostatic surges on the RS232 lines.

Filtering guarantees:

- EMI/RFI protection in input and output,
- Signal smoothing.

Signals available on the RS232 serial link are:

- TX data (CT103/TX),
- RX data (CT104/RX),
- Request To Send (CT105/RTS),
- Clear To Send (CT106/CTS),
- Data Terminal Ready (CT108-2/DTR),
- Data Set Ready (CT107/DSR),
- Data Carrier Detect (CT109/DCD),
- Ring Indicator (CT125/RI).

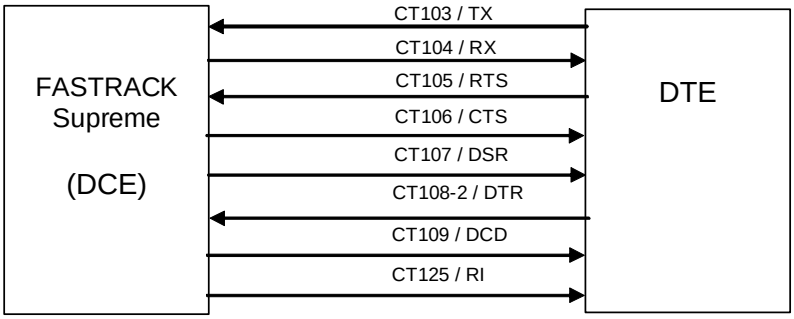


Figure 16: RS232 Serial Link signals

RS232 interface has been designed to allow flexibility in the use of the serial interface signals. However, the use of TX, RX, CTS and RTS signals is mandatory, which is not the case for DTR, DSR, DCD and RI signals which can be not used.

7.4.2 Autobauding Mode

The autobauding mode allows the FASTRACK Supreme to detect the baud rate used by the DTE connected to the RS232 serial link.

Autobauding mode is controlled by AT commands. See "AT Commands Interface Guide" [6] for details on this function.

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7.4.3 Pin Description

Signal	Sub HD connector Pin number	I/O	I/O type RS232 STANDARD	Description
CTXD/CT103	2	I	TX	Transmit serial data
CRXD/CT104	6	O	RX	Receive serial data
CRTS/CT105	12	I	RTS	Request To Send
CCTS/CT106	11	O	CTS	Clear To Send
CDSR/CT107	7	O	DSR	Data Set Ready
CDTR/CT108-2	8	I	DTR	Data Terminal Ready
CDCD/CT109	1	O	DCD	Data Carrier Detect
CRI/CT125	13	O	RI	Ring Indicator
CT102/GND	9		GND	Ground

7.4.4 Serial Port Auto shut down Feature

The UART1 can be shut down when there is no activity between the DTE and the FASTRACK Supreme Plug & Play. This can help for improving power consumption performance.

Serial Port Auto shut down feature is easily controlled by AT command **AT+WASR**.

- **AT+WASR=1** for entering the serial port auto shut down mode
- **AT+WASR=0** for exiting the serial port auto shut down mode

Refer to "AT Commands Interface Guide" [6] for further information on AT commands.

CAUTION: GPIO24 is reserved for serial port auto shut down feature. It is prohibited for customer use. Improper access to GPIO24 by customer may lead to unexpected behavior on UART1 performance.

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7.5 General Purpose Input/Output (GPIO)

The FASTRACK Supreme provides two General Purpose Input / Output lines available for external use: GPIO21 and GPIO25.

These GPIOs may be controlled by AT commands:

- **AT+WIOW** for a write access to the GPIO value, when the GPIO is used as an output,
- **AT+WIOR** for a read access to the GPIO value, when the GPIO is used as an input.

Refer to "AT Commands Interface Guide" [6] for further information on AT commands.

After reset, both GPIOs are configured as inputs. The **AT+WIOM** command has to be used to change this configuration (refer to "AT Commands Interface Guide" [6] for further details).

Pin description

Signal	Power Supply connector (4-pin Micro-Fit)	I/O	I/O Voltage	Reset state	Description	Mulitplex with
GPIO21	3	I/O	2V8	Undefined	General Purpose I/O	No mux
GPIO25	4	I/O	2V8	Z	General Purpose I/O	INT1

Notes:

- The power supply cable may need to be modified due to the GPIO signals (GPIO21 & GPIO25) available on the 4-pin Micro-FIT connector of the FASTRACK Supreme.
- The previous generation M1306B have GPIO4 and GPIO5 being replaced by GPIO21 and GPIO25 respectively, for which both are of LOW level at reset state.

7.6 BOOT

This signal must not be connected. Its use is strictly reserved to Wavecom or competent retailers.

Caution: Previous generation M1306B has BOOT signal of HIGH level at 2.8V. But the FASTRACK Supreme now of 1.8V BOOT instead.

7.7 RESET

7.7.1 General presentation

This signal is used to force a reset procedure by providing low level during at least 200 µs.

This signal must be considered as an emergency reset only. A reset procedure is automatically driven by an internal hardware during the power-up sequence.

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This signal may also be used to provide a reset to an external device. It then behaves as an output. If no external reset is necessary, this input may be left open, if used (emergency reset), it has to be driven either by an open collector or an open drain output:

- RESET pin 14 = 0, for FASTRACK Supreme Reset,
- RESET pin 14 = 1, for normal mode.

Pin description

Signal	Sub HD 15-Pin connector Pin number	I/O	I/O type	Voltage	Description
RESET	14	I/O	Open Drain	1V8	FASTRACK Supreme Reset

Caution: Previous generation M1306B has RESET signal of HIGH level at 2.8V. But the FASTRACK Supreme now of 1.8V RESET instead.

Additional comments on RESET:

The RESET process is activated either by the external RESET signal or by an internal signal (coming from a RESET generator). This automatic reset is activated at Power-up.

The FASTRACK Supreme remains in RESET mode as long as the RESET signal is held low.

Caution: This signal should be used only for "emergency" reset.

A software reset is always preferred to a hardware reset.

Note: See "AT Commands Interface Guide" [6] for further information on software reset.

7.7.2 Reset Sequence

To activate the "emergency" reset sequence, the RESET signal has to be set to low for 200 µs minimum.

As soon as the reset is done, the AT interface answers "OK" to the application. For this, the application must send **AT↵.**

If the application manages hardware flow control, the AT command may be sent during the initialization phase. Another solution is to use the **AT+WIND** command to get an unsolicited status from the FASTRACK Supreme.

For further details, refer to AT commands "AT Commands Interface Guide" [6].

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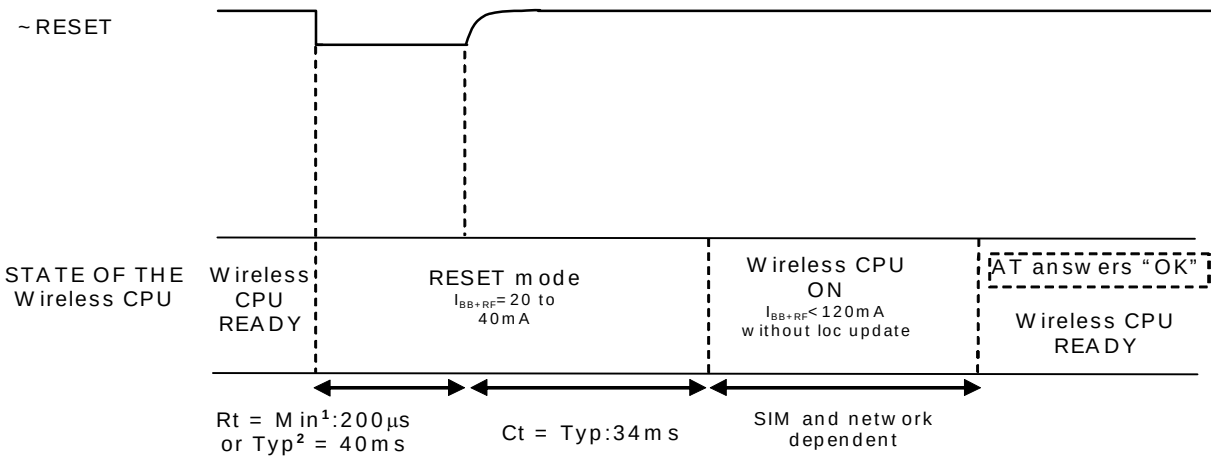


Figure 17: Reset sequence diagram

7.8 Audio

Audio interface is a standard one for connecting a phone handset.

Echo cancellation and noise reduction features are also available to improve the audio quality in case of hand-free application.

7.8.1 Microphone Inputs

The microphone inputs are differential ones in order to reject common mode noise and TDMA noise.

They already include the convenient biasing for an electret microphone (0.5 mA and 2 Volts) and are ESD protected.

This electret microphone may be directly connected to these inputs allowing an easy connection to a handset.

The microphone impedance must be around 2 kΩ.

AC coupling is already embedded in the Wireless CPU®.

The gain of the microphone inputs is internally adjusted and may be tuned from 30 dB to 51 dB using an **AT +VGT** command (refer to AT commands documentation [6]).

Pin description

Signal	Sub D 15-pin Pin #	I/O	I/O type	Description
CMIC2P	4	I	Analog	Microphone positive input
CMIC2N	5	I	Analog	Microphone negative input

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7.8.2 Speaker Outputs

This connection is differential to reject common mode noise and TDMA noise.

Speaker outputs are connected to internal push-pull amplifiers and may be loaded down between 32 to 150 Ohms and up to 1 nF (see details in table *Speaker gain vs Max output voltage,* in "AT Commands Interface Guide" [6]). These outputs may be directly connected to a speaker.

The output power may be adjusted by step of 2 dB. The gain of the speaker outputs is internally adjusted and may be tuned using an **AT +VGR** command (refer to AT commands documentation [6]).

Pin description

Signal	Sub D 15-pin Pin #	I/O	I/O type	Description
CSPK2P	10	O	Analog	Speaker positive output
CSPK2N	15	O	Analog	Speaker negative output

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7.9 Real Time Clock (RTC)

The FASTRACK Supreme has now implemented the Real Time Clock for saving date and time when the Plug & Play is unplugged from the DC power supply through the DC power cable.

Item		Min	Typical	Max
Charging Time start from fully discharged to fully charged			940 min	
RTC Time Period*	Guarantee		2475 min	
	Non-guarantee		5225 min	

Remark: The RTC time period is measured from the RTC battery is fully charged before being unplugged from the DC power source.

7.10 FLASH LED

The FASTRACK Supreme has a red LED indicator to show the status of the GSM network. For detail description of the various status, please refer to Section 5.3.

However, during operation mode of Slow Standby, there will be no network registration and so the red LED indicator will always be ON. It is possible for user to deactivate the LED indication during Slow Standby mode, in order to reduce power consumption.

The Flash LED can be deactivated by AT command *at+whcnf=1,0*
The Flash LED can be activated by AT command *at+whcnf=1,1*

However, the new setting will be taken into account only after a restart. For detail, please refer to Document[6].

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8 Technical Characteristics

8.1 Mechanical Characteristics

Table 15: Mechanical characteristics

Dimensions	73 x 54.5 x 25.5 mm (excluding connectors)
Overall Dimension	88 x 54.5 x 25.5 mm
Weight	≈ 80 grams (FASTRACK Supreme only) < 120 grams (FASTRACK Supreme + bridles + power supply cable)
Volume	101.5 cm^3
Housing	Aluminum profiled

The next page gives the dimensioning diagram of the FASTRACK Supreme including the clearance areas to take into account for the FASTRACK Supreme installation.

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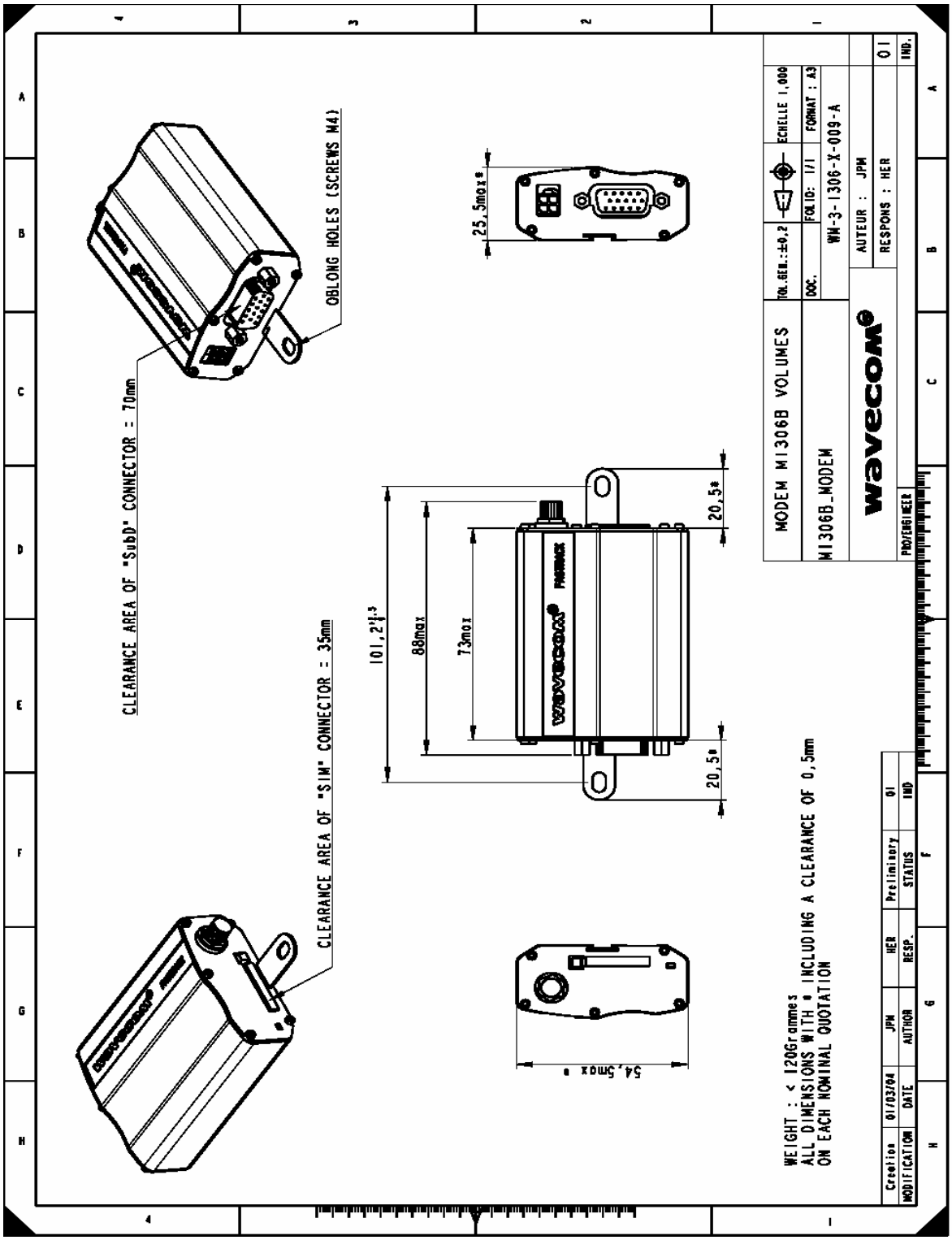


Figure 18: Dimensioning diagram

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8.2 Electrical Characteristics

8.2.1 Power Supply

Table 16: Electrical characteristics

Operating Voltage ranges	5.5 V to 32 V DC.
Maximum current	480 mA Average at 5.5V. 2.1 A Peak at 5.5 V. (TBC)

Note:

The FASTRACK Supreme is permanently powered once the power supply is connected. The following table describes the consequences of over-voltage and under-voltage with the FASTRACK Supreme.

Warning:

All the input voltages specification described in this Section are at the FASTRACK Supreme input. While powering the FASTRACK Supreme, take into account the input drop caused by the power cable. With the delivered cable, this input drop is around 700 mV at 5.5 V and 220 mV at 32V.

Table 17: Effects of power supply defect

If the voltage	then
falls below 5.5 V,	the GSM communication is not guaranteed.
is over 32 V (Transient peaks),	the FASTRACK Supreme guarantees its own protection.
Is over 32 V (continuous overvoltage)	the protection of the FASTRACK Supreme is done by the fuse (the supply voltage is disconnected).

The fuse is a 800 mA / 250 V FAST-ACTING 5*20mm. See Section 10 for recommended references.

The following table provides information on power consumption of the FASTRACK Supreme, assuming an operating temperature of +25 °C and using a 3 V SIM card.

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8.2.2 Power Consumption

The following table provides information on power consumption of the FASTRACK Supreme, assuming an operating temperature of +25 °C and using a 3 V SIM card.

Table 18: Power consumption (1*)

Power Consumption in E-GSM 900/DCS 1800 MHz - GPRS class 10				E-GSM 900	DCS 1800
GSM	I_{peak}	**GSM900**: During **TX** bursts @ **PCL5** **DCS1800** : During **TX** bursts @ **PCL0**	@ 5.5V	TBC	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
	I_{avg}	**GSM900 : Average @ PCL5** **DCS1800 : Average @ PCL0**	@ 5.5V	TBC	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
GPRS Class 2	I_{peak}	**GSM900**: During **1TX** bursts @ **PCL5** **DCS1800** : During **1TX** bursts @ **PCL0**	@ 5.5V	TBC	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
	I_{avg}	GSM900 : **Average 1TX/1RX @PCL5** DCS1800 : **Average 1TX/1RX @PCL0**	@ 5.5V	TBC	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
GPRS Class 10	I_{peak}	**GSM900**: During 2**TX** bursts @ **PCL5 (Gamma 3)** **DCS1800** : During 2**TX** bursts @ **PCL0 (Gamma 2)**	@ 5.5V	TBC	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
	I_{avg}	GSM900 : **Average 2TX/3RX @ PCL5 (Gamma 3)** DCS1800 : **Average 2TX/3RX @ PCL0 (Gamma 2)**	@ 5.5V	TBC	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
EGPRS Class 2	I_{peak}	**GSM900**: During **1TX** bursts @ **PCL8 (Gamma 6)** **DCS1800** : During **1TX** bursts @ **PCL2 (Gamma 5)**	@ 5.5V	TBC	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
	I_{avg}	GSM900 : **Average 1TX/1RX @ PCL8 (Gamma 6)** DCS1800 : **Average 1TX/1RX @ PCL2 (Gamma 5)**	@ 5.5V	TBC	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC

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Power Consumption in E-GSM 900/DCS 1800 MHz - GPRS class 10				E-GSM 900	DCS 1800
EGPRS Class 10	I_{peak}	**GSM900**: During **2TX** bursts @ **PCL8 (Gamma 6)** **DCS1800** : During 2**TX** bursts @ **PCL2 (Gamma 5)**	@ 5.5V	TBC	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
	I_{avg}	GSM900 : **Average 2TX/3RX @ PCL8 (Gamma 6)** DCS1800 : **Average 2TX/3RX @ PCL2 (Gamma 5)**	@ 5.5V	TBC	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
I_{avg} in Fast Idle mode Page 9 (2*)		Serial port auto shut down deactivated	@ 5.5V	33	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
		Serial port auto shut down activated	@ 5.5V	17	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
I_{avg} in Slow Idle mode Page 9 (3*)		Serial port auto shut down deactivated	@ 5.5V	23	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
		Serial port auto shut down activated	@ 5.5V	5	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
I_{avg} in Fast Standby mode (4*)		Serial port auto shut down deactivated	@ 5.5V	52	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC
		Serial port auto shut down activated	@ 5.5V	35	TBC
			@ 13.2V	TBC	TBC
			@ 32V	TBC	TBC

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Power Consumption in E-GSM 900/DCS 1800 MHz - GPRS class 10			E-GSM 900	DCS 1800
I_{avg} in Slow Standby mode (with FLASH LED activated) (4*)	Serial port auto shut down deactivated	@ 5.5V	24	TBC
		@ 13.2V	TBC	TBC
		@ 32V	TBC	TBC
	Serial port auto shut down activated	@ 5.5V	8	TBC
		@ 13.2V	TBC	TBC
		@ 32V	TBC	TBC
I_{avg} in Slow Standby mode (with FLASH LED deactivated) (4*)	Serial port auto shut down deactivated	@ 5.5V	TBC	TBC
		@ 13.2V	TBC	TBC
		@ 32V	TBC	TBC
	Serial port auto shut down activated	@ 5.5V	4	TBC
		@ 13.2V	TBC	TBC
		@ 32V	TBC	TBC

(1*):The power consumption might vary by 5 % over the whole operating temperature range (-20 °C to +55 °C).
(2*): In this Mode, the RF function is active and the FASTRACK Supreme synchronized with the network, but there is no communication.
(3*): In this Mode, the RF function is disabled, but regularly activated to keep the synchronization with the network. This Mode works only when the DTE send AT command to shut down the serial link by software approach (DTE turns DTR in inactive state).
(4*): In this Mode, the RF function is disabled, and there is no synchronization with the network.

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8.2.3 Audio Interface

The audio interface is available through the Sub HD 15-pin connector.

Table 19: Audio parameters caracteristics

Audio parameters	Min	Typ	Max	Unit	Comments
Microphone input current @2 V/2 kΩ		0.5		mA	
Absolute microphone input voltage			100	mVpp	AC voltage
Speaker output current 150 Ω //1 nF		16		mA	
Absolute speaker impedance	32	50		Ω	
Impedance of the speaker amplifier output in differential mode			1	Ω	+/-10 %

Table 20: Microphone inputs internal audio filter characteristics

Frequency	Gain
0-150 Hz	< -22 dB
150-180 Hz	< -11 dB
180-200 Hz	< -3 dB
200-3700 Hz	0 dB
>4000 Hz	< -60 dB

Table 21: Recommended characteristics for the microphone:

Feature	Value
Type	Electret 2 V / 0.5 mA
Impedance	Z = 2 kΩ
Sensitivity	-40 dB to –50 dB
SNR	> 50 dB
Frequency response	compatible with the GSM specifications

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Table 22: Recommended characteristics for the speaker:

Feature	Value
Type	10 mW, electro-magnetic
Impedance	Z = 32 to 50 Ω
Sensitivity	110 dB SPL min. (0 dB = 20 µPa)
Frequency response	compatible with the GSM specifications

8.2.4 General Purpose Input/Output

Both GPIO21 and GPIO25 may be interfaced with a component that comply with 3 Volts CMOS levels.

Table 23: Operating conditions

Parameter	I/O type	Min	Typ	Max	Condition
V_{IL}	CMOS			0.84 V	
V_{IH}	CMOS	1.96 V			
V_{OL}	CMOS			0.4 V	I_{OL} = -4 mA
V_{OH}	CMOS	2.4 V			I_{OH} = 4 mA
I_{OH}				4mA	
I_{OL}				-4mA	

Clamping diodes are present on I/O pads.

8.2.5 SIM Interface

Table 24: SIM card characteristics

SIM card	1.8V / 3 V

8.2.6 RESET Signal

Table 25: Electrical characteristics

Parameter	Min	Typ	Max	Unit
Input Impedance (R)*		330K		kΩ
Input Impedance (C)		10n		nF

*Internal pull-up

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Table 26: Operating conditions

Parameter	Minimum	Typ	Maximum	Unit
~RESET time (Rt) [1]	200			µs
~RESET time (Rt) [2] at power up only	20	40	100	ms
Cancellation time (Ct)		34		ms
V_H	0.57			V
V_{IL}	0		0.57	V
V_{IH}	1.33			V

* $V_{H:}$ Hysterisis Voltage

1 This reset time is the minimum to be carried out on the ~RESET signal when the power supply is already stabilized.

2 This reset time is internally carried out by the Wireless CPU power supply supervisor only when the Wireless CPU power supplies are powered ON.

8.2.7 RF Characteristics

8.2.7.1 Frequency Ranges

Table 27: Frequency ranges

Characteristic	GSM 850	E-GSM 900	DCS 1800	PCS 1900
Frequency TX	824 to 849 MHz	880 to 915 MHz	1710 to 1785 MHz	1850 to 1910 MHz
Frequency RX	869 to 894 MHz	925 to 960 MHz	1805 to 1880 MHz	1930 to 1990 MHz

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8.2.7.2 RF Performances

RF performances are compliant with the ETSI recommendation GSM 05.05.

The RF performances for receiver and transmitter are given in the table below.

Table 28: Receiver and transmitter RF performances

Receiver	
E-GSM900/GSM850 Reference Sensitivity	-104 dBm Static & TUHigh
DCS1800/PCS1900 Reference Sensitivity	-102 dBm Static & TUHigh
Selectivity @ 200 kHz	> +9 dBc
Selectivity @ 400 kHz	> +41 dBc
Linear dynamic range	63 dB
Co-channel rejection	>= 9 dBc
Transmitter	
Maximum output power (E-GSM 900/GSM850) at ambient temperature	33 dBm +/- 2 dB
Maximum output power (DCS1800/PCS1900) at ambient temperature	30 dBm +/- 2 dB
Minimum output power (E-GSM 900/GSM850) at ambient temperature	5 dBm +/- 5 dB
Minimum output power (DCS1800/PCS1900) at ambient temperature	0 dBm +/- 5 dB

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8.2.7.3 External Antenna

The external antenna is connected to the FASTRACK Supreme via the SMA connector.

The external antenna must fulfill the characteristics listed in the table below.

Table 29: **External antenna characteristics**

Antenna frequency range	Quad-band GSM 850/GSM900/DCS1800/PCS1900 MHz
Impedance	50 Ohms nominal
DC impedance	0 Ohm
Gain (antenna + cable)	0 dBi
VSWR (antenna + cable)	2

Note: Refer to Section 10 for recommended antenna.

8.3 Environmental Characteristics

The FASTRACK Supreme Plug & Play is compliant with the following operating class. To ensure the proper operation of the FASTRACK Supreme, the temperature of the environment must be within a specific range as described in the table below.

Table 30: Ranges of temperature

Conditions	Temperature range
Operating / Class A	-20 °C to +55°C
Operating / Class B	-30 °C to +85°C
Storage	-40 °C to +85°C

Function Status Classification:

Class A:

The FASTRACK Supreme remains fully functional, meeting GSM performance criteria in accordance with ETSI requirements, across the specified temperature range.

Class B:

The FASTRACK Supreme remains fully functional, across the specified temperature range. Some GSM parameters may occasionally deviate from the ETSI/PTCRB specified requirements and this deviation does not affect the ability of the FASTRACK Supreme to connect to the cellular network and function fully, as it does within the Class A range.

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The detailed climatic and mechanics standard environmental constraints applicable to the FASTRACK Supreme are listed in the table below:

Table 31: Environmental standard constraints

Environmental Tests (IEC TR 60721-4)		**Environmental Classes (IEC 60721-3)**			
Tests	**Standards**	**Storage (IEC 60721-3-1) Class IE13**	**Transportation** (IEC 60721-3-2) Class IE23	**Operation**	
				Stationary (IEC 60721-3-3) **Class IE35**	Non-Stationary **(IEC 60721-3-7) Class IE73**
Cold	IEC 60068-2-1 : Ab/Ad	-25°C, 16 h	-40°C, 16 h	-5°C, 16 h	-5°C, 16 h
Dry heat	IEC 60068-2-2 : Bb/Bd	+70°C, 16 h	+70°C, 16 h	+55°C, 16 h	+55°C, 16 h
Change of temperature	IEC 60068-2-14 : Na/Nb	-33°C to ambient 2 cycles, t1=3 h 1 °C.min^{-1}	-40°C to ambient 5 cycles, t1=3 h t2<3 min	-5°C to ambient 2 cycles, t1=3 h 0,5 °C.min^{-1}	-5°C to ambient 5 cycles, t1=3 h t2<3 min
Damp heat	IEC 60068-2-56 : Cb	+30°C, 93% RH 96 h	+40°C, 93% RH 96 h minimum	+30°C, 93% RH, 96 h	+30°C, 93% RH, 96 h
Damp heat, cyclic	60068-2-30 : Db Variant 1 or 2	+40°C, 90% to 100% RH One cycle Variant 2	+55°C, 90% to 100% RH Two cycles Variant 2	+30°C, 90% to 100% RH Two cycles Variant 2	+40°C, 90% to 100% RH Two cycles Variant 1
Vibration (sinusoidal)	IEC 60068-2-6 : Fc	1-200 Hz 2 m.s^{-2} 0,75 mm 3 axes 10 sweep cycles	1-500 Hz 10 m.s^{-2} 3,5 mm 3 axes 10 sweep cycles	1-150 Hz 2 m.s^{-2} 0,75 mm 3 axes 5 sweep cycles	1-500 Hz 10 m.s^{-2} 3,5 mm 3 axes 10 sweep cycles
Vibration (random)	IEC 60068-2-64 : Fh	-	10-100 Hz / 1,0 m^2.s^{-3} 100-200 Hz / -3 dB.octave^{-1} 200-2000 Hz / 0,5 m^2.s^{-3} 3 axes 30 min	-	-
Shock (half-sine)	IEC 60068-2-27 : Ea	-	-	50 m.s^{-2} 6 ms 3 shocks 6 directions	150 m.s^{-2} 11 ms 3 shocks 6 directions
Bump	IEC 60068-2-29 : Eb	-	250 m.s^{-2} 6 ms 50 bumps vertical direction	-	-
Free fall	ISO 4180-2	-	Two falls in each specified attitude	-	2 falls in each specified attitude 0,025 m (<1kg)
Drop and topple	IEC 60068-2-31 : Ec	-	One drop on relevant corner One topple about each bottom edge	-	One drop on each relevant corner One topple on each of 4 bottom edges

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Notes:

Short description of Class IE13 (*For more information see standard IEC 60721-3-1)*

"Locations without controlled temperature and humidity, where heating may be used to raise low temperatures, locations in buildings providing minimal protection against daily variations of external climate, prone to receiving rainfall from carrying wind".

Short description of Class IE23 (*For more information, see standard IEC 60721-3-2)*

"Transportation in unventilated compartments and in conditions without protection against bad weather, in all sorts of trucks and trailers in areas of well developed road network, in trains equipped with buffers specially designed to reduce shocks and by boat".

Short description of Class IE35 (*For more information see standard IEC 60721-3-3)*

"Locations with no control on heat or humidity where heating may be used to raise low temperatures, to places inside a building to avoid extremely high temperatures, to places such as hallways, building staircases, cellars, certain workshops, equipment stations without surveillance".

Short description of Class IE73 (*For more information see standard IEC 60721-3-7)*

"Transfer to places where neither temperature nor humidity are controlled but where heating may be used to raise low temperatures, to places exposed to water droplets, products can be subjected to ice formation, these conditions are found in hallways and building staircases, garages, certain workshops, factory building and places for industrial processes and hardware stations without surveillance".

Warning: The specification in the above table applies to the FASTRACK Supreme product only. Customers are advised to verify that the environmental specification of the SIM Card used is compliant with the FASTRACK Supreme environmental specifications. Any application must be qualified by the customer with the SIM Card in storage, transportation and operation.

The use of standard SIM cards may drastically reduce the environmental conditions in which the Product can be used. These cards are particularly sensible to humidity and temperature changes. These conditions may produce oxidation of the SIM card metallic layers and cause, in the long term, electrical discontinuities. This is particularly true in left alone applications, where no frequent extraction/insertion of the SIM card is performed.

In case of mobility when the application is moved through different environments with temperature variations, some condensation may appear. These events have a negative impact on the SIM and may favor oxidation.

If the use of standard SIM card, with exposition to the environmental conditions described above, can not be avoided, special care must be taken in the integration of the final application in order to minimize the impact of these conditions. The solutions that may be proposed are:

- Lubrication of the SIM card to protect the SIM Contact from oxidation.
- Putting the FASTRACK Supreme Plug & Play in a waterproof enclosure with desiccant bags.

Lubrication of the SIM card had been tested by Wavecom (using Tutela Fluid 43EM from MOLYDUVAL) and gives very good results.

If waterproof enclosure with a desiccant solution is used, check with your desiccant retailer the quantity that must be used according to the enclosure dimensions. Ensure humidity has been removed before sealing the enclosure.

Any solution selected must be qualified by the customer on the final application.

To minimize oxidation problem on the SIM card, its manipulation must be done with the greatest precautions. In particular, the metallic contacts of the card must never be touched with bare fingers or any matter which

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may contain polluted materials liable to produce oxidation (such as, e.g. substances including chlorine). In case a cleaning of the Card is necessary, a dry cloth must be used (never use any chemical substance).

8.4 Conformity

The complete product complies with the essential requirements of article 3 of R&TTE 1999/5/EC Directive and satisfied the following standards:

Domain	Applicable standard
Safety standard	EN 60950 (ed.1999)
Efficient use of the radio frequency spectrum	EN 301 419-(v 4.1.1) EN 301 511 (V 7.0.1)
EMC	EN 301 489–1 (edition 2002) EN 301 489-7 (edition 2002)
Global Certification Forum – Certification Criteria	GCF-CC V3.13.0
PTCRB	
FCC	
IC	

8.5 Protections

8.5.1 Power Supply

The FASTRACK Supreme is protected by a 800 mA / 250 V fuse directly bonded on the power supply cable.

The model of fuse used is: **FSD 800 mA / 250 V FAST-ACTING**.

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8.5.2 Overvoltage

The FASTRACK Supreme is protected against voltage over +32 V.

When input voltages exceed +32 V, the supply voltage is disconnected in order to protect the internal electronic components from an overvoltage.

8.5.3 Electrostatic Discharge

The FASTRACK Supreme withstands ESD according to IEC 1000-4-2 requirements for all accessible parts of the FASTRACK Supreme except the RF part:

- 8 kV of air discharge,
- 4 kV of contact discharge.

8.5.4 Miscellaneous

Filtering guarantees:

- EMI/RFI protection in input and output,
- Signal smoothing.

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9 Safety recommendations

9.1 General Safety

It is important to follow any special regulations regarding the use of radio equipment due in particular to the possibility of radio frequency (RF) interference. Please follow the safety advice given below carefully.

Switch OFF your Wireless CPU®:

- When in an aircraft. The use of cellular telephones in an aircraft may endanger the operation of the aircraft, disrupt the cellular network and is illegal. Failure to observe this instruction may lead to suspension or denial of cellular telephone services to the offender, or legal action or both,
- When at a refueling point,
- When in any area with a potentially explosive atmosphere which could cause an explosion or fire,
- In hospitals and any other place where medical equipment may be in use.

Respect restrictions on the use of radio equipment in:

- Fuel depots,
- Chemical plants,
- Places where blasting operations are in progress,
- Any other area where signalization reminds that the use of cellular telephone is forbidden or dangerous.
- Any other area where you would normally be advised to turn off your vehicle engine.

There may be a hazard associated with the operation of your FASTRACK Supreme Plug & Play close to inadequately protected personal medical devices such as hearing aids and pacemakers. Consult the manufacturers of the medical device to determine if it is adequately protected.

Operation of your FASTRACK Supreme Plug & Play close to other electronic equipment may also cause interference if the equipment is inadequately protected. Observe any warning signs and manufacturers' recommendations.

The FASTRACK Supreme Plug & Play is designed for and intended to be used in "***fixed***" and "***mobile***" applications:

- **"*Fixed*"** means that the device is physically secured at one location and is not able to be easily moved to another location.
- **"*Mobile*"** means that the device is designed to be used in other than fixed locations and generally in such a way that a separation distance of at least 20 cm (8 inches) is normally maintained between the transmitter's antenna and the body of the user or nearby persons.

The FASTRACK Supreme Plug & Play is not designed for and intended to be used in portable applications (within 20 cm or 8 inches of the body of the user) and such uses are strictly prohibited.

9.2 Vehicle Safety

Do not use your FASTRACK Supreme Plug & Play while driving, unless equipped with a correctly installed vehicle kit allowing 'Hands-Free' Operation.

Respect national regulations on the use of cellular telephones in vehicles. Road safety always comes first.

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If incorrectly installed in a vehicle, the operation of FASTRACK Supreme Plug & Play telephone could interfere with the correct functioning of vehicle electronics. To avoid such problems, make sure that the installation has been performed by a qualified personnel. Verification of the protection of vehicle electronics should form part of the installation.

The use of an alert device to operate a vehicle's lights or horn on public roads is not permitted.

9.3 Care and Maintenance

Your FASTRACK Supreme Plug & Play is the product of advanced engineering, design and craftsmanship and should be treated with care. The suggestion below will help you to enjoy this product for many years.

Do not expose the FASTRACK Supreme Plug & Play to any extreme environment where the temperature or humidity is high.

Do not use or store the FASTRACK Supreme Plug & Play in dusty or dirty areas. Its moving parts (SIM holder for example) can be damaged.

Do not attempt to disassemble the Wireless CPU®. There are no user serviceable parts inside.

Do not expose the FASTRACK Supreme Plug & Play to water, rain or spilt beverages. It is not waterproof.

Do not abuse your FASTRACK Supreme Plug & Play by dropping, knocking, or violently shaking it. Rough handling can damage it.

Do not place the FASTRACK Supreme Plug & Play alongside computer discs, credit or travel cards or other magnetic media. The information contained on discs or cards may be affected by the Wireless CPU®.

The use of third party equipment or accessories, not made or authorized by Wavecom may invalidate the warranty of the Wireless CPU®.

Do contact an authorized Service Center in the unlikely event of a fault in the Wireless CPU®.

9.4 Your Responsibility

This FASTRACK Supreme Plug & Play is under your responsibility. Please treat it with care respecting all local regulations. It is not a toy. Therefore, keep it in a safe place at all times and out of the reach of children.

Try to remember your Unlock and PIN codes. Become familiar with and use the security features to block unauthorized use and theft.

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10 Recommended Accessories

Accessories recommended by Wavecom for the FASTRACK Supreme are given in the table below.

Table 32: List of recommended accessories

Designation	Part number	Supplier
Quad-band antenna	1140.26	ALLGON
	MA112VX00	MAT Equipement
	MCA1890 MH/PB/SMA m	HIRSCHMANN
SMA/FME Antenna adaptor		PROCOM
Power adaptor (Europe)	EGSTDW P2 EF9W3 24W Out:12 V - 2A In: 100 to 240 V – 50/60 Hz – 550 mA Mounted with micro-fit connector	EGSTDW (for power adaptor) MOLEX (for micro-fit connector)*
Fuse	F800L250V	Shanghai Fullness
IESM GPS + USB	M13SUE01	WAVECOM
IESM IO + USB	M13SUE02	WAVECOM
IESM IO + USB + GPS	M13SUE03	WAVECOM

* Information not available for this preliminary version.

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11 Online Support

Wavecom provides an extensive range on online support which includes the following areas of Wavecom's wireless expertise:

- the latest version of this document
- new versions of our Operating System user guides
- comprehensive support for Open AT®
- regulatory certifications
- carrier certifications
- application notes

To gain access to this support, simply visit our web site at www.wavecom.com or click on the desire link in Page. Privileged access via user login is provided to Wavecom authorized distributors.

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VpCI™ EMITTING SYSTEMS & ELECTRONIC PRODUCTS

VpCI®-110 Emitter, Patented



PRODUCT DESCRIPTION

Cortec® VpCI-110 emitters are designed to provide corrosion protection for metal components and parts enclosed in non-ventilated control boxes, cabinets, or tool boxes up to 10 cubic feet (283 liters) in volume. The Vapor phase Corrosion Inhibitor (VpCI) emits vapors which form a molecular layer on internal metal surfaces to protect critical, complex, and expensive electronic equipment and other metal components during operation, shipping, or storage. VpCI-110 is a small foam emitter through which corrosion inhibitors are slowly released, and moisture and air pollutants can enter to be absorbed. It provides long-term protection against corrosion even in the presence of adverse conditions including salt, moisture, airborne contaminants, H_2S, SO_2, NH_3, and others.

TYPICAL APPLICATIONS

VpCI-110 can be effectively used for:

- Operations, packaging, and storage electrical equipment
- Marine navigation and communication electronic equipment
- Aerospace electrical controls
- Electric motors
- Switching equipment
- Fuse boxes and power boxes
- Medical equipment
- Electrical wireways and terminal boxes
- Scientific and measuring instruments
- Telecommunications equipment
- Remote electronics devices
- Tool-boxes, parts-storage, and other containers holding metals

FEATURES

- Economical to use
- Provides continuous protection for up to 24 months during operation and/or shutdown
- Effective in polluted and humid environments
- Does not interfere with electrical, optical, or mechanical performance
- Multimetal protection
- Quick and easy installation
- Non-toxic and safe to handle
- Compact and space-saving
- Free of nitrites, halogens, and phosphates
- No spraying, wiping, or dipping required
- Low VOC values
- Meets Southern California Clean Air Act and other National and local regulations
- Self-stick back
- Self-stick date label
- Accepted by FDA for corrosion protection of electrical and electronic equipment within food processing plants
- Canadian Food Inspection Agency acceptance for indirect food contact
- NSN 6850-01-456-2971
- Conforms to MIL I-22110C
- Federal Standard 101, Ardec Technical Report 99-05, Picatinny Arsenal, New Jersey, USA

CORTEC CORPORATION
Environmentally Safe VpCI™/MCI® Technologies

METHOD OF APPLICATION

VpCI-110 is extremely simple and convenient to install. The device should be installed at the earliest possible time. Simply select a space within enclosure where corrosion protection would be useful. Verify the surface is clean and free of debris. Peel off the protective peel strip from the bottom of the device and attach it to the clean surface.

VpCI-110 emitters can be installed in any position. For volumes greater than 10 cubic feet (283 liters), use more than one device. If the enclosure is not totally airtight, or if the access doors are opened frequently, replace the VpCI-110 device more often than every 2 years. After periods of heavy maintenance replace the device. For additional protection spray the enclosure very lightly with ElectriCorr® VpCI-238 or VpCI-239.

SPECIFICATIONS

Packaging	12 individually wrapped emitters per carton
Protection	up to 10 ft^3 (283 liters) per device
Standard Size	Foam device with adhesive backing 2.5″ D x 2″ H (6.4 cm D x 5 cm H)

FOR INDUSTRIAL USE ONLY

KEEP OUT OF REACH OF CHILDREN

KEEP CONTAINER TIGHTLY SEALED

NOT FOR INTERNAL CONSUMPTION

CONSULT MATERIAL SAFETY DATA SHEET FOR MORE INFORMATION

LIMITED WARRANTY

All statements, technical information and recommendations contained herein are based on tests Cortec Corporation believes to be reliable, but the accuracy or completeness thereof is not guaranteed.

Cortec Corporation warrants Cortec® products will be free from defects when shipped to customer. Cortec Corporation's obligation under this warranty shall be limited to replacement of product that proves to be defective. To obtain replacement product under this warranty, the customer must notify Cortec Corporation of the claimed defect within six months after shipment of product to customer. All freight charges for replacement products shall be paid by customer.

Cortec Corporation shall have no liability for any injury, loss or damage arising out of the use of or the inability to use the products.

BEFORE USING, USER SHALL DETERMINE THE SUITABILITY OF THE PRODUCT FOR ITS INTENDED USE, AND USER ASSUMES ALL RISK AND LIABILITY WHATSOEVER IN CONNECTION THEREWITH. No representation or recommendation not contained herein shall have any force or effect unless in a written document signed by an officer of Cortec Corporation.

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Environmentally Safe VpCI®/MCI® Technologies

4119 White Bear Parkway, St. Paul, MN 55110 USA
Phone (651) 429-1100, Fax (651) 429-1122
Toll Free (800) 4-CORTEC, E-mail info@cortecvci.com
Internet http://www.CortecVCI.com

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1.7. TERMINALS, LINKS & OTHER ACCESSORIES

- PHOENIX CONTACT – **TCP 10A (0712314) + UK 6-FSI/C (3118203)** – 10A Miniature Thermal Circuit Breakers
- PHOENIX CONTACT – **TCP 4A (0712259) + UK 6-FSI/C (3118203)** – 4A Miniature Thermal Circuit Breakers
- PHOENIX CONTACT – **TCP 2A (0712217) + UK 6-FSI/C (3118203)** – 2A Miniature Thermal Circuit Breakers
- PHOENIX CONTACT – **PIT 2,5 (3209510)** – Through Terminals (Grey)
- PHOENIX CONTACT – **D-ST 2,5 (3030417)** – Through Terminal Endplate
- PHOENIX CONTACT – **PIT 2,5-MT (3210156)** – Disconnect Terminals (Grey)
- PHOENIX CONTACT – **D-PIT 2,5-MT (3211003)** – Disconnect Terminals Endplate
- PHOENIX CONTACT – **UBE (0800310)** – Group Marker Carrier
- PHOENIX CONTACT – **PS-5 (3030983)** – Test Plug Adapter
- PHOENIX CONTACT – **SZS 0.6x3.5 (1205053)** – Screw Driver
- PHOENIX CONTACT – **FBS 20-5 (3030226)** – Plug-In Bridge
- PHOENIX CONTACT – **ZB 5 CUS (0824962)** – Terminal Numbers
- WEIDMULLER – **(8611320000)** – Adapter
- MAXON – **MA.2025** – Ethernet Router
- MAXON – **C3LA30-BD170F** – Antenna
- LUMIFA – **LF1B-C35-2THWW4** – Switchboard LED

CLIPSAL NEUTRAL / ACTIVE / METER LINKS

Clipsal Links are produced from Impact Resistant materials to prevent cracking in transit or during installation.

The transparent covers enable you to check wiring and locate the sealing screw at a glance. The sealing screw (nylon with brass insert) resists stripping. Voltage and amperage ratings are clearly marked on both the cover and brass bar.

All links are available with black or red covers and bases for neutral, active or meter applications as required by local authorities.

T-Type - 500 Volt 140 Ampere

L4T35
500V 140A 4 Hole Neutral Link with two screws per tunnel. Black base and cover.

L4T35R
500V 140A 4 Hole Active Link. Red base and cover.

Dimensions: 65 x 46 x 43mm.
Mounting centres: 28mm. 1 tunnel 8.7mm diameter accommodate 1 x 25mm^2 cable.
3 tunnels 7.7mm diameter accommodate 1 x 25mm^2 cable.
Certificate of Suitability No. CS2252N.


L4T35R

Mini Links with Cover

500V 100A
2 screws per tunnel.

L5
500V 100A 5 Hole Neutral Link with two screws per tunnel. Black base and cover.

L5R
500V 100A 5 Hole Active Link. Red base and cover.

Dimensions: 65 x 46 x 43mm.
Mounting centres: 46mm.
3 tunnels, 6.3mm diameter accommodate 1 x 16mm^2.
2 tunnels, 5.8mm diameter accommodate 1 x 16mm^2.

L5BW
500V 110A 5 Hole Back Wiring Neutral Link with two screws per tunnel. Black base and cover.

L5BWR
500V 110A 5 Hole Back Wiring Active Link. Red base and cover.

Dimensions: 65 x 46 x 43mm.
Mounting centres: 46mm.
5 tunnels, 7mm diameter accommodate 1 x 25mm^2.
Transparent black cover, with cut outs.

L6
500V 100A 6 Hole Neutral Link with two screws per tunnel. Black base and cover.

L6R
500V 100A 6 Hole Active Link. Red base and cover.

Dimensions: 65 x 46 x 43mm.
Mounting centres: 46mm.
3 tunnels, 6.3mm diameter accommodate 1 x 16mm^2 cable.
3 tunnels, 5.8mm diameter accommodate 1 x 16mm^2 cable.

L6/25
500V 110A 6 Hole Neutral Link with 2 screws per tunnel. Black base and cover.

L6/25R
500V 110A 6 Hole Active Link. Red base and cover.

Dimensions: 65 x 46 x 43mm.
Mounting centres: 46mm.
2 tunnels, 7.5mm diameter accommodate 2 x 25mm^2 cable.
1 tunnel, 5.5mm diameter accommodates 1 x 16mm^2 cable.
3 tunnels, 4.7mm diameter accommodate 3 x 10mm^2 cable.
Transparent black cover with cut-outs.

L7
500V 100A 7 Hole Neutral Link with two screws per tunnel. Black base and cover.


L7

2 Pumps

SUPPLIER: Grundfos
30 Blanck Street
Ormeau QLD 4208

Ph: (07) 5540 6700
Fax: (07) 5540 6710

MODEL: MOB-QUU-3xCRNE 45-2 BOOSTER

kW RATING: 7.5kW

VOLTAGE: 415V

GRUNDFOS **INSTRUCTIONS**

BoosterpaQ - Hydro MPC

(US) **Installation and operating instructions**



LIMITED WARRANTY

Products manufactured by GRUNDFOS PUMPS CORPORATION (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos' manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by Grundfos are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty. Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions. Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limit actions on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

CONTENTS

		Page
1.	**Symbols used in this document**	**4**
2.	**Scope of these instructions**	**4**
3.	**Product description**	**4**
4.	**Nameplate**	**5**
5.	**Software label**	**5**
6.	**Type key**	**6**
6.1	Examples of control variants	6
7.	**Installation**	**9**
7.1	Mechanical installation	9
7.1.1	Location	9
7.1.2	Pipework	9
7.1.3	Foundation	9
7.1.4	Vibration dampers	9
7.1.5	Expansion joints	9
7.2	Electrical installation	10
7.3	Start-up	10
8.	**Control panel**	**12**
8.1	Display (pos. 1)	12
8.1.1	Menu line	12
8.1.2	Top line	12
8.1.3	Graphical illustration	12
8.1.4	Scroll bar	12
8.1.5	Bottom line	12
8.2	Buttons and indicator lights	13
8.2.1	Arrow to the right (pos. 2)	13
8.2.2	Help (pos. 3)	13
8.2.3	Up and down (pos. 4 and 5)	13
8.2.4	Plus and minus (pos. 6 and 7)	13
8.2.5	Esc (pos. 8)	13
8.2.6	Home (pos. 9)	13
8.2.7	Ok (pos. 10)	13
8.2.8	Indicator lights (pos. 11 and 12)	13
8.2.9	Contrast (pos. 13)	13
8.2.10	Back light	13
9.	**Functions**	**14**
9.1	Tree of functions	14
9.2	Overview	17
9.3	Description of functions	19
9.4	Status (1)	19
9.4.1	Current alarms (3.1)	19
9.4.2	System (1.2)	19
9.4.3	Operating mode (1.2.1)	20
9.4.4	Setpoint (1.2.2)	20
9.4.5	Setpoint influence (1.2.3)	20
9.4.6	Measured values (1.2.4)	21
9.4.7	Analog inputs (1.2.5)	21
9.4.8	Pump 1...6 (1.3 to 1.8)	21
9.5	Operation (2)	21
9.5.1	Operation (2)	22
9.5.2	System operating mode (2.1.1)	22
9.5.3	Control mode (2.1.2)	23
9.5.4	Setpoints (2.1.3)	25
9.5.5	Individual pump control (2.1.4)	25
9.5.6	Setting of individual operating mode (2.1.4.1 to 2.1.4.6)	26
9.6	Alarm (3)	27
9.6.1	Alarm status (3)	27
9.6.2	Current alarms (3.1)	32
9.6.3	Alarm log (3.2)	32
9.7	Settings (4)	32
9.7.1	Primary controller (4.1)	33
9.7.2	PI controller (4.1.1)	33
9.7.3	Alternative setpoints (4.1.2)	33
9.7.4	Alternative setpoints 2 to 7 (4.1.2.1 to 4.1.2.7)	34
9.7.5	External setpoint influence (4.1.3)	34
9.7.6	Setting of influence function (4.1.3.2)	35
9.7.7	Primary sensor (4.1.4)	35
9.7.8	Clock program (4.1.6)	36
9.7.9	Proportional pressure (4.1.7)	36
9.7.10	S-system configuration (4.1.8)	37
9.7.11	Pump cascade control (4.2)	37
9.7.12	Min. time between start/stop (4.2.1)	38
9.7.13	Max. number of starts/hour (4.2.1)	38
9.7.14	Standby pumps (4.2.3)	38
9.7.15	Forced pump changeover (4.2.4)	39
9.7.16	Pump test run (4.2.5)	39
9.7.17	Pilot pump (4.2.6)	40
9.7.18	Pump stop attempt (4.2.7)	40
9.7.19	Pump start and stop speed (4.2.8)	41
9.7.20	Min. performance (4.2.9)	41
9.7.21	Compensation for pump start-up time (4.2.10)	42
9.7.22	Secondary functions (4.3)	42
9.7.23	Stop function (4.3.1)	42
9.7.24	Soft pressure build-up (4.3.3)	44
9.7.25	Emergency run (4.3.5)	45
9.7.26	Digital inputs (4.3.7)	45
9.7.27	Functions of digital inputs (4.3.7.1)	46
9.7.28	Analog inputs (4.3.8)	46
9.7.29	Analog inputs (4.3.8.1 to 4.3.8.7)	47
9.7.30	Analog inputs and measured value (4.3.8.1.1 to 4.3.8.7.1)	47
9.7.31	Digital outputs (4.3.9)	48
9.7.32	Functions of digital outputs (4.3.9.1 to 4.3.9.16)	48
9.7.33	Min., max. and user-defined duty (4.3.14)	49
9.7.34	Min. duty (4.3.14.1)	49
9.7.35	Max. duty (4.3.14.2)	49
9.7.36	User-defined duty (4.3.14.3)	50
9.7.37	Pump curve data (4.3.19)	50
9.7.38	Control source (4.3.20)	51
9.7.39	Fixed inlet pressure (4.3.22)	52
9.7.40	Flow estimation (4.3.23)	52
9.7.41	Monitoring functions (4.4)	52
9.7.42	Dry-running protection (4.4.1)	53
9.7.43	Dry-running protection with pressure/level switch (4.4.1.1)	53
9.7.44	Dry-running protection with pressure transmitter (4.4.1.2)	54
9.7.45	Dry-running protection with level transmitter (4.4.1.3)	54
9.7.46	Min. pressure (4.4.2)	55
9.7.47	Max. pressure (4.4.3)	55
9.7.48	External fault (4.4.4)	56
9.7.49	Limit 1 and 2 exceeded (4.4.5 and 4.4.6)	56
9.7.50	Pumps outside duty range (4.4.7)	57
9.7.51	Pressure relief (4.4.8)	57
9.7.52	Functions, CU 351 (4.5)	58
9.7.53	Display language (4.5.1)	58
9.7.54	Display units (4.5.2)	59
9.7.55	Date and time (4.5.3)	60
9.7.56	Passwords (4.5.4)	60
9.7.57	Ethernet (4.5.5)	60
9.7.58	GENIbus number (4.5.6)	61
9.7.59	Software status (4.5.9)	61
9.8	Data communication	62
9.8.1	Ethernet	62
9.8.2	GENIbus	64
10.	**External variable frequency drive**	**65**
10.1	VLT 2800	65
10.2	Danfoss VLT 8000 factory settings	66
10.3	Danfoss VLT 8000 extended menu programming	66
10.4	Danfoss VLT 8000 factory settings	67
10.5	Danfoss VLT 8000 extended menu programming	67
10.6	Baldor Smart motor settings	68
10.7	VLT FC 202	69

11.	**Fault finding chart**	**70**
12.	**Maintenance**	**71**
12.1	Pumps	71
12.2	Motor bearings	71
12.3	CU 351	71
13.	**Frost protection**	**71**
14.	**Taking out of operation**	**71**
15.	**Technical data**	**71**
15.1	Pressure	71
15.2	Temperature	72
15.3	Relative humidity	72
15.4	Sound pressure	72
16.	**Electrical data**	**72**
17.	**Related documents**	**72**
18.	**Disposal**	**72**

Warning

Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

1. Symbols used in this document

Warning

If these safety instructions are not observed, it may result in personal injury!

Caution ***If these safety instructions are not observed, it may result in malfunction or damage to the equipment!***

Note ***Notes or instructions that make the job easier and ensure safe operation.***

2. Scope of these instructions

These installation and operating instructions apply to Grundfos Hydro MPC booster systems.

Hydro MPC is a range of factory-assembled booster systems, ready for installation and operation.

3. Product description

As standard, Hydro MPC booster systems consist of two to six CR(E) pumps coupled in parallel and mounted on a common base frame with all the necessary fittings and a control panel.

Note ***A diaphragm tank is required in most installations.***

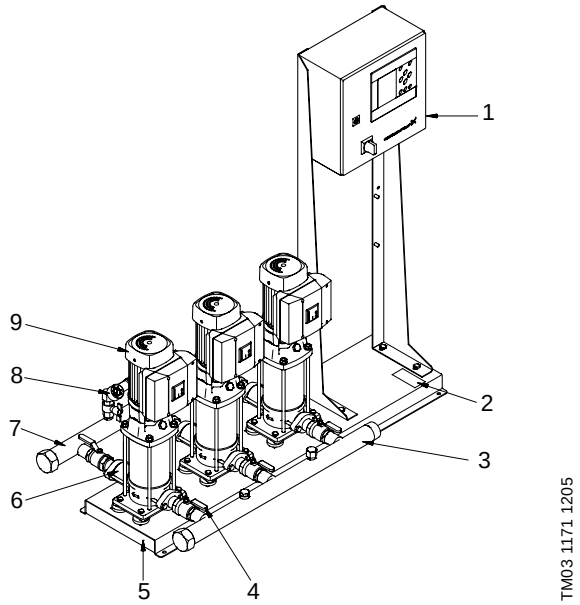


Fig. 1 Hydro MPC booster system

Pos.	Description	Quantity
1	Control panel	1
2	Nameplate	1
3	Suction manifold (stainless steel)	1
4	Isolating valve	2 per pump
5	Base frame (stainless steel)	1
6	Non-return valve	1 per pump
7	Discharge manifold (stainless steel)	1
8	Pressure transmitter/pressure gauge	2
9	Pump	2 - 6

Hydro MPC booster systems are divided into seven groups based on control variant:

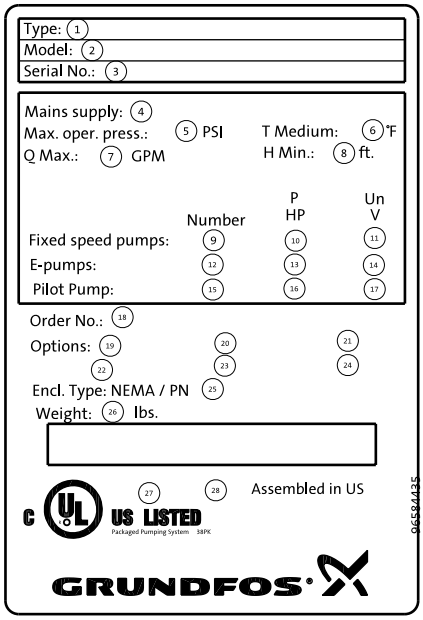
Control variant	Description
-E	Two to six CRE pumps
-ED	Two CRE pumps and up to four constant speed CR pumps
-ES	One CRE pump and up to five constant speed CR pumps
-EF	Two to six CR pumps connected to external variable frequency drives (VFD)
-EDF	Two CR pumps connected to external variable frequency drives and up to four constant speed CR pumps
-F	Up to six CR pumps connected to an external variable frequency drive. The speed-controlled operation alternates between the pumps.
-S	Two to six constant speed CR pumps

See also section *6.1 Examples of control variants*.

Hydro MPC booster systems always includes application-optimised software for setting the booster system to the application in question.

4. Nameplate

The nameplate of the booster system is fitted on the base frame. See position 2 in fig. 1.



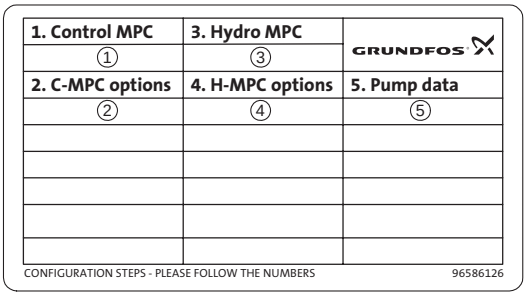
TM03 1741 3105

Fig. 2 Nameplate

Pos.	Description
1	Type designation
2	Model
3	Serial number
4	Supply voltage
5	Maximum operating pressure in PSI
6	Liquid temperature in °F
7	Maximum flow rate in GPM
8	Minimum head in feet
9	Number of fixed speed and/or auxiliary pumps
10	Motor power in HP for fixed speed pumps
11	Nominal voltage in volts for fixed speed pumps
12	Number of E-pumps
13	Motor power in HP for E-pumps
14	Nominal voltage in volts for E-pumps
15	Number of pilot pumps
16	Motor power in HP for pilot pump
17	Nominal voltage in volts for pilot pump
18	Order number
19-24	Options
25	Enclosure type
26	Weight in lbs
27	Approval marks
28	Production location & date code

5. Software label

The software label is placed on the back of the CU 351 controller.



TM03 1742 3105

Fig. 3 Software label

Pos.	Description
1	Control MPC - GSC file number
2	Control MPC options - GSC file numbers
3	Hydro MPC - GSC file number
4	Hydro MPC options - GSC file numbers
5	Pump data - GSC file numbers

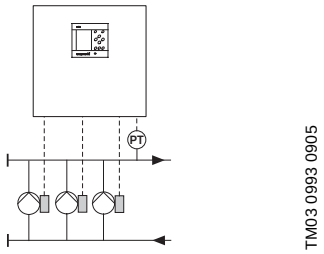
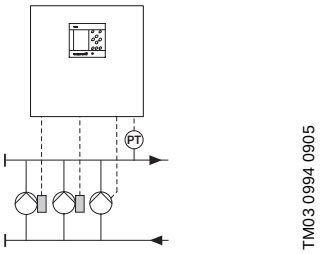
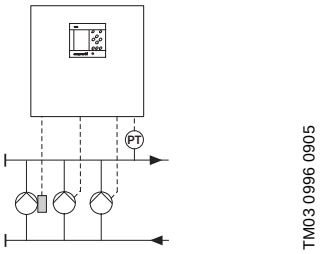
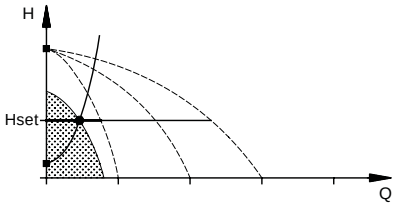
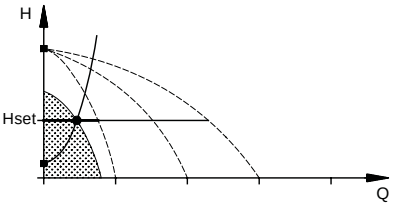
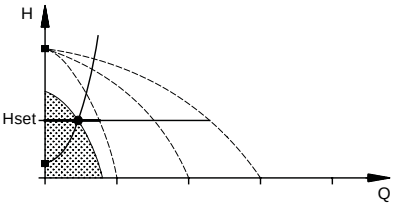
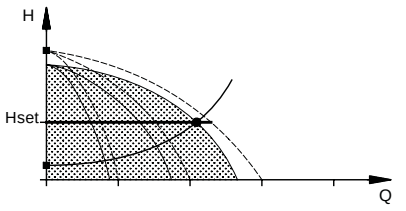
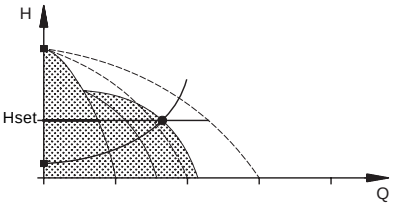
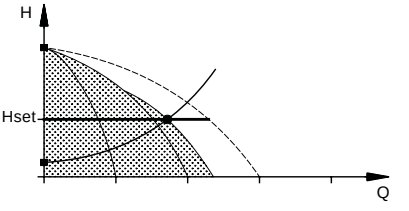
Note ***A GSC (Grundfos Standard Configuration) file is a configuration data file.***

6. Type key

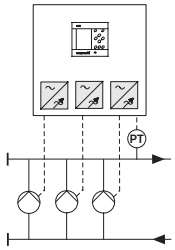
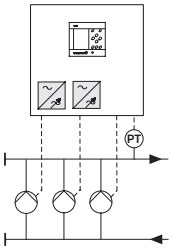
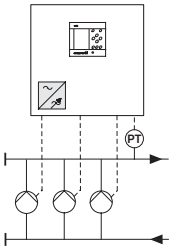
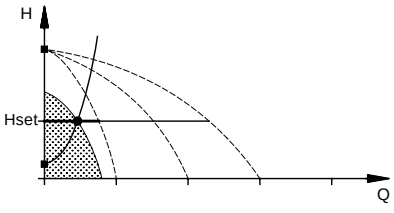
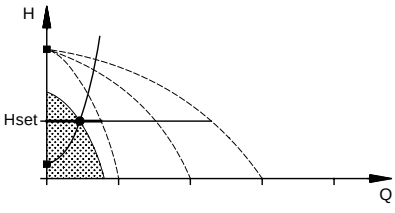
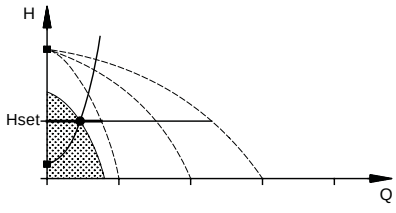
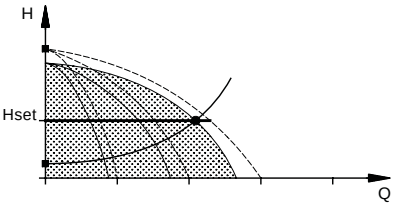
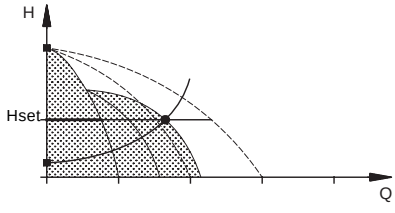
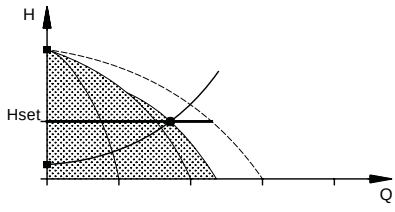
Example	Hydro MPC	-ED	2 CRE 5-10	1 CR 5-10	3x460 V, 60Hz
Type range					
Subgroups: Pumps with integrated variable frequency drive: -E, -ED, -ES Pumps with external VFD: -EF, -EDF, -F Constant speed pumps (start/stop): -S					
Number of pumps with integrated variable frequency drive and pump type					
Number of constant speed pumps and pump type					
Supply voltage, frequency					

6.1 Examples of control variants

Booster systems with motors that include an integrated variable frequency drive (CRE)

Hydro MPC-E	Hydro MPC-ED	Hydro MPC-ES
Hydro MPC booster system with three CRE pumps.	Hydro MPC booster system with two CRE pumps and one constant speed CR pump.	Hydro MPC booster system with one CRE pump and two constant speed CR pumps.
 TM03 0993 0905	 TM03 0994 0905	 TM03 0996 0905
One CRE pump in operation.	One CRE pump in operation.	One CRE pump in operation.
 TM00 7995 2296	 TM00 7995 2296	 TM00 7995 2296
Three CRE pumps in operation.	Two CRE pumps and one constant speed CR pump in operation.	One CRE pump and two constant speed CR pumps in operation.
 TM00 7996 2296	 TM03 0814 0505	 TM00 7998 2296
• The MPC-E system maintains a constant pressure through continuous adjustment of the speed of the pumps. • The system performance is adjusted to the demand through cutting in/out the required number of pumps and through parallel control of the pumps in operation. • Pump changeover is automatic and depends on load, operating hours and fault. • All pumps in operation will run at equal speed.	• The MPC-ED system maintains a constant pressure through continuous adjustment of the speed of two CRE pumps, while the CR pump is constant speed. • One CRE pump always starts first. If the pressure cannot be maintained by the pump, the second CRE pump will be cut in. If the two CRE pumps cannot maintain the pressure, the CR pump will be cut in. • Pump changeover is automatic and depends on load, operating hours and fault.	• The MPC-ES system maintains a constant pressure through continuous adjustment of the speed of the CRE pump. The other pumps are cut in/out according to demand to achieve a performance corresponding to the consumption. • The CRE pump always starts first. If the pressure cannot be maintained by the pump, one or both CR pumps will be cut in. • Changeover among the constant speed pumps is automatic and depends on load, operating hours and fault.

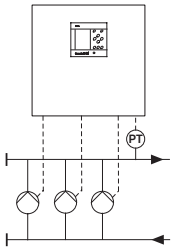
Booster systems with motors connected to external variable frequency drive (VFD)

Hydro MPC-EF	Hydro MPC-EDF	Hydro MPC-F
Hydro MPC booster system with three CR pumps connected to external variable frequency drives in the control panel.	Hydro MPC booster system with two CR pumps connected to external frequency converters in the control cabinet and one constant speed CR pump.	Hydro MPC booster system with three CR pumps connected to an external frequency converter in the control cabinet. The speed-controlled operation alternates between the pumps.
 TM03 0995 0905	 TM03 0997 0905	 TM03 1265 1505
One CR pump in operation.	One CR pump connected to an external variable frequency drive in operation.	One CR pump connected to an external variable frequency drive in operation.
 TM00 7995 2296	 TM00 7995 2296	 TM00 7995 2296
Three CR pumps in operation.	Two CR pumps connected to external variable frequency drives and one constant speed CR pump in operation.	One CR pump connected to an external variable frequency drive and two constant speed CR pumps in operation.
 TM00 7996 2296	 TM03 0814 0505	 TM00 7998 2296
• The MPC-EF system maintains a constant pressure through continuous adjustment of the speed of the pumps. • The system performance is adjusted to the demand through cutting in/out the required number of pumps and through parallel control of the pumps in operation. • Pump changeover is automatic and depends on load, operating hours and fault. • All pumps in operation will run at equal speed.	• The MPC-EDF system maintains a constant pressure through continuous adjustment of the speed of two CR pumps connected to external variable frequency drives, while the third CR pump is constant speed. • One CR pump connected to an external variable frequency drive always starts first. If the pressure cannot be maintained by the pump, the second CR pump connected to an external variable frequency drive will be cut in. If the pressure cannot be maintained by the two pumps, the constant speed CR pump will be cut in. • Pump changeover is automatic and depends on load, operating hours and fault.	• The MPC-F system maintains a constant pressure through continuous adjustment of the speed of the CR pump connected to the external variable frequency drive. The speed-controlled operation alternates between the pumps. • One CR pump connected to the external variable frequency drive always starts first. If the pressure cannot be maintained by the pump, one or two constant speed CR pumps will be cut in. • Pump changeover is automatic and depends on load, operating hours and fault.

Booster system with constant speed pumps (on/off)

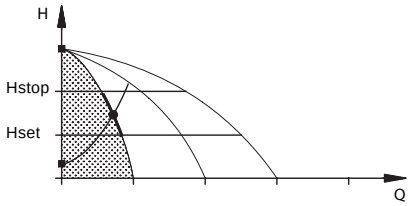
Hydro MPC-S

Hydro MPC booster system with three constant speed CR pumps.



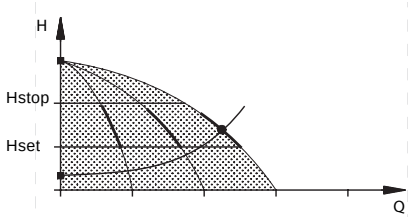
TM03 0999 0905

One constant speed CR pump in operation.



TM03 9204 3607

Three constant speed CR pumps in operation.



TM03 9203 3607

- Hydro MPC-S maintains a pressure differential through cutting in/out the required number of pumps.
- The operating range of the pumps will lie between H_{set} and H_{stop} (cut-out pressure).
- Pump changeover is automatic and depends on load, operating hours and fault.

7. Installation

Warning

Installation and operation must comply with local regulations and accepted codes of good practice.

Before installation check that

- the booster system corresponds to the one ordered.
- no visible parts have been damaged.

7.1 Mechanical installation

7.1.1 Location

The booster system must be installed in a well ventilated room to ensure sufficient cooling of the motors and control panel.

Note ***Hydro MPC is not designed for outdoor installation unless protected and must not be exposed to direct sunlight.***

The booster system must have a 3 feet clearance in front and on the two sides for inspection and dismantling.

7.1.2 Pipework

Arrows on the pump base show the direction of flow of water through the pump.

The pipework connected to the booster system must be of adequate size. The pipes are connected to the manifolds of the booster system. Either end can be used. Apply sealing compound to the unused end of the manifold and fit the screw cap. For manifolds with flanges, fit a blanking flange with gasket.

To achieve optimum operation and minimise noise and vibration, it may be necessary to consider vibration dampening of the booster system.

Noise and vibration are generated by the rotations in the motor and pump and by the flow in pipework and fittings. The effect on the environment is subjective and depends on correct installation and the state of the other parts of the system.

If booster system is to be installed where first customer on the line is close to the booster system, it is advisable to fit expansion joints on the suction and discharge pipes to prevent vibration being transmitted through the pipework.

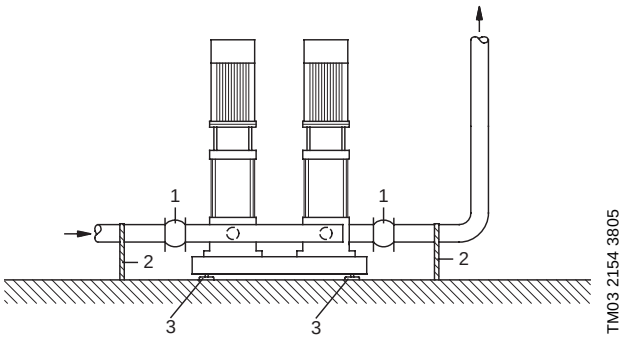


Fig. 4 Sketch showing the position of expansion joints, pipe supports and machine shoes

Pos.	Description
1	Expansion joint
2	Pipe support and good location for system isolation valve (not shown)
3	Machine shoe

Note ***Expansion joints, pipe supports and machine shoes shown in the figure above are not supplied with a standard booster system.***

All nuts should be checked and re-tightened if necessary prior to start-up.

The pipes must be fastened to parts of the building to ensure that they cannot move or be twisted.

7.1.3 Foundation

The booster system should be positioned on an even and solid surface, for instance a concrete floor or foundation. If the booster system is not fitted with machine shoes, it must be bolted to the floor or foundation.

Note ***As a rule the weight of a concrete foundation should be 1.5 x the weight of the booster system.***

7.1.4 Vibration dampers

To prevent the transmission of vibrations to buildings, it imay be necessary to isolate the booster system foundation from building parts by means of vibration dampers.

The right damper varies from installation to installation, and a wrong damper may increase the vibration level. Vibration dampers should therefore be sized by the supplier of vibration dampers. If the booster system is installed on a base frame with vibration dampers, expansion joints should always be fitted on the manifolds. This is important to prevent the booster system from "hanging" in the pipework.

7.1.5 Expansion joints

Expansion joints are installed to

- absorb expansions/contractions in the pipework caused by changing liquid temperature
- reduce mechanical strains in connection with pressure surges in the pipework
- isolate mechanical structure-borne noise in the pipework (only rubber bellows expansion joints).

Note ***Expansion joints must not be installed to compensate for inaccuracies in the pipework such as center displacement of flanges.***

Fit expansion joints at a distance of minimum 1 to 1 1/2 times the nominal flange diameter from the manifold on the suction as well as on the discharge side. This prevents the development of turbulence in the expansion joints, resulting in better suction conditions and a minimum pressure loss on the pressure side. At high water velocities (> 10 ft/sec) it is advisable to install larger expansion joints corresponding to the pipework.



Fig. 5 Examples of rubber bellows expansion joints without and with limit rods

Expansion joints with limit rods can be used to minimise the forces caused by the expansion joints. Expansion joints with limit rods are always recommended for flanges larger than 6 inches.

The pipework should be anchored so that it does not stress the expansion joints and the pump. Follow the supplier's instructions and pass them on to advisers or pipe installers.

7.2 Electrical installation

Warning

The electrical installation should be carried out by an authorized person in accordance with local regulations and the relevant wiring diagram.

- The electrical installation of the booster system must comply with enclosure class IP54.
- Make sure that the booster system is suitable for the electricity supply to which it is connected.
- Make sure that the wire cross-section corresponds to the specifications in the wiring diagram.

The connection of the electrical supply, transmitters and external monitoring equipment must be carried out by an authorized electrician in accordance with the NEC, local regulations and the BoosterpaQ wiring diagram.

Ensure that the Hydro MPC controls and the pumps are suitable for the electricity supply on which they will be used (see Technical Data). Please read the wiring diagram carefully. According to the NEC, if the motors cannot be seen from the control panel, they must be fitted with a disconnect switch.

Any BoosterpaQ that utilizes a variable frequency drive (E, ED, ES, EF, EDF, F) should be connected to an electrical supply with all phase lines electrically symmetrical with respect to ground. A "four wire wye" electrical supply with line impedance between 0.5% - 3% is recommended. If a variable frequency drive is connected to a delta transformer or if line impedance is not within the recommended 0.5% - 3%, the drive may not operate correctly and may not provide optimum performance (excessive faults, erratic behavior, or complete failure). Ask your power company or electrician to determine what type of electrical supply is present. Generator supplied power must meet public utility power quality standards.

7.3 Start-up

1. Have a qualified person check for proper power supply and plumbing connections. Make sure the main power is off.
2. Check that the air pre-charge in the diaphragm tank is 0.7 times the required discharge pressure set-point (0.9 times for MPC-S systems). System pressure must not be applied to the tank connection during the tank precharge process. If water is supplied to the tank from the system, close the tank valve and bleed off the pressure in the tank before the pressurizing process.

Prime the system as follows

3. **Suction pressure system** (pumps are flooded at least as high as the highest part of the pumps)
   – close all discharge manifold pump isolation valves and open all inlet manifold pump isolation valves
   – open the vent plug on top of each pump. It is a small hex head screw in a large vent plug. Air and water will escape from the pump through a small hole in the large vent plug. When the air is out and water is flowing steadily, tighten the small hex head screw on the vent plug to stop the flow.

Note ***If you are filling an empty piping system, do not allow the pumps to run with the discharge valves wide open as cavitation may occur.***

4. **Suction lift system** (the water source is below the pumps or does not flood the pumps to the highest point on the pumps).
   – close all discharge manifold pump isolation valves and open all inlet manifold pump isolation valves
   – for suction lift applications, a foot valve must be placed on the inlet piping at the water source (tank, etc). If there is a fill point above the highest point of the pumps, you may fill the system from this point. If there is no fill point above the highest point of the pumps, remove the large vent plug on each pump. Fill each pump until the water is up to the vent plug, then replace the vent plugs.
5. Ensure all circuit breakers are in the "on" position.
6. Make sure the discharge manifold pump isolation valves are closed. Switch on main power.

Caution ***The pumps may start at this time.***

7. At this time "Start-up wizard" may now be ran. Step 8 can be skipped upon completion of "Start-up wizard". If "Start-up wizard" could not be ran or already ran proceed to step 8.
8. Run the "Start-up wizard" again by performing the following: Move top line display to "Settings". If prompted for password enter "6814", next move down to "Functions, CU 351" and press the "OK" button. Now move down to "Run wizard again" and press the "OK" button.
9. Vent the system by opening the vent plug on each pump (as in Step 3, while the pump is running starting in step 18 of the "Start-up wizard".). Venting with the pumps running ensures all air is removed from the suction piping. Do not run the system with the discharge manifold pump isolation valves closed more than five minutes to prevent over-heating of the pump liquid.
10. As pumps stop, check pump rotation. Repeat as necessary. If the area is dark, a flashlight may be required, or remove a coupling guard on each pump for better visibility. Disconnect the main power when removing coupling guards.

Warning

Do not touch the couplings while the pumps are turning as injury may result. Replace all coupling guards after the rotation check. Disconnect main power when removing and replacing coupling guards (or open service disconnect switches if this option was supplied).

If the rotation is incorrect on any 3 phase pumps, switch any 2 of the 3 power main wires supplied to the control panel (L1, L2, L3). If that doesn't correct the rotation, call your Grundfos representative.

Note ***If you are filling an empty piping system, do not allow the pumps to run with the discharge valves wide open as cavitation may occur.***

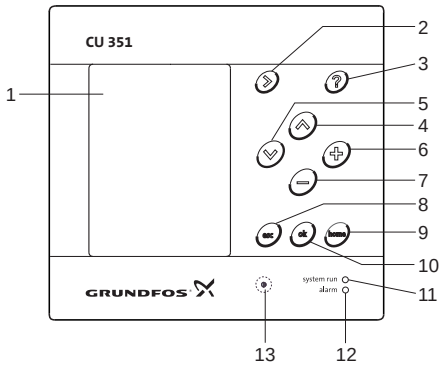
11. Upon completion of venting pumps and checking for correct rotation you are now ready to bring the BoosterpaQ into normal operation. With the discharge manifold isolation valves still closed, partially open each pump discharge isolation valve to allow water to enter into the discharge piping of the BoosterpaQ. Continue the process of filling the discharge piping until discharge piping pressure is approximately at the desired Setpoint pressure of the BoosterpaQ.
12. Open the discharge manifold isolation valves for each pump completely. System is now ready for operation.

It may be necessary to clear alarms in the fault log. Follow the steps in paragraph sections *9.6* to clear alarms.

INSTALLATION AND STARTUP NOTES

8. Control panel

The control panel in the front cover of the control cabinet features a display, a number of buttons and two indicator lights. The control panel enables manual setting and monitoring of the performance of the Hydro MPC.



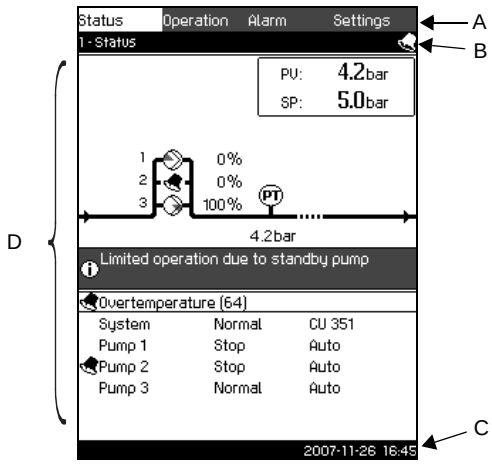
TM03 1304 1705

Fig. 6 Control panel

Key

Pos.	Description
1	Display
2	Arrow to the right
3	Help
4	Up
5	Down
6	Plus
7	Minus
8	Esc
9	Home
10	Ok
11	Indicator light, operation (green)
12	Indicator light, fault (red)
13	Contrast

8.1 Display (pos. 1)



TM03 8947 4807

Fig. 7 Display design

8.1.1 Menu line

The menu line (A) is illustrated in fig. 7.

The display has four main menus:

Status:	Indication of system status
Operation:	Change of operating parameters such as setpoint (password option)
Alarm:	Alarm log for fault finding
Settings:	Change of settings (password option)

8.1.2 Top line

The top line (B) is illustrated in fig. 7.

The top line shows

- the display number and title (left side)
- the selected menu (left side)
- the symbol in case of alarm (right side)
- the symbol if the service language has been selected (right side).

8.1.3 Graphical illustration

The graphical illustration (D) may show a status, an indication or other elements, depending on the position in the menu structure.

The illustration may show the entire system or part of it as well as various settings.

8.1.4 Scroll bar

If the list of illustration elements exceeds the display, the symbols and will appear in the scroll bar to the right. Use the and buttons to move up and down in the list.

8.1.5 Bottom line

The bottom line (C) shows the date and time.

8.2 Buttons and indicator lights

The buttons (pos. 2 to 10 in fig. 6) on the CU 351 are active when they are illuminated.

8.2.1 Arrow to the right (pos. 2)

Press the (>) button to move to the next menu in the menu structure. If you press (>) when the **Settings** menu is highlighted, you go to the **Status** menu.

8.2.2 Help (pos. 3)

When the (?) button is illuminated, a help text applying to the current display will appear if the button is pressed.

Close the text by pressing the (esc) button.

8.2.3 Up and down (pos. 4 and 5)

Press the (^) and (v) buttons to move up and down in lists.

A text can be selected when it is in a box.

If a text is marked and the (^) button is pressed, the text above will be marked instead. If the (v) button is pressed, the text below will be marked.

If the (v) button is pressed in the last line in the list, the first line will be marked.

If the (^) button is pressed in the first line in the list, the last line will be marked.

8.2.4 Plus and minus (pos. 6 and 7)

Use the (+) and (−) buttons to increase and reduce values.
A value is activated when the (ok) button is pressed.

8.2.5 Esc (pos. 8)

Use the (esc) button to go one display back in the menu.

If a value has been changed and the (esc) button is pressed, the new value will not be saved. For further information, see section *8.2.7 Ok (pos. 10)*.

If the (ok) button is pressed before the (esc) button, the new value will be saved. For further information, see section *8.2.7 Ok (pos. 10)*.

8.2.6 Home (pos. 9)

Press the (home) button to return to the **Status** menu.

8.2.7 Ok (pos. 10)

Use the (ok) button as an enter button.

The (ok) button is also used to start the setting of a value.

If a value has been changed and the (ok) button is pressed, the new value will be activated.

8.2.8 Indicator lights (pos. 11 and 12)

The Hydro MPC control panel incorporates a green and red indicator light.

The green indicator light is on when the Hydro MPC is in operation.It is flashing if the Hydro MPC has been set to stop.

The red indicator light is on if there is an alarm or a warning. The fault can be identified from the alarm list.

8.2.9 Contrast (pos. 13)

The contrast in the display can be changed by means of the (◑) button:

1. Press (◑).
2. Adjust the contrast with (+) and (−).

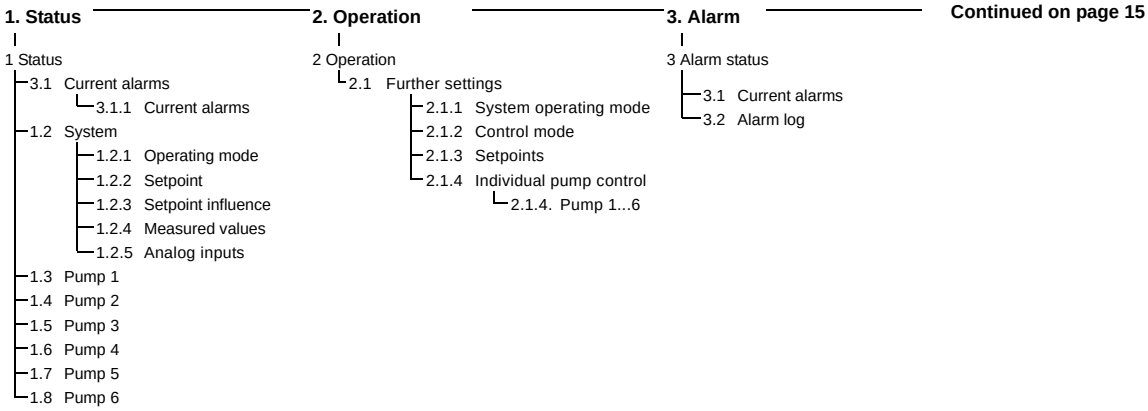
8.2.10 Back light

If no button is touched for 15 minutes, the back light of the panel will be dimmed, and the first display in the **Status** menu will appear.

Press any button to re-activate the back light.

9. Functions

9.1 Tree of functions



Key to the four main menus, Status, Operation, Alarm and Settings

Status
The **Status** menu shows alarms and the status of system and pumps. **Note:** No settings can be made in this menu.
Operation
In the **Operation** menu, the most basic parameters can be set, such as setpoint, operating mode, control mode and individual pump control.
Alarm
The **Alarm** menu gives an overview of alarms and warnings. Alarms and warnings can be reset in this menu.
Settings
In the **Settings** menu, it is possible to set various functions: • Primary controller Setting of alternative setpoints, external setpoint influence, primary sensor, clock program, proportional pressure and S-system configuration. • Pump cascade control Setting of min. time between start/stop, max. number of starts/hour, number of standby pumps, forced pump changeover, pump test run, pilot pump, pump stop attempt, pump start and stop speed, min. performance and compensation for pump start-up time. • Secondary functions Setting of stop function, soft pressure build-up, digital and analog inputs, digital outputs, emergency run, min., max. and user-defined duty, pump curve data, flow estimation, control source and fixed inlet pressure. • Monitoring functions Setting of dry-running protection, min. and max. pressure, external fault, limit 1 and 2 exceeded, pumps outside duty range and pressure relief. • Functions, CU 351 Selection of service language, main language and units. Setting of date and time, passwords, Ethernet connection, GENIbus number and software status.

Continued from page 16

4. Settings

- 4.1 Primary controller
  - 4.1.1 PI controller
  - 4.1.2 Alternative setpoints
    - 4.1.2.1 Alternative setpoints 2...7
  - 4.1.3 External setpoint influence
    - 4.1.3.1 Set the influence function
      - 4.1.3.2 Setting of influence function
  - 4.1.4 Primary sensor
  - 4.1.6 Clock program
  - 4.1.7 Proportional pressure
  - 4.1.8 S-system configuration
- 4.2 Pump cascade control
  - 4.2.1 Min. time between start/stop
    Max. number of starts/hour
  - 4.2.3 Standby pumps
  - 4.2.4 Forced pump changeover
  - 4.2.5 Pump test run
  - 4.2.6 Pilot pump
  - 4.2.7 Pump stop attempt
  - 4.2.8 Pump start and stop speed
  - 4.2.9 Min. performance
  - 4.2.10 Compensation for pump start-up time
- 4.3 Secondary functions
  - 4.3.1 Stop function
    - 4.3.1.1 Stop parameters
  - 4.3.3 Soft pressure build-up
  - 4.3.5 Emergency run
  - 4.3.7 Digital inputs
    - Function, DI1..DI3 (CU 351), [10, 12, 14]
    - Function, DI1..DI9 (IO 351-41), [10...46]
    - Function, DI1..DI9 (IO 351-42), [10...46]
  - 4.3.8 Analog inputs
    - Setting, analog input AI1..AI3 (CU 351), [51, 54, 57]
      - Function, AI1...AI3 (CU 351), [51, 54, 57]
    - Setting, AI1..AI2 (IO 351-41), [57, 60]
      - Function, AI1..AI2 (IO 351-41), [57, 60]
    - Setting, AI1..AI2 (IO 351-42), [57, 60]
      - Function, AI1..A2 (IO 351-42), [57, 60]
  - 4.3.9 Digital outputs
    - Function, DO1 and DO2 (CU 351), [71, 74]
    - Function, DO1...DO7 (IO 351-41), [77...88]
    - Function, DO1...DO7 (IO 351-42), [77...88]
  - 4.3.14 Min., max. and user-defined duty
    - 4.3.14.1 Min. duty
    - 4.3.14.2 Max. duty
    - 4.3.14.3 User-defined duty
  - 4.3.19 Pump curve data
    - 4.3.23 Flow estimation
  - 4.3.20 Control source
  - 4.3.22 Fixed inlet pressure
  - 4.3.23 Flow estimation
- 4.4 Monitoring functions
  - 4.4.1 Dry-running protection
    - 4.4.1.1 Pressure/level switch
    - 4.4.1.2 Measurement, inlet pressure
    - 4.4.1.3 Measurement, tank level
  - 4.4.2 Min. pressure
  - 4.4.3 Max. pressure
  - 4.4.4 External fault
  - 4.4.5 Limit 1 exceeded
  - 4.4.6 Limit 2 exceeded
  - 4.4.7 Pumps outside duty range
  - 4.4.8 Pressure relief

Continued from page 16

4. Settings

- 4.5 Functions, CU 351
  - Change language to service language (GB)
  - Run wizard again
  - 4.5.1 Display language
  - 4.5.2 Display units
    - 4.5.2.1 Units for pressure
    - 4.5.2.2 Units for differential pressure
    - 4.5.2.3 Units for head
    - 4.5.2.4 Units for level
    - 4.5.2.5 Units for flow rate
    - 4.5.2.6 Units for volume
    - 4.5.2.7 Units for specific energy
    - 4.5.2.8 Units for temperature
    - 4.5.2.9 Units for power
    - 4.5.2.10 Units for energy
  - 4.5.3 Date and time
  - 4.5.4 Password
  - 4.5.5 Ethernet
  - 4.5.6 GENIbus number
  - 4.5.9 Software status

9.2 Overview

Section	Display and display number	See page
9.4 Status (1)		19
9.4.1	*Current alarms (3.1)*	19
9.4.2	*System (1.2)*	19
9.4.3	*Operating mode (1.2.1)*	20
9.4.4	*Setpoint (1.2.2)*	20
9.4.5	*Setpoint influence (1.2.3)*	20
9.4.6	*Measured values (1.2.4)*	21
9.4.7	*Analog inputs (1.2.5)*	21
9.4.8	*Pump 1...6 (1.3 to 1.8)*	21
9.5 Operation (2)		21
9.5.1	*Operation (2)*	22
9.5.2	*System operating mode (2.1.1)*	22
9.5.3	*Control mode (2.1.2)*	23
9.5.4	*Setpoints (2.1.3)*	25
9.5.5	*Individual pump control (2.1.4)*	25
9.5.6	*Setting of individual operating mode (2.1.4.1 to 2.1.4.6)*	26
9.6 Alarm (3)		27
9.6.1	*Alarm status (3)*	27
9.6.2	*Current alarms (3.1)*	32
9.6.3	*Alarm log (3.2)*	32
9.7 Settings (4)		32
9.7.1	*Primary controller (4.1)*	33
9.7.2	*PI controller (4.1.1)*	33
9.7.3	*Alternative setpoints (4.1.2)*	33
9.7.4	*Alternative setpoints 2 to 7 (4.1.2.1 to 4.1.2.7)*	34
9.7.5	*External setpoint influence (4.1.3)*	34
9.7.6	*Setting of influence function (4.1.3.2)*	35
9.7.7	*Primary sensor (4.1.4)*	35
9.7.8	*Clock program (4.1.6)*	36
9.7.9	*Proportional pressure (4.1.7)*	36
9.7.10	*S-system configuration (4.1.8)*	37
9.7.11	*Pump cascade control (4.2)*	37
9.7.12	*Min. time between start/stop (4.2.1)*	38
9.7.13	*Max. number of starts/hour (4.2.1)*	38
9.7.14	*Standby pumps (4.2.3)*	38
9.7.15	*Forced pump changeover (4.2.4)*	39
9.7.16	*Pump test run (4.2.5)*	39
9.7.17	*Pilot pump (4.2.6)*	40
9.7.18	*Pump stop attempt (4.2.7)*	40
9.7.19	*Pump start and stop speed (4.2.8)*	41
9.7.20	*Min. performance (4.2.9)*	41
9.7.21	*Compensation for pump start-up time (4.2.10)*	42
9.7.22	*Secondary functions (4.3)*	42
9.7.23	*Stop function (4.3.1)*	42
9.7.24	*Soft pressure build-up (4.3.3)*	44
9.7.25	*Emergency run (4.3.5)*	45
9.7.26	*Digital inputs (4.3.7)*	45
9.7.27	*Functions of digital inputs (4.3.7.1)*	46
9.7.28	*Analog inputs (4.3.8)*	46
9.7.29	*Analog inputs (4.3.8.1 to 4.3.8.7)*	47
9.7.30	*Analog inputs and measured value (4.3.8.1.1 to 4.3.8.7.1)*	47
9.7.31	*Digital outputs (4.3.9)*	48
9.7.32	*Functions of digital outputs (4.3.9.1 to 4.3.9.16)*	48
9.7.33	*Min., max. and user-defined duty (4.3.14)*	49
9.7.34	*Min. duty (4.3.14.1)*	49

Section	Display and display number	See page
9.7.35	*Max. duty (4.3.14.2)*	49
9.7.36	*User-defined duty (4.3.14.3)*	50
9.7.37	*Pump curve data (4.3.19)*	50
9.7.38	*Control source (4.3.20)*	51
9.7.39	*Fixed inlet pressure (4.3.22)*	52
9.7.40	*Flow estimation (4.3.23)*	52
9.7.41	*Monitoring functions (4.4)*	52
9.7.42	*Dry-running protection (4.4.1)*	53
9.7.43	*Dry-running protection with pressure/level switch (4.4.1.1)*	53
9.7.44	*Dry-running protection with pressure transmitter (4.4.1.2)*	54
9.7.45	*Dry-running protection with level transmitter (4.4.1.3)*	54
9.7.46	*Min. pressure (4.4.2)*	55
9.7.47	*Max. pressure (4.4.3)*	55
9.7.48	*External fault (4.4.4)*	56
9.7.49	*Limit 1 and 2 exceeded (4.4.5 and 4.4.6)*	56
9.7.51	*Pressure relief (4.4.8)*	57
9.7.52	*Functions, CU 351 (4.5)*	58
9.7.53	*Display language (4.5.1)*	58
9.7.54	*Display units (4.5.2)*	59
9.7.55	*Date and time (4.5.3)*	60
9.7.56	*Passwords (4.5.4)*	60
9.7.57	*Ethernet (4.5.5)*	60
9.7.58	*GENIbus number (4.5.6)*	61
9.7.59	*Software status (4.5.9)*	61

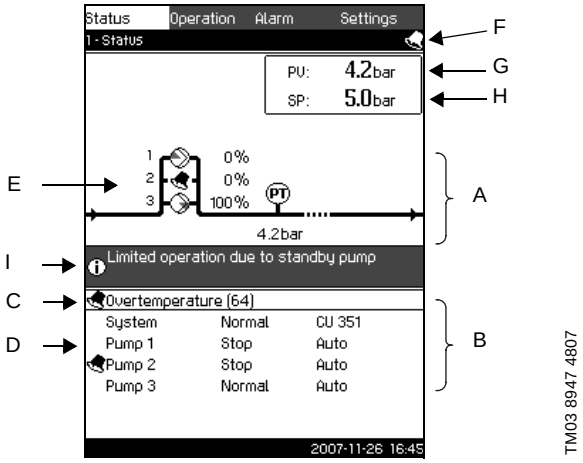
9.3 Description of functions

The description of functions is based on the four main menus of the CU 351 control unit: **Status**, **Operation**, **Alarm** and **Settings**.

The functions apply to all control variants unless otherwise stated.

9.4 Status (1)

The first status display is shown below. This display is shown when the Hydro MPC is switched on, and it appears when the buttons of the control panel have not been touched for 15 minutes.



TM03 8947 4807

Fig. 8 Status

Description

No settings can be made in this menu.

The current value (process value, PV) of the control parameter, usually the discharge pressure, is shown in the upper right corner (G) together with the selected setpoint (SP) (H).

The upper half of the display (A) shows a graphic illustration of the Hydro MPC booster system and part of the system. The selected measuring parameters are shown with sensor symbol and current value.

In the middle of the display, an information field (I) is shown if any incidents occur.

The lower display half (B) shows

- the latest current alarm, if any, and the fault cause together with the fault code in brackets
- system status with current operating mode and control source
- pump status with current operating mode and manual/auto.

Note ***If a fault has occurred, the symbol will be shown in the alarm line (C) together with the cause and fault code, for instance Limit 2 exceeded (191).***

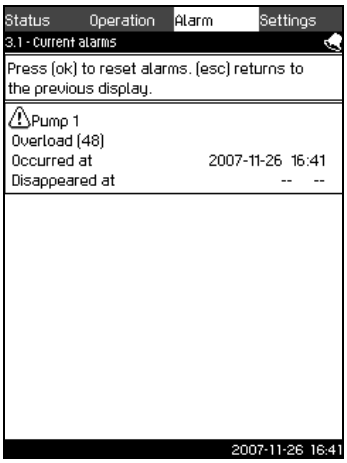
If the fault is related to one of the pumps, the symbol will also be shown in front of the status line (D) of the pump in question. At the same time, the symbol will be flashing instead of the pump symbol (E). The symbol will be shown to the right in the top line of the display (F). As long as a fault is present, this symbol will be shown in the top line of all displays.

To open a menu line, mark the line with ⌄ or ⌃, and press ok.

The display makes it possible to open status displays showing

- current alarms
- system status
- status of each pump.

9.4.1 Current alarms (3.1)



TM03 2293 4807

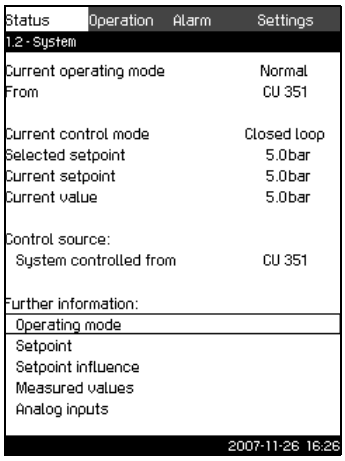
Fig. 9 Current alarms

Description

In this display, current unreset alarms and warnings are shown.

For further information, see sections *9.6.2 Current alarms (3.1)* and *9.6.3 Alarm log (3.2)*.

9.4.2 System (1.2)



TM03 8946 4807

Fig. 10 System

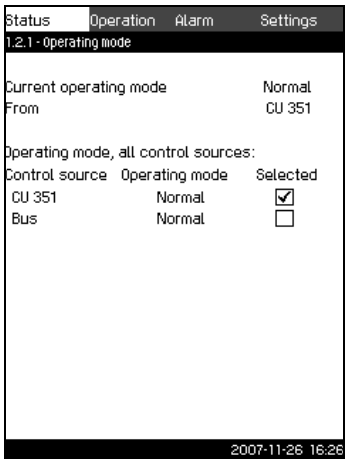
Description

This display shows the current operational state of the Hydro MPC booster system. It is possible to go to subdisplays showing details.

The display makes it possible to open specific displays about

- operating mode
- setpoint
- setpoint influence
- measured values
- analog inputs.

9.4.3 Operating mode (1.2.1)



TM03 2273 4807

Fig. 11 Operating mode

Description

Here the operating mode of the Hydro MPC booster system is shown as well as from where the Hydro MPC is controlled.

Operating modes

Hydro MPC has six operating modes:

1. *Normal*
   The booster system adapts its performance to the requirement.
2. *Max.*
   The pumps run at a constant high speed. Normally, all pumps run at maximum speed.
3. *User-defined*
   The pumps run at a constant speed set by the user. Usually it is a performance between *Max.* and *Min*.
4. *Min.*
   The pumps run at a constant low speed. Normally, one pump is running at a speed of 70 %.
5. *Stop*
   All pumps have been stopped.
6. *Emergency run*
   The pumps run according to the setting made in the display *Emergency run (4.3.5)*.

The performance required in the operating modes *Max., Min., User-defined* and *Emergency run* can be set in the **Settings** menu. See sections *9.7.33 Min., max. and user-defined duty (4.3.14)* and *9.7.25 Emergency run (4.3.5)*.

The current operating mode can be controlled from four different sources: *Fault*, *External signal*, *CU 351* and *Bus*.

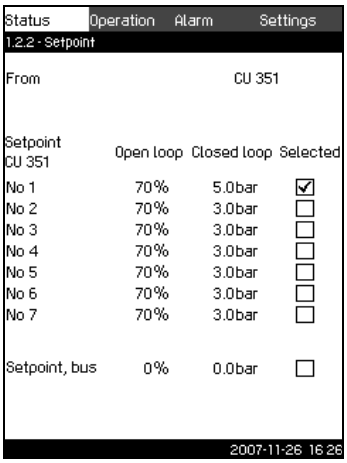
Control source

Hydro MPC can be set to remote control via an external bus (option). In this case, a setpoint and an operating mode must be set via the bus.

In the **Settings** menu, it is possible to select whether the CU 351 or the external bus is to be the control source.

The status of this setting is shown in the display **Operating mode**.

9.4.4 Setpoint (1.2.2)



TM03 2272 4807

Fig. 12 Setpoint

Description

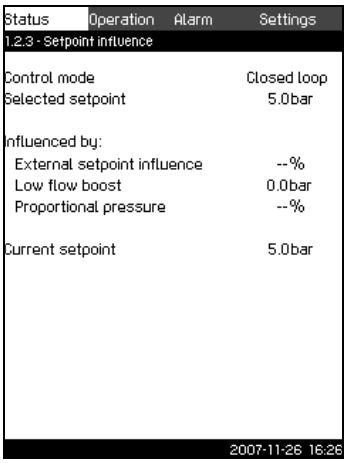
This display shows the selected setpoint and whether it comes from the CU 351 or an external bus.

The display also shows all seven possible setpoints from CU 351 (for closed- and open-loop control). At the same time, the selected setpoint is shown.

As it is a status display, no settings can be made.

Setpoints can be changed in the **Operation** menu.

9.4.5 Setpoint influence (1.2.3)



TM03 8948 4807

Fig. 13 Setpoint influence

Description

The selected setpoint can be influenced by parameters. The parameters are shown as percentage from 0 to 100 % or as a pressure measured in bar. They can only reduce the setpoint, as the influence in percentage divided with 100 is multiplied with the selected setpoint:

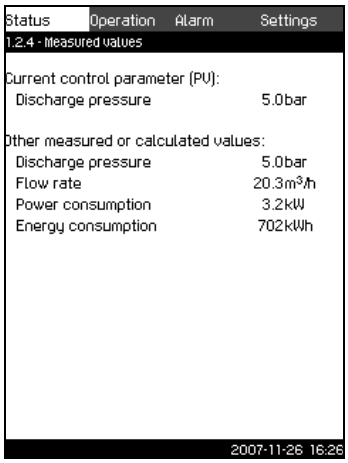
$$\text{Setpoint}_{\text{current(SP)}} = \text{Setpoint}_{\text{selected}} \times \text{Infl.}(1) \times \text{Infl.}(2) \times \ldots$$

The display shows the parameters influencing the selected setpoint and the percentage or value of influence.

Some of the possible parameters can be set in the display *External setpoint influence (4.1.3)*. The parameter low flow boost is set as an on/off band as a percentage of the setpoint set in the display *Stop function (4.3.1)*. The parameter is set as a percentage in the display *Proportional pressure (4.1.7)*.

Finally the resulting current setpoint (SP) is shown.

9.4.6 Measured values (1.2.4)



TM03 2270 4807

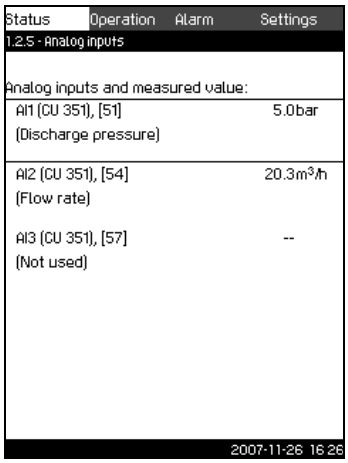
Fig. 14 Measured values

Description

This display gives a general status of all measured and calculated parameters.

Note ***The lines "Power consumption" and "Energy consumption" are only shown in Hydro MPC-E booster systems.***

9.4.7 Analog inputs (1.2.5)



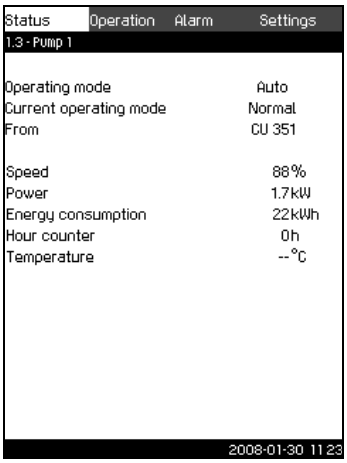
TM03 8949 4807

Fig. 15 Analog inputs

Description

The display shows an overview of the analog inputs and the current measured values of each input. See sections *9.7.28 Analog inputs (4.3.8)*, *9.7.29 Analog inputs (4.3.8.1 to 4.3.8.7)* and *9.7.30 Analog inputs and measured value (4.3.8.1.1 to 4.3.8.7.1)*.

9.4.8 Pump 1...6 (1.3 to 1.8)



TM03 2268 4807

Fig. 16 Pump 1

Description

This display shows the operational state of the individual pumps.

The pumps may have different operating modes:

- *Auto*
  Together with the other pumps in automatic operation, the pump is controlled by the PI controller which ensures that the booster system delivers the required performance (pressure).
- *Manual*
  The pump is not controlled by the PI controller. In manual operation, the pump has one of the following operating modes:
  – *Max.*
    The pump runs at a set maximum speed. (This operating mode can only be selected for variable-speed pumps.)
  – *Normal*
    The pump runs at a set speed.
  – *Min.*
    The pump runs at a set minimum speed. (This operating mode can only be selected for variable-speed pumps.)
  – *Stop*
    The pump has been forced to stop.

Besides information about the operating mode, it is possible to read various parameters in the status display, such as these:

- speed (only 0 or 100 % are shown for mains-operated pumps)
- power consumption (only CR(I)E pumps)
- energy consumption (only CR(I)E pumps)
- operating hours.

9.5 Operation (2)

In this menu, the most basic parameters can be set, such as setpoint, operating mode, control mode and forced control of pumps.

9.5.1 Operation (2)

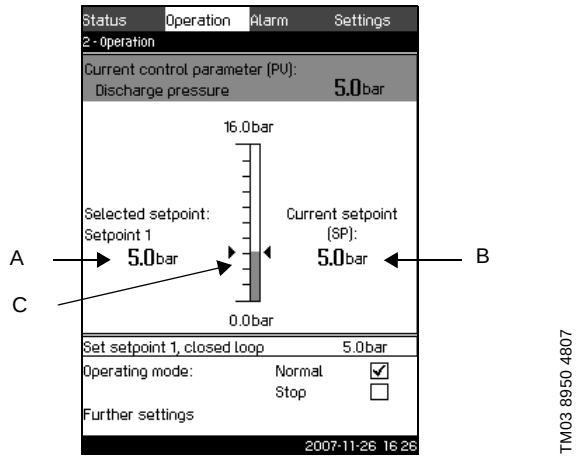


Fig. 17 Operation

Description

The column shows the setting range. In closed-loop control, it corresponds to the range of the primary sensor, here 0-16 bar. In open-loop control, the setting range is 0-100 %.

At the left hand of the column, the selected setpoint 1 (A) is shown, i.e. the value set in the display. At the right hand of the column, the current setpoint (B) is shown, i.e. the setpoint acting as reference for the PI controller. If no kind of external setpoint influence has been selected, the two values will be identical. The current measured value (discharge pressure) is shown as the grey part of the column (C). See sections *9.7.5 External setpoint influence (4.1.3)* and *9.7.6 Setting of influence function (4.1.3.2)*.

Below the display is a menu line for setting of setpoint 1 and selection of operating mode, including the operating modes *Normal* and *Stop*. It is possible to select further settings: system operating mode, control mode, setpoints for closed and open loop as well as individual pump control.

Setting range

Setpoint:

Closed-loop control:	Measuring range of the primary sensor
Open-loop control:	0-100 %

Setting via control panel

Setpoint:

1. Mark the **Operation** menu with ⊙.
2. Mark Setpoint 1 with ⊙ or ⊙. Set the value with ⊕ or ⊖.
3. Save with ⊙.

Operating mode:

1. Mark the **Operation** menu with ⊙.
2. Mark operating mode **Normal** or **Stop** with ⊙ or ⊙. Save with ⊙.

Further settings:

1. Mark the **Operation** menu with ⊙.
2. Mark **Further settings** with ⊙ or ⊙, and press ⊙.
3. Select one of the settings below with ⊙ or ⊙, and press ⊙:

- system operating mode (see section *9.5.2*)
- control mode (see section *9.5.3*)
- setpoints (see section *9.5.4*)
- individual pump control (see section *9.5.6*).

Factory setting

The setpoint is a value suitable for the Hydro MPC booster system in question. The factory setting may have been changed in the start-up menu.

9.5.2 System operating mode (2.1.1)

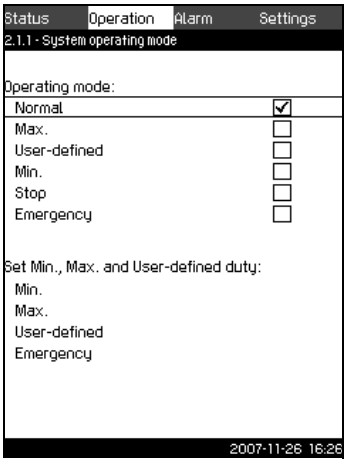


Fig. 18 System operating mode

Description

Hydro MPC can be set to six different operating modes. *Normal* is the typical setting. See section *9.4.3 Operating mode (1.2.1)*.

The performance of the operating modes *Max., Min.*, *User-defined* and *Emergency run* can be set in the **Settings** menu.

In the display shown, it is possible to go directly to the **Settings** menu in order to set the pump performance or the setpoint.

Setting range

It is possible to select the operating modes *Normal*, *Max.*, *Min.*, *User-defined, Stop* and *Emergency run*.

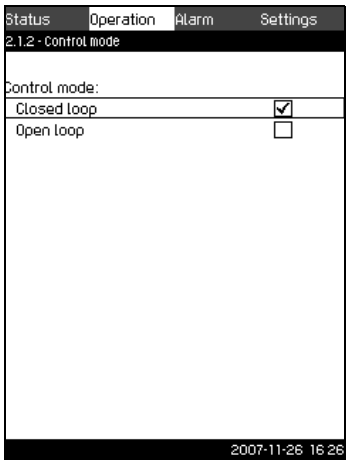
Setting via control panel

1. Mark the **Operation** menu with ⊙.
2. Mark **Further settings** with ⊙ or ⊙, and press ⊙.
3. Mark **System operating mode** with ⊙ or ⊙, and press ⊙.
4. Select the desired operating mode by marking one of the lines with check boxes with ⊙ or ⊙, and press ⊙.
5. In order to set the performance in min., max., user-defined duty or emergency run, mark the desired line at the bottom of the display, and press ⊙.
   See sections *9.7.33 Min., max. and user-defined duty (4.3.14)* and *9.7.25 Emergency run (4.3.5)*.

Factory setting

Normal.

9.5.3 Control mode (2.1.2)



TM03 2283 4807

Fig. 19 Control mode

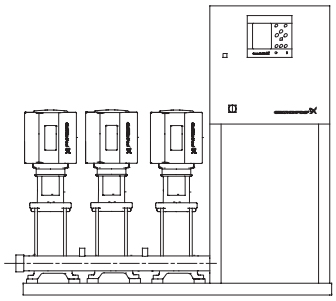
Description

There are two control modes, namely closed and open loop.

Examples:

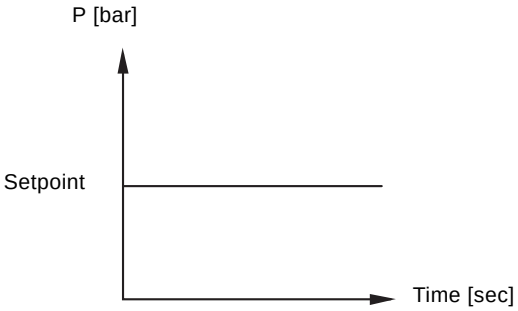
Closed loop

The typical control mode is closed loop where the built-in PI controller ensures that the booster system delivers the discharge pressure required (setpoint). The performance is based on the setpoint set for closed loop. See figs 20 and 21.



TM03 2231 3905

Fig. 20 Booster system controlled by built-in PI controller (closed loop)



TM03 2390 4105

Fig. 21 Regulation curve for closed loop

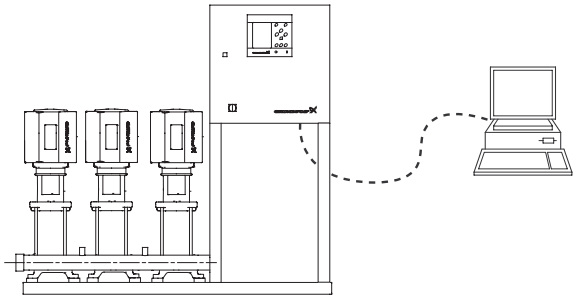
Setting via control panel

1. Mark the **Operation** menu with ▶.
2. Mark **Further settings** with ▼ or ▲, and press OK.
3. Mark **Control mode** with ▼ or ▲, and press OK.
4. Select **Closed loop** with ▼ or ▲, and press OK.
5. Set the setpoint. See sections *9.5.4 Setpoints (2.1.3)* and *9.5.1 Operation (2)*.

Open loop

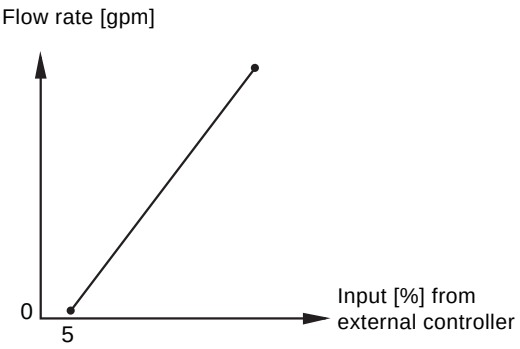
In open-loop control, the pumps run at a fixed speed.
The pump speed is calculated from the performance set by the user (0-100 %). The pump performance in percentage is proportional with the flow rate.

Open-loop control is usually used when the booster system is controlled by an external controller which controls the performance via an external signal. The external controller could for instance be a building management system connected to the Hydro MPC. In such cases, the Hydro MPC is like an actuator. See figs 22 and 23.



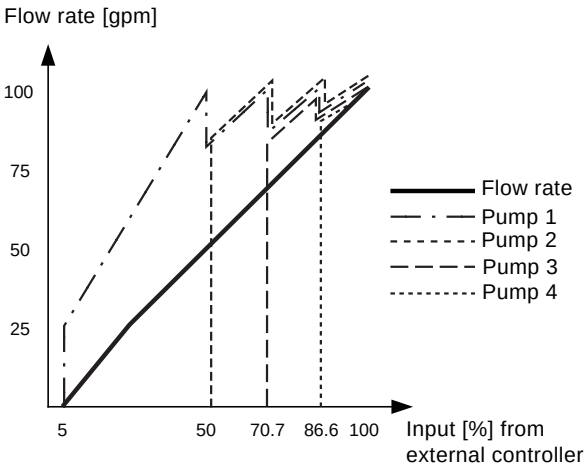
TM03 2232 3905

Fig. 22 Booster system with external controller (open loop)



TM03 2391 3607

Fig. 23 Regulation curve for open loop



TM03 9977 4807

Fig. 24 Regulation curve for Hydro MPC-E in open loop

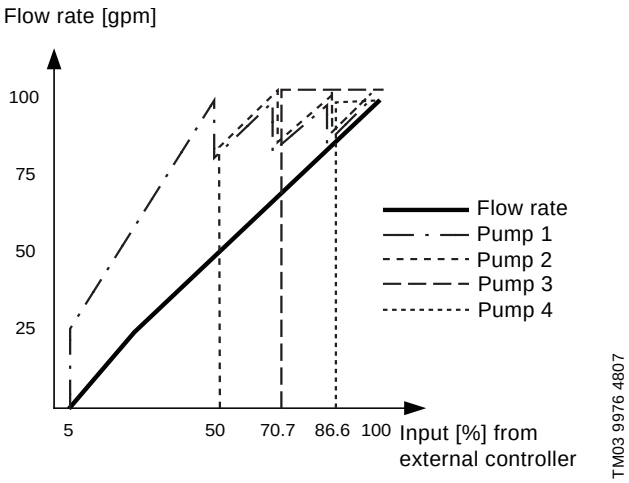


Fig. 25 Regulation curve for Hydro MPC-ED in open loop

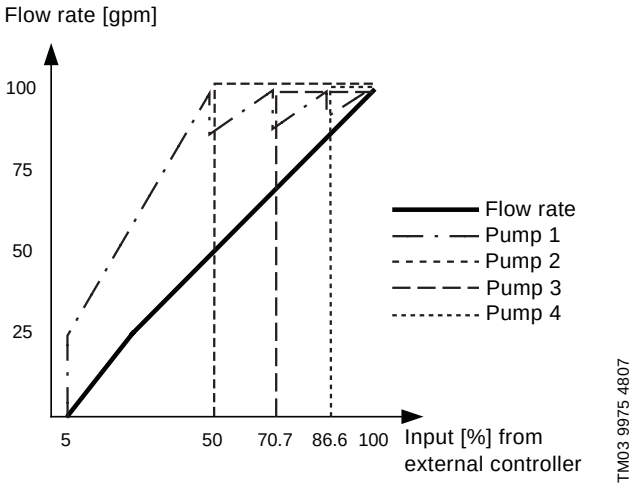


Fig. 26 Regulation curve for Hydro MPC-ES in open loop

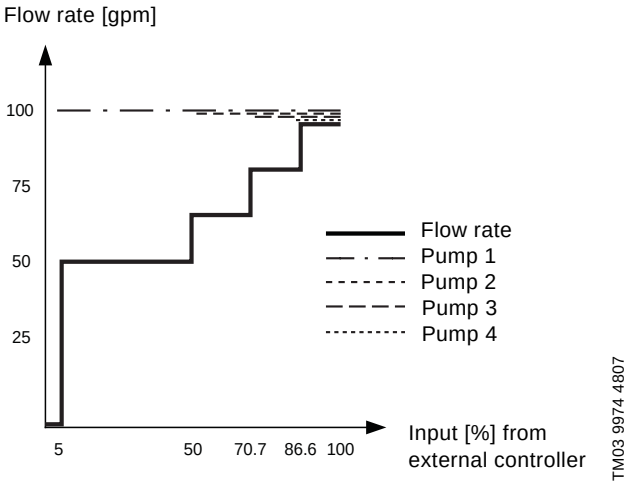


Fig. 27 Regulation curve for Hydro MPC-S in open loop

Correlating open loop input setpoint percentage with number of pumps in operation. Example: MPC system with (4) pumps

- Setpoint 0% to 5% = All pumps stopped

One pump operation from setpoint from 5% to √ (1-pump/4-pumps) = 50%

- Two pump operation from 50% to √ (2-pump/4-pumps) = 70.7%
- Three pump operation from 70.7% to √ (3-pumps/4-pumps) = 86.6%
- Four pump operation from 86.6% to 100%

For staging pumps off the cut-out is 2% less then cut-in. Example: staging from 4-pump to 3-pump operation will occur at 84.6% reference signal.

Setting range

These settings must be made in connection with open loop:

- stop of the Hydro MPC booster system
- selection of control mode *Open loop*
- setting of setpoint 1, open loop
- setting of external setpoint influence
- selection of operating mode *Normal*.

Setting via control panel

To set an external control source to control the Hydro MPC booster system, proceed as follows:

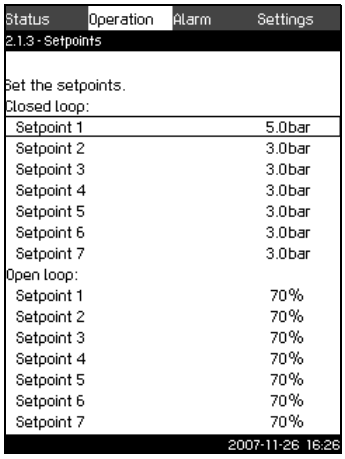
1. Mark the **Operation** menu with ›.
2. Mark the operating mode **Stop** with ⌄ or ⌃, and press ok. The check mark in the right box shows that the operation has been stopped.
3. Mark **Further settings** with ⌄ or ⌃, and press ok.
4. Mark **Control mode** with ⌄ or ⌃, and press ok.
5. Select **Open loop** with ⌄ or ⌃, and press ok.
6. Return by pressing esc twice.
7. Mark **Set setpoint 1, open loop** with ⌄ or ⌃.
8. Set the setpoint to 100 % with +, and save with ok.
9. Mark the **Settings** menu with ›.
10. Mark **Primary controller** with ⌄ or ⌃, and press ok.
11. Mark **External setpoint influence** with ⌄ or ⌃, and press ok.
12. Mark **Go to setting of analog input** with ⌄ or ⌃, and press ok.
13. Select the analog input with ⌄ or ⌃, and press ok.
14. Select the range of the analog input with ⌄ or ⌃, and press ok. The selection is indicated by a check mark.
15. Mark **Measured input value** with ⌄ or ⌃, and press ok. Now the display 4.3.8.1.1 appears.
16. Select **0-100 % signal** with ⌄ or ⌃, and press ok.
17. Press esc to return to display 4.3.8.1.
18. Set the minimum sensor value with + or −, and save with ok.
19. Set the maximum sensor value with + or −, and save with ok.
20. Return by pressing esc twice.
21. Mark **Input value to be influenced by** with ⌄ or ⌃, and press ok.
22. Mark **0-100 % signal** with ⌄ or ⌃, and press ok.
23. Return with esc.
24. Mark **Set the influence function** with ⌄ or ⌃, and press ok. For details, see section *9.7.6 Setting of influence function (4.1.3.2)*.
25. Mark the menu line for number of points with ⌄ or ⌃, and press ok.

26. Select the required number of points with ⊕ or ⊖, and save with ok.
27. Mark **External input value** (point 1) with ∨ or ∧.
28. Set the value of the external input value with ⊕ or ⊖, and save with ok.
29. Mark **Reduce setpoint to** (point 1) with ∨ or ∧.
30. Set the value as a percentage with ⊕ or ⊖, and save with ok.
31. Repeat 27 to 31 for all chosen points.
32. Return with esc.
33. Mark **Filter time** with ∨ or ∧, set the time in seconds with ⊕ or ⊖, and save with ok.
34. Mark **Activated** with ∨ or ∧, and press ok. The check mark in the right box shows that the function has been activated.
35. Return by pressing esc twice.
36. Mark the **Operation** menu with ›.
37. Mark the operating mode **Normal** with ∨ or ∧, and press ok. The check mark in the right box shows that the operation is normal. The booster system can now be controlled by an external controller.

Factory setting

Closed-loop control.

9.5.4 Setpoints (2.1.3)



TM03 8952 4807

Fig. 28 Setpoints

Description

In addition to the primary setpoint 1 (shown in the display 2 in the **Operation** menu), six alternative setpoints can be set for closed-loop control. It is furthermore possible to set seven setpoints for open-loop control.

As described in sections *9.7.3 Alternative setpoints (4.1.2)* and *9.7.4 Alternative setpoints 2 to 7 (4.1.2.1 to 4.1.2.7)*, it is possible to activate one of the alternative setpoints by means of external contacts.

Setting range

The setting range of setpoints for closed-loop control depends on the range of the primary sensor. See section *9.7.7 Primary sensor (4.1.4)*.

In open loop control, the setting range is 0 - 100 %.

Setting via control panel

1. Mark the **Operation** menu with ›.
2. Mark **Further settings** with ∨ or ∧, and press ok.
3. Mark **Setpoints** with ∨ or ∧, and press ok.
4. Select the setpoint with ∨ or ∧.
5. Set the setpoint with ⊕ or ⊖, and press ok.

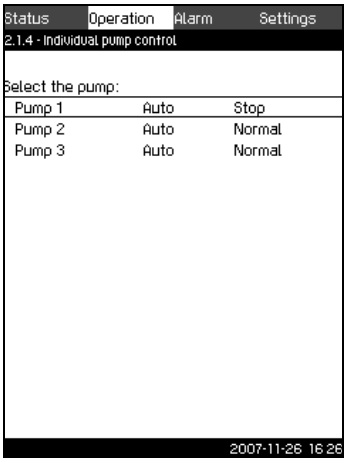
Factory setting

Setpoint 1 for closed-loop control is a value suitable for the Hydro MPC in question.

The alternative setpoints for closed-loop control are 3 bar.

All setpoints for open-loop control are 70 %.

9.5.5 Individual pump control (2.1.4)



TM03 8953 4807

Fig. 29 Individual pump control

Description

It is possible to change the operating mode from automatic operation to one of the manual operating modes.

Auto

The pumps are controlled by the PI controller, ensuring that the booster system delivers the required performance (pressure).

Manual

The pump is not controlled by the PI controller, but set to one of the following manual operating modes:

- *Max.*
  The pump runs at a set maximum speed. (This operating mode can only be selected for variable-speed pumps.)
- *Normal*
  The pump runs at a set speed.
- *Min.*
  The pump runs at a set minimum speed. (This operating mode can only be selected for variable-speed pumps.)
- *Stop*
  The pump has been forced to stop.

Pumps in manual operation are not part of the normal pump cascade and speed control. The manual pumps are a "disturbance" of the normal control of Hydro MPC.

If one or more pumps are in manual operation, Hydro MPC may not be able to deliver the set performance.

There are two displays for the function. In the first display, the pump to be set is selected, and in the next display, the operating mode is selected.

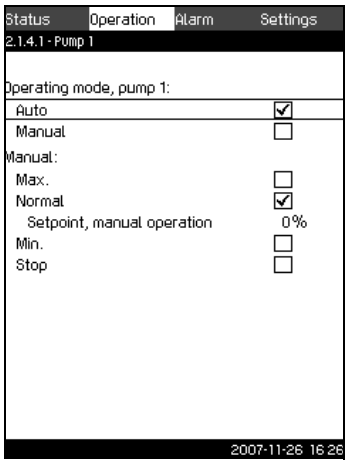
Setting range

All pumps can be selected.

Setting via control panel

1. Mark the **Operation** menu with ›.
2. Mark **Further settings** with ∨ or ∧, and press ok.
3. Mark **Individual pump control** with ∨ or ∧, and press ok.
4. Select the pump with ∨ or ∧, and press ok.

9.5.6 Setting of individual operating mode (2.1.4.1 to 2.1.4.6)



TM03 8954 4807

Fig. 30 Setting of individual operating mode

Description

This display is shown for the individual pumps and makes it possible to set an operating mode.

Setting range

It is possible to select *Auto* or *Manual* as well as the operating mode of the pump for manual operation - *Max.*, *Normal*, *Min.* or *Stop*. For mains-operated pumps only *Normal* or *Stop* can be selected.

Setting via control panel

1. Mark the **Operation** menu with ⊙.
2. Mark **Individual pump control** with ⊙ or ⊙, and press ⊙.
3. Select the pump with ⊙ or ⊙, and press ⊙.
4. Mark **Auto** or **Manual** with ⊙ or ⊙, and press ⊙.
5. *Manual:* Select the operating mode with ⊙ or ⊙, and press ⊙.
6. *Normal:* Mark **Setpoint** with ⊙ or ⊙.
   Set the speed of the variable-speed pump with ⊙ or ⊙, and press ⊙.

Factory setting

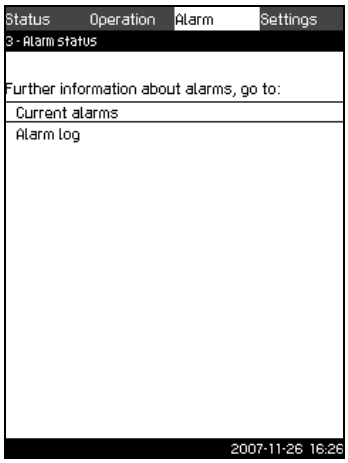
Auto.

9.6 Alarm (3)

The **Alarm** menu gives an overview of alarms and warnings.

In this menu, it is possible to reset alarms and to see the alarm log.

9.6.1 Alarm status (3)



TM03 2291 4807

Fig. 31 Alarm status

Description

A fault in the Hydro MPC booster system or one of the components monitored can cause an alarm ⊗ or a warning ⚠. Besides the fault signal via the alarm/warning signal relay and the red indicator light on the CU 351, an alarm can also cause a change of operating mode, for instance from *Normal* to *Stop*. A warning only causes a fault indication.

The table shows the possible causes of fault together with an alarm code number, and whether they result in an alarm or a warning. It also shows to what operating mode the booster system changes in case of alarm, and whether restart of the booster system and reset of the alarm is manual or automatic.

The table also shows that the reaction to some of the fault causes mentioned can be set in the **Settings** menu. See sections *9.7.24 Soft pressure build-up (4.3.3)* and *9.7.41 Monitoring functions (4.4)* to *9.7.51 Pressure relief (4.4.8)*.

Fault	Warning(⚠)/alarm(⊗)	Change of operating mode to	Reset of alarm Restart	Set in the Settings menu	Alarm code
Water shortage	⚠		Auto		206
Water shortage	⊗	Stop	Man/auto	X	214
Pressure high	⊗	Stop	Auto		210
Pressure low	⚠		Auto	X	211
	⊗	Stop	Man		
Pressure relief	⚠		Auto	X	219
Alarm, all pumps	⊗	Stop	Auto		203
External fault	⚠		Auto	X	3
	⊗	Stop	Man		
Dissimilar sensor signals	⚠		Auto		204
Fault, primary sensor	⊗	Stop	Auto		89
Fault, sensor	⚠		Auto		88
Communication fault	⚠		Auto		10
Phase failure	⚠		Auto		2
Undervoltage, pump	⚠		Auto		7, 40, 42, 73
Overvoltage, pump	⚠		Auto		32
Overload, pump	⚠		Auto		48, 50, 51, 54
Overtemperature, pump	⚠		Auto		64, 65, 67
Other fault, pump	⚠		Auto		76, 83
Internal fault, CU 351	⚠		Auto		72, 83, 157
Internal fault, IO 351	⊗	Stop	Auto		83, 157
VFD not ready	⚠		Auto		213
Fault, Ethernet	⚠		Auto		231, 232
Limit 1 exceeded	⚠ ⊗		Man/auto	X	190
Limit 2 exceeded	⚠ ⊗		Man/auto	X	191
Pressure build-up fault	⚠ ⊗		Man/auto	X	215
Pumps outside duty range	⚠		Man/auto	X	208
Pilot pump fault	⚠		Auto		216

Alarm (3) continued

MPC alarm indication "Protocol description"	Alarm code	Associated device and device no.	Description/cause	Remedy	Reset type[1]	Alarm/warning Action type[2]
1. Phase failure, pump	2	Pump 1-6	-	1. Check that all three power supply phases are within a 15 V window.	Auto	Warning
2. Undervoltage	7	Pump 1-6	HSD = hardware shut-down. There has been a fault, and the permissible number of restarts for the fault type has been exceeded. a) Fault in power supply. a) Terminal box defective.	1. Restore power supply. 2. Replace terminal box.	Auto	Warning
3. Undervoltage, pump	40	Pump 1-6	a) Power supply voltage is too low at start.	1. Bring voltage back to prescribed level.	Auto	Warning
4. Undervoltage, pump	42	Pump 1-6	a) Faulty power supply at the time of staging on a pump.	1. Restore proper power supply.	Auto	Warning
5. Undervoltage, pump	73	Pump 1-6	a) Low supply voltage. b) Power supply failure while motor is running.	1. Restore proper power supply.	Auto	Warning
6. Overvoltage, pump	32	Pump 1-6	a) Supply voltage is too high at start.	1. Bring voltage back to prescribed level.	Auto	Warning
7. Overload, associated device	48	Pump 1-6	a) Heavy overload has caused software shutdown (SSD).	1. Check and possibly reduce load.	Auto	Warning
8. Overload, associated device	50	Pump 1-6	a) MPF = motor protection function. The built-in motor protection has detected a sustained overload (MPF 60 sec. limit)>	1. Check and possibly reduce load/improve cooling.	Auto	Warning
9. Overload, associated device	51	Pump 1-6	a) Heavy overload (Imax. very high). Pump blocked at start.	1. Unblock the pump.	Auto	Warning
10. Overload, associated device	54	Pump 1-6	a) The built-in motor protection has detected a transitory overload (MPF 3 sec. limit).	1. Check and possibly reduce load/improve cooling	Auto	Warning
11. Over temperature, pump	65	Pump 1-6	a) PTC sensor in the motor has signalled over temperature.	1. Check and possibly reduce load/improve cooling.	Auto	Warning
12. Over temperature, pump	67	Pump 1-6	a) Terminal box has indicated over temperature.	1. Check and possibly reduce load/improve cooling. (Temperature during operation can be read via PC Tool E-products.)	Auto	Warning

MPC alarm indication "Protocol description"	Alarm code	Associated device and device no.	Description/cause	Remedy	Reset type[1]	Alarm/warning Action type[2]
13. Other fault, associated device	76	Pump 1-6	a) Internal communication error has occurred in the pump.	Try to reset the fault: 1. Switch off the supply power. 2. Wait until all diodes are out. 3. Switch on the supply power. If this does not remedy the fault, replace the terminal box.	Auto	Warning
14. Limit 1 exceeded	190	Measured parameter	a) The measured parameter has exceeded the limit set.	1. Remove the cause of the fault.	Auto/ manual	Alarm/warning Stop/ unchanged
15. Limit 2 exceeded	191	Measured parameter	a) The measured parameter has exceeded the limit set.	1. Remove the cause of the fault.	Auto/ manual	Alarm/warning Stop/ unchanged
16. Pressure relief	219	System	a) The monitored pressure could not be reduced sufficiently.	1. Reduce the pressure to below the limit.	Auto	Warning Unchanged
17. Pressure build-up fault	215	System	a) The pressure set cannot be reached within the configured time.	1. Check limit and pipes.	Auto/ manual	Alarm/warning Stop/ unchanged
18. Pumps outside duty range	208	System	a) The pump is running outside the defined range.	1. Check the system.	Auto/ manual	Warning Unchanged
19. Pilot pump fault	216	Pilot pump	a) Pilot pump fault	1. Check wires. 2. Check the pump.	Auto	Warning

MPC alarm indication "Protocol description"	Alarm code	Associated device and device no.	Description/cause	Remedy	Reset type[1]	Alarm/warning Action type[2]
20. Water shortage, level 1 *Water shortage, level 1	206	System	a) The pre-pressure (or the level in the feed tank) is below its programmable warning limit.	1. Check the actual and the corresponding settings. 2. Check the sensor/switch, wiring and input according to the wiring diagram. 3. Check the sensor/switch.	Auto	Warning Unchanged
21. Water shortage, level 2 *Water shortage, level 2	214		a) The pre-pressure (or the level in the feed tank) is below its programmable warning limit.		Auto/ Manual	Alarm Stop
			b) The pre-pressure switch detect water shortage.			Warning Unchanged
22. Discharge pressure high *Pressure above max. pressure	210		a) The system pressure is above the programmable high-pressure alarm limit.		Auto/ Manual	Alarm Fast stop (over rule min. seq. time)
23. Discharge pressure low *Pressure below min. pressure	211		a) The system pressure is below the programmable low-pressure alarm limit.		Auto/ Manual	Alarm/Warning Stop/ Unchanged
24. All pumps in alarm *All pumps in alarm	203		a) All pumps, set to Auto, is stopped on account of pump alarm	Troubleshoot according to the alarm message/code: 1. System 2. Pumps installed Use fault fault finding for the pump.	Auto	Alarm Stop
			b) Pumps are not indicating alarm	Check the Genibus wires eg. connection, polarisation.		
25. External fault signal *External fault signal	003		a) External fault digital input activated.	1. Check the external signal source. 2. Check the digital input according to the wiring diagram	Auto/ Manual	Alarm/Warning Stop/ Unchanged
26. Inconsistency between sensors *Inconsistency between sensors	204	Primary sensor and/or redundant sensor	a) Primary feedback sensor value (pressure) is inconsistent with redundant feedback sensor value.	1. Check the wiring and input according to the wiring diagram. 2. Check the sensor output according to the measured value.	Auto	Warning Unchanged
27. Primary sensor *Closed loop feedback sensor signal fault	089	Primary sensor	a) A fault in the sensor assigned to the feed back control is detected.	1. Check the wiring and input according to the wiring diagram. 2. Check the sensor output according to the measured value.	Auto	Alarm Stop
			b) Error in the settings of the sensor which is assigned to the regulator.	Check the primary sensor settings		
28. Sensor fault *General (measurement) sensor signal fault	088	CU 351 IO 351 as IO module	a) The signal (ex. 4-20 mA) from one of the analog sensors is outside the selected signal range.	1. Check the wiring and input according to the wiring diagram. 2. Check the sensor output according to the measured value		Warning Unchanged

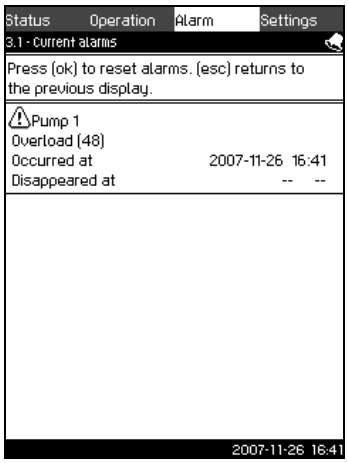
MPC alarm indication "Protocol description"	Alarm code	Associated device and device no.	Description/cause	Remedy	Reset type[1]	Alarm/warning Action type[2]
29. CU 351 internal fault *Real time clock out of order	157	CU 351	a) The real-time clock in CU 351 is out of order.	Replace the CU 351	Auto	Warning Unchanged
30. Ethernet fault *Ethernet: No address from DHCP server	231		a) No address from DHCP server	1. Communication error. 2. Please contact the system integrator.		
31. Ethernet fault *Ethernet: Auto disabled due to misuse	232		a) Auto-disabled due to misuse			
32. FLASH parameter verification error *FLASH parameter verification error	083		a) Verification error in CU 351 FLASH memory	Replace the CU 351		
33. IO 351 internal fault *Hardware fault type 2	080	IO 351	a) IO 351 pump module hardware fault b) IO 351 I/O module hardware fault	See current alarms and identify the faulty IO 351 module from the alarm message and replace the module.		
34. VFD not ready *VFD not ready	213	Pump 1-6 CU 351	a) The VFD signal relay do not release the VFD for operation	1. Check for VFD alarm 2. Check the wiring and input according to the wiring diagram.		
35. Communication fault *Pump communication fault	010	Pump 1-6 IO 351	a) No GeniBus communication with a device connected to CU 351	See actual alarms and identify the faulty device from the alarm message. 1. Check power supply 2. Check GeniBus cable connection 3. Check, with R100, that the device GeniBus no. is correct.		
36. Device alarms	From device	Pump 1-6	a) The device is in alarm	See actual alarms and identify the faulty device from the alarm message. 1. Fault find according to the service instruction for the device.		

1) Reset type is either fixed as "Auto acknowledge" (Auto) or can be programmed to be Auto or manual ackknowledge (Auto/Man)*.

2) Programmable action types:

- Go to operating mode "Stop" (no delay (<0.5 s) between pump disconnections).
- Go to operating mode "Min".
- Go to operating mode "User-defined".
- Go to operating mode "Max".
- Set pumps in source mode "Local". - No action (warning only)

9.6.2 Current alarms (3.1)



TM03 2293 4807

Fig. 32 Current alarms

Description

This submenu shows the following:

- Warnings ⚠ caused by faults that still exist.
- Warnings ⚠ caused by faults that have disappeared, but the warning requires manual reset.
- Alarms ⊗ caused by faults that still exist.
- Alarms ⊗ caused by faults that have disappeared, but the alarm requires manual reset.

All warnings and alarms with automatic reset are automatically removed from the menu when the fault has disappeared.

Alarms requiring manual reset are reset in this display by pressing (ok). An alarm cannot be reset until the fault has disappeared.

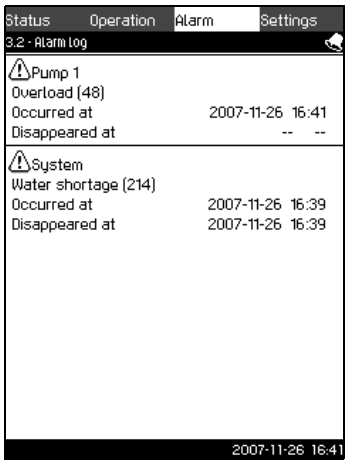
For every warning or alarm, the following is shown:

- Whether it is a warning ⚠ or an alarm ⊗.
- Where the fault occurred: System, Pump 1, Pump 2, etc.
- In case of input-related faults, the input is shown.
- What the cause of the fault is, and the alarm code in brackets: Water shortage (214), Max. pressure (210), etc.
- When the fault occurred: Date and time.
- When the fault disappeared: Date and time. If the fault still exists, date and time are shown as --...--.

The latest warning/alarm is shown at the top of the display.

9.6.3 Alarm log (3.2)

The alarm log can store up to 24 warnings and alarms.



TM03 2292 4807

Fig. 33 Alarm log

Description

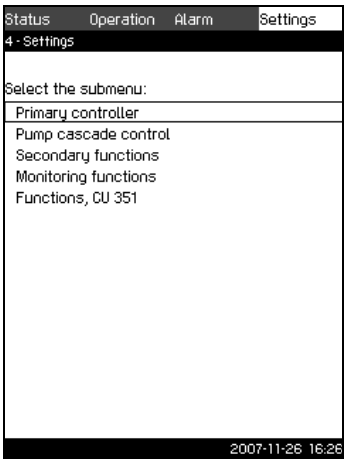
Here warnings and alarms are shown.

For every warning or alarm, the following is shown:

- Whether it is a warning ⚠ or an alarm ⊗.
- Where the fault occurred. System, Pump 1, Pump 2, etc.
- In case of input-related faults, the input is shown.
- What the cause of the fault is, and the alarm code in brackets: Water shortage (214), Max. pressure (210), etc.
- When the fault occurred: Date and time.
- When the fault disappeared: Date and time. If the fault still exists, date and time are shown as --...--.

The latest warning/alarm is shown at the top of the display.

9.7 Settings (4)



TM03 2294 4807

Fig. 34 Settings

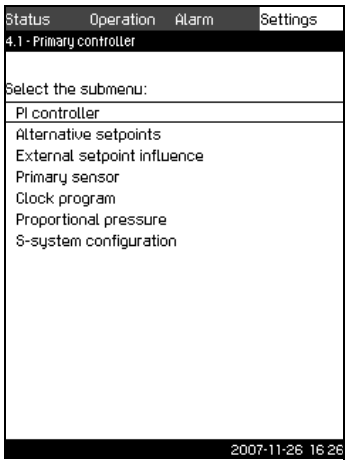
In the **Settings** menu, it is possible to set the following functions:

- Primary controller
  Setting of PI controller, alternative setpoints, external setpoint influence, primary sensor, clock program, proportional pressure and S-system configuration.
- Pump cascade control
  Setting of min. time between start/stop, max. number of starts/hour, number of standby pumps, forced pump changeover, pump test run, pilot pump, pump stop attempt, pump start and stop speed, min. performance and compensation for pump start-up time.
- Secondary functions
  Setting of stop function, soft pressure build-up, digital and analog inputs, digital outputs, emergency run, min., max. and user-defined duty, pump curve data, flow estimation, control source and fixed inlet pressure.
- Monitoring functions
  Setting of dry-running protection, min. and max. pressure, external fault, limit 1 and 2 exceeded, pumps outside duty range and pressure relief.
- Functions, CU 351
  Selection of service language, main language and units. Setting of time and date, passwords, Ethernet connection, GENIbus number and software status.

Usually, all these functions are set correctly when the Hydro MPC is switched on.

It is only necessary to make settings in this menu if the functionality is to be expanded with for instance alternative setpoints or setpoint influence, or if the settings of the CU 351 are to be adjusted.

9.7.1 Primary controller (4.1)



TM03 8955 4807

Fig. 35 Primary controller

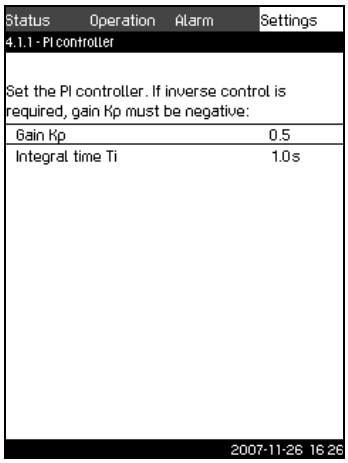
Description

In this menu section, it is possible to set the functions related to the primary controller.
It is only necessary to make settings in this menu if the functionality is to be expanded with for instance alternative setpoints, external setpoint influence, clock program or proportional pressure.

The following menus can be selected:

- PI controller
- Alternative setpoints
- External setpoint influence
- Primary sensor
- Clock program
- Proportional pressure
- S-system configuration.

9.7.2 PI controller (4.1.1)



TM03 2387 4807

Fig. 36 PI controller

Description

Hydro MPC includes a standard PI controller which ensures that the pressure is stable and corresponds to the setpoint.

It is possible to adjust the PI controller if a faster or slower reaction to changes of consumption is required.

A faster reaction is obtained if K_p is increased and T_i is reduced.

A slower reaction is obtained if K_p is reduced and T_i is increased.

Setting range

- Gain K_p: –30 to 30.
  Note: For inverse control, set K_p to a negative value.
- Integral time T_i: 0.1 to 3600 seconds.

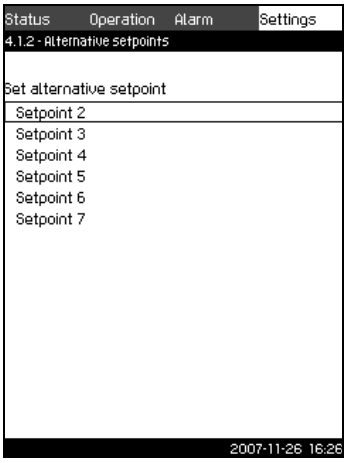
Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Primary controller** with ⊙ or ⊙, and press ⊙.
3. Mark **PI controller** with ⊙ or ⊙, and press ⊙.
4. Select the gain (K_p) with ⊙ or ⊙. Set the value with ⊙ or ⊙, and save with ⊙.
   Note: Usually it is not necessary to adjust K_p.
5. Select the integral time (T_i) with ⊙ or ⊙. Set the time with ⊙ or ⊙, and press ⊙.

Factory setting

- K_p: 0.5
- T_i: 1 second

9.7.3 Alternative setpoints (4.1.2)



TM03 2383 4807

Fig. 37 Alternative setpoints

Description

This function makes it possible to select up to six setpoints (No 2 to 7) as alternatives to the primary setpoint (No 1). The primary setpoint (No 1) is set in the **Operation** menu.
Every alternative setpoint can be addressed manually to a separate digital input (DI). When the contact of the input is closed, the alternative setpoint applies.

If more than one alternative setpoint has been selected and they are activated at the same time, the CU 351 selects the setpoint with the lowest number.

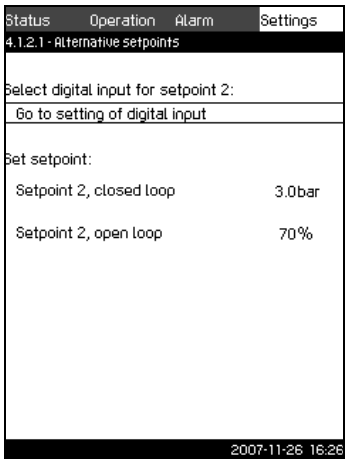
Setting range

- Six setpoints, No 2 to 7.

Factory setting

No alternative setpoints have been selected.

9.7.4 Alternative setpoints 2 to 7 (4.1.2.1 to 4.1.2.7)



TM03 2384 4807

Fig. 38 Alternative setpoints 2 to 7

For each alternative setpoint, select the digital input to activate the setpoint.

It is possible to set a setpoint for closed loop and for open loop.

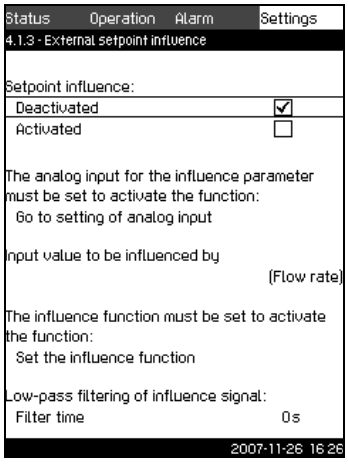
Setting via control panel

1. Mark the **Settings** menu with (>).
2. Mark **Primary controller** with (v) or (^), and press (ok).
3. Mark **Alternative setpoints** with (v) or (^), and press (ok).
4. Select the alternative setpoint with (v) or (^), and press (ok).
5. Mark **Go to setting of digital input** with (v) or (^), and press (ok).
   Now the display *Digital inputs (4.3.7)* appears. Set the input and return with (esc).
6. Mark the menu line of the setpoint (closed or open loop) with (v) or (^).
7. Set the required setpoint with (+) or (−), and save with (ok). Set both setpoints if Hydro MPC is to be controlled both in open and closed loop.

Factory setting

No alternative setpoints have been set.

9.7.5 External setpoint influence (4.1.3)



TM03 8956 4807

Fig. 39 External setpoint influence

Description

This function makes it possible to adapt the setpoint by letting measuring parameters influence the setpoint. Typically an analog signal from a flow or temperature transmitter, or a similar transmitter.

As an example, the setpoint can be adapted to parameters that can influence the discharge pressure or temperature of the system. The parameters which influence the performance of the booster system are shown as a percentage from 0 to 100 %. They can only reduce the setpoint, as the influence as a percentage divided with 100 is multiplied with the setpoint:

$$\text{Setpoint}_{\text{current(SP)}} = \text{Setpoint}_{\text{selected}} \times \text{Infl.(1)} \times \text{Infl.(2)} \times \ldots$$

The influence values can be set individually.

A low-pass filter ensures smoothing of the measured value which influences the setpoint. This results in stable setpoint changes.

Setting range

The following parameters can be selected.

- 0-100 % signal
- Inlet pressure
- Discharge pressure
- External pressure
- Differential pressure, pump
- Differential pressure, external
- Flow rate
- Tank level, discharge side
- Tank level, suction side
- Flow pipe temperature
- Return pipe temperature
- Ambient temperature
- Return pipe temperature, external
- Differential temperature.

Setting via control panel

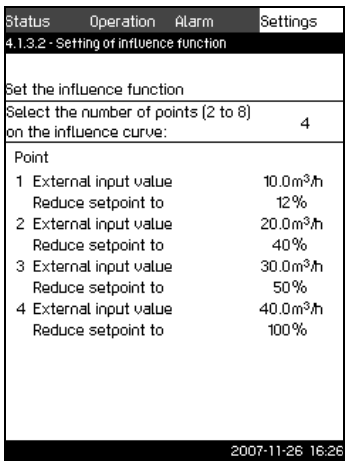
1. Mark the **Settings** menu with (>).
2. Mark **Primary controller** with (v) or (^), and press (ok).
3. Mark **External setpoint influence** with (v) or (^), and press (ok).
4. Mark **Input value to be influenced by** with (v) or (^), and press (ok).
   Now a list of available parameters appear.
5. Mark the parameter which is to influence the setpoint with (v) or (^), and press (ok).
6. Return with (esc).
7. Mark **Set the influence function** with (v) or (^), and press (ok). For details, see section *9.7.6 Setting of influence function (4.1.3.2)*.
8. Mark the menu line for number of points with (v) or (^), and press (ok).
9. Select the required number of points with (+) or (−), and save with (ok).
10. Mark **External input value** (point 1) with (v) or (^).
11. Set the value of the external input value with (+) or (−), and save with (ok).
12. Mark **Reduce setpoint to** (point 1) with (v) or (^).
13. Set the value as a percentage with (+) or (−), and save with (ok).
14. Repeat points 8 to 13 for all desired parameters.
15. Return with (esc).
16. Mark **Filter time** with (v) or (^), set the time in seconds with (+) or (−), and save with (ok).

17. Mark **Activated** with ⊙ or ⊙, and press ⊙. The check mark in the right box shows that the function has been activated.

Factory setting

Setpoint influence is not activated.

9.7.6 Setting of influence function (4.1.3.2)



TM03 2389 4807

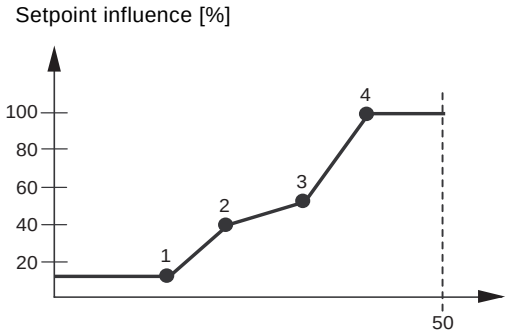
Fig. 40 Setting of influence function

Description

In this menu, you select the relation between the measuring parameter which is to influence the setpoint and the desired influence as a percentage.

The relation is set by entering values in a table with maximum eight points by means of the control panel.

Example with four points:



TM03 1691 4807

Fig. 41 Relation between setpoint influence and flow rate

The control unit of the Hydro MPC draws straight lines between the points. A horizontal line is drawn from the minimum value of the relevant sensor (0 m^3/h in the example) to the first point. This is also the case from the last point to the sensor's maximum value (example 50 m^3/h).

Setting range

Two to eight points can be selected. Each point contains the relation between the value of the parameter which is to influence the setpoint and the influence of the value.

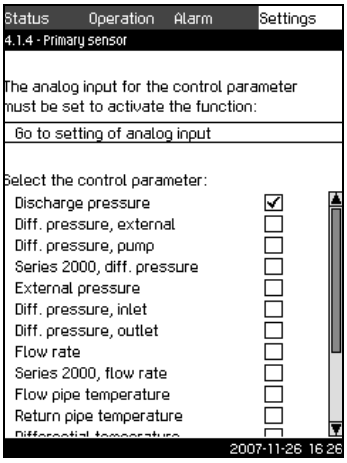
Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Primary controller** with ⊙ or ⊙, and press ⊙.
3. Mark **External setpoint influence** with ⊙ or ⊙, and press ⊙.
4. Mark **Set the influence function** with ⊙ or ⊙, and press ⊙.
5. Mark the menu line for number of points with ⊙ or ⊙, and press ⊙.
6. Select the required number of points with ⊕ or ⊖, and save with ⊙.
7. Mark **External input value** (point 1) with ⊙ or ⊙.
8. Set the value of the external input value with ⊕ or ⊖, and save with ⊙.
9. Mark **Reduce setpoint to** (point 1) with ⊙ or ⊙.
10. Set the value as a percentage with ⊕ or ⊖, and save with ⊙.
11. Repeat points 7 to 10 for all desired parameters.

Factory setting

External setpoint influence is not activated.

9.7.7 Primary sensor (4.1.4)



TM03 8958 4807

Fig. 42 Primary sensor

Description

In this display, select the control parameter of Hydro MPC and the sensor to measure the value.

Usually, the control parameter is the discharge pressure which is measured by a sensor fitted on the discharge manifold and connected to analog input AI1 of the CU 351.

If another control parameter is selected, the sensor must be connected to AI3 (CU 351) which is then set to one of the chosen parameters listed below.

Setting range

- Discharge pressure (factory setting)
- Differential pressure, external
- Differential pressure, pump
- Series 2000, differential pressure
- External pressure
- Differential pressure, inlet
- Differential pressure, outlet
- Flow rate
- Series 2000, flow rate
- Flow pipe temperature
- Return pipe temperature
- Differential temperature
- Ambient temperature
- Return pipe temperature, external
- 0-100 % signal
- Not used.

From factory the discharge pressure sensor is connected to AI1 (CU 351). If one of the above parameters is selected, the sensor in question must be connected to AI3 (CU 351) and set in order to function as the primary sensor.

Setting via control panel

1. Mark the **Settings** menu with ▷.
2. Mark **Primary controller** with ▽ or △, and press ok.
3. Mark **Primary sensor** with ▽ or △, and press ok.
4. Mark **Go to setting of analog input** with ▽ or △, and press ok.
   Now the display *Analog inputs (4.3.8)* appears. Select the analog input (AI) for the primary sensor, and set the parameters for this sensor. Return to display *Primary sensor (4.1.4)* with esc.
5. Select the control parameter for the primary sensor with ▽ or △, and press ok.

If the primary parameter is discharge pressure, AI1 (CU 351) must be set to this parameter.

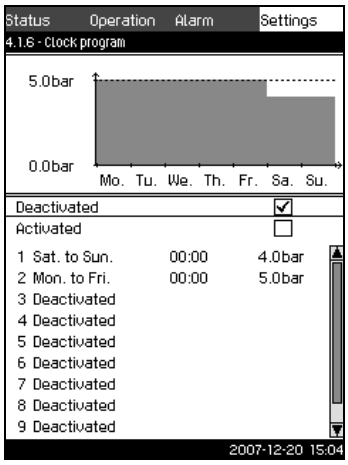
Note

If the primary parameter is external pressure or flow rate, AI3 (CU 351) must be set to this parameter.

Factory setting

The primary parameter is discharge pressure. The sensor is connected to AI1 (CU 351).

9.7.8 Clock program (4.1.6)



TM03 8990 4807

Fig. 43 Clock program

Description

With this function, it is possible to set setpoints and day and time for their activation. It is also possible to set day and time for stop of the Hydro MPC system.

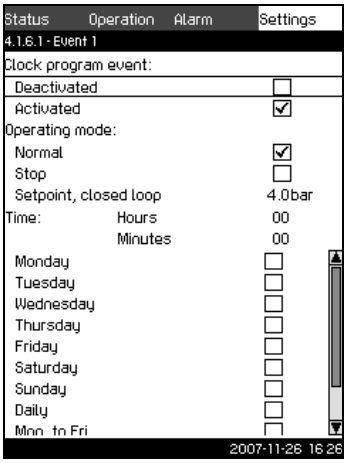
If the clock program is deactivated, the setpoint of the program will remain active.

Setting range

- Activation of the function.
- Activation and setting of event.

Setting via control panel

1. Mark the **Settings** menu with ▷.
2. Mark **Primary controller** with ▽ or △, and press ok.
3. Mark **Clock program** with ▽ or △, and press ok.
4. Mark event **1** with ▽ or △, and press ok.



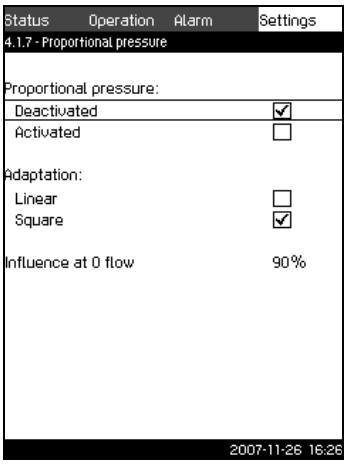
TM03 8959 4807

5. Mark operating mode **Normal** or **Stop** with ▽ or △, and press ok. (If **Stop** is selected, point 7 is skipped.)
6. Mark **Setpoint, closed loop** with ▽ or △. Set the pressure with ⊕ or ⊖, and save with ok.
7. Mark **Time (hours, minutes)** with ▽ or △.
8. Set the time with ⊕ or ⊖, and save with ok.
9. Mark day of week on which the settings are to be activated with ▽ or △, and press ok.
10. Mark **Activated** with ▽ or △, and press ok.
11. Return with esc.
12. Mark **Activated** with ▽ or △, and press ok. The check mark in the right box shows that the function has been activated.
13. Repeat points 4 to 11 if several events are to be activated.
    Note: Up to ten events can be set.

Factory setting

The function is deactivated.

9.7.9 Proportional pressure (4.1.7)

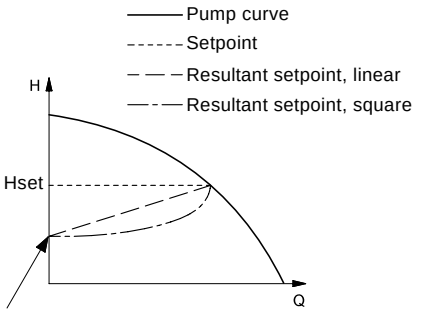


TM03 8960 4807

Fig. 44 Proportional pressure

Description

The function can only be activated in pressure-controlled systems and automatically adapts the setpoint set to the current flow rate. The adaptation can be linear or square. See fig. 45.



Starting point of proportional pressure control
(Influence at 0 flow = x % of H_{set})

TM03 8524 1807

Fig. 45 Proportional pressure

The function has these purposes:

- to compensate for pressure losses
- to reduce the energy consumption
- to increase the comfort for the user.

Setting range

- Activation of the function.
- Selection of control mode.
- Setting of setpoint influence.

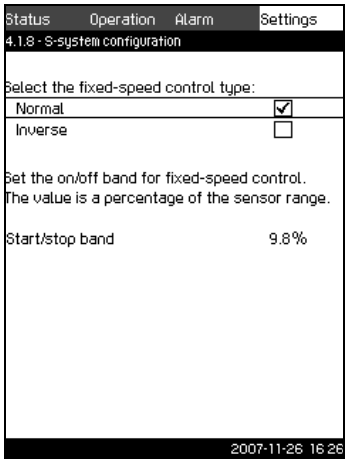
Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Primary controller** with ⊙ or ⊙, and press ⊙.
3. Mark **Proportional pressure** with ⊙ or ⊙, and press ⊙.
4. Mark **Activated** with ⊙ or ⊙, and press ⊙. The check mark in the right box shows that the function has been activated.
5. Mark **Adaptation, linear** or **square** with ⊙ or ⊙, and press ⊙.
6. Mark **Influence at 0 flow** with ⊙ or ⊙. Set the value with ⊙ or ⊙, and save with ⊙.

Factory setting

The function is deactivated.

9.7.10 S-system configuration (4.1.8)



TM03 8961 4807

Fig. 46 S-system configuration

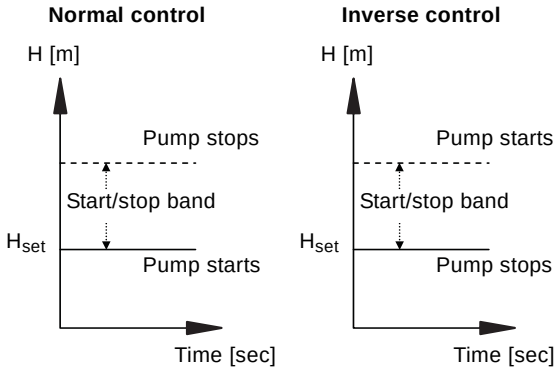
Description

The function makes it possible to invert the control of mains-operated pumps (Hydro MPC-S). That is to set whether pumps are to be started or stopped depending on the current value.

A start/stop band must be set in order to use this function. See fig. 47.

Normal control: A pump is stopped when the current value becomes higher than H_{set} + start/stop band. And a pump is started when the current value becomes lower than H_{set}. See fig. 47.

Inverse control: A pump is started when the current value becomes higher than H_{set} + start/stop band. And a pump is stopped when the current value becomes lower than H_{set}. See fig. 47.



TM03 9205 3607 - TM03 9205 3607

Fig. 47 Normal and inverse control

Setting range

- Selection of configuration (normal or inverse control).
- Setting of start/stop band.

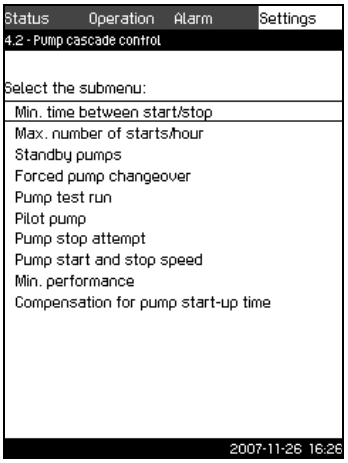
Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Primary controller** with ⊙ or ⊙, and press ⊙.
3. Mark **S-system configuration** with ⊙ or ⊙, and press ⊙.
4. Mark **Inverse** with ⊙ or ⊙, and press ⊙.
5. Mark **Start/stop band** with ⊙ or ⊙. Set the value ⊙ with or ⊙, and save with ⊙.

Factory setting

Normal.

9.7.11 Pump cascade control (4.2)



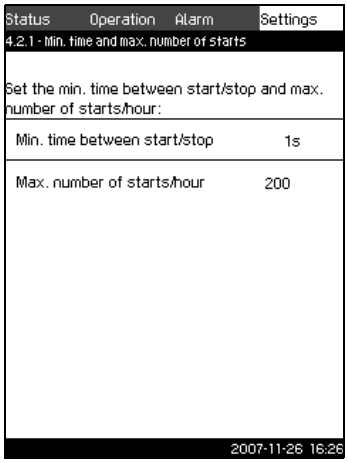
TM03 8962 4807

Fig. 48 Pump cascade control

In this menu section, it is possible to set the functions connected to pump cascade control. The following menus can be selected:

- Min. time between start/stop
- Max. number of starts/hour
- Standby pumps
- Forced pump changeover
- Pump test run
- Pilot pump
- Pump stop attempt
- Pump start and stop speed
- Min. performance
- Compensation for pump start-up time.

9.7.12 Min. time between start/stop (4.2.1)



TM03 2367 4807

Fig. 49 Min. time between start/stop

Description

This function ensures a delay between the starting/stopping of one pump and the starting/stopping of another pump.

The purpose is to prevent hunting when pumps start and stop continuously.

Setting range

From 1 to 3600 seconds.

Setting via control panel

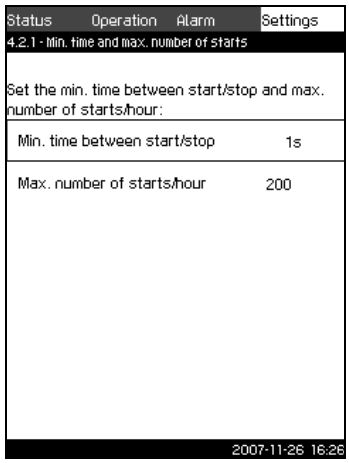
1. Mark the **Settings** menu with ⊙.
2. Mark **Pump cascade control** with ⊙ or ⊙, and press ⊙.
3. Mark **Min. time between start/stop** with ⊙ or ⊙, and press ⊙.
4. Mark **Min. time between start/stop** with ⊙ or ⊙, and press ⊙.
5. Set the required minimum time with ⊙ or ⊙, and save with ⊙.

Factory setting

Minimum time between start/stop of pumps:

Hydro MPC-E and -EF:	1 second
Other variants:	5 seconds

9.7.13 Max. number of starts/hour (4.2.1)



TM03 2367 4807

Fig. 50 Max. number of starts/hour

Description

This function limits the number of pump starts and stops per hour for the complete system. It reduces noise emission and improves the comfort of booster systems with mains-operated pumps.

Each time a pump starts or stops, the CU 351 calculates when the next pump is allowed to start/stop in order not to exceed the permissible number of starts per hour.

The function always allows pumps to be started to meet the requirement, but pump stops will be delayed, if needed, in order not to exceed the permissible number of starts per hour.

The time between pump starts must be between the minimum time between start/stop, see section *9.7.12*, and 3600/n, n being the set number of starts per hour.

Setting range

1 to 1000 starts per hour.

Setting via control panel

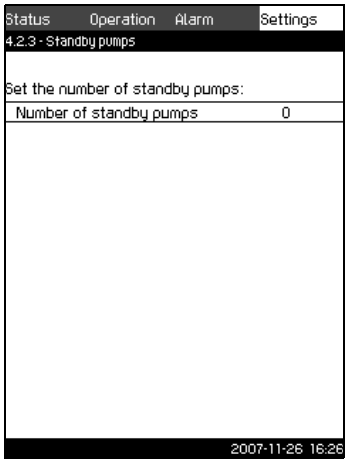
1. Mark the **Settings** menu with ⊙.
2. Mark **Pump cascade control** with ⊙ or ⊙, and press ⊙.
3. Mark **Max. number of starts/hour** with ⊙ or ⊙, and press ⊙.
4. Mark **Max. number of starts/hour** with ⊙ or ⊙, and press ⊙.
5. Set the permissible number of starts per hour with ⊙ or ⊙, and save with ⊙.

Factory setting

Hydro MPC-E and -EF:	200 starts per hour
Other variants:	100 starts per hour

Note **This function has no influence on *Stop function (4.3.1)*.**

9.7.14 Standby pumps (4.2.3)



TM03 2366 4807

Fig. 51 Standby pumps

Description

This function makes it possible to limit the maximum performance of the Hydro MPC, by selecting one or more pumps as standby pumps.

If a three-pump system has one standby pump, maximum two pumps are allowed to be in operation at a time.

If one of the two pumps in operation has a fault and is stopped, the standby pump will be started. The performance of the booster system is thus not reduced.

The status as standby pump alternates between all pumps.

Setting range

The number of possible standby pumps in a Hydro MPC booster system is equal to the total number of pumps in the system minus 1.

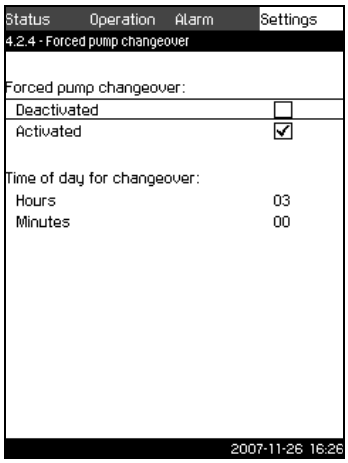
Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Pump cascade control** with ⊙ or ⊙, and press ⊙.
3. Mark **Standby pumps** with ⊙ or ⊙, and press ⊙.
4. Select the number of standby pumps with ⊙ or ⊙, and save with ⊙.

Factory setting

The number of standby pumps is set to 0, i.e. function is deactivated.

9.7.15 Forced pump changeover (4.2.4)



TM03 2365 4807

Fig. 52 Forced pump changeover

Description

This function ensures that the pumps run for the same number of operating hours.

In certain applications, the requirement remains constant for long periods and does not require all pumps to run. In such situations, pump changeover does not take place naturally, and forced pump changeover may thus be required.

Once every 24 hours, the CU 351 checks if any pump running has a larger number of operating hours than pumps that are stopped. If this is the case, the pump will be stopped and replaced by a pump with a lower number of operating hours.

Setting range

The function can be activated/deactivated. The hour of the day at which the changeover is to take place can be set.

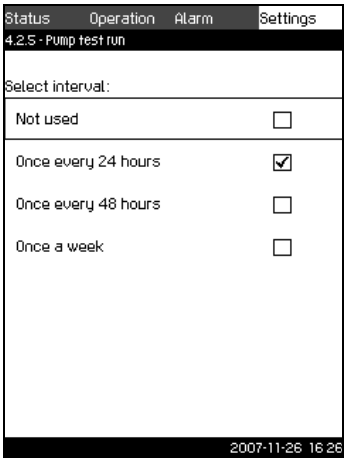
Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Pump cascade control** with ⊙ or ⊙, and press ⊙.
3. Mark **Forced pump changeover** with ⊙ or ⊙, and press ⊙.
4. Mark **Activated** with ⊙ or ⊙, and press ⊙. The check mark in the right box shows that the function has been activated.
5. Mark **Time for changeover** with ⊙, and press ⊙.
6. Set the time with ⊙ or ⊙, and save with ⊙.

Factory setting

The function is activated. The time is set to 03:00.

9.7.16 Pump test run (4.2.5)



TM03 2364 4807

Fig. 53 Pump test run

Description

This function is primarily used in situations where the forced pump changeover is deactivated, and/or if the Hydro MPC is set to operating mode *Stop*, for instance in a period when the system is not needed.
In such situations, it is important to test the pumps regularly.

The function ensures that

- pumps do not seize up during a long standstill due to deposits from the pumped liquid.
- the pumped liquid does not decay in the pump.
- trapped air is removed from the pump.

The pumps start automatically one by one and run for five seconds.

Note ***Pumps in the operating mode Manual are not included in the test run. If there is an alarm, the test run will not be carried out.***

Setting range

- Not used.
- Once every 24 hours.
- Once every 48 hours.
- Once a week.

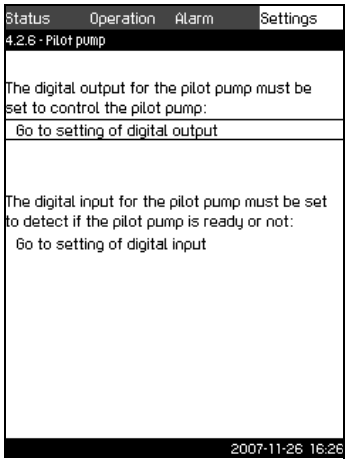
Setting via control panel

1. Mark the **Settings** menu with ▷.
2. Mark **Pump cascade control** with ▽ or △, and press ok.
3. Mark **Pump test run** with ▽ or △, and press ok.
4. Select the interval with ▽ or △.
5. Activate the function with ok.

Factory setting

Test runs are set to once every 24 hours.

9.7.17 Pilot pump (4.2.6)



TM03 8963 4807

Fig. 54 Pilot pump

Description

The function controls a pilot pump via a digital output. The pilot pump takes over the operation from the main pumps in periods when the consumption is so small that the stop function of the main pumps is activated. See section *9.7.23 Stop function (4.3.1)*.

Via a digital input, the operational state of the pilot pump is monitored, i.e. whether it is operational or in a fault condition.

The purpose is to

- save energy
- reduce the number of operating hours of the main pumps.

If the pilot pump cannot keep the pressure by itself, one or more main pumps are started. If only one main pump is started and runs on/off operation, the pilot pump remains cut in. If one or more main pumps run continuously, the pilot pump is cut out.

Note ***If the setpoint of the main pumps is changed, the setpoint of the pilot pump must be changed too.***

Setting range

- See section *9.7.31 Digital outputs (4.3.9)*.
- See section *9.7.26 Digital inputs (4.3.7)*.

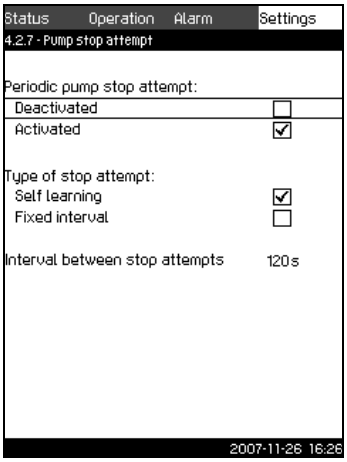
Setting via control panel

1. Mark the **Settings** menu with ▷.
2. Mark **Pump cascade control** with ▽ or △, and press ok.
3. Mark **Pilot pump** with ▽ or △, and press ok.
4. Mark **Go to setting of digital output** with ▽ or △, and press ok.
5. Select a digital output with ▽ or △, and press ok.
6. Mark **Pilot pump control** with ▽ or △, and save with ok.
7. Return by pressing esc twice.
8. Mark **Go to setting of digital input** with ▽ or △, and press ok.
9. Select a digital input ▽ or △, and press ok.
10. Mark **Pilot pump fault** with ▽ or △, and save with ok.

Factory setting

The function is deactivated.

9.7.18 Pump stop attempt (4.2.7)



TM03 8964 4807

Fig. 55 Pump stop attempt

Description

The function makes it possible to set automatic stop attempts of a pump when several pumps are running. It ensures that the optimum number of pumps is always running, in terms of energy consumption. At the same time, the purpose is to avoid disturbances in connection with automatic stop of pumps.

Stop attempts can either take place with a fixed interval set under **Interval between stop attempts** or by self learning. If self learning is selected, the interval between stop attempts will be increased if repeated attempts to stop the pump fail.

Setting via control panel

1. Mark the **Settings** menu with ▷.
2. Mark **Pump cascade control** with ▽ or △, and press ok.
3. Mark **Pump stop attempt** with ▽ or △, and press ok.
4. Mark **Self learning** or **Fixed interval** with ▽ or △, and press ok.
5. If **Fixed interval** is selected:
6. Mark **Interval between stop attempts** with ▽ or △.
7. Set the interval with ⊕ or ⊖, and save with ok.
8. Mark **Activated** with ▽ or △, and press ok. The check mark in the right box shows that the function has been activated.

Factory setting

The function is activated.

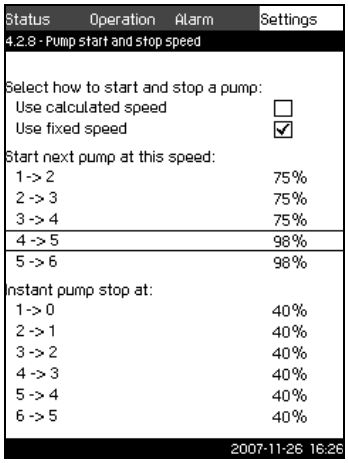
9.7.19 Pump start and stop speed (4.2.8)

Description

The function controls the starting and stopping of pumps. There are two options:

1. Use calculated speed
   This function ensures that the optimum number of pumps is always running at a desired duty point, in terms of energy consumption. The CU 351 calculates the required number of pumps and their speed. This requires that the differential pressure of the pump is measured by a differential pressure sensor or separate pressure sensors on the inlet and discharge side.
   When calculated speed has been selected, the CU 351 ignores the percentages set.
2. Use fixed speed
   The pumps are started and stopped at speeds set by the user.

1. Use calculated speed



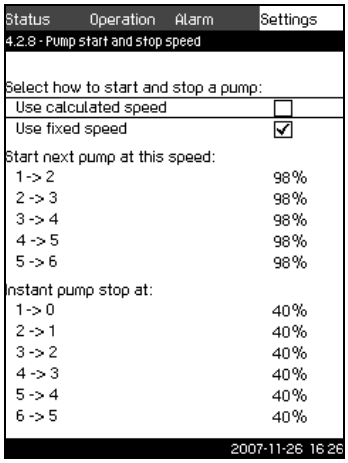
TM03 8966 4807

Fig. 56 Calculated pump start and stop speed

Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Pump cascade control** with ⊙ or ⊙, and press ⊙.
3. Mark **Pump start and stop speed** with ⊙ or ⊙, and press ⊙.
4. Mark **Use calculated speed** with ⊙ or ⊙, and press ⊙.

2. Use fixed speed



TM03 8965 4807

Fig. 57 Fixed pump start and stop speed

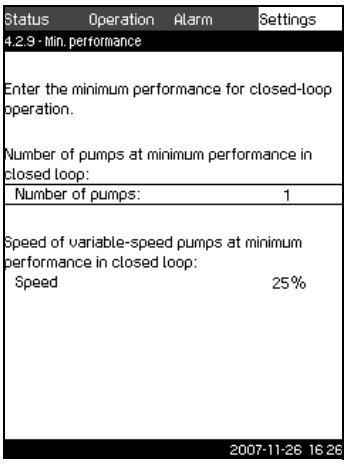
Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Pump cascade control** with ⊙ or ⊙, and press ⊙.
3. Mark **Pump start and stop speed** with ⊙ or ⊙, and press ⊙.
4. Mark **Use fixed speed** with ⊙ or ⊙, and press ⊙.
5. Mark **Start of next pump at: 1->2** with ⊙ or ⊙, and press ⊙.
6. Set the speed as percentage with ⊕ or ⊖, and save with ⊙. Set the other pumps in the same way.
7. Mark **Instant pump stop at: 1->0** with ⊙ or ⊙, and press ⊙.
8. Set the speed as percentage with ⊕ or ⊖, and save with ⊙. Set the other pumps in the same way.

Factory setting

The function is set to calculated speed.

9.7.20 Min. performance (4.2.9)



TM03 8967 4807

Fig. 58 Min. performance

Description

This function ensures circulation in a system. Note that the stop function, if activated, can influence this function. See section *9.7.23 Stop function (4.3.1)*. Examples:

- If 0 or 1 pump has been selected as a minimum, the stop function can stop the pump if there is no or a very small consumption.
- If two or more pumps have been selected as a minimum, the stop function is not active.

Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Pump cascade control** with ⊙ or ⊙, and press ⊙.
3. Mark **Min. performance** with ⊙ or ⊙, and press ⊙.
4. Set **Number of pumps** with ⊕ or ⊖, and save with ⊙.
5. Mark **Speed** with ⊙ or ⊙. Set the speed with ⊕ or ⊖, and save with ⊙.

Factory setting

The number of pumps is set to 1. The speed in closed loop is set to 25 %.

9.7.21 Compensation for pump start-up time (4.2.10)

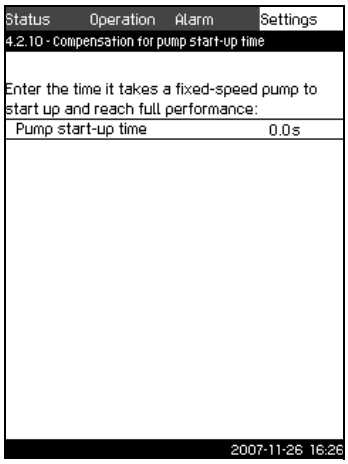


Fig. 59 Compensation for pump start-up time

Description

The function is used for the system types -ES, -ED, -F and -EDF.

The purpose is to avoid disturbances when a mains-operated pump with fixed speed is started. The function compensates for the time it takes a mains-operated pump to reach its full performance after start. The start-up time of the mains-operated pump must be known.

Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Pump cascade control** with ⊙ or ⊙, and press ⊙.
3. Mark **Compensation for pump start-up time** with ⊙ or ⊙, and press ⊙.
4. Set the start-up time with ⊙ or ⊙, and save with ⊙.

Factory setting

The start-up time is set to 0 seconds.

9.7.22 Secondary functions (4.3)

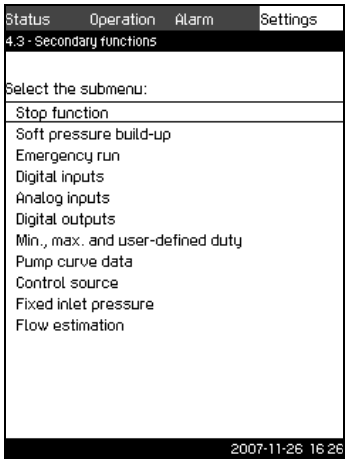


Fig. 60 Secondary functions

Description

Functions that are secondary in relation to the normal operation of the Hydro MPC booster system can be set in this display. Secondary functions are functions that offer additional functionality.

The display makes it possible to open specific displays regarding:

- *Stop function (4.3.1)*
- *Soft pressure build-up (4.3.3)*
- *Digital inputs (4.3.7)*
- *Analog inputs (4.3.8)*
- *Digital outputs (4.3.9)*
- *Emergency run (4.3.5)*
- *Min., max. and user-defined duty (4.3.14)*
- *Pump curve data (4.3.19)*
- *Flow estimation (4.3.23)*
- *Control source (4.3.20)*
- *Fixed inlet pressure (4.3.22)*.

9.7.23 Stop function (4.3.1)

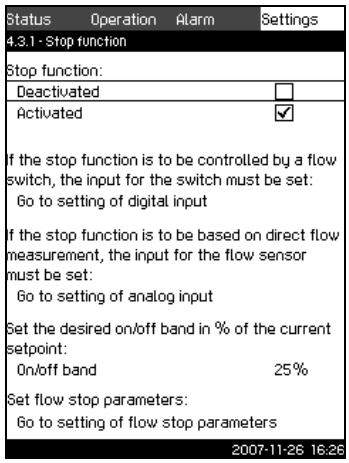


Fig. 61 Stop function

Description

This function makes it possible to stop the last pump if there is no or a very small consumption. The purpose is to

- save energy
- prevent heating of shaft seal faces due to increased mechanical friction as a result of reduced cooling by the pumped liquid
- prevent heating of the pumped liquid.

The description of the stop function applies to all Hydro MPC booster systems with variable-speed pumps. Hydro MPC-S will have on/off control of all pumps as described in section *6.1 Examples of control variants*.

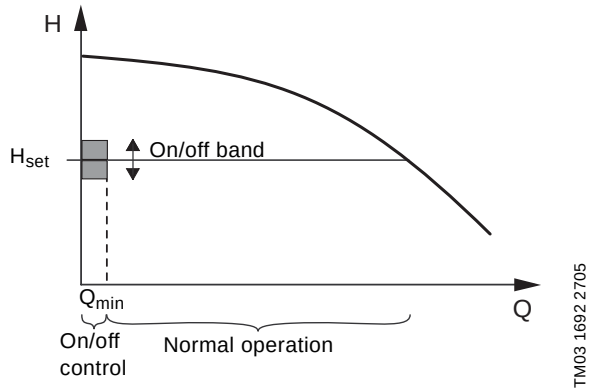


Fig. 62 On/off band

When the stop function is activated, the operation of Hydro MPC is continuously monitored to detect a low flow rate.
When the CU 351 detects no or a low flow rate ($Q < Q_{min}$), it changes from constant-pressure operation to on/off control of the last pump in operation.

Before stopping, the pump increases the pressure to a value corresponding to H_{set} + 0.5 x on/off band. The pump is restarted when the pressure is H_{set} – 0.5 x on/off band. See fig. 63.

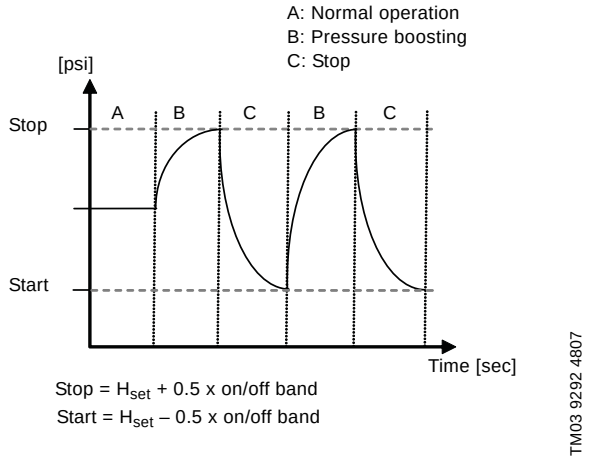


Fig. 63 On/off operation

The flow rate is estimated by the CU 351 when the pump is in the stop period. As long as the flow rate is lower than Q_{min}, the pump will run on/off. If the flow rate is increased to above Q_{min}, the pump returns to normal operation, H_{set}. H_{set} is equal to the current setpoint. See section *9.4.4 Setpoint (1.2.2)*.

Detection of low flow rate

Low flow rate can be detected by means of

- direct flow measurement with a flowmeter or flow switch
- estimation of flow rate by measurement of current pressure and speed.

If the booster system is not connected to a flowmeter or flow switch, the stop function will use the estimating function.

If the detection of low flow rate is based on flow estimation, a diaphragm tank of a certain size and with a certain precharge pressure is required.

Diaphragm tank size

Pump type	Recommended diaphragm tank size [gallons]						
	-E	-ED	-ES	-EF	-EDF	-F	-S
CR(E) 3	4.4	4.4	4.4	4.4	4.4	4.4	20
CR(E) 5	4.4	4.4	4.4	4.4	4.4	4.4	34
CR(E) 10	10.2	10.2	10.2	10.2	10.2	10.2	62
CR(E) 15	34	34	34	34	34	34	211
CR(E) 20	34	34	34	34	34	34	211
CR(E) 32	44	44	44	44	44	44	317
CR(E) 45	86	86	86	86	86	86	528
CR(E) 64	132	132	132	132	132	132	1056
CR 90	-	-	-	132	132	132	1056

Precharge pressure

Hydro MPC-E, -ED, -ES, -EF, -EDF and -F: 0.7 x setpoint.

Hydro MPC-S: 0.9 x setpoint.

During each flow estimation (every 2 minutes), the estimating function will disturb the discharge pressure by ±10 % of the setpoint. If this disturbance is not acceptable, the stop function must be based on direct flow measurement with a flowmeter or flow switch.

The minimum flow rate can be set, i.e. the flow rate at which the booster system changes to on/off control of the last pump in operation.

If both a flowmeter and a flow switch are connected, the changeover to on/off control is determined by the unit first indicating low flow rate.

Setting range

On/off band:	5 to 30 %
Min. flow rate:	2 to 50 % of the nominal flow rate (Q_{nom}) of one of the pumps. (Can only be set if direct flow measurement by means of flowmeter has been selected.)

Setting via control panel

System without flow switch or flowmeter

1. Mark the **Settings** menu with ⊙.
2. Mark **Secondary functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Stop function** with ⊙ or ⊙, and press ⊙.
4. Mark **Activated** with ⊙ or ⊙, and press ⊙.
   The activation is indicated by a check mark in the box.
5. Mark **On/off band** with ⊙ or ⊙.
6. Set the on/off band with ⊙ or ⊙, and save with ⊙.
7. Mark **Go to setting of flow stop parameters** with ⊙ or ⊙, and press ⊙.
   Now the display below is shown.

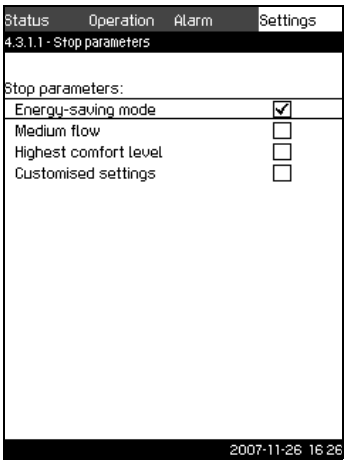


Fig. 64 Stop parameters

8. Select one of the stop parameters with ⊙ or ⊙, and save with ⊙. If **Customised settings** are selected, the parameters shown in fig. 65 must be set. See examples below.

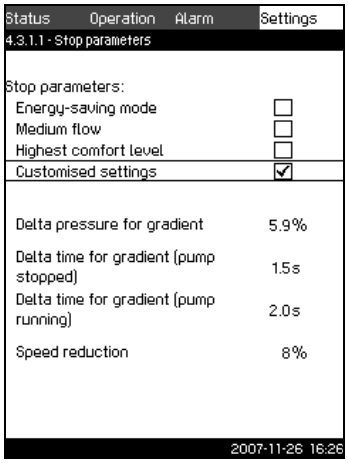


Fig. 65 Customised settings

Note ***Rule of thumb: Speed reduction = 2 x delta pressure for gradient.***

Example 1: Increasing the stop limit, Q_{min} (high flow limit)

- Increase the delta pressure for gradient.
- Reduce the delta time for gradient (pump stopped).
- Reduce the delta time for gradient (pump running).
- Increase the speed reduction.

Example of increased stop limit	
Parameter	**Value**
Delta pressure for gradient	6 %
Delta time for gradient (pump stopped)	1.5 sec
Delta time for gradient (pump running)	2.0 sec
Speed reduction	10 %

Example 2: Reducing the stop limit, Q_{min} (low flow limit)

- Reduce the delta pressure for gradient.
- Increase the delta time for gradient (pump stopped).
- Increase the delta time for gradient (pump running).
- Reduce the speed reduction.

Example of reduced flow limit	
Parameter	**Value**
Delta pressure for gradient	3 %
Delta time for gradient (pump stopped)	15.0 sec
Delta time for gradient (pump running)	25.0 sec
Speed reduction	6 %

Note ***The stop limit depends on the tank size.***

System with flow switch

Make the following additional settings:

1. Mark **Go to setting of digital input** with ⌄ or ⌃, and press ok. Now the display *Digital inputs (4.3.7)* appears.
2. Select the digital input where the flow switch is connected with ⌄ or ⌃, and press ok.
3. Mark **Flow switch** with ⌄ or ⌃, press ok and return with esc.

Note ***An open contact indicates low flow.***

System with flowmeter

Make the following additional settings:

1. Mark **Go to setting of analog input** with ⌄ or ⌃, and press ok. Now the display *Analog inputs (4.3.8)* appears.
2. Select the analog input where the flowmeter is connected, and set up the input for the flowmeter by selecting **Flow rate**.
3. Return to **Stop function** by pressing esc twice.
4. Mark **Stop limit** with ⌄ or ⌃.
5. Set the value with ⊕ or ⊖, and save with ok.

Factory setting

The function is activated.

On/off band: 25 %

Min. flow rate: 30 % of the nominal flow rate of one pump

9.7.24 Soft pressure build-up (4.3.3)

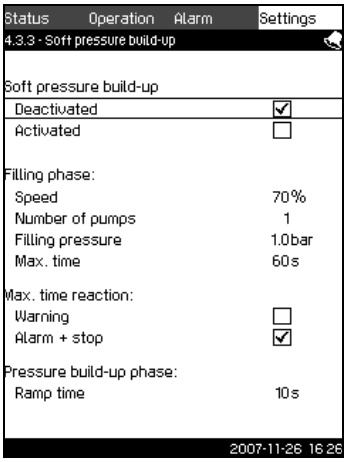


Fig. 66 Soft pressure build-up

Description

The function ensures a smooth start-up of systems with for instance empty pipes.

Start-up takes place in two phases. See fig. 67.

1. Filling phase.
   The pipework is slowly filled with water. When the pressure sensor of the system detects that the pipework has been filled, phase two begins.
2. Pressure build-up phase.
   The system pressure is increased until the setpoint is reached. The pressure build-up takes place over a ramp time. If the setpoint is not reached within a given time, a warning or an alarm can be given, and the pumps can be stopped at the same time.

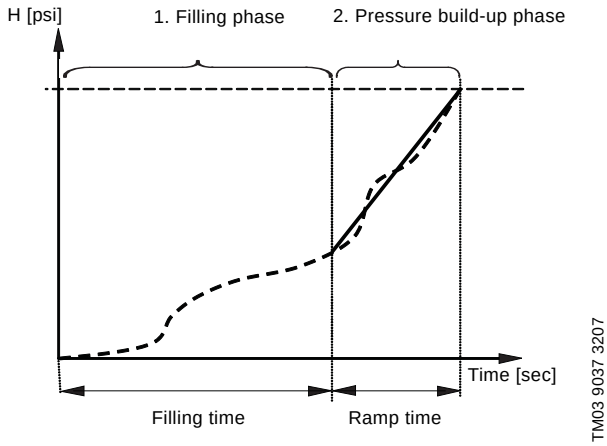


Fig. 67 Filling and pressure build-up phases

Setting range

- Activation of the function.
- Setting of pump speed.
- Setting of number of pumps.
- Setting of filling pressure.
- Setting of maximum filling time.
- Setting of warning or alarm + stop.
- Setting of ramp time for the pressure build-up phase.

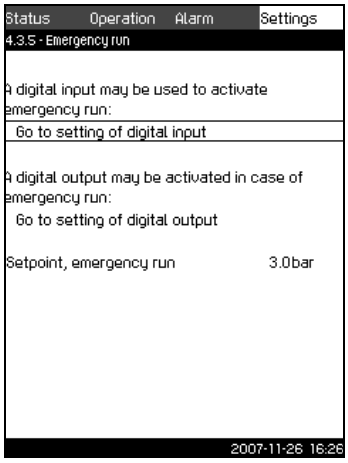
Setting via control panel

1. Mark the **Settings** menu with ⊙
2. Mark **Secondary functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Soft pressure build-up** with ⊙ or ⊙, and press ⊙.
4. Mark **Speed** with ⊙ or ⊙.
5. Set the value with ⊙ or ⊙, and save with ⊙.
6. Mark **Number of pumps** with ⊙ or ⊙.
7. Set the value with ⊙ or ⊙, and save with ⊙.
8. Mark **Filling pressure** with ⊙ or ⊙.
9. Set the value with ⊙ or ⊙, and save with ⊙.
10. Mark **Max. time** with ⊙ or ⊙.
11. Set the value with ⊙ or ⊙, and save with ⊙.
12. Mark **Warning** or **Alarm + stop** with ⊙ or ⊙, and press ⊙.
13. Mark **Ramp time** with ⊙ or ⊙.
14. Set the value with ⊙ or ⊙, and save with ⊙.
15. Mark **Activated**, and press ⊙.

Factory setting

The function is deactivated.

9.7.25 Emergency run (4.3.5)



TM03 8971 4807

Fig. 68 Emergency run

Description

When this function has been activated, the pumps will keep running regardless of warnings or alarms. The pumps will run according to a setpoint set specifically for this function.

Caution ***In case of sensor fault, both main and standby pumps will run at 100 % speed!***

Setting range

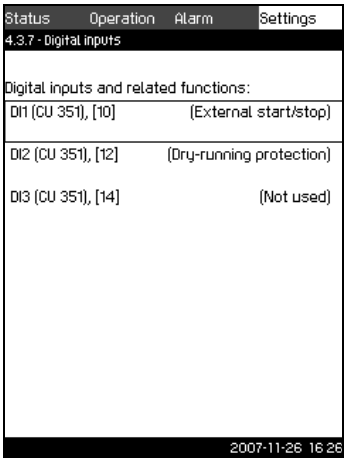
- Setting of digital input (*9.7.26 Digital inputs (4.3.7)*).
- Setting of digital output (*9.7.31 Digital outputs (4.3.9)*).
- Setting of setpoint for emergency run.

Setting via control panel

1. Mark the **Settings** menu with ⊙
2. Mark **Secondary functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Emergency run** with ⊙ or ⊙, and press ⊙.
4. Mark **Go to setting of digital input** with ⊙ or ⊙, and press ⊙.
5. Select a digital input with ⊙ or ⊙, and press ⊙.
6. Mark **Emergency run** with ⊙ or ⊙, and save with ⊙.
7. Return by pressing ⊙ twice.
8. Mark **Go to setting of digital output** with ⊙ or ⊙, and press ⊙.
9. Select a digital output with ⊙ or ⊙, and press ⊙.
10. Mark **Emergency run** with ⊙ or ⊙, and save with ⊙.
11. Return by pressing ⊙ twice.
12. Mark **Setpoint, emergency run** with ⊙ or ⊙.
13. Set the value with ⊙ or ⊙, and save with ⊙.

Note ***When this function has been set as described above, it can also be activated via the display System operating mode (2.1.1).***

9.7.26 Digital inputs (4.3.7)



TM03 2359 4807

Fig. 69 Digital inputs

Description

In this menu, the digital inputs of the CU 351 can be set. Each input, except DI1, can be activated and related to a certain function.

As standard, the Hydro MPC has three digital inputs. If the Hydro MPC incorporates an IO 351B module (option), the number of digital inputs is 12.

In the display, all digital inputs are shown so that their physical position in the Hydro MPC can be identified.

Example

DI1 (IO 351-41), [10]:

DI1:	Digital input No 1
(IO 351-41):	IO 351, GENIbus number 41
[10]:	Terminal No 10

For further information on the connection of various digital inputs, see the wiring diagram supplied with the control cabinet.

Setting range

The digital input to be set is selected in the display *Digital inputs (4.3.7)*.

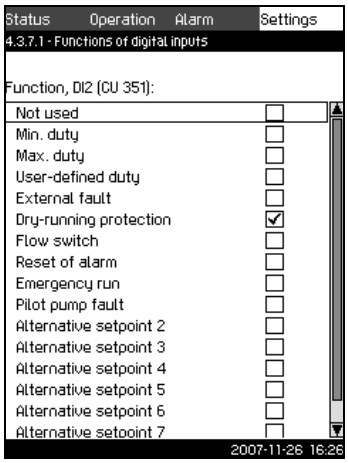
Note ***DI1 (CU 351) cannot be selected.***

Setting via control panel

1. Mark the **Settings** menu with ⊙.

2. Mark **Secondary functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Digital inputs** ⊙ or ⊙, and press ⊙.
4. Select the digital input with ⊙ or ⊙, and press ⊙.

9.7.27 Functions of digital inputs (4.3.7.1)



TM03 8972 4807

Fig. 70 Functions of digital inputs

Description

In the displays 4.3.7.1, a function can be related to the digital inputs.

Setting range

It is possible to select one function in each display:

Function	Contact activated	
Not used		
Min. duty		= Operating mode *Min.*
Max. duty		= Operating mode *Max.*
User-defined duty		= Operating mode *User-defined*
External fault		= External fault
Dry-running protection		= Water shortage
Flow switch		= Flow rate > Set switch value
Reset of alarm		= Reset alarms
Emergency run		= Operating mode *Emergency run*
Pilot pump fault		= Pilot pump fault
Alternative setpoint 2		= Setpoint 2 selected
Alternative setpoint 3		= Setpoint 3 selected
Alternative setpoint 4		= Setpoint 4 selected
Alternative setpoint 5		= Setpoint 5 selected
Alternative setpoint 6		= Setpoint 6 selected
Alternative setpoint 7		= Setpoint 7 selected

See the relevant sections for further information about the functions.

Generally, a closed contact activates the function selected.

Setting via control panel

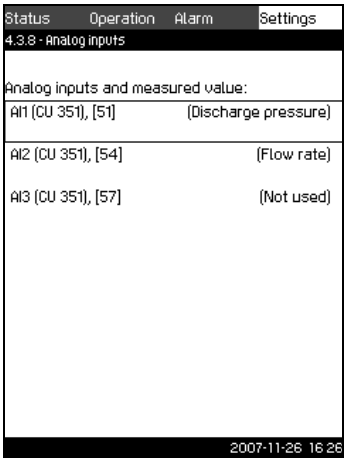
1. Mark the **Settings** menu with ⊙.
2. Mark **Secondary functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Digital inputs** with ⊙ or ⊙, and press ⊙.
4. Select the digital input with ⊙ or ⊙, and press ⊙.
5. Select the desired function with ⊙ or ⊙, and activate it with ⊙.
   The activation is indicated by a check mark in the box.

Factory setting

Digital input	Function
DI1 (CU 351) [10]	External start/stop. Open contact = stop. **Note:** Input No 1 cannot be changed.
DI2 (CU 351) [12]	Monitoring of water shortage (dry-running protection). Open contact = water shortage (if the Hydro MPC is supplied with this option).

Note ***Monitoring of water shortage requires a pressure switch connected to the Hydro MPC.***

9.7.28 Analog inputs (4.3.8)



TM03 2356 4807

Fig. 71 Analog inputs

Description

In this display, the analog inputs of the Hydro MPC can be set.

Each input can be activated and related to a certain function.

As standard, the Hydro MPC has three analog inputs. If the Hydro MPC incorporates an IO 351B module (option), the number of analog inputs is 5.

In the display, all analog inputs are shown so that their physical position in the Hydro MPC can be identified. A redundant primary sensor can be fitted as back-up for the primary sensor in order to increase reliability and prevent stop of operation.

Note ***If two sensors are to be redundant, each must have a separate analog input.***

Example

AI1 (CU 351) [51]:

AI1:	Analog input No 1
(CU 351):	CU 351
[51]:	Terminal No 51

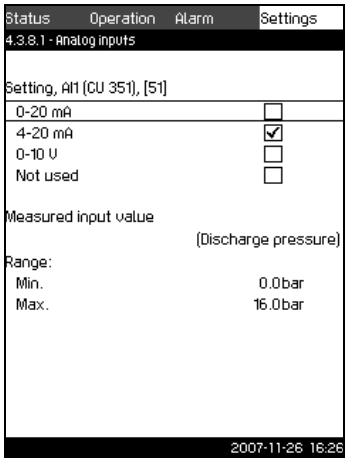
Setting range

In the display *Analog inputs (4.3.8)*, the analog input to be set is selected.

Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Secondary functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Analog inputs** with ⊙ or ⊙, and press ⊙.
4. Select the analog input with ⊙ or ⊙, and press ⊙.

9.7.29 Analog inputs (4.3.8.1 to 4.3.8.7)



TM03 2357 4807

Fig. 72 Analog inputs

Description

In the displays 4.3.8.1 to 4.3.8.7, analog inputs can be set. Each display is divided into three parts:

- Setting of input signal, for instance 4-20 mA
- Measured input value, for instance discharge pressure
- Measuring range of the sensor/signal transmitter, for instance 0-16 bar.

Setting range

It is possible to set the following parameters in each display:

- Not used
- Range of input signal, 0-20 mA, 4-20 mA, 0-10 V
- Measured input value
- Sensor range.

Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Secondary functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Analog inputs** with ⊙ or ⊙, and press ⊙.
4. Select the analog input with ⊙ or ⊙, and press ⊙.
5. Mark the setting of the analog input with ⊙ or ⊙, and activate it with ⊙.
   The activation is indicated by a check mark in the box.

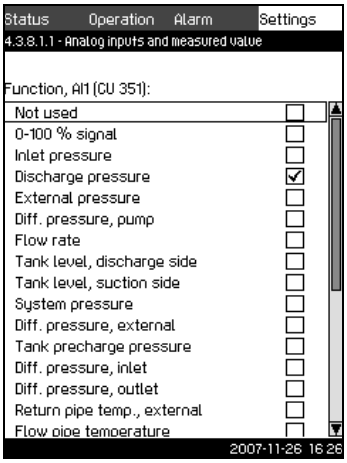
Note

If an analog input is deactivated, the display will only show the top part, i.e. the setting of the analog input.
If the input is activated, the middle part, "Measured input value", is shown. This makes it possible to relate a function to the analog input in another display. When the analog input has been related to a function, CU 351 will return to the display for setting of analog inputs.

Factory setting

Analog input	Function
AI1 (CU 351) [51]	Discharge pressure
AI2 (CU 351) [54]	Tank precharge pressure (if Hydro MPC is supplied with measurement of tank precharge pressure)
AI3 (CU 351) [57]	Redundant primary sensor (if Hydro MPC is supplied with this option)

9.7.30 Analog inputs and measured value (4.3.8.1.1 to 4.3.8.7.1)



TM03 8973 4807

Fig. 73 Analog inputs and measured value

Description

In the display *Analog inputs and measured value (4.3.8.1.1 to 4.3.8.7.1)*, a function can be related to the individual analog inputs.

Setting range

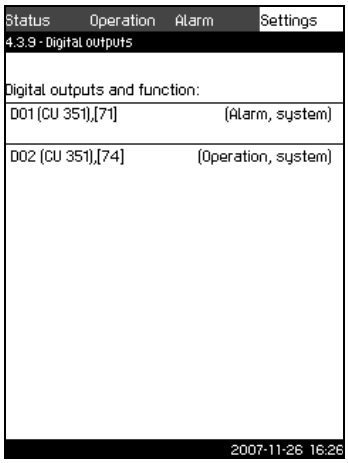
It is possible to select one function per analog input.

- Not used
- 0-100 % signal
- Inlet pressure
- Discharge pressure
- External pressure
- Differential pressure, pump
- Flow rate
- Tank level, discharge side
- Tank level, suction side
- System pressure
- Differential pressure, external
- Tank precharge pressure
- Differential pressure, inlet
- Differential pressure, outlet
- Return pipe temperature, external
- Flow pipe temperature
- Return pipe temperature
- Differential temperature
- Ambient temperature
- Power, pump 1 to 6
- Power, VFD.

Setting via control panel

1. Mark the **Settings** menu with ▶.
2. Mark **Secondary functions** with ▼ or ▲, and press OK.
3. Mark **Analog inputs** with ▼ or ▲, and press OK.
4. Select the analog input with ▼ or ▲, and press OK.
5. Set the range of the analog input with ▼ or ▲, and press OK.
   The activation is indicated by a check mark.
6. Mark **Measured input value** with ▼ or ▲, and press OK.
   Now the display 4.3.8.1.1 appears.
7. Select the input with ▼ or ▲, and press OK.
8. Press ESC to return to display 4.3.8.1.
9. Set the minimum sensor value with ⊕ or ⊖, and save with OK.
10. Set the maximum sensor value with ⊕ or ⊖, and save with OK.

9.7.31 Digital outputs (4.3.9)



TM03 2333 4807

Fig. 74 Digital outputs

Description

In this display, the digital relay outputs of the Hydro MPC can be set. Each output can be activated and related to a certain function.

As standard, the Hydro MPC has two digital outputs.

If the Hydro MPC incorporates an IO 351B module (option), the number of digital outputs is 9.

In the display, all digital outputs are shown so that their physical position in the Hydro MPC can be identified.

Example

DO1 (IO 351-41) [71]:

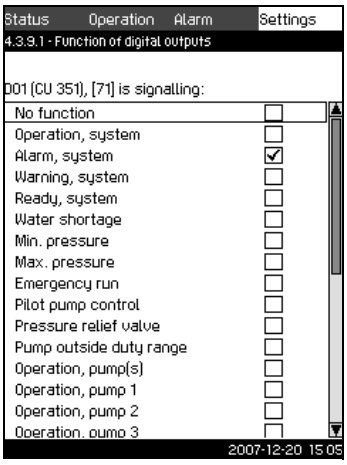
DO1	Digital output No 1
(IO 351-41)	IO 351B, GENIbus number 41
[71]	Terminal No 71

For further information on the connection of various digital outputs, see the wiring diagram supplied with the CU 351.

Setting range

In the display *Digital outputs (4.3.9)*, the digital output to be used is selected.

9.7.32 Functions of digital outputs (4.3.9.1 to 4.3.9.16)



TM03 8974 4807

Fig. 75 Functions of digital outputs

Description

In the displays *Functions of digital outputs (4.3.9.1 to 4.3.9.16)*, a function can be related to the individual outputs.

Setting range

It is possible to select one function in each display:

- No function
- Operation, system
- Alarm, system
- Warning, system
- Ready, system
- Water shortage
- Min. pressure
- Max. pressure
- Emergency run
- Pilot pump control
- Pressure relief valve
- Operation, pump 1 to 6
- Alarm, pump 1 to 6
- Alarm, limit 1 exceeded
- Warning, limit 1 exceeded
- Alarm, limit 2 exceeded
- Warning, limit 2 exceeded.

Setting via control panel

1. Mark the **Settings** menu with ▶.
2. Mark **Secondary functions** ▼ with or ▲, and press OK.
3. Mark **Digital outputs** with ▼ or ▲, and press OK.
4. Select the digital output with ▼ or ▲, and press OK.
5. Mark the desired function with ▼ or ▲, and activate it with OK.
   The activation is indicated by a check mark in the box.

Factory setting

Digital output	Function
DO1 (CU 351) [71]	Alarm, system
DO2 (CU 351) [74]	Operation, system

9.7.33 Min., max. and user-defined duty (4.3.14)

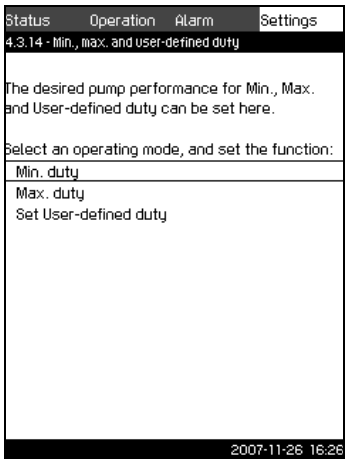


Fig. 76 Min., max. and user-defined duty

Description

Hydro MPC is usually controlled in a closed loop to maintain a discharge pressure. In certain periods, it may be necessary to let the booster system run in open loop at a set pump performance.

Setting range

The CU 351 makes it possible to change between three operating modes:

1. *Min. duty (4.3.14.1)*.
2. *Max. duty (4.3.14.2)*.
3. *User-defined duty (4.3.14.3)*.

Note ***For each of these modes, the number of operating pumps and the pump performance (speed) can be set.***

9.7.34 Min. duty (4.3.14.1)

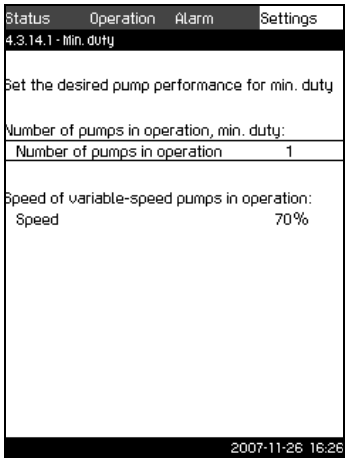


Fig. 77 Min. duty

Description

In all booster systems apart from Hydro MPC-S, minimum duty is only possible for variable-speed pumps. In Hydro MPC-S systems, only the number of pumps running at 100 % speed can be set.

Setting range

- Number of pumps in operation.
- Speed as percentage (25 to 100 %) for variable-speed pumps.

Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Secondary functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Min., max. and user-defined duty** with ⊙ or ⊙, and press ⊙.
4. Mark **Min. duty** with ⊙ or ⊙, and press ⊙.
5. Mark **Number of pumps in operation, min. duty** with ⊙ or ⊙.
6. Set the number with ⊙ or ⊙, and save with ⊙.
7. Mark **Speed** with ⊙ or ⊙.
8. Set the value with ⊙ or ⊙, and save with ⊙.

Factory setting

Number of pumps in operation during min. duty:	1
Speed as percentage for variable-speed pumps:	70

9.7.35 Max. duty (4.3.14.2)

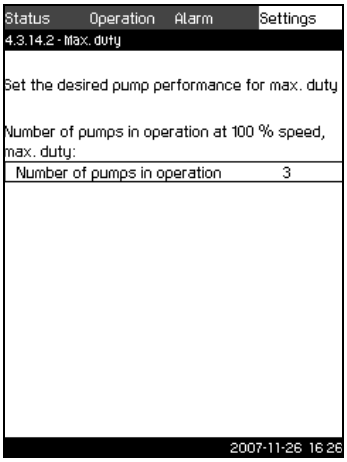


Fig. 78 Max. duty

Description

The function makes it possible for a set number of pumps to run at maximum performance when the function is activated.

Setting range

In this display, the number of pumps to run in the operating mode *Max.* can be set. All pumps run at 100 % speed.

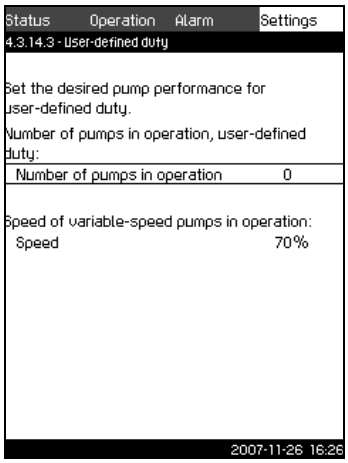
Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Secondary functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Min., max. and user-defined duty** with ⊙ or ⊙, and press ⊙.
4. Mark **Max. duty** with ⊙ or ⊙, and press ⊙.
5. Mark **Number of pumps in operation at 100 % speed, max. duty** with ⊙ or ⊙.
6. Set the number with ⊙ or ⊙, and save with ⊙.

Factory setting

Number of pumps in operation during max. duty:	All pumps (except standby pumps)

9.7.36 User-defined duty (4.3.14.3)



TM03 2352 4807

Fig. 79 User-defined duty

Description

In this display, it is possible to set a user-defined performance, typically a performance between min. and max. duty.

The function makes it possible to set a pump performance by selecting the number of pumps to run and the speed of variable-speed pumps.

This function primarily selects the variable-speed pumps. If the number of selected pumps exceeds the number of variable-speed pumps, mains-operated pumps are started too.

Setting range

- Number of pumps in operation.
- Speed as percentage for variable-speed pumps.
  Note: In Hydro MPC booster systems with only variable-speed pumps, the speed can be set between 25 and 100 %; in booster systems with both variable-speed pumps and mains-operated pumps the speed can be set between 70 and 100 %.

Setting via control panel

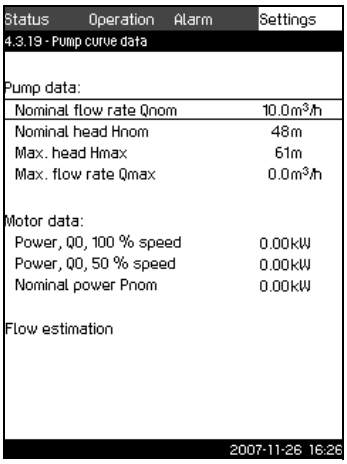
1. Mark the **Settings** menu with ⊙.
2. Mark **Secondary functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Min., max. and user-defined duty** with ⊙ or ⊙, and press ⊙.
4. Mark **User-defined duty** with ⊙ or ⊙, and press ⊙.
5. Mark **Number of pumps in operation, user-defined duty** with ⊙ or ⊙.
6. Set the number with ⊙ or ⊙, and save with ⊙.
7. Mark **Speed** with ⊙ or ⊙.
8. Set the value with ⊙ or ⊙, and save with ⊙.

Factory setting

The function is not activated, as the following has been set:

Number of pumps in operation during user-defined duty:	0

9.7.37 Pump curve data (4.3.19)



TM03 8975 4807

Fig. 80 Pump curve data

Description

The CU 351 has a number of functions using these pump data:

- Nominal flow rate, Q_{nom}, in m^3/h
- Nominal head, H_{nom}, in metres
- Max. head, H_{max}, in metres
- Max. flow rate, Q_{max}, in m^3/h
- Power, Q_0, 100 % speed, in kW
- Power, Q_0, 50 % speed, in kW
- Nominal power, P_{nom}, in kW.

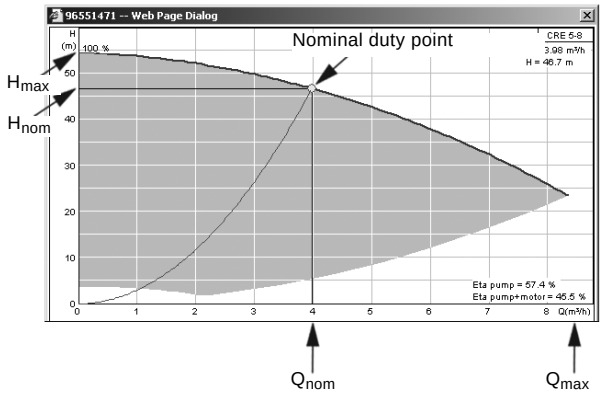
Note ***Grundfos can supply hydraulic data for CR, CRI, CRE and CRIE pumps where GSC files can be downloaded directly to the CU 351.***

Note ***The electrical data, "Power, Q0, 100 % speed" and "Power, Q0, 50 % speed" must be entered manually.***

For Grundfos E-pumps, the data of input power (P1) must be entered.

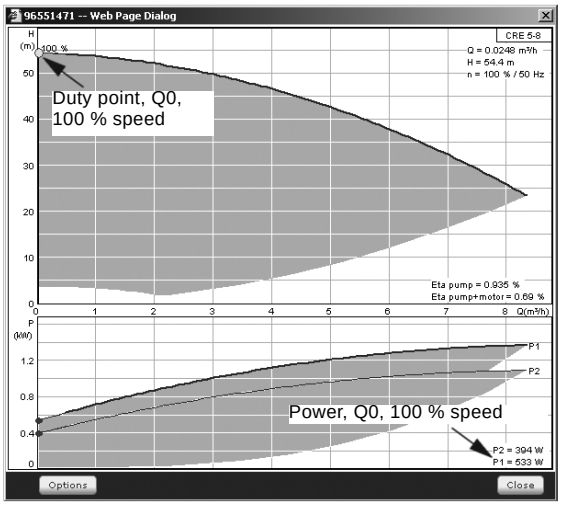
The data are read by means of the pump performance curves which can be found in WebCAPS on Grundfos' homepage, www.grundfos.com. See examples in figs 81 to 84.

If WebCAPS is not accessible, try to bring a pump into the three duty points: Power, Q0, 100 % speed, Power, Q0, 50 % speed and Nominal power, Pnom. Read the power values in displays 1.3 to 1.8, depending on the pump. See section *9.4.8 Pump 1...6 (1.3 to 1.8)*.



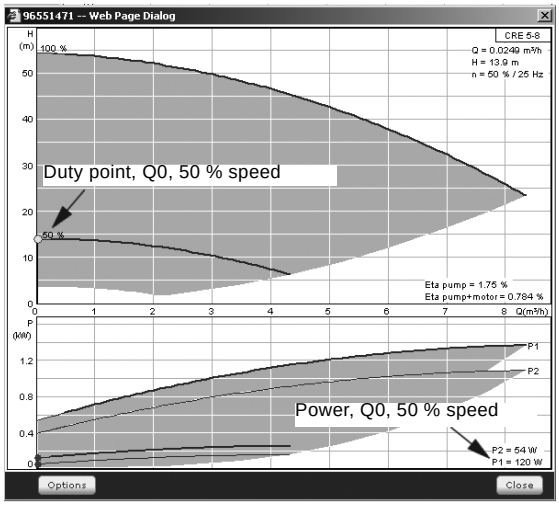
TM03 9993 4807

Fig. 81 Reading of Q_{nom}, H_{nom}, H_{max} and Q_{max} (WebCAPS)



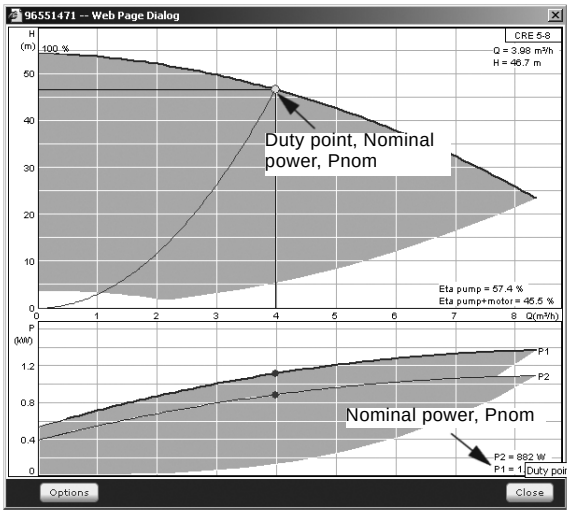
TM03 9994 4807

Fig. 82 Reading of Power, Q0, 100 % speed (WebCAPS)



TM03 9995 4807

Fig. 83 Reading of Power, Q0, 50 % speed (WebCAPS)



TM03 9996 4807

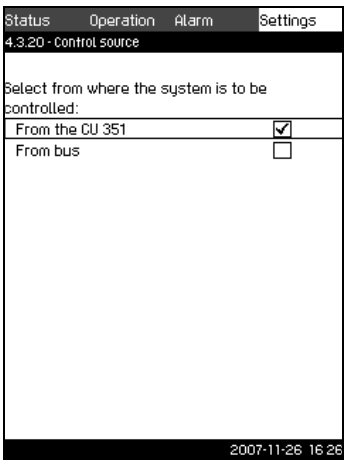
Fig. 84 Reading of Nominal power, Pnom (WebCAPS)

Note ***Q_{nom} and H_{nom} are the rated duty point of the pumps and usually the duty point with the highest efficiency.***

Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Secondary functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Pump curve data** with ⊙ or ⊙, and press ⊙.
4. Mark **Nominal flow rate Q_{nom}** with ⊙ or ⊙.
5. Set the value with ⊙ or ⊙, and save with ⊙.
6. Mark **Nominal head H_{nom}** with ⊙ or ⊙.
7. Set the value with ⊙ or ⊙, and save with ⊙.
8. Mark **Max. head H_{max}** with ⊙ or ⊙.
9. Set the value with ⊙ or ⊙, and save with ⊙.
10. Mark **Max. flow rate Q_{max}** with ⊙ or ⊙.
11. Set the value with ⊙ or ⊙, and save with ⊙.
12. Mark **Power, Q_0, 100 % speed** with ⊙ or ⊙.
13. Set the value with ⊙ or ⊙, and save with ⊙.
14. Mark **Power, Q_0, 50 % speed** with ⊙ or ⊙.
15. Set the value with ⊙ or ⊙, and save with ⊙.
16. Mark **Nominal power P_{nom}** with ⊙ or ⊙.
17. Set the value with ⊙ or ⊙, and save with ⊙.

9.7.38 Control source (4.3.20)



TM03 2342 4807

Fig. 85 Control source

Description

Hydro MPC can be remote-controlled via an external bus connection (option). See section *9.8.2 GENIbus*. Control of the Hydro MPC can also take place via the bus connection. For further information, see section *9.8 Data communication*.

In this display, the control source, CU 351 or the external bus connection, is selected.

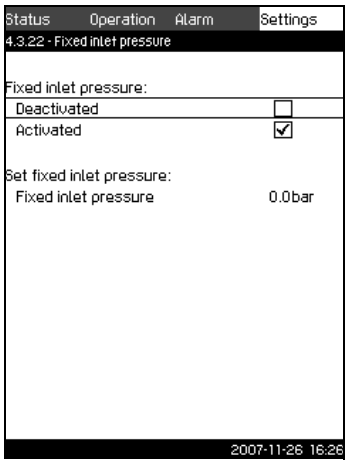
Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Secondary functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Control source** with ⊙ or ⊙, and press ⊙.
4. Select the desired control source with ⊙ or ⊙, and save with ⊙.

Factory setting

The control source is CU 351.

9.7.39 Fixed inlet pressure (4.3.22)



TM03 8975 4807

Fig. 86 Fixed inlet pressure

Description

If the Hydro MPC has a fixed inlet pressure, it can be entered in this display so that the CU 351 can optimise the performance and control of the booster system.

Setting range

A fixed inlet pressure can be set, and the function can be activated/deactivated.

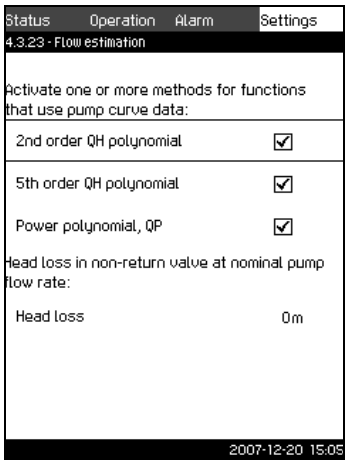
Setting via control panel

1. Mark the **Settings** menu with ▶.
2. Mark **Secondary functions** with ▼ or ▲, and press OK.
3. Mark **Fixed inlet pressure** with ▼ or ▲, and press OK.
4. Set the inlet pressure with + or −, and save with OK.
5. Mark **Activated** with ▼ or ▲, and press OK. The activation is indicated by a check mark in the box.

Factory setting

The function is deactivated.

9.7.40 Flow estimation (4.3.23)



TM03 8977 4807

Fig. 87 Flow estimation

Description

As described in section *9.7.37 Pump curve data (4.3.19)*, the CU 351 can optimise operation according to performance curves and motor data. In this display, curve types are selected which the CU 351 will use for the optimisation if they are available.

At large flow rates, there may be a considerable head loss between the pump discharge flange and the pressure sensor. The loss is caused by non-return valves and pipe bends. To improve the flow estimation of the system, it is necessary to compensate for the difference between the measured and the actual differential pressure across the pump. This is done by entering the head loss in non-return valves and pipe bends at the rated flow rate of one pump.

Setting range

- 2nd order QH polynomial
- 5th order QH polynomial
- Power polynomial, QP
- Head loss.

Note ***It is possible to select several curve types, as the CU 351 makes a priority based on the data available.***

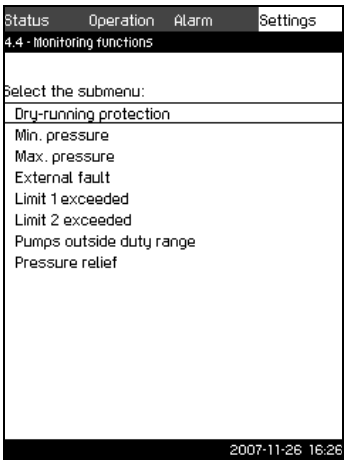
Setting via control panel

1. Mark the **Settings** menu with ▶.
2. Mark **Secondary functions** with ▼ or ▲, and press OK.
3. Mark **Flow estimation** with ▼ or ▲, and press OK.
4. Select the curve type by marking one of the lines at the selection box with ▼ or ▲, and press OK.

Factory setting

All polynomials are selected.

9.7.41 Monitoring functions (4.4)



TM03 8978 4807

Fig. 88 Monitoring functions

Description

Hydro MPC has a series of functions that constantly monitor the operation of the booster system.

The primary purpose of the monitoring functions is to ensure that faults do not damage pumps or the system.

Setting range

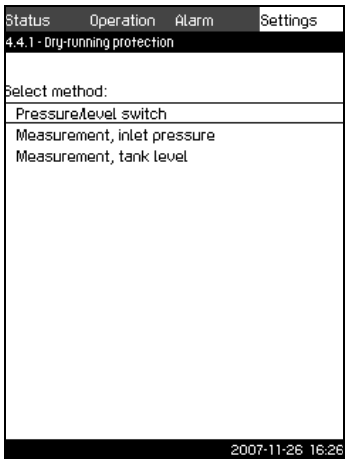
The following functions can be selected:

- *Dry-running protection (4.4.1)*
- *Min. pressure (4.4.2)*
- *Max. pressure (4.4.3)*
- *External fault (4.4.4)*
- *Limit 1 and 2 exceeded (4.4.5 and 4.4.6)*
- *Pumps outside duty range (4.4.7)*
- *Pressure relief (4.4.8)*.

Setting via control panel

1. Mark the **Settings** menu with ▶.
2. Mark **Monitoring functions** with ▼ or ▲, and press OK.
3. Select the function with ▼ or ▲, and press OK.

9.7.42 Dry-running protection (4.4.1)



TM03 2320 4807

Fig. 89 Dry-running protection

Description

Dry-running protection is one of the most important monitoring functions, as bearings and shaft seal may be damaged if the pumps run dry. Grundfos thus always recommends dry-running protection in connection with Hydro MPC booster systems.

The function is based on monitoring of the inlet pressure or the level in a possible tank or pit on the suction side.

Level switches, pressure switches or analog sensors signalling water shortage at a set level can be used.

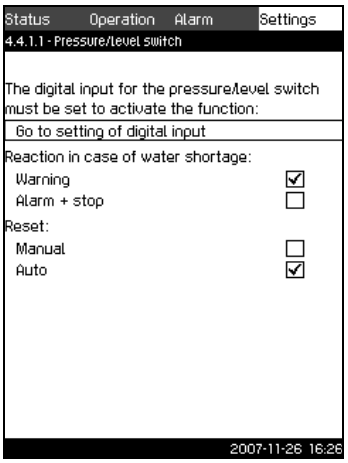
There are three different methods for detection of water shortage:

- Pressure switch on suction manifold or float switch/electrode relay in the supply tank. See section *9.7.43 Dry-running protection with pressure/level switch (4.4.1.1)*.
- Measurement of inlet pressure in the suction manifold by means of an analog pressure transmitter. See section *9.7.44 Dry-running protection with pressure transmitter (4.4.1.2)*.
- Measurement of level in the supply tank by means of an analog level transmitter. See section *9.7.45 Dry-running protection with level transmitter (4.4.1.3)*.

Setting via control panel

1. Mark the **Settings** menu with ›.
2. Mark **Monitoring functions** with ⌄ or ⌃, and press ok.
3. Mark **Dry-running protection** with ⌄ or ⌃, and press ok.
4. Select the method with ⌄ or ⌃, and press ok.

9.7.43 Dry-running protection with pressure/level switch (4.4.1.1)



TM03 2329 4807

Fig. 90 Dry-running protection with pressure/level switch

Description

Dry-running protection can take place by means of a pressure switch on the suction manifold or a level switch in a tank on the suction side.

When the contact is **open**, the CU 351 will register water shortage after a time delay of approx. 5 sec. It is possible to set whether the indication is to be just a warning or an alarm stopping the pumps.

In the display, it is possible to set whether restart and reset of the alarm is to be automatic or manual.

Setting range

- Selection of digital input for the function.
- Reaction in case of water shortage: Warning or alarm + stop.
- Restart: Manual or automatic.

Setting via control panel

1. Mark the **Settings** menu with ›.
2. Mark **Monitoring functions** with ⌄ or ⌃, and press ok.
3. Mark **Dry-running protection** with ⌄ or ⌃, and press ok.
4. Mark **Pressure/level switch** with ⌄ or ⌃, and press ok.
5. Mark **Go to setting of digital input**, and press ok. Now the display *Digital inputs (4.3.7)* appears. Set the input to dry-running protection. Return with esc.
6. Mark **Warning** or **Alarm + stop** with ⌄ or ⌃, and save with ok.
7. Mark **Manual** or **Auto** with ⌄ or ⌃, and save with ok.

Factory setting

If the booster system is equipped with a pressure switch for dry-running protection, it is set to alarm + stop in case of water shortage.

Restart: Manual.

9.7.44 Dry-running protection with pressure transmitter (4.4.1.2)

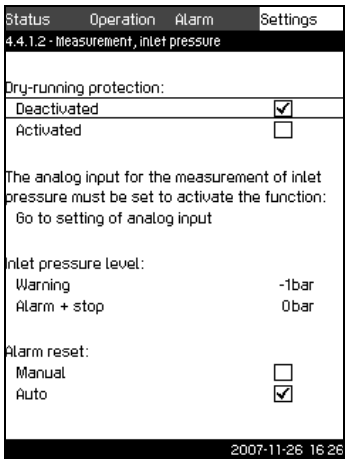


Fig. 91 Dry-running protection with pressure transmitter

Description

Dry-running protection can take place by means of a pressure transmitter measuring the inlet pressure.

It is possible to set two levels of inlet pressure: Warning and alarm + stop.

In the display, it is possible to set whether restart and reset of the alarm is to be automatic or manual.

Setting range

- Selection of analog input for the function.
- Activation of the function.
- Inlet pressure level for warning.
- Inlet pressure level for alarm + stop.
- Restart: Manual or automatic.

Setting via control panel

1. Mark the **Settings** menu with (>).
2. Mark **Monitoring functions** with (v) or (^), and press (ok).
3. Mark **Dry-running protection** with (v) or (^), and press (ok).
4. Mark **Measurement, inlet pressure** with (v) or (^), and press (ok).
5. Mark **Go to setting of analog input**, and press (ok). Now the display *Analog inputs (4.3.8)* appears. Set the input to **Inlet pressure, and save** with (ok). Return with (esc).
6. Mark **Activated** with (v) or (^), and press (ok).
7. Mark **Warning** with (v) or (^). Set the level with (+) or (−), and save with (ok).
8. Mark **Alarm + stop** with (v) or (^). Set the level with (+) or (−), and save with (ok).
9. Mark **Manual** or **Auto** with (v) or (^), and save with (ok).

Note ***If one of the levels is not required, the level value must be the minimum value of the inlet pressure transmitter. This deactivates the function.***

Factory setting

If the booster system is supplied with a pressure transmitter on the suction side, the transmitter has been set.

The warning level is 0.5 bar and the alarm level 0.2 bar. The function is activated.

Restart: Manual.

9.7.45 Dry-running protection with level transmitter (4.4.1.3)

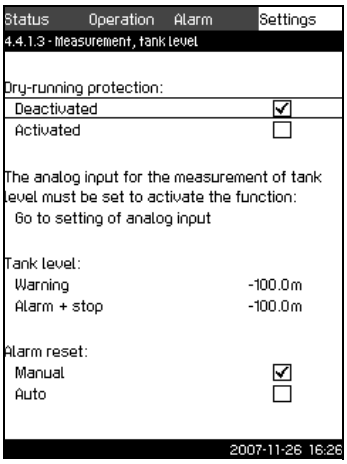


Fig. 92 Dry-running protection with level transmitter

Description

Dry-running protection can take place by means of a level transmitter measuring the level in a tank on the suction side.

It is possible to set two levels: Warning and alarm + stop.

In the display, it is possible to set whether restart and reset of alarms is to be automatic or manual.

Setting range

- Selection of analog input for the function.
- Activation of the function.
- Tank level for warning.
- Tank level for alarm + stop.
- Restart: Manual or automatic.

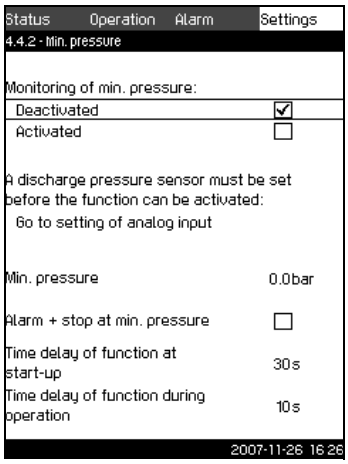
Setting via control panel

1. Mark the **Settings** menu with (>).
2. Mark **Monitoring functions** with (v) or (^), and press (ok).
3. Mark **Dry-running protection** with (v) or (^), and press (ok).
4. Mark **Measurement, tank level** with (v) or (^), and press (ok).
5. Mark **Go to setting of analog input**, and press (ok). Now the display *Analog inputs (4.3.8)* appears. Set the input to **Tank level, suction side**. Return with (esc).
6. Mark **Activated** with (v) or (^), and press (ok).
7. Mark **Warning** with (v) or (^). Set the level with (+) or (−), and save with (ok).
8. Mark **Alarm + stop** with (v) or (^). Set the level with (+) or (−), and save with (ok).
9. Mark **Manual** or **Auto** with (v) or (^), and save with (ok).

Factory setting

The function is deactivated.

9.7.46 Min. pressure (4.4.2)



TM03 8981 4807

Fig. 93 Min. pressure

Description

The discharge pressure can be monitored so that the CU 351 can react if the pressure becomes lower than a set minimum level for an adjustable time.

The minimum pressure can be monitored if a fault indication is required in situations where the discharge pressure becomes lower than the set minimum pressure.

It is possible to set whether the indication is to be just a warning or an alarm stopping the pumps. This may be desirable if Hydro MPC is used for an irrigation system where a very low discharge pressure may be due to pipe fracture and thus an extraordinarily high consumption and a very low counter-pressure. In such situations, it is desirable that the booster system stops and indicates alarm. This situation will require a manual reset of alarms.

It is possible to set a start-up delay ensuring that the Hydro MPC can build up pressure before the function is activated. It is also possible to set a time delay, i.e. for how long time the discharge pressure may be lower than the set minimum pressure before the alarm is activated.

Setting range

- Activation of the function.
- Minimum pressure level within the range of the primary sensor.
- Activation of stop when the pressure falls below the minimum pressure.
- Time delay at start-up.
- Time delay during operation.

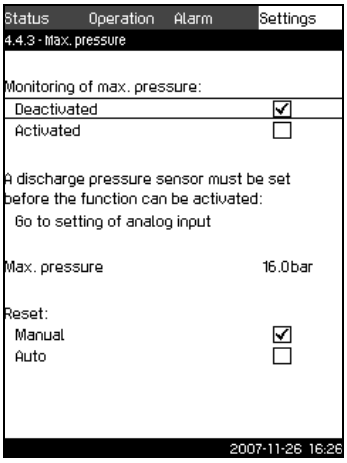
Setting via control panel

1. Mark the **Settings** menu with ▶.
2. Mark **Monitoring functions** with ▼ or ▲, and press OK.
3. Mark **Min. pressure** with ▼ or ▲, and press OK.
4. Mark **Activated** with ▼ or ▲, and press OK to activate/deactivate the function.
5. Mark **Min. pressure** with ▼ or ▲. Set the pressure with + or −, and save with OK.
6. Mark **Stop at min. pressure** with ▼ or ▲, and press OK to activate/deactivate the function.
7. Mark **Time delay of function at start-up** with ▼ or ▲. Set the time with + or −, and save with OK.
8. Mark **Time delay of function during operation** with ▼ or ▲. Set the time with + or −, and save with OK.

Factory setting

The function is deactivated.

9.7.47 Max. pressure (4.4.3)



TM03 8982 4807

Fig. 94 Max. pressure

Description

The discharge pressure can be monitored so that the CU 351 can react if the pressure becomes higher than a set maximum level.

In certain installations, a too high discharge pressure may cause damage. It may therefore be necessary to stop all pumps for a short period if the pressure is too high.

It is possible to set whether the Hydro MPC is to restart automatically after the pressure has dropped below the maximum level, or if the system must be reset manually. Restart will be delayed by an adjustable time. See section *9.7.12 Min. time between start/stop (4.2.1)*.

Setting range

- Activation of the function.
- Maximum pressure level within the range of the primary sensor.
- Manual or automatic restart after fault.

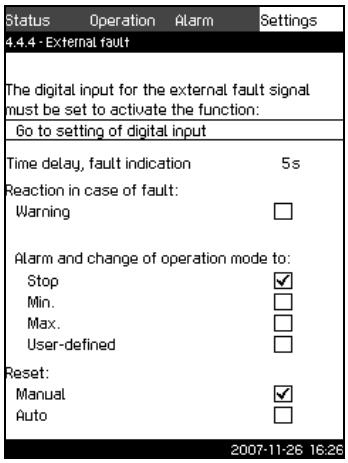
Setting via control panel

1. Mark the **Settings** menu with ▶.
2. Mark **Monitoring functions** with ▼ or ▲, and press OK.
3. Mark **Max. pressure** with ▼ or ▲, and press OK.
4. Mark **Activated** with ▼ or ▲, and press OK to activate/deactivate the function.
5. Mark **Max. pressure** with ▼ or ▲. Set the pressure with + or −, and save with OK.
6. Mark **Manual** or **Auto** with ▼ or ▲. Activate the function with OK.

Factory setting

The function is deactivated.

9.7.48 External fault (4.4.4)



TM03 2313 4807

Fig. 95 External fault

Description

The function is used when the CU 351 is to be able to receive a fault signal from an external contact. In case of external fault, the CU 351 indicates warning or alarm. In case of alarm, the booster system changes to another manual operating mode, for instance *Stop*.

Setting range

- Selection of digital input for the function.
- Setting of time delay from closing of the contact until the CU 351 reacts.
- Reaction in case of external fault: Warning or alarm and change of operating mode.
- Restart after alarm: Manual or automatic.

Setting via control panel

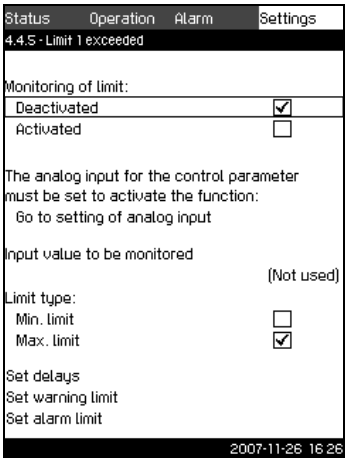
1. Mark the **Settings** menu with ▶.
2. Mark **Monitoring functions** with ▼ or ▲, and press OK.
3. Mark **External fault** with ▼ or ▲, and press OK.
4. Mark **Go to setting of digital input** with ▼ or ▲, and press OK. Now the display *Digital inputs (4.3.7)* appears. Set the input to **External fault**. Return with ESC.
5. Mark **Time delay, fault indication** with ▼ or ▲. Set the time with + or −, and save with OK.
6. Mark **Warning** with ▼ or ▲ if only a warning is required in case of external fault. Activate the function with OK.
7. Select operating mode with ▼ or ▲ if the booster system is to give alarm and change operating mode in case of external fault. Activate the function with OK.
8. Mark **Manual** or **Auto** with ▼ or ▲. Activate the function with OK.

Factory setting

The function is deactivated. If the function is activated, the following values have been set from factory:

- Time delay: 5 seconds.
- Operating mode in case of alarm: Stop.
- Restart: Manual.

9.7.49 Limit 1 and 2 exceeded (4.4.5 and 4.4.6)



TM03 8983 4807

Fig. 96 Limit 1 exceeded

Description

With this function, the CU 351 can monitor set limits of analog values. It will react if the values exceed the limits. Each limit can be set as a maximum or minimum value. For each of the monitored values, a warning limit and an alarm limit must be defined.

The function makes it possible to monitor two different locations in a pump system at the same time. For instance the pressure at a consumer and the pump discharge pressure. This ensures that the discharge pressure does not reach a critical value.

If the value exceeds the warning limit, a warning is given. If the value exceeds the alarm limit, the pumps are stopped.

A delay can be set between the detection of an exceeded limit and the activation of a warning or an alarm. A delay can also be set for resetting a warning or an alarm.

A warning can be reset automatically or manually.

It is possible to set whether the system is to restart automatically after an alarm, or if the alarm must be reset manually. Restart can be delayed by an adjustable time. It is also possible to set a start-up delay ensuring that the system reaches a steady state before the function becomes active.

Setting range

- Activation of an analog input for the function.
- Selection of the measured value to be monitored.
- Setting of limit type (min./max.).
- Setting of warning limit.
- Setting of alarm limit.

Setting via control panel

Note ***Analog inputs must be correctly set before the function is activated. See section 9.7.28 Analog inputs (4.3.8).***

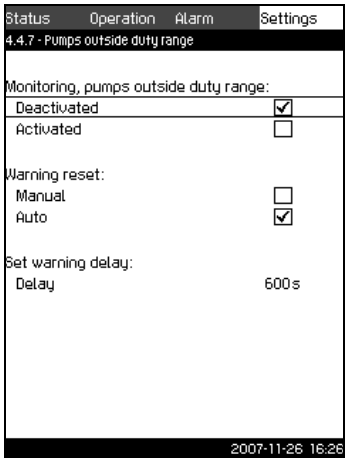
1. Mark the **Settings** menu with ▶
2. Mark **Monitoring functions** with ▼ or ▲, and press OK
3. Mark **Limit 1 exceeded** or **Limit 2 exceeded** with ▼ or ▲, and press OK.
4. Mark **Go to setting of analog input** with ▼ or ▲, and press OK.
5. Select the analog input with ▼ or ▲, and press OK.
6. Mark the setting of the analog input with ▼ or ▲, and activate it with OK.
   The activation is indicated by a check mark in the box.

7. Mark **Measured value** with ⌄ or ⌃, and press ok. Now the display 4.3.8.1.1 appears.
8. Select the input with ⌄ or ⌃, and press ok.
9. Press esc to return to display 4.3.8.1.
10. Set the minimum sensor value with + or −, and save with ok.
11. Set the maximum sensor value with + or −, and save with ok.
12. Return by pressing esc twice.
13. Mark **Measured value to be monitored** with ⌄ or ⌃., and press ok. Select the input with ⌄ or ⌃, and press ok.
14. Return with esc.
15. Mark **Min. limit** or **Max. limit** with ⌄ or ⌃., and press ok.
16. Mark **Set delays** with ⌄ or ⌃, and press ok
17. Mark **Time delay of function at start-up** with ⌄ or ⌃. Set the time with + or −, and save with ok.
18. Mark **Time delay of function during operation** with ⌄ or ⌃. Set the time with + or −, and save with ok.
19. Mark **Time delay of function at reset** with ⌄ or ⌃. Set the time with + or −, and save with ok.
20. Return with esc.
21. Mark **Set warning limit** with ⌄ or ⌃, and press ok.
22. Mark **Activated** with ⌄ or ⌃, and press ok.
23. Mark **Warning limit** with ⌄ or ⌃. Set the value with + or −, and save with ok.
24. Mark **Manual** or **Auto** with ⌄ or ⌃. Activate the function with ok.
25. Return with esc.
26. Mark **Set alarm limit** with ⌄ or ⌃, and press ok.
27. Mark **Activated** with ⌄ or ⌃, and press ok.
28. Mark **Alarm limit** with ⌄ or ⌃. Set the value with + or −, and save with ok.
29. Mark **Manual** or **Auto** with ⌄ or ⌃. Activate the function with ok.
30. Return with esc.
31. Mark **Activated** with ⌄ or ⌃, and press ok to activate the function.

Factory setting

The function is deactivated.

9.7.50 Pumps outside duty range (4.4.7)



TM03 8984 4807

Fig. 97 Pumps outside duty range

Description

The function gives a warning if the duty point of the pumps moves outside the defined range. For instance, if the inlet pressure becomes lower than a minimum permissible value, thus causing a risk of cavitation for some pump types.

The warning is given with a set time delay. It is possible to set whether the warning is to be reset automatically or manually when the duty point comes within the defined duty range. It is also possible to set a relay output to be activated when the warning is given, and to be deactivated when the warning is reset.

This function requires that the discharge pressure and the inlet pressure (either measured or configured) or the differential pressure of the pumps is monitored, and that CU 351 contains valid pump data from either a GSC file or from manual input. See section *9.7.37 Pump curve data (4.3.19)*.

Setting range

- Activation of the function.
- Setting of manual or automatic reset.
- Setting of warning delay.

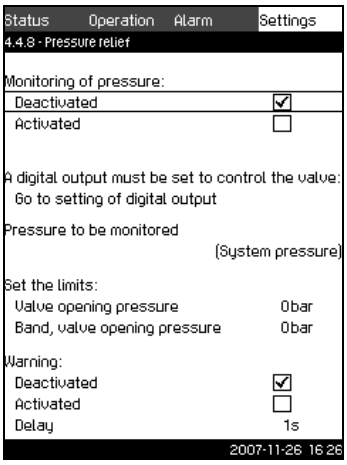
Setting via control panel

1. Mark the **Settings** menu with ⌄
2. Mark **Monitoring functions** with ⌄ or ⌃, and press ok.
3. Mark **Pumps outside duty range** with ⌄ or ⌃, and press ok.
4. Mark **Manual** or **Auto** with ⌄ or ⌃, and activate the function with ok.
5. Mark **Warning delay** with ⌄ or ⌃. Set the time with ⌄ or −, and save with ok.
6. Mark **Activated** with ⌄ or ⌃, and press ok to activate the function.

Factory setting

The function is deactivated.

9.7.51 Pressure relief (4.4.8)



TM03 8986 4807

Fig. 98 Pressure relief

Description

The purpose of the function is to reduce the pressure in the pipework by opening a solenoid valve if it exceeds a set limit. If the pressure is not reduced within a given time, the solenoid valve will be closed, and a warning can be given.

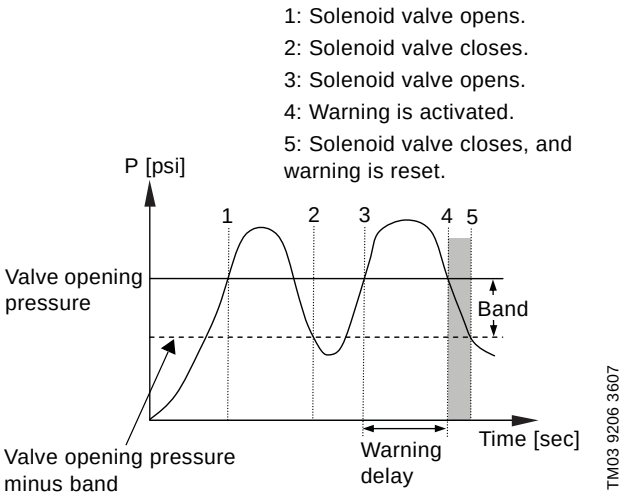


Fig. 99 Pressure relief

Setting range

- Setting of digital output.
- Setting of pressure to be monitored.
- Setting of valve opening pressure.
- Setting of band for valve opening pressure.
- Setting of warning or alarm.
- Activation of the function.

Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Monitoring functions** with ⊙ or ⊙, and press ⊙.
3. Mark **Pressure relief** with ⊙ or ⊙, and press ⊙.
4. Mark **Go to setting of digital output** with ⊙ or ⊙, and press ⊙.
5. Select a digital output with ⊙ or ⊙, and press ⊙.
6. Mark **Pressure relief** with ⊙ or ⊙, and save with ⊙.
7. Return by pressing ⊙ twice.
8. Mark **Pressure to be monitored** with ⊙ or ⊙, and press ⊙.
9. Mark **Discharge pressure**, **System pressure** or **External pressure** with ⊙ or ⊙, and save with ⊙.
10. Return with ⊙.
11. Mark **Valve opening pressure** with ⊙ or ⊙. Set the pressure with ⊙ or ⊙, and save with ⊙.
12. Mark **Band, valve opening pressure** with ⊙ or ⊙. Set the pressure with ⊙ or ⊙, and save with ⊙.
13. Mark **Warning**, **Deactivated** or **Activated** with ⊙ or ⊙, and press ⊙.
14. Mark **Delay** with ⊙ or ⊙. Set the time with ⊙ or ⊙, and save with ⊙. (Only to be set if warning has been activated.)
15. Mark **Activated** with ⊙ or ⊙, and press ⊙ activate the function.

Factory setting

The function is deactivated.

9.7.52 Functions, CU 351 (4.5)

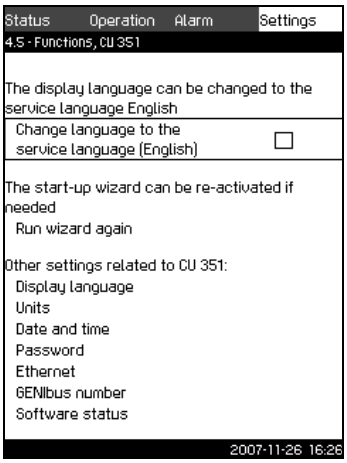


Fig. 100 Functions, CU 351

Description

In this submenu, it is possible to make the basic settings of the CU 351.

CU 351 comes with most of these settings, or they are made at start-up and normally not to be changed.

The service language, English, can be activated for service purposes. If no buttons are touched for 15 minutes, the display will return to the language selected at start-up or to the language set in section *9.7.53 Display language (4.5.1)*.

Note ***If the service language is selected, the symbol will be shown to the right of the top line of all displays.***

Setting range

- Activation of service language, British English.
- Re-activation of start-up wizard.
  (After start-up, the wizard is inactive.)
- Selection of display language.
- Selection of display units.
- Setting date and time.
- Selection of password for the menus **Operation** and **Settings**.
- Setting of Ethernet communication.
- Setting of GENIbus number.
- Reading of software status.

9.7.53 Display language (4.5.1)

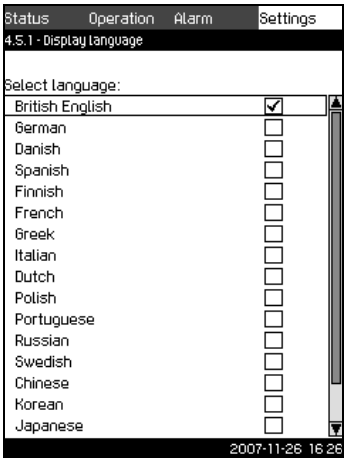


Fig. 101 Display language

Description

Here the language for the CU 351 display is selected.

Setting range

- British English
- German
- Danish
- Spanish
- Finnish
- French
- Greek
- Italian
- Dutch
- Polish
- Portuguese
- Russian
- Swedish
- Chinese
- Korean
- Japanese
- Czech
- Turkish.

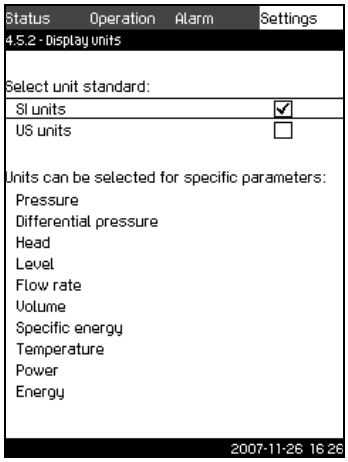
Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Functions, CU 351** with ⊙ or ⊙, and press ⊙.
3. Mark **Display language** with ⊙ or ⊙, and press ⊙.
4. Select language with ⊙ or ⊙, and save with ⊙.

Factory setting

The display language is English. It can be changed at start-up.

9.7.54 Display units (4.5.2)



TM03 8988 4807

Fig. 102 Display units

Description

In this display, it is possible to select units for the various parameters.

As basic setting, it is possible to select between SI and US units. It is also possible to select other units for the individual parameters.

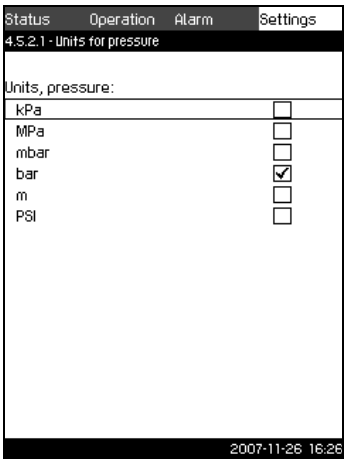
Setting range

Parameter	Basic setting		Possible units
	SI	US	
Pressure	bar	psi	kPa, MPa, mbar, bar, m, psi
Differential pressure	m	psi	kPa, MPa, mbar, bar, m, psi
Head	m	ft	m, cm, ft, in
Level	m	ft	m, cm, ft, in
Flow rate	m^3/h	gpm	m^3/s, m^3/h, l/s, gpm, yd^3/s, yd^3/min, yd^3/h
Volume	m^3	gal	l, m^3, gal, yd^3
Specific energy	kWh/m^3	Wh/gal	kWh/m^3, Wh/gal, Wh/kgal, BTU/gal, HPh/gal
Temperature	°C	°F	K, °C, °F
Differential temperature	K	K	K
Power	kW	HP	W, kW, MW, HP
Energy	kWh	kWh	kWh, MWh, BTU, HPh

Note ***If units are changed from SI to US or vice versa, all individually set parameters will be changed to the basic setting in question.***

Setting via control panel

1. Mark the **Settings** menu with ⊙.
2. Mark **Functions, CU 351** with ⊙ or ⊙, and press ⊙.
3. Mark **Units** with ⊙ or ⊙, and press ⊙.
4. Select the unit with ⊙ or ⊙, and save with ⊙.
   A check mark shows that the unit has been selected.
5. Select the measuring parameter with ⊙ or ⊙, and press ⊙ to open the display for the measuring parameter.
   See the example.



TM03 2310 4807

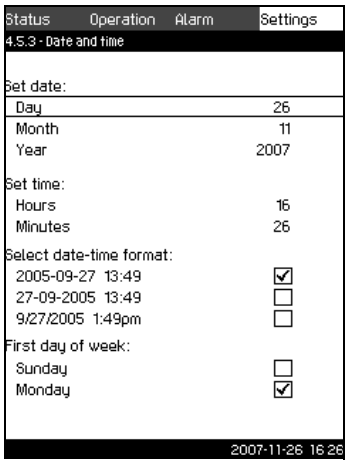
Fig. 103 Example of selection of display units

6. Select the unit with ⊙ or ⊙, and save with ⊙.
   A check mark shows that the unit has been selected.

Factory setting

CU 351 has been set to US units from factory.

9.7.55 Date and time (4.5.3)



TM03 8989 4807

Fig. 104 Date and time

Description

In this display, date and time are set as well as how they are to be shown in the display.

The clock has a built-in rechargeable voltage supply which can supply the clock for up to 20 days if the voltage supply to the Hydro MPC is interrupted.

If the clock is without voltage for more than 20 days, it must be set again.

Setting range

The date can be set as day, month and year. The time can be set as a 24-hour clock showing hours and minutes.

There are three formats.

Examples of format
2005-09-27 13:49
27-09-2005 13:49
9/27/2005 1:49pm

It is also possible to select if Sunday or Monday is to be the first day of week.

Setting via control panel

1. Mark the **Settings** menu with (›).
2. Mark **Functions, CU 351** with (v) or (^), and press (ok).
3. Mark **Date and time** with (v) or (^), and press (ok).
4. Mark **Day**, **Month** and **Year** with (v) or (^), and set the date with (+) or (−). Save with (ok).
5. Mark **Hours** and **Minutes** with (v) or (^), and set the time with (+) or (−). Save with (ok).
6. Select the format with (v) or (^), and save with (ok).
7. Mark **First day of week**, **Sunday** or **Monday** with (v) or (^), and save with (ok)

Factory setting

Local time.

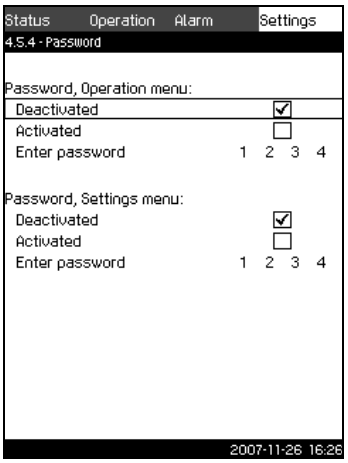
Note

If the booster has been without voltage for more than 20 days since it left the factory, the clock may have returned to the original setting: 01-01-2005 0:00.

Date and time may have been changed during the setting of Hydro MPC.

There is no automatic changeover to/from daylight-saving time.

9.7.56 Passwords (4.5.4)



TM03 2899 4807

Fig. 105 Passwords

Description

In this display it is possible to limit the access to the **Operation** and **Settings** menus by means of a password. If the access is limited, it is not possible to view or set any parameters in the menus.

The password must consist of four digits and may be used for both menus.

Note

If you have forgotten the password(s), contact Grundfos.

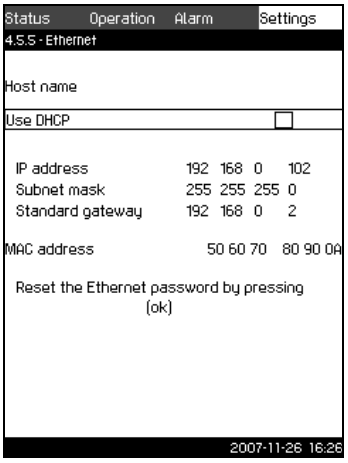
Setting via control panel

1. Mark the **Settings** menu with (›).
2. Mark **Functions, CU 351** with (v) or (^), and press (ok).
3. Mark **Password** with (v) or (^), and press (ok).
4. Mark the password to be activated, and press (ok).
5. Mark **Enter password**, and press (ok).
   Now the first digit of the password is flashing.
6. Select the digit with (+) or (−), and save with (ok).
   Now the second digit of the password is flashing.
7. Repeat points 4 to 6 if it is necessary to activate the other password.

Factory setting

Both passwords are deactivated. If a password is activated, the factory setting will be "6814".

9.7.57 Ethernet (4.5.5)



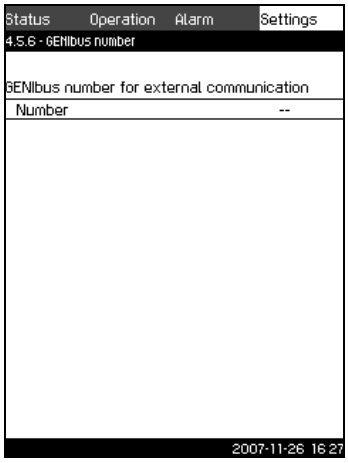
TM03 2298 4807

Fig. 106 Ethernet

Description

The CU 351 is equipped with an Ethernet connection for communication with a computer, either directly or via Internet. For further information, see section *9.8.1 Ethernet*.

9.7.58 GENIbus number (4.5.6)



TM03 2297 4807

Fig. 107 GENIbus number

Description

CU 351 can communicate with external units via an RS-485 interface (option). For further information, see fig. 109 and section *9.8.2 GENIbus*.

Communication is carried out according to the Grundfos bus protocol, GENIbus, and enables connection to a building management system or another external control system.

Operating parameters, such as setpoint and operating mode, can be set via the bus signal. Furthermore, status about important parameters, such as current value and input power, and fault indications can be read from the CU 351.

Contact Grundfos for further information.

Setting range

The number can be set between 1 and 64.

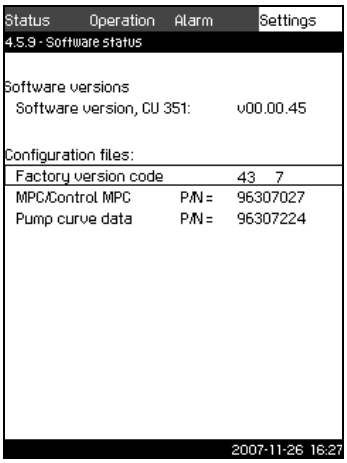
Setting via control panel

1. Mark the **Settings** menu with ▶.
2. Mark **Functions, CU 351** with ▼ or ▲, and press OK.
3. Mark **GENIbus number** with ▼ or ▲, and press OK.
4. Select the number with + or −, and save with OK.

Factory setting

No number is set ("–").

9.7.59 Software status (4.5.9)



TM03 2296 4807

Fig. 108 Software status

Description

This display shows the status of the software installed in the CU 351. Furthermore, the version code and the product numbers of configuration files (GSC) read into the unit are shown.

As it is a status display, no settings can be made.

9.8 Data communication

CU 351 is equipped with a hardware enabling communication with external units, such as a computer, via an external GENIbus or Ethernet connection.

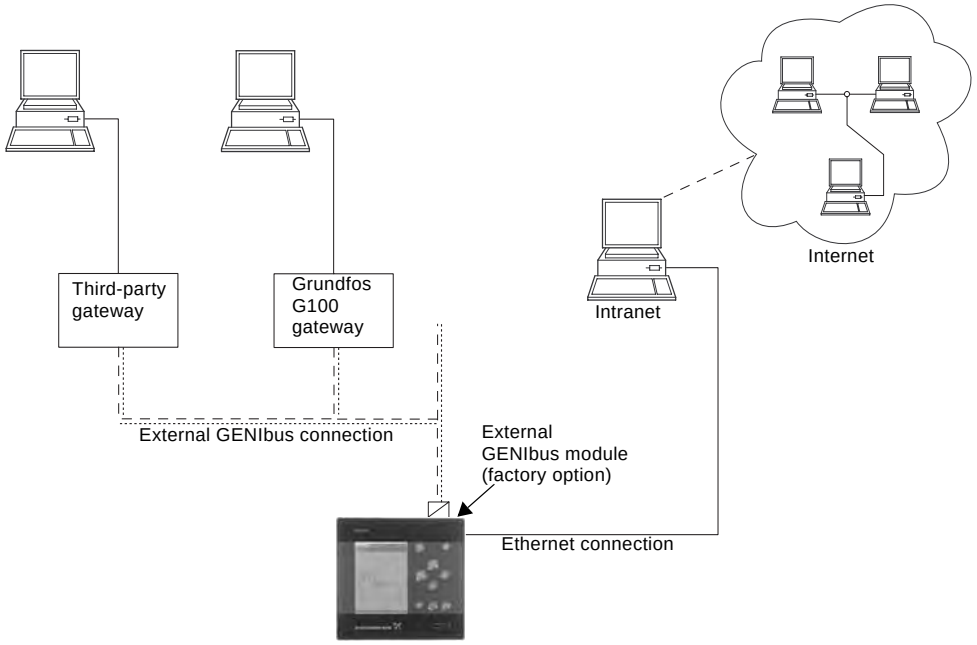


Fig. 109 Data communication via external GENIbus and Ethernet connection

9.8.1 Ethernet

Ethernet is the most widely used standard for local networks (LAN). The standardisation of this technology has created some of the easiest and cheapest ways of creating communication between electrical units, for instance between computers or between computers and control units.

The web server of the CU 351 makes it possible to connect a computer to the CU 351 via an Ethernet connection. The user interface can thus be exported from the CU 351 to a computer so that the CU 351 and consequently the Hydro MPC booster system can be monitored and controlled externally.

Note ***Grundfos recommends that you protect the connection to the CU 351 according to your safety requirements in consultation with the system administrator.***

In order to use the web server, you must know the IP address of the CU 351. All network units must have a unique IP address in order to communicate with each other. The IP address of the CU 351 from factory is 192.168.0.102.

Alternatively to the factory-set IP address, it is possible to use a dynamic assignment of IP address. This is possible by activating a DHCP (Dynamic Host Configuration Protocol) either directly in the CU 351 or via the web server. See the example in fig. 110.

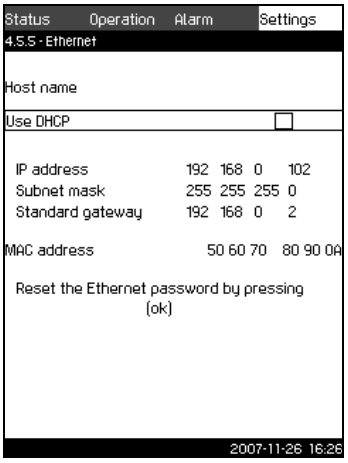


Fig. 110 Example of setting of Ethernet

Dynamic assignment of an IP address for the CU 351 requires a DHCP server in the network. The DHCP server assigns a number of IP addresses to the electrical units and makes sure that two units do not receive the same IP address.

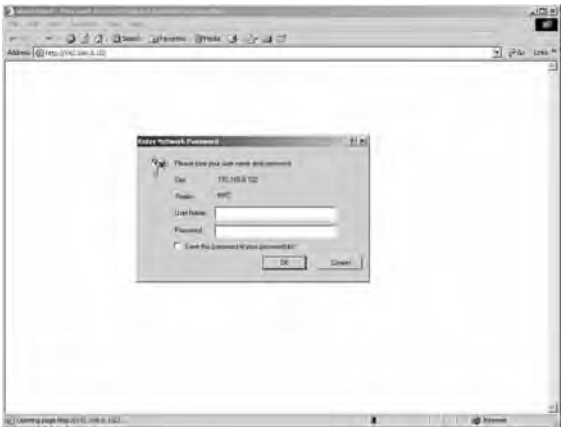
A traditional Internet browser is used for connection to the web server of the CU 351.

If you want to use the factory-set IP address, no changes are required in the display. Open the Internet browser and enter the IP address of the CU 351.

In order to use dynamic assignment, the function must be activated. Click (ok) **Use DHCP** in the menu line. A check mark next to the menu line shows that activation has been made. After activation in the display, open the Internet and enter the host name of the CU 351 instead of the IP address. The Internet browser will now try to connect to the CU 351. The host name can be read in the display, but can only be changed by either a GSC-file (configuration file) or via a web server. See *Change of network setting* on page 63.

Note ***To use DHCP, a host name is required.***

This is the first display shown when connecting to the CU 351.



TM03 2048 3505

Fig. 111 Connection to CU 351

Factory setting

User name: admin
Password: admin

When user name and password have been entered, a Java Runtime Environment application starts up in the CU 351, provided that it has been installed on the computer in question. If this is not the case, but the computer is connected to Internet, then use the link on the screen to download and install the Java Runtime Environment application.



TM03 2049 3505

Fig. 112 Display with link to the JavaScript® program

The Java Runtime Environment application will then export the CU 351 user interface (including display and operating panel) to the computer screen. It is now possible to monitor and control the CU 351 from the computer.



TM03 2047 3505

Fig. 113 Network setting

Change of network setting

When connection to the web server of the CU 351 has been established, it is possible to change the network setting.



TM03 2050 3505

Fig. 114 Change of network setting

1. Press the icon >**Network admin**.
2. Enter the changes.
3. Press **Submit** to activate the changes.

Change of password



TM03 2051 3505

Fig. 115 Change of password

1. Press the icon >**Change password**.
2. Enter the new password.
3. Press **Submit** to activate the new password.

9.8.2 GENIbus

By installing a GENIbus module it is possible to connect a CU 351 to an external network. The connection can take place via a GENIbus-based network or a network based on another protocol via a gateway. See fig. 109. For further information, contact Grundfos.

The gateway may be a Grundfos G100 gateway or a third party gateway. For further information on the G100 gateway, see the G100 data booklet (publication number V7139522).

10. External variable frequency drive

External variable frequency drives used in Hydro MPC booster system variants -F, -EF and -EDF come with the manufacturer's factory settings. See tables below.

At start-up, the factory settings must be changed to the Grundfos settings in the tables below.

In order not to affect the functions of the CU 351 at optimum operation, only the parameters shown should be adjusted. Other parameters should be as set from factory.

10.1 VLT 2800

Press [QUICK MENU] + [+] to access all parameters.

Parameter	Factory setting		Grundfos setting	
	Function	Value or number in the display of VLT	Function	Value or number in the display of VLT
2	Local/remote operation		Local/remote operation	0
3	Local reference		Local reference	Default
101	Torque characteristics		Torque characteristics	2
102	Motor power		Motor power	Motor nameplate in kW
103	Motor voltage		Motor voltage	Motor nameplate
104	Motor frequency		Motor frequency	Motor nameplate, Hz
105	Motor current		Motor current	Motor nameplate, SFA
106	Rated motor speed		Rated motor speed	Motor nameplate RPM
107	Automatic motor adaptation		Automatic motor adaptation	2
128	Thermal motor protection		Thermal motor protection	4
204	Minimum reference		Minimum reference	20 Hz
205	Maximum reference		Maximum reference	60 Hz
206	Ramp type		Ramp type	2
207	Ramp up time		Ramp up time	1.5 sec
208	Ramp down time		Ramp down time	3 sec
214	Reference function		Reference function	2
215	Preset reference		Preset reference	100
302	Digital input		Digital input	7
304	Digital input		Digital input	0
305	Digital input6		Digital input6	24
323	Relay output		Relay output	1
406	Automatic restart time		Automatic restart time	10 sec
411	Switching frequency		Switching frequency	4500

* Thermistor function used for thermal protection of LC filter.

** For information about languages available, see relevant documentation.

*** Use data from the Hydro MPC booster set.

Factory setting of VLT 2800

To recall the factory settings of all parameters, follow one of the procedures below:

1. Set the parameter 620 to (3).
2. Disconnect the power supply.
3. Re-connect the power supply.
4. All parameters are now factory-set except from the fault log.

or

1. Disconnect the power supply.
2. Press and hold [QUICK MENU] + [+] + [CHANGE DATA] and re-connect the power supply.

All parameters are now factory-set, including the fault log.

10.2 Danfoss VLT 8000 factory settings

Press [EXTEND MENU] to access all parameters.

Parameter	Function	Grundfos setting	
		Value	
001	Language	English	0
002	Motor power	Motor nameplate	
003	Motor voltage	Motor nameplate	
004	Motor frequency	Motor nameplate	
005	Motor current	Motor nameplate (SFA)	
006	Motor speed	Motor nameplate (RPM)	
201	Minimum frequency	20 Hz	
202	Maximum frequency	60 Hz	
207	Ramp up time	1.5 sec	
208	Ramp down time	3 sec	
323	Relay 1 function	Ready signal	1
326	Relay 2 function	Running	3

10.3 Danfoss VLT 8000 extended menu programming

Parameter	Function	Grundfos setting	
		Value	
007	Large readout	Frequency [Hz]	3
008	Small display readout	Motor voltage [V]	16
009	Small display readout	Motor current	5
010	Small display readout	Power [Hp]	6
101	Torque characteristics	VT low	2
113	Motor Preheater DC Current	0%	
117	Motor Thermal Protection	ETR Trip 1	4
208	Automatic ramp-down	Disable	0
210	Reference type	External/preset	2
302	Pin 18	Start	1
303	Pin 19	Reverse and start	2
304	Pin 27	Safety interlock	3
308	Pin 53	Reference	1
309	Term. 53, min. scaling	0.0 V	
310	Term. 53, max. scaling	10 V	
325	Relay 01, off delay	1 sec.	
400	Reset function	Automatic reset x 10	6
401	Automatic restart time	5 sec.	
407	Switching frequency	4500	
408	Interference reduction method	Fixed switching freq.	0
016	Lock for data change	Locked	1

10.4 Danfoss VLT 8000 factory settings

Press [EXTEND MENU] to access all parameters.

Parameter	Function	Grundfos setting	
		Value	
001	Language	English	0
002	Motor power	Motor nameplate	
003	Motor voltage	Motor nameplate	
004	Motor frequency	Motor nameplate	
005	Motor current	Motor nameplate (SFA)	
006	Motor speed	Motor nameplate (RPM)	
201	Minimum frequency	20 Hz	
202	Maximum frequency	60 Hz	
207	Ramp up time	1.5 sec	
208	Ramp down time	3 sec	
323	Relay 1 function	Ready signal	1
326	Relay 2 function	Running	3

10.5 Danfoss VLT 8000 extended menu programming

Parameter	Function	Grundfos setting	
		Value	
007	Large readout	Frequency [Hz]	3
008	Small display readout	Motor voltage [V]	16
009	Small display readout	Motor current	5
010	Small display readout	Power [Hp]	6
101	Torque characteristics	VT low	2
113	Motor Preheater DC Current	0%	
117	Motor Thermal Protection	ETR Trip 1	4
208	Automatic ramp-down	Disable	0
210	Reference type	External/preset	2
302	Pin 18	Start	1
303	Pin 19	Reverse and start	2
304	Pin 27	Safety interlock	3
308	Pin 53	Reference	1
309	Term. 53, min. scaling	0.0 V	
310	Term. 53, max. scaling	10 V	
325	Relay 01, off delay	1 sec.	
400	Reset function	Automatic reset x 10	6
401	Automatic restart time	5 sec.	
407	Switching frequency	4500	
408	Interference reduction method	Fixed switching freq.	0
016	Lock for data change	Locked	1

10.6 Baldor Smart motor settings

Section	Parameter	Grundfos setting	
		Value	
Level 2 blocks			
Output limts	Min. output frequency	12 Hz	
Output limts	Max. output	60 Hz	
Output limts	PK current limit	Max. of drive	
Output limts	PWM frequency	6 kHz	
Miscellaneous	Restart aut/man	Auto	
Motor data	Motor voltage	230 V	
Motor data	Motor rated amps	SFA on nameplate	
Level 1 blocks			
Preset speed	Preset speed #1	60 Hz	
Accel	Accel #1	CR 3 - CR 10	1.5 sec.
		CR 15 - CR 90	2.0 sec.
Decel rate	Decel #1	CR 3 - CR 10	3.0 sec.
		CR 15 - CR 90	4.0 sec.
Output	Opto output #1	Ready	
Input	Operating mode	#1 2 wire / 7 spd	
Input	ANA CMD select	Pot. / 0-10 V	
V/Hz and Boost	V/Hz profile	67% sqr. law	

10.7 VLT FC 202

Press [EXTEND MENU] to access all parameters.

Parameter	Function	Grundfos setting	
		Value	
001	Language	English	0
002	Motor Speed Unit	Hz	1
003	Regional Settings	North America	1
020	Display Line 1.1	Small Power [hp]	1611
021	Display Line 1.2	Small Motor Voltage	1612
022	Display Line 1.3	Small Motor Current	1614
023	Display Line 2 Large	Frequency	1615
024	Display Line 3 Large	Speed [RMP]	1617
100	Configuration Mode	Open Loop	0
103	Torque Characteristics	Variable Torque	1
121	Motor Power [HP]	Nameplate	
122	Motor Voltage	Nameplate	
123	Motor Frequency	Nameplate	
124	Motor Current	Nameplate	
125	Motor Nominal Speed	Nameplate	
190	Motor Thermal Protection	ETR trip 1	4
302	Minimum Reference	0.000 Hz	
303	Maximum Reference	60.000 Hz	
304	Reference Function	Sum	0
310	Preset Reference	100.00%	
313	Reference Site	Remote	1
341	Ramp 1 Ramp up Time	1.50 s	
342	Ramp 1 Ramp down Time	3.00 s	
412	Motor Speed Low Limit [Hz]	0.0 Hz	
414	Motor Speed High Limit [Hz]	60.0 Hz	
419	Max Output Frequency	65.0 Hz	
511	Terminal 19 Digital Input	Start reversing	11
513	Terminal 29 Digital Input	Preset reference on	15
540.0	Function Relay	Drive ready	2
542.0	Off Delay, Relay	2.00 s	
610	Terminal 53 Low Voltage	0.00 V	
611	Terminal 53 High Voltage	10.00 V	
614	Terminal 53 Low Ref. / Feedb.	20.000 Hz	
615	Terminal 53 High Ref. / Feedb.	60.000 Hz	
1400	Switching Pattern	60 AVM	0
1401	Switching Frequency	5.0 kHz	7

Factory setting of VLT FC 100

To recall the factory settings of all parameters, follow one of the procedures below:

1. Select parameter 14-22.
2. Press [OK].
3. Select “Initialisation” (for NLCP select “2”).
4. Press [OK].
5. Disconnect the power supply.
6. Reconnect the power supply.
7. All parameters are now factory-set, except RFI 1, protocol, address, baud rate, minimum response delay, maximum response delay, maximum inter-char delay, operating data, historic log and fault log.

or

1. Disconnect the power supply.
2. Press and hold [STATUS] + [MAIN MENU] + [OK] and reconnect the power supply.
3. All parameters are now factory-set, except operating hours, the number of power-ups and overtemp’s and overvolt’s.

11. Fault finding chart



Warning

Before making any connections in pumps, terminal boxes or breaker cabinet, make sure that the electricity supply has been switched off for at least 5 minutes and that it cannot be accidentally switched on.

Fault	Possible cause	Remedy
Pumps do not run when started.	Current pressure is higher than or equal to the setpoint.	Wait until the pressure has dropped, or lower the pressure on the discharge side of the Hydro MPC, and check that the pumps start.
	Electricity supply disconnected.	Connect the electricity supply.
	Main switch cut out.	Cut in the main switch.
	Main switch is defective.	Replace the main switch.
	Motor protection is activated.	Contact Grundfos.
	Motor is defective.	Repair or replace the motor.
	Pressure transmitter fault - Pressure transmitter is defective.	Replace the pressure transmitter. Transmitters with 0-20 mA or 4-20 mA output signals are monitored by the Hydro MPC.
	- Cable is broken or short-circuited.	Repair or replace the cable.
The pumps start, but stop immediately. The operating pressure is not reached.	Dry running or no inlet pressure.	Re-establish the supply of water to the Hydro MPC. When the inlet pressure has been re-established, the pumps will restart after 15 seconds.
The Hydro MPC is stopped and cannot restart.	Pressure transmitter fault - Pressure transmitter is defective.	Replace the pressure transmitter. Transmitters with 0-20 mA or 4-20 mA output signals are monitored by the Hydro MPC.
	- Cable is broken or short-circuited.	Repair or replace the cable.
	CU 351 fault - Electricity supply disconnected.	Connect the electricity supply.
	- CU 351 defective.	Contact Grundfos.
Unstable water delivery from Hydro MPC (applies to unstable water supply).	Inlet pressure is too low.	Check the suction pipe and possible suction strainer.
	Suction pipe or pumps partly blocked by impurities.	Clean the suction pipes, strainer or pumps.
	Pumps suck air.	Check the suction pipe for leakages.
	Pressure transmitter defective.	Replace the transmitter.
Pumps are running, but deliver no water.	The valves are closed.	Open the valves.
	Suction pipe or pumps blocked by impurities.	Clean the suction pipe or pumps.
	Non-return valve blocked in closed position.	Clean the non-return valve. The non-return valve must move freely.
	Suction pipe leaky.	Check the suction pipe for leakages.
	Air in suction pipe or pumps.	Vent and prime the pumps. Check the suction pipe for leakages.
The Hydro MPC is unable to reach the setpoint.	Too high consumption.	- Reduce consumption (if possible). - Install a bigger Hydro MPC booster system.
	Too many standby pumps selected.	Reduce the number of standby pumps.
	Pipe fracture or leakage in the system.	Check the system, and repair damages, if necessary.
Leakage from the shaft seal.	Shaft seal is defective.	Replace the shaft seal.
	Height adjustment of pump shaft inaccurate.	Readjust the shaft height.
Noise.	The pumps are cavitating.	Clean the suction pipe/pumps and possibly the suction strainer.
	The pumps do not rotate freely (friction resistance) due to inaccurate height adjustment of the pump shaft.	Readjust the shaft height.
Very frequent starts and stops.	Wrong diaphragm tank precharge pressure.	Set correct precharge pressure.

12. Maintenance



Warning

Before starting work on the pumps, make sure that the electricity supply has been switched off. Lock the main switch with a padlock to ensure that it cannot be accidentally switched on.

12.1 Pumps

Pump bearings and shaft seal are maintenance-free.

12.2 Motor bearings

Motors without grease nipples are maintenance-free.

Motors with grease nipples should be lubricated with a high-temperature lithium-based grease. See the instructions on the fan cover of Grundfos motors.

In the case of seasonal operation (motor is idle for more than 6 months of the year), it is recommended to grease the motor when the pump is taken out of operation.

12.3 CU 351

The CU 351 is maintenance-free. It must be kept clean and dry. Protect it against direct sunlight. Furthermore, the CU 351 must not be outside the ambient temperature range. See section *15. Technical data*.

13. Frost protection

Pumps which are not being used during periods of frost should be drained to avoid damage.

Drain the pump by loosening the vent screw in the pump head and by removing the drain plug from the base.



Warning

Care must be taken to ensure that the escaping water does not cause injury to persons or damage to the motor or other components. In hot water installations, special attention should be paid to the risk of injury caused by scalding hot water.

Do not tighten the vent screw and replace the drain plug until the pump is to be used again.

14. Taking out of operation

Switch off the main switch to take the booster system out of operation.



Warning

The conductors in front of the main switch are still energised. Lock the main switch with a padlock to ensure that it cannot be accidentally switched on.

Individual pumps are taken out of operation by switching off the corresponding motor-protective circuit breaker, automatic circuit breaker or fuse.

15. Technical data

15.1 Pressure

Inlet pressure

Hydro MPC booster sets can operate with a positive inlet pressure (precharged pressure system) or with a negative inlet pressure (i.e vacuum at the inlet manifold).

Calculation of the inlet pressure is recommended when

- water is drawn through long pipes,
- water is drawn from depths,
- inlet conditions are poor.

Note ***In this installation and operating instruction the term 'inlet pressure' is defined as the pressure/ vacuum which can be measured immediately before the booster set.***

To avoid cavitation, make sure that there is a minimum inlet pressure on the suction side of the booster set. The minimum inlet pressure in bar can be calculated as follows:

$$H = P_b - NPSH - H_f - H_v - H_S$$

P_b = Barometric pressure in feet (33.9 feet at sea level). In closed systems, P_b indicates system pressure in feet.

H_f = Friction loss in suction piping in feet. (At the highest flow the pump will be delivering).

H_v = Vapor pressure in feet.

NPSH = **N**et **P**ositive **S**uction **H**ead in feet.
NPSH can be read from the NPSH curve at the maximum capacity at which the pump will run.
(See installation and operating instructions for CR, CRI, CRN).

H_S = Safety margin = minimum 2 feet.

If "H" is calculated as positive, the pump can operate at a suction of maximum "H" feet. If "H" is calculated as negative, an inlet pressure (psia) of minimum "H" feet is required.

Maximum inlet pressure

Pump	Maximum inlet pressure [psi]
60 Hz	
CR(E) 5-7	145
CR(E) 10-3	116
CR(E) 15-3	145
CR(E) 20-3	145
CR(E) 32-2	58
CR(E) 45-2-1	145
CR(E) 64-2-1	145
CR 90-2-1	218

Note ***The maximum inlet pressure is determined by the construction of the pump, such as bearing pressure.***
For information about other CR pump sizes, see WebCAPS on www.grundfos.com.

Operating pressure

As standard the maximum operating pressure is 230 psi [16 bar].

On request, Grundfos offers Hydro MPC booster systems with a maximum operating pressure higher than 230 psi [16 bar].

15.2 Temperature

Liquid temperature: 32 °F to +158 °F

Ambient temperature: 32 °F to +104 °F

15.3 Relative humidity

Max. relative humidity: 95 %

15.4 Sound pressure

For sound pressure level, see the installation and operating instructions for the CR pumps.

The sound pressure level for a number of pumps can be calculated as follows:

$L_{max} = L_{pump} + (n - 1) \times 3$

L_{max} = Maximum sound pressure level.

L_{pump} = Sound pressure level for one pump.

n = Number of pumps.

16. Electrical data

Supply voltage

See nameplate of the Hydro MPC.

Backup fuse

See the wiring diagram supplied with the Hydro MPC.

Digital inputs

Open circuit voltage:	24 VDC
Closed circuit current:	5 mA, DC
Frequency range:	0-4 Hz

Note ***All digital inputs are supplied with PELV voltage (Protective Extra-Low Voltage).***

Analog inputs

Input current and voltage:	0-20 mA 4-20 mA 0-10 V
Tolerance:	±3.3 % of full scale
Repetitive accuracy:	±1% of full scale
Input resistance, current:	< 250 Ω
Input resistance, voltage, CU 351:	10 kΩ ±10 %
Input resistance, voltage, IO 351:	> 50 kΩ ± 10 %
Supply to sensor:	24 V, maximum 50 mA, short-circuit protected

Note ***All analog inputs are supplied with PELV voltage (Protective Extra-Low Voltage).***

Digital outputs (relay outputs)

Maximum contact load:	240 VAC, 2 A
Minimum contact load:	5 VDC, 10 mA

All digital outputs are potential-free relay contacts.

Note ***Some outputs have a common C terminal. For further information, see the wiring diagram supplied with the Hydro MPC.***

Inputs for PTC sensor/thermal switch

For PTC sensors to DIN 44082. Thermal switches can also be connected.

Open circuit voltage:	12 VDC ±15 %
Closed circuit current:	2.6 mA, DC

Note ***Inputs for PTC sensors are electrically separated from the other inputs and outputs of the Hydro MPC.***

17. Related documents

Further product information about Hydro MPC booster systems can be found in the following documents.

All documents are available in WebCAPS on Grundfos' homepage, www.grundfos.com.

Title	Frequency	Publication number
Product Guide		
Grundfos Hydro MPC	60 Hz	L-BPQ-PG-01
Grundfos CR,CRI,CRN	60 Hz	L-CR-PG-001
Installation and operating instructions		
CR, CRI, CRN	60 Hz	L-CP-TL-003
CRE, CRIE, CRNE, CRKE, SPKE, MTRE, CHIE *	60 Hz	L-MLE-TL-02
Service documentation		
Service instructions	50/60 Hz	96646712
Service kit catalog	50/60 Hz	96488862
Other documentation		
Wiring diagram**	-	-

* Only relevant for Hydro MPC-E, -ED and -ES booster systems.

** A wiring diagram is supplied with the booster system.

18. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

Subject to alterations.

3 Valves

SUPPLIER: Tyco Northgate
88 Frederick Street
Northgate Qld 4013

Ph: (07) 3266 2255
Fax: (07) 3260 5221

MODEL: 150 Dia DF R.S Sluice Valve ACC

Resilient Seated Gate Valves - Figure 500
DN80 - DN600

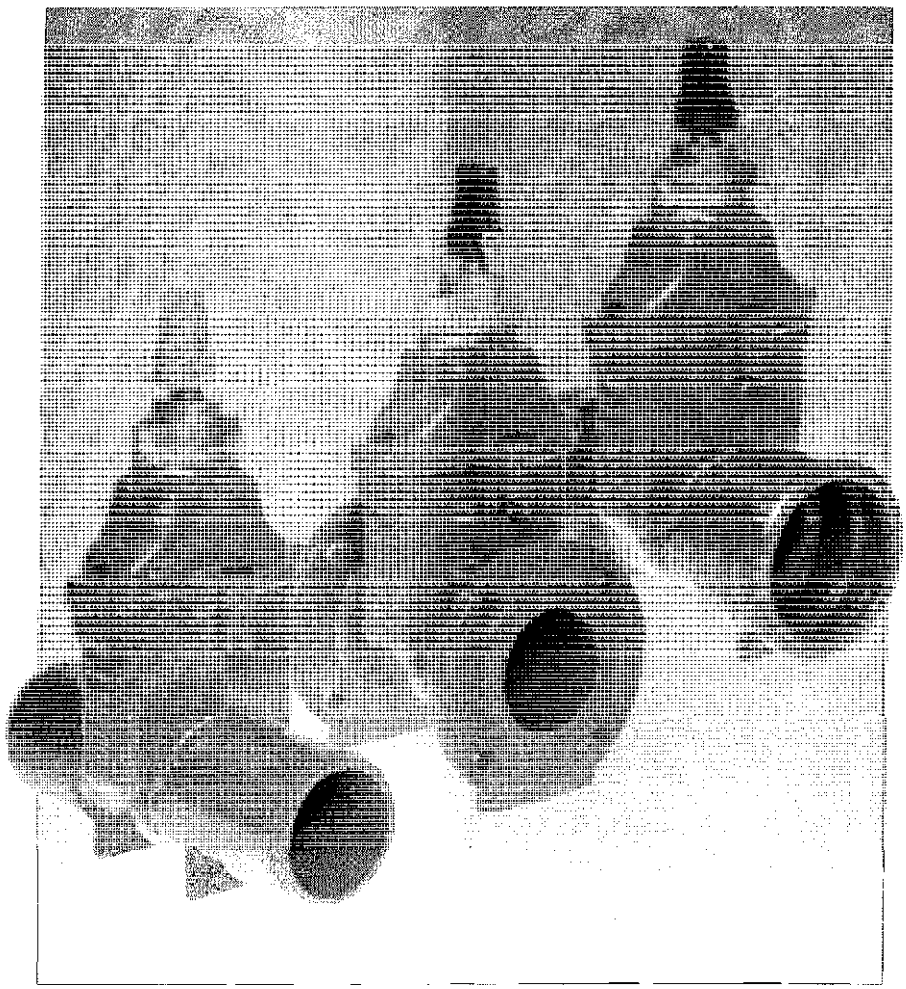
tyco
Flow Control

Tyco Water

Figure 500 resilient seated gate valves are designed and manufactured to AS 2638-2.

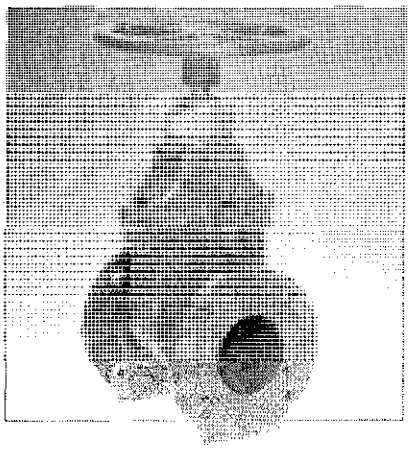
Features

- Ductile Iron body and bonnet for high strength and impact resistance.
- Ductile Iron gate fully encapsulated in EPDM rubber to ensure drop tight sealing.
- Grade 431 Stainless Steel spindle for high strength and corrosion resistance.
- Gunmetal dezincification resistant top casting incorporating dual O-ring seals and wiper ring for long life operation.
- Back seal facility to allow for replacement of seals under full operating pressure.
- Rilsan® Nylon 11 coating for long life corrosion protection.
- Straight through full bore to avoid debris traps.
- Isolated fasteners for corrosion protection.
- Anti-friction thrust washer for low operating torques.
- Integral cast in feet for safe and easy storage.
- Integral lifting lugs for installation convenience.
- Anticlockwise closing or clockwise closing available.
- Key, hand wheel or gearbox operation available.



General Application

Figure 500 resilient seated gate valves are suitable for use with drinking water and waste water, in below or above ground applications. Used for the isolation of sections and branches in pipelines.



Technical Data

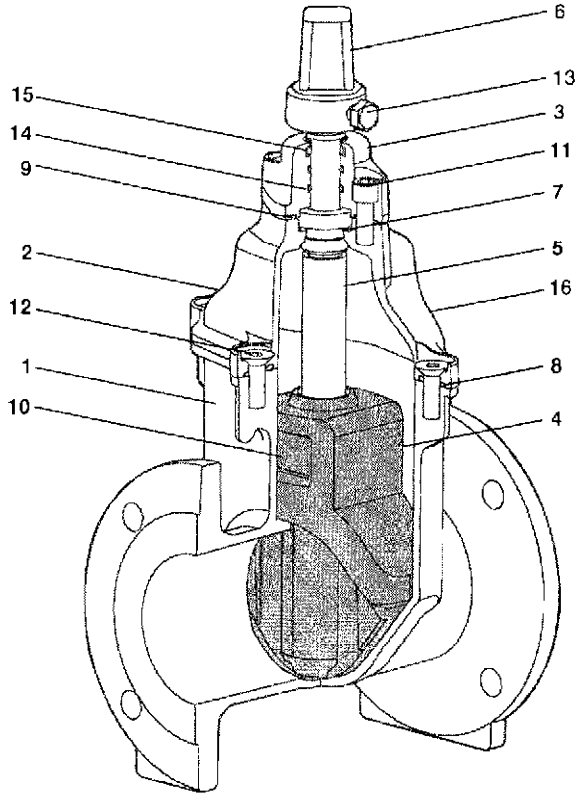
Size Range: DN80-DN600
Allowable Operating Pressure: 1600 kPa
Maximum Temperature: 40°C
End Connections:
Flanged to AS 4087 Fig B5
TYTON® Socket
Spigot to AS/NZS 2280
Flange – TYTON Socket
Approvals:
WSAA Appraisal No. 98/21
ISC AS 2638 Product Mark
Regisration No. PRD/R61/0412/2
Certified to AS 4020 -suitable for contact with drinking water.

A.B.N. 75 087 415 745

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TWS500/504

Resilient Seated Gate Valves - Figure 500
DN80 - DN600



Parts List

No	Description	Material	Standard
1	Body	Ductile Iron	AS 1831 400-12
2	Bonnet	Ductile Iron	AS 1831 400-12
3	Seal Retainer	Gunmetal	AS 1565 C83600
4	Gate	Ductile Iron (EPDM Encapsulated)	AS 1831 400-12
5	Spindle	Stainless Steel	ASTM A 276 431
6	Spindle Cap	Ductile Iron	AS 1831 400-12
7	Thrust Washer	Acetal	-
8	Body Gasket	EPDM	AS 1646
9	Bonnet Gasket	EPDM	AS 1646
10	Gate Nut	Gunmetal	AS 1565 C83600
11	Socket Head Screws	High Tensile Alloy Steel	-
12	Countersunk Screws	High Tensile Alloy Steel	-
13	Hex Head Screw	Stainless Steel	ASTM A276 316
14	O-Rings	Nitrile Rubber	AS 1646
15	Wiper Ring	Nitrile Rubber	AS 1646
16	Fusion Coating	Rilsan® Nylon II	AS/NZS 4158

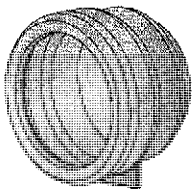
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Resilient Seated Gate Valves - Figure 500
DN80 - DN600

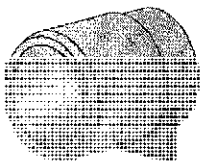
End Connections



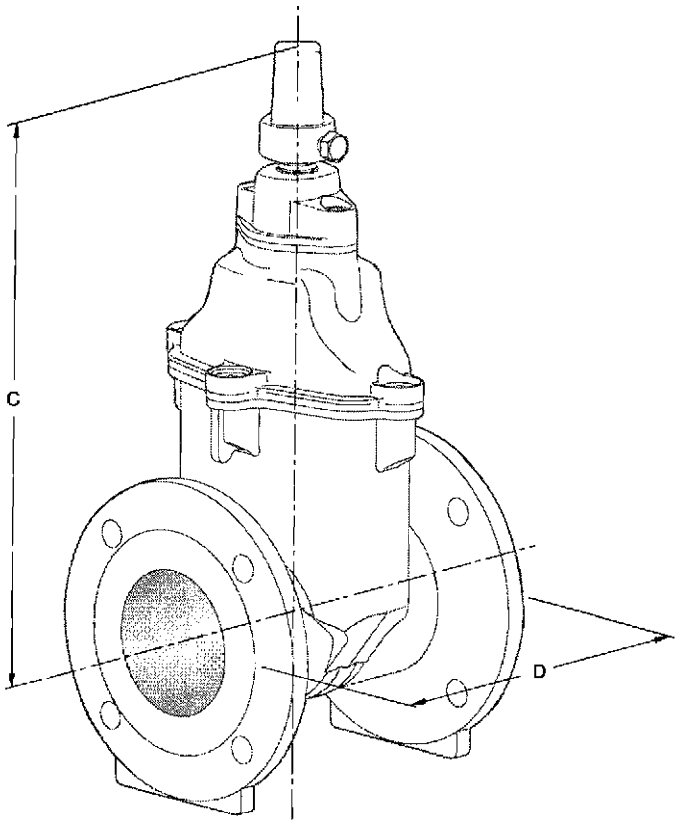
Flange



Socket



Spigot



Dimensions (mm)

Valve Size	C	D TYTON Socket	D Flange AS4087 Fig B5	D Spigot	Turns to Close	Torque to Seal Nm	Approx. Mass kg
80*	367	-	203	305	20	40	18
100†	402	150	229	365	23	50	24
150†	502	170	267	380	26	75	43
200†	610	195	292	410	34	120	75
225†	649	205	305	420	38	140	85
250†	723	235	330	435	42	180	110
300	810	245	356	450	50	200	160
375	960	275	381	-	62	420	340
450	1145	-	432	-	76	500	560
500	1290	-	457	-	82	530	710
600	1467	-	508	-	98	550	940

Note: *For compatability with Series 1 PVC (white) pipe, PLASTYT gaskets may be used in TYTON sockets.*
** Flange to Polydex socket available.*
† Flange to TYTON socket available.

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Resilient Seated Gate Valves - Figure 500
DN80 - DN600

Available Range

	Resilient Seated Gate Valves Inside Screw Class 16				
	Key Operated				Handwheel Operated
DN	Fl-Fl	Sc-Sc	Sp-Sp	Fl-Sc	Fl-Fl
80	✓		✓	✓	✓
100	✓	✓	✓	✓	✓
150	✓	✓	✓	✓	✓
200	✓	✓	✓	✓	✓
225	✓	✓	✓	✓	✓
250	✓	✓	✓	✓	✓
300	✓	✓	✓	✓	✓
375	✓	✓			✓
450	✓				✓
500	✓				✓
600	✓				✓
Fig No.	500	500	500	500	500H
Coating					
Rilsan Nylon 11	✓	✓	✓	✓	✓
Options					
Anticlockwise Closing	✓	✓	✓	✓	
Clockwise Closing	✓	✓	✓	✓	✓
Gear Actuator	✓				
Flange Drilling Fig B5 (TC)	✓			✓	✓

Recommended Specification

- Gate valves shall be resilient seated conforming to AS2638.2.
- The allowable operating pressure shall be 1600kPa.
- Operation shall be by means of a key/handwheel.
- The direction of closing shall be anticlockwise/clockwise.
- The valve body and bonnet shall be cast in Ductile Iron and coated with a thermally applied polymeric coating to AS/NZS 4158.
- The gate shall be cast in Ductile Iron and fully encapsulated in EPDM rubber - partially coated wedges are not acceptable.
- The spindle shall be Grade 431 Stainless Steel incorporating a failsafe thrust collar.
- The spindle seal retainer shall be manufactured from a dezincification resistant copper alloy to AS1565.
- The spindle seal shall be affected by a minimum of two O-rings, which can be replaced under full operating pressure.
- Fasteners shall be completely isolated from the external environment.
- Valves shall be manufactured under a product certification scheme and each valve marked in accordance with the certification body's requirements.

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4 Flowmeter

SUPPLIER: Endress & Hauser Australia
2/35 Miles Platting Rd.
Eight Mile Plains Qld 4113
Ph: (07) 3457 0200
Fax: (07) 3457 0299

MODEL: DN150 PROMAG 50W1F

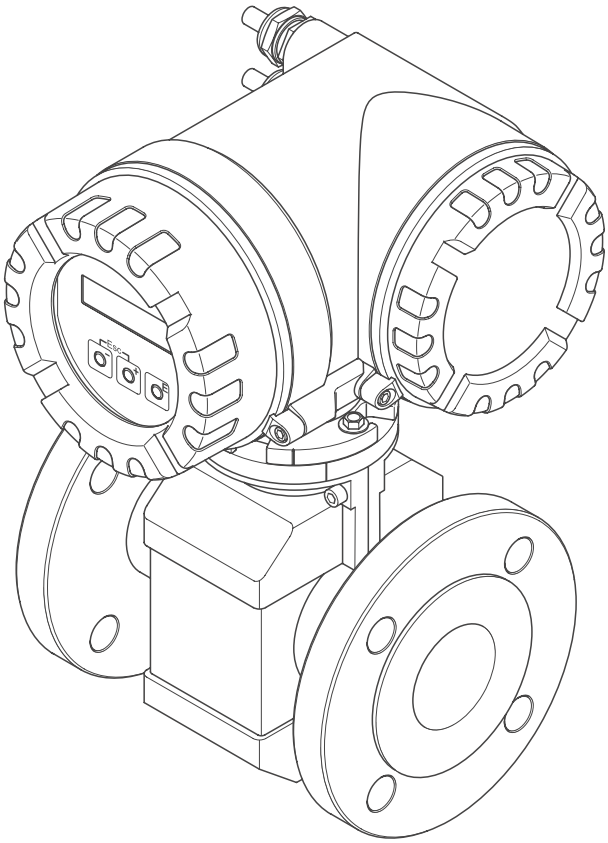
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating Instructions

Proline Promag 50

Electromagnetic Flow Measuring System

HART® FIELD COMMUNICATION PROTOCOL



BA046D/06/en/03.05
50097090
Valid as of version:
V 2.00.XX (Device software)

Endress+Hauser
People for Process Automation

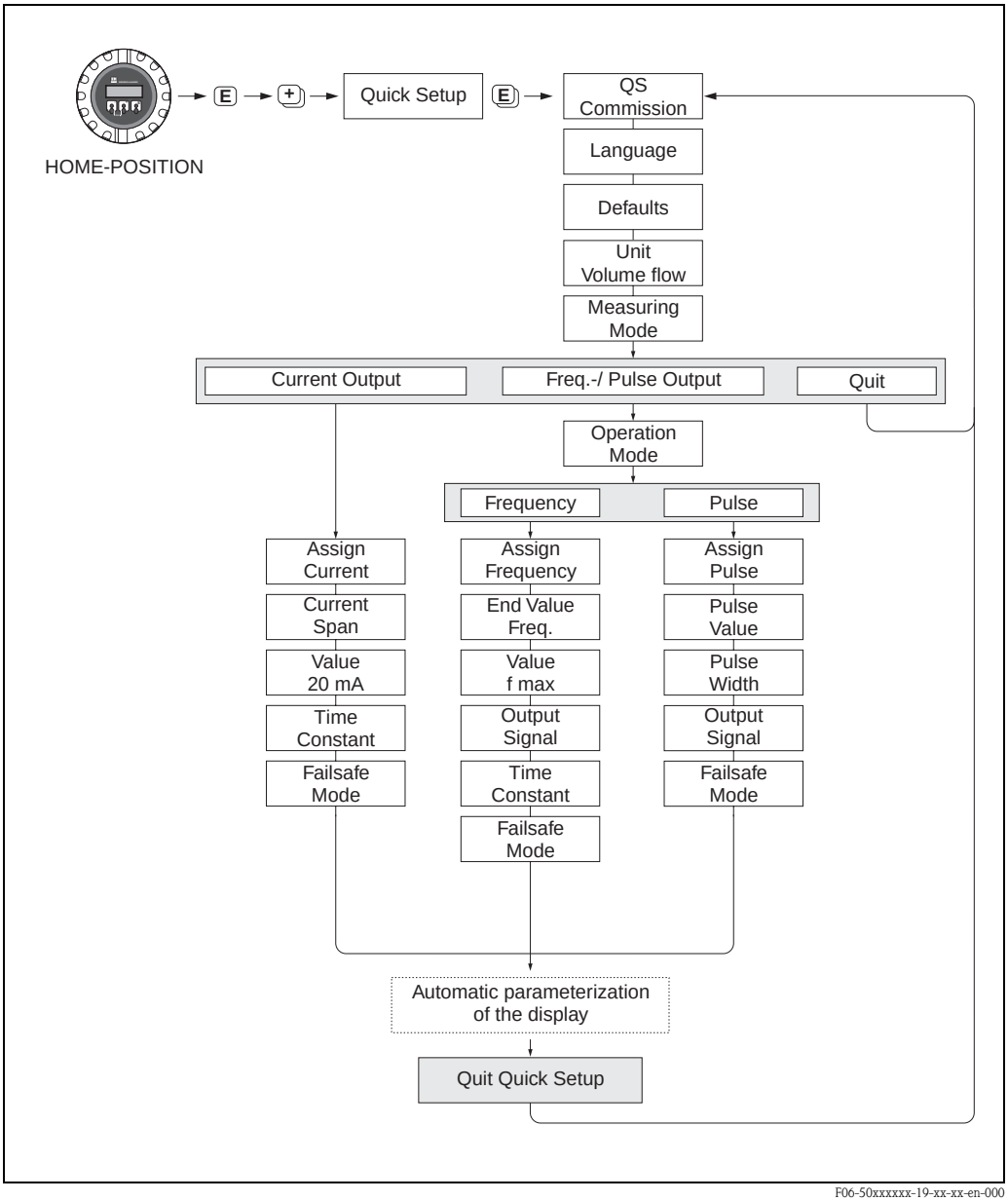
Brief operating instructions

These brief operating instructions show you how to configure the measuring device quickly and easily:

Safety instructions	Page 7
▼	
Installation	Page 13
▼	
Wiring	Page 47
▼	
Display and operating elements	Page 61
▼	
Commissioning with "QUICK SETUP"	Page 80 ff.
You can commission the measuring device quickly and easily, using the special "Quick Setup" menu. It enables to configure important basic functions using the local display, for example display language, measured variables, units engineering, type of signal, etc. The following adjustments can be made separately as necessary: – Empty-pipe/full-pipe adjustment for empty pipe detection (EPD) – Configuration of current output (active/passive)	
▼	
Customer-specific cofiguration	Page 62
Complex measuring operations necessitate additional functions that you can configure as necessary with the aid of the function matrix, and customize to suit the process parameters. All functions are described in detail, as is the function matrix itself, in the **"Description of Device Functions"** manual, which is a separate part of this Operating Instruction.	

✎ Note!
Always start trouble-shooting with the checklist on Page 89, if faults occur after commissioning or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

"QUICK SETUP" commissioning



F06-50xxxxxx-19-xx-xx-en-000

Contents

1 Safety instructions 7

1.1 Designated use 7
1.2 Installation, commissioning and operation 7
1.3 Operational safety 7
1.4 Return 8
1.5 Notes on safety conventions and icons 8

2 Identification 9

2.1 Device designation 9
2.1.1 Nameplate of the transmitter 9
2.1.2 Nameplate of the sensor 10
2.1.3 Nameplate, connections 11
2.2 CE mark, declaration of conformity 11
2.3 Registered trademarks 12

3 Installation 13

3.1 Incoming acceptance, transport and storage 13
3.1.1 Incoming acceptance 13
3.1.2 Transport 13
3.1.3 Storage 14
3.2 Installation conditions 15
3.2.1 Dimensions 15
3.2.2 Mounting location 15
3.2.3 Orientation 17
3.2.4 Vibrations 18
3.2.5 Foundations, supports 19
3.2.6 Adapters 20
3.2.7 Nominal diameter and flow rate 20
3.2.8 Length of connecting cable 25
3.3 Installation instructions 26
3.3.1 Installing the Promag W sensor 26
3.3.2 Installing the Promag P sensor 33
3.3.3 Installing the Promag H sensor 39
3.3.4 Turning the transmitter housing 42
3.3.5 Turning the local display 43
3.3.6 Installing the wall-mount transmitter housing 44
3.4 Installation check 46

4 Wiring 47

4.1 Connecting the remote version 47
4.1.1 Connecting Promag W / P / H 47
4.1.2 Cable specifications 51
4.2 Connecting the measuring unit 52
4.2.1 Transmitter 52
4.2.2 Terminal assignment 54
4.2.3 HART connection 55
4.3 Potential equalisation 56
4.3.1 Standard case 56
4.3.2 Special cases 57
4.4 Degree of protection 59
4.5 Electical connection check 60

5 Operation 61

5.1 Display and operating elements 61
5.2 Brief operating instruction to the function matrix . . 62
5.2.1 General notes 63
5.2.2 Enabling the programming mode 63
5.2.3 Disabling the programming mode 63
5.3 Error messages 64
5.4 Communication 65
5.4.1 Operating options 66
5.4.2 Current device description files 67
5.4.3 Device and process variables 68
5.4.4 Universal / Common practice HART commands 69
5.4.5 Device status / Error messages 74

6 Commissioning 79

6.1 Function check 79
6.1.1 Switching on the measuring device 79
6.2 Application-specific commissioning 80
6.2.1 “Commissioning” Quick Setup menu 80
6.2.2 Empty-pipe/full-pipe adjustment 81
6.2.3 Current output: active/passive 82
6.3 Data storage device (HistoROM) 82
6.3.1 HistoROM/S-DAT (sensor-DAT) 82

7 Maintenance 83

7.1 Exterior cleaning 83
7.2 Seals 83

8 Accessories 85

8.1 Device-specific accessories 85
8.2 Measuring principle-specific accessories 86
8.3 Communication-specific accessories 87
8.4 Communication-specific accessories 87

9 Trouble-shooting 89

9.1 Trouble-shooting instructions 89
9.2 System error messages 90
9.3 Process error messages 93
9.4 Process errors without messages 94
9.5 Response of outputs to errors 95
9.6 Spare parts 97
9.7 Removing and installing printed circuit boards 98
9.8 Replacing the device fuse 102
9.9 Replacing exchangeable measuring electrodes . . . 103
9.10 Software history 105

10 Technical data 107

10.1 Technical data at a glance 107
10.1.1 Application 107
10.1.2 Function and system design 107

10.1.3 Input 107
10.1.4 Output 108
10.1.5 Power supply 108
10.1.6 Performance characteristics 109
10.1.7 Operating conditions 110
10.1.8 Mechanical construction 114
10.1.9 Human interface 118
10.1.10 Certificates and approvals 118
10.1.11 Ordering information 119
10.1.12 Accessories 119
10.1.13 Supplementary documentation 119

11 Index 121

1 Safety instructions

1.1 Designated use

The measuring device described in this Operating Manual is to be used only for measuring the flow rate of conductive fluids in closed pipes. A minimum conductivity of 20 μS/cm is required for measuring demineralized water. Most fluids can be metered, provided they have a minimum conductivity of 5 μS/cm, for example:
- acids, alkalis,
- drinking water, wastewater, sewage sludge,
- milk, beer, wine, mineral water, etc.

Resulting from incorrect use or from use other than that designated the operational safety of the measuring devices can be suspended. The manufacturer accepts no liability for damages being produced from this.

1.2 Installation, commissioning and operation

Note the following points:
- Installation, connection to the electricity supply, commissioning and maintenance of the device must be carried out by trained, qualified specialists authorized to perform such work by the facility's owner-operator. The specialist must have read and understood this Operating Manual and must follow the instructions it contains.
- The device must be operated by persons authorized and trained by the facility's owner-operator. Strict compliance with the instructions in the Operating Manual is mandatory.
- Endress+Hauser will be happy to assist in clarifying the chemical resistance properties of parts wetted by special fluids, including fluids used for cleaning.
- If welding work is performed on the piping system, do not ground the welding appliance through the Promag flowmeter.
- The installer must ensure that the measuring system is correctly wired in accordance with the wiring diagrams. The transmitter must be grounded, unless the power supply is galvanically insulated.
- Invariably, local regulations governing the opening and repair of electrical devices apply.

1.3 Operational safety

Note the following points:
- Measuring systems for use in hazardous environments are accompanied by separate Ex documentation, which is an *integral part* of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory. The symbol on the front of this supplementary Ex documentation indicates the approval and the certification body (Ex Europe, FM USA, SP Canada).
- The measuring device complies with the general safety requirements in accordance with EN 61010, the EMC requirements of EN 61326/A1, and NAMUR recommendation NE 21.
- Depending on the application, the seals of the process connections of the Promag H sensor require periodic replacement.
- The manufacturer reserves the right to modify technical data without prior notice. Your Endress+Hauser distributor will supply you with current information and updates to this Operating Manual.

1.4 Return

The following procedures must be carried out before a flowmeter requiring repair or calibration, for example, is returned to Endress+Hauser:

- Always enclose a duly completed "Declaration of contamination" form. Only then can Endress+Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EN 91/155/EEC.
- Remove all residues. Pay special attention to the grooves for seals and crevices which could contain residues. This is particularly important if the substance is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

Note!
You will find a *preprinted* "Declaration of contamination" form at the back of this manual.

Warning!
- Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.
- Costs incurred for waste disposal and injury (burns, etc.) due to inadequate cleaning will be charged to the owner-operator.

1.5 Notes on safety conventions and icons

The devices are designed to meet state-of-the-art safety requirements, have been tested, and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures". They can, however, be a source of danger if used incorrectly or for other than the designated use.
Consequently, always pay particular attention to the safety instructions indicated in this Operating Manual by the following icons:

Warning!
"Warning" indicates an action or procedure which, if not performed correctly, can result in injury or a safety hazard. Comply strictly with the instructions and proceed with care.

Caution!
"Caution" indicates an action or procedure which, if not performed correctly, can result in incorrect operation or destruction of the device. Comply strictly with the instructions.

Note!
"Note" indicates an action or procedure which, if not performed correctly, can have an indirect effect on operation or trigger an unexpected response on the part of the device.

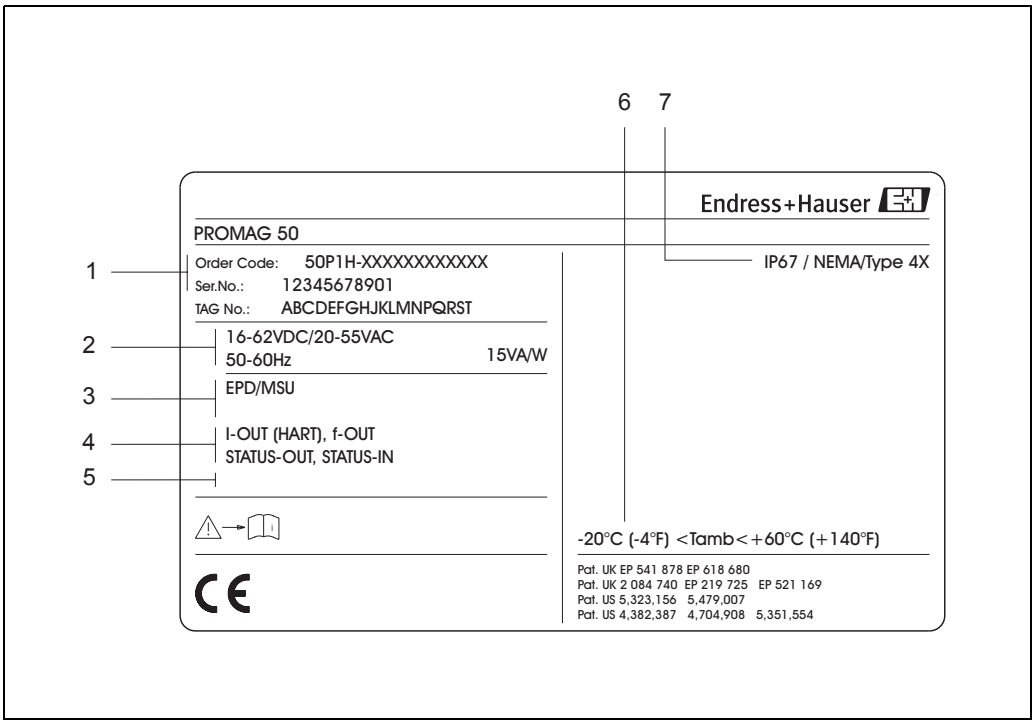
2 Identification

2.1 Device designation

The “Promag 50” flow measuring system consists of the following components:
- Promag 50 transmitter
- Promag W, Promag P or Promag H sensor

In the *compact version*, transmitter and sensor form a single mechanical unit; in the *remote version* they are installed separately.

2.1.1 Nameplate of the transmitter

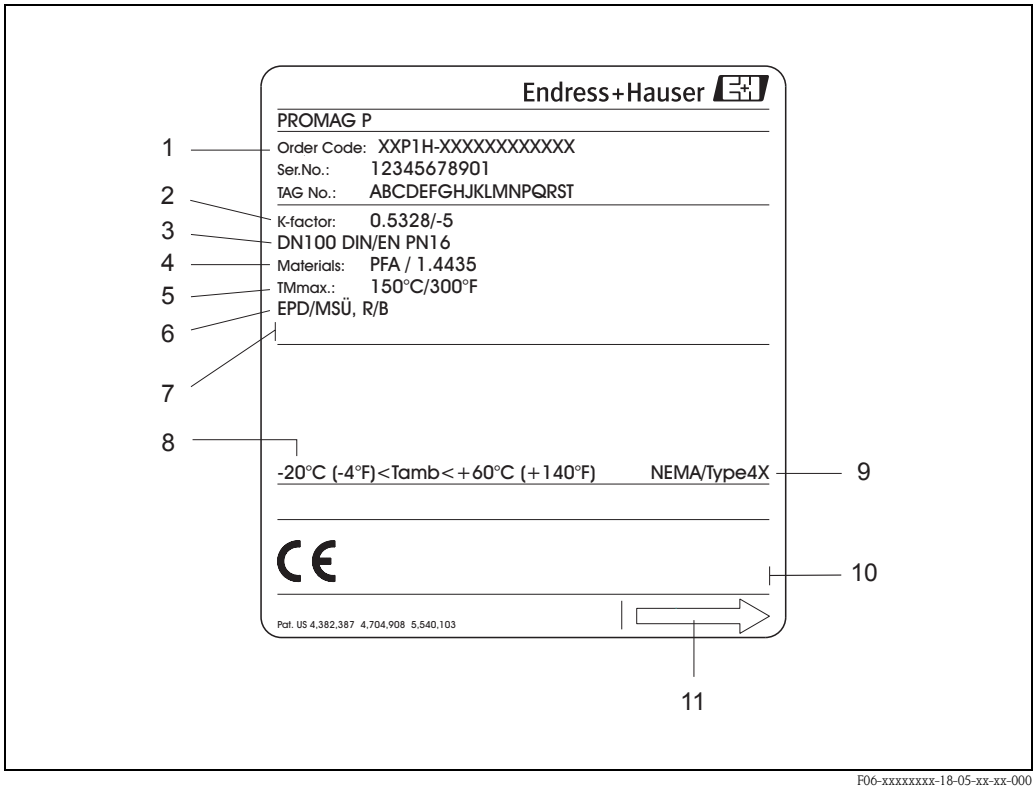


F06-50xxxxxx-18-06-xx-xx-000

Fig. 1: Nameplate specifications for the “Promag 50” transmitter (example)

1 Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.
2 Power supply / frequency: 16...62 V DC / 20...55 V AC / 50...60 Hz
Power consumption: 15 VA / W
3 Additional functions and software:
– EPD/MSU: with Empty Pipe Detection
– ECC: with Electrode Cleaning Circuitry
4 Outputs / inputs:
I-OUT (HART): with current output (HART)
f-OUT: with pulse/frequency output
STATUS-IN: with status input (auxiliary input)
STATUS-OUT: with status output (switch output)
5 Reserved for information on special products
6 Ambient temperature range
7 Degree of protection

2.1.2 Nameplate of the sensor



F06-xxxxxxxx-18-05-xx-xx-000

Fig. 2: Nameplate specifications for the "Promag" sensor (example)

1 Ordering code/serial number: See the specifications on the order confirmation for the meanings of the individual letters and digits.
2 Calibration factor: 0.5328; zero point: −5
3 Nominal diameter: DN 100
Pressure rating: EN (DIN) PN 16 bar
4 TMmax +150 °C (max. fluid temperature)
5 Materials:
– Lining: PFA
– Measuring electrodes: stainless steel 1.4435
6 Additional information (examples):
– EPD/MSU: with Empty Pipe Detection electrode
– R/B: with reference electrode
7 Reserved for information on special products
8 Ambient temperature range
9 Degree of protection
10 Reserved for additional information on device version (approvals, certificates)
11 Flow direction

2.1.3 Nameplate, connections

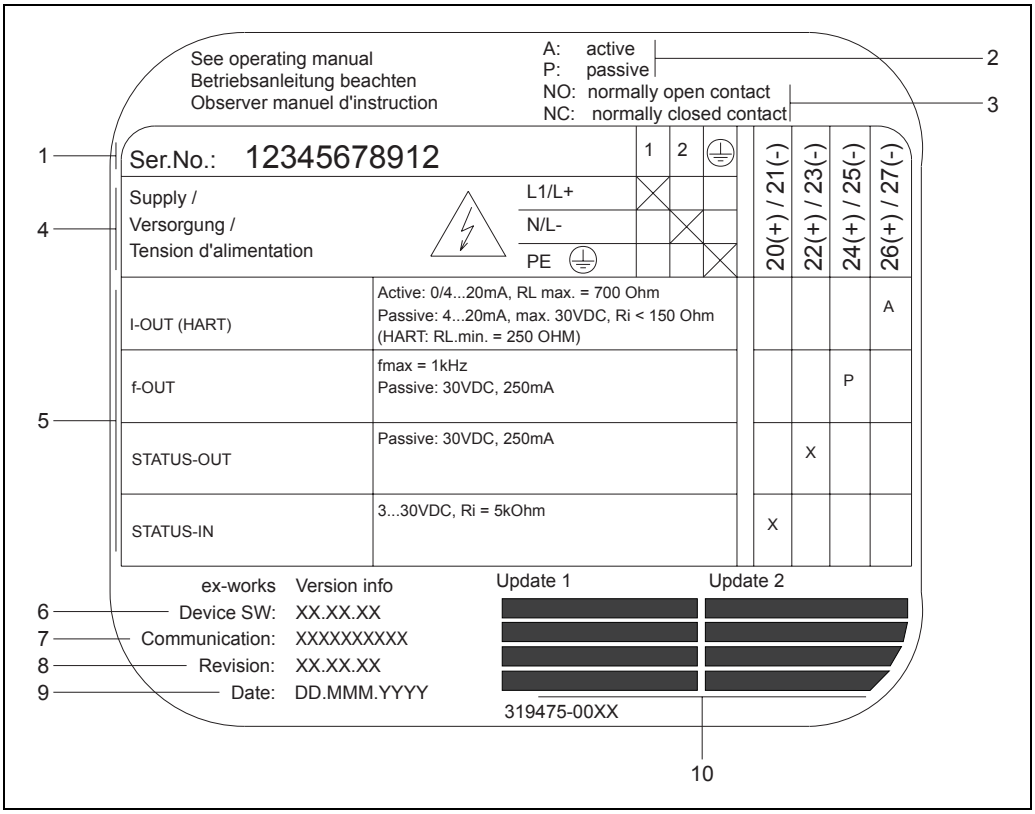


Fig. 3: Nameplate specifications for Proline transmitter (example)

1 Serial number
2 Possible configuration of current output
3 Possible configuration of relay contacts
4 Terminal assignment, cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L- for DC*
5 Signals present at inputs and outputs, possible configuration and terminal assignment (20...27), see also "Electrical values of inputs/outputs"
6 Version of device software currently installed
7 Installed communication type, e.g.: HART, PROFIBUS PA, etc.
8 Information on current communication software (Device Revision and Device Description), e.g.: Dev. 01 / DD 01 for HART
9 Date of installation
10 Current updates to data specified in points 6 to 9

2.2 CE mark, declaration of conformity

The devices are designed to meet state-of-the-art safety requirements in accordance with sound engineering practice. They have been tested and left the factory in a condition in which they are safe to operate. The devices comply with the applicable standards and regulations in accordance with EN 61010 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and with the EMC reqiurements of EN 61326/A1.
The measuring system described in this Operating Manual is therefore in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

2.3 Registered trademarks

KALREZ ®, VITON ®
are registered trademarks of E.I. Du Pont de Nemours & Co., Wilmington, USA

TRI-CLAMP ®
is a registered trademark of Ladish & Co., Inc., Kenosha, USA

HART ®
is a registered trademark of HART Communication Foundation, Austin, USA

HistoROM™, S-DAT®, ToF Tool - Fieldtool® Package, Fieldcheck®, Applicator®
are registered trademarks of Endress+Hauser Flowtec AG, Reinach, CH

3 Installation

3.1 Incoming acceptance, transport and storage

3.1.1 Incoming acceptance

- Check the packaging and the contents for damage.
- Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.1.2 Transport

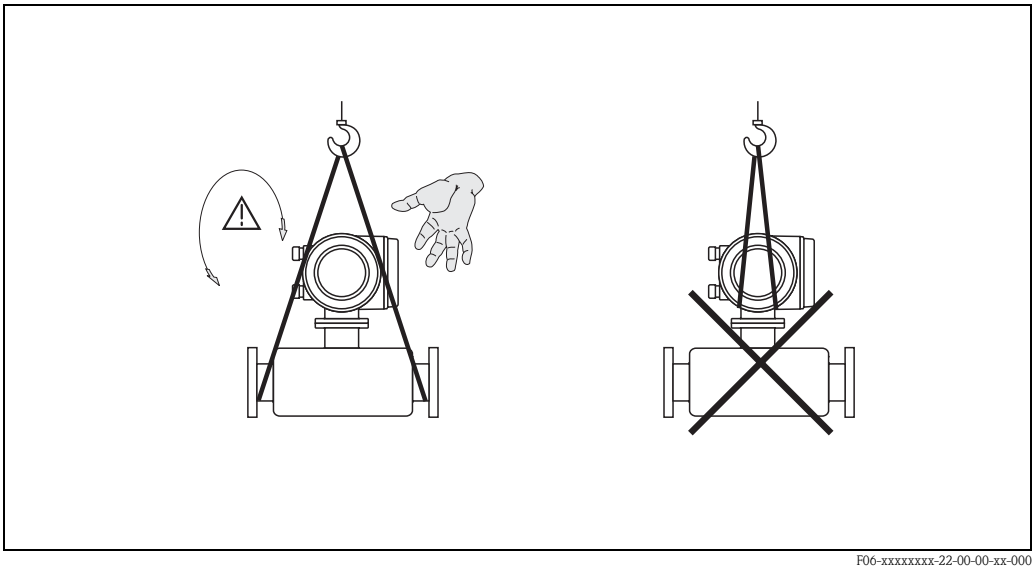
The following instructions apply to unpacking and to transporting the device to its final location:
- Transport the devices in the containers in which they are delivered.
- Do not remove the protective plates or caps on the process connections until the device is ready to install. This is particularly important in the case of sensors with PTFE linings.

Special notes on flanged devices

Caution!
- The wooden covers mounted on the flanges before the device leaves the factory protect the linings on the flanges during storage and transportation. Do not remove these covers until *immediately before* the device is installed in the pipe.
- Do not lift flanged devices by the transmitter housing, or the connection housing in the case of the remote version.

Transporting flanged devices (DN ≤ 300):
Use webbing slings slung round the two process connections (Fig. 4). Do not use chains, as they could damage the housing.

Warning!
Risk of injury if the measuring device slips. The center of gravity of the assembled measuring device might be higher than the points around which the slings are slung.
At all times, therefore, make sure that the device does not unexpectedly turn around its axis or slip.

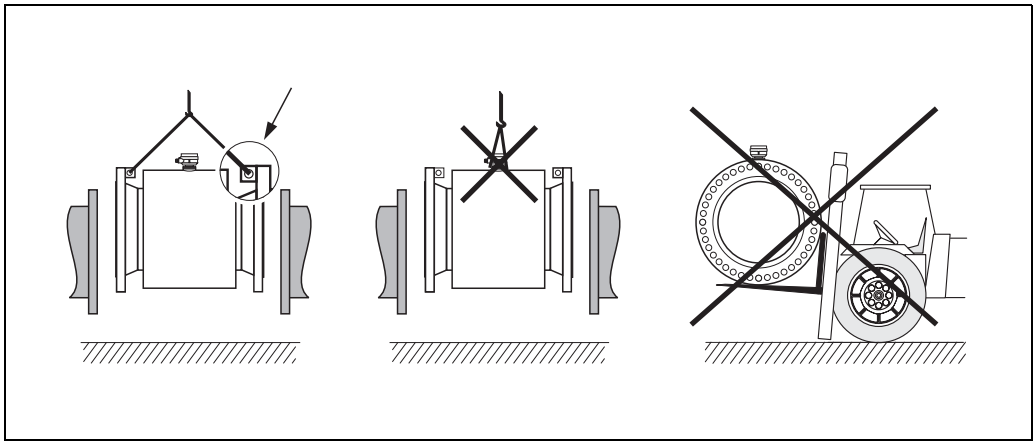


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Fig. 4: Transporting transmitters with DN ≤ 300

Transporting flanged devices (DN ≥ 350):
Use only the metal eyes on the flanges for transporting the device, lifting it and positioning the sensor in the piping.

Caution!
Do not attempt to lift the sensor with the tines of a fork-lift truck beneath the metal casing. This would buckle the casing and damage the internal magnetic coils.



F06-5xFxxxxx-22-xx-xx-xx-001

Fig. 5: Transporting sensors with DN ≥ 350

3.1.3 Storage

Note the following points:
- Pack the measuring device in such a way as to protect it reliably against impact for storage (and transportation). The original packaging provides optimum protection.
- The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.
- The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.
- Choose a storage location where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.
- Do not remove the protective plates or caps on the process connections until you are ready to install the device. This is particularly important in the case of sensors with PTFE linings.

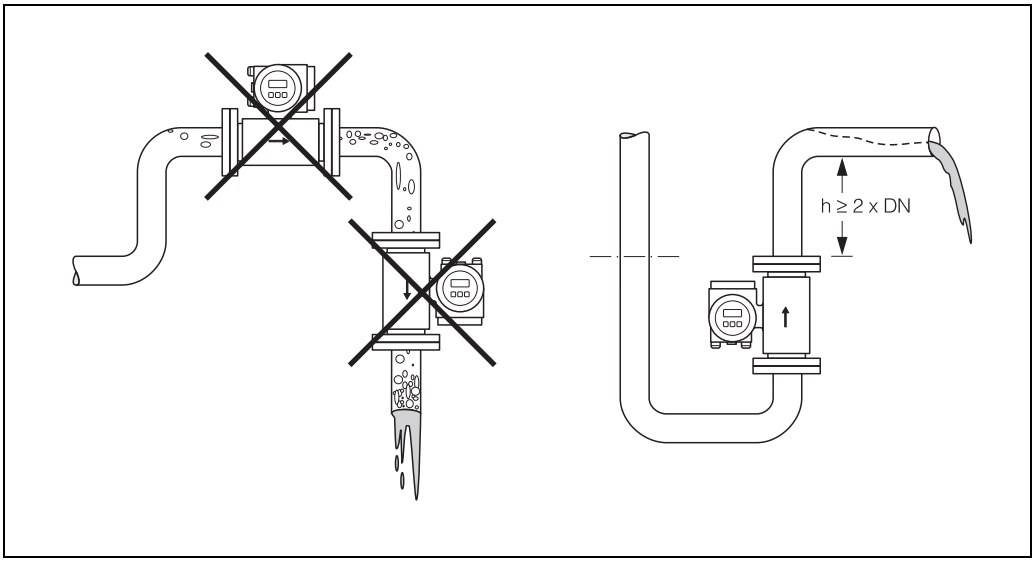
3.2 Installation conditions

3.2.1 Dimensions

All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation “Technical Information”.

3.2.2 Mounting location

Correct measuring is possible only if the pipe is full. **Avoid** the following locations:
- Highest point of a pipeline. Risk of air accumulating
- Directly upstream a free pipe outlet in a vertical pipeline.

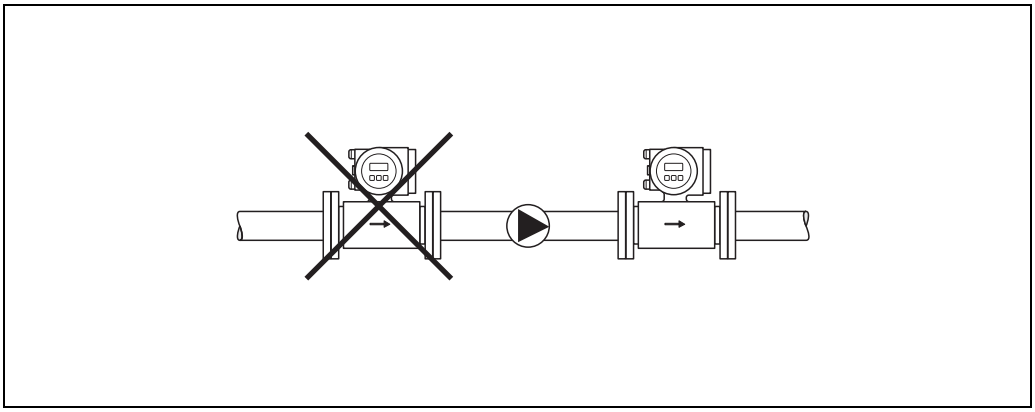


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Fig. 6: Location

Installation of pumps
Do not install the sensor on the intake side of a pump. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the lining's resistance to partial vacuum can be found on → Page 113.

It might be necessary to install pulse dampers in systems incorporating reciprocating, diaphragm or peristaltic pumps. Information on the measuring system's resistance to vibration and shock can be found on → Page 110.

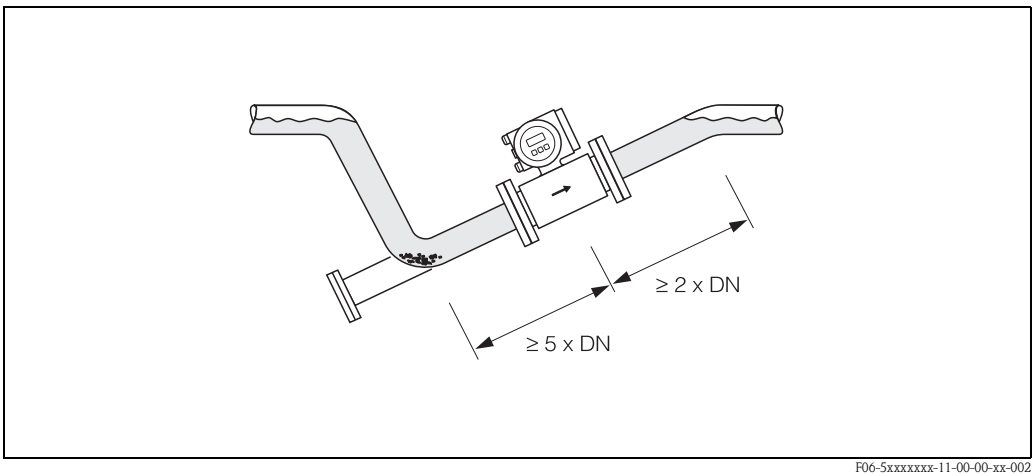


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Fig. 7: Installation of pumps

Partially filled pipes
Partially filled pipes with gradients necessitate a drain-type configuration. The Empty Pipe Detection function (see Page 81) offers additional protection by detecting empty or partially filled pipes.

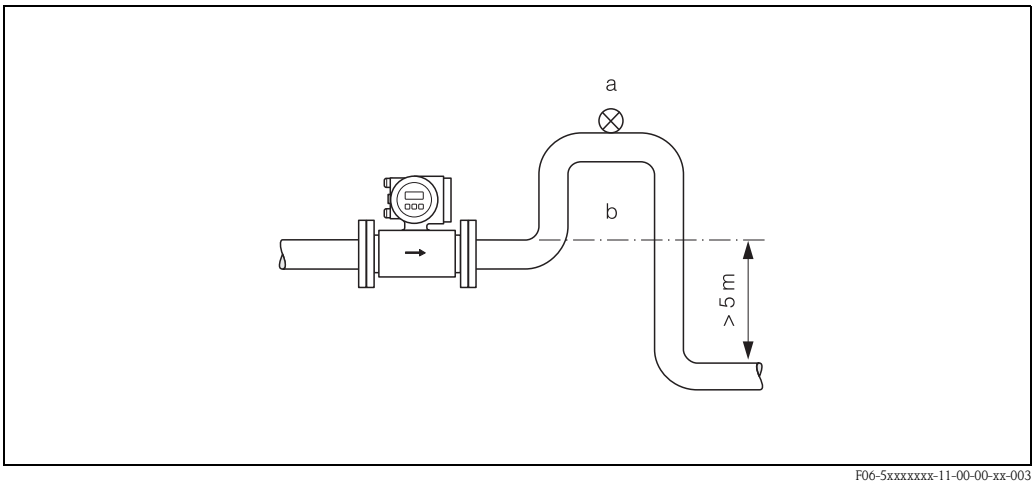
Caution!
Risk of solids accumulating. Do not install the sensor at the lowest point in the drain.
It is advisable to install a cleaning valve.



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Fig. 8: Installation in partially filled pipe

Down pipes
Install a siphon or a vent valve downstream of the sensor in down pipes longer than 5 meters. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. These measures also prevent the system losing prime, which could cause air inclusions. Information on the lining's resistance to partial vacuum can be found on Page 113.



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Fig. 9: Measures for installation in a down pipe (a = vent valve; b = siphon)

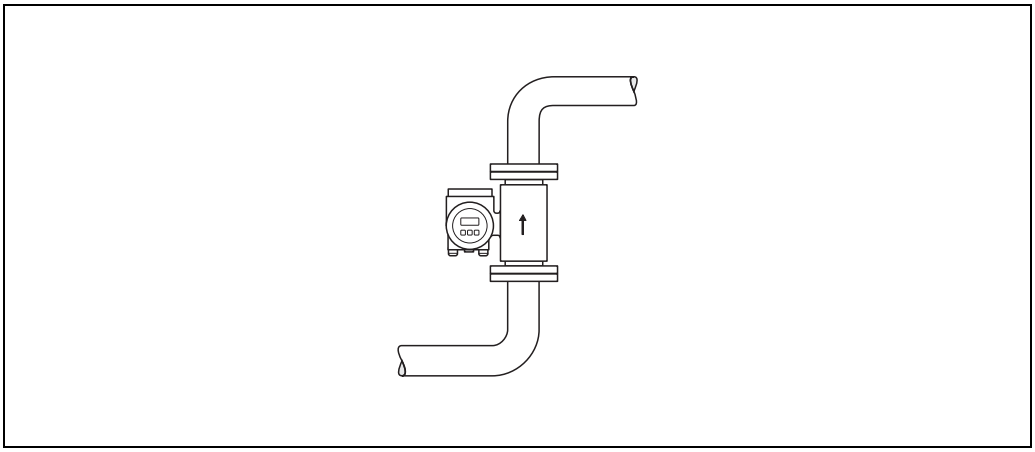
3.2.3 Orientation

An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube. Promag, nevertheless, supplies a range of functions and accessories for correct measuring of problematic fluids:

- Electrode Cleaning Circuit (ECC) for applications with accretive fluids, e.g. electrically conductive deposits → "Description of Device Functions" manual.
- Empty Pipe Detection (EPD) ensures the detection of partially filled measuring tubes, e.g. in the case of degassing fluids or varying process pressure (see Page 81)
- Exchangeable Measuring Electrodes for abrasive fluids (see Page 103)

Vertical orientation

This is the ideal orientation for self-emptying piping systems and for use in conjunction with Empty Pipe Detection.



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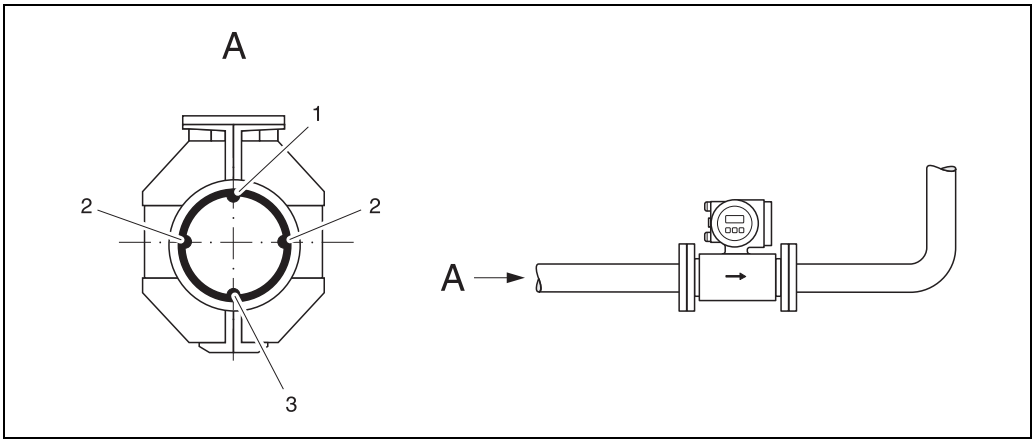
Fig. 10: Vertical orientation

Horizontal orientation

The measuring electrode plane should be horizontal. This prevents brief insulation of the two electrodes by entrained air bubbles.

Caution!

Empty Pipe Detection functions correctly only when the measuring device is installed horizontally and the transmitter housing is facing upward (Fig. 11). Otherwise there is no guarantee that Empty Pipe Detection will respond if the measuring tube is only partially filled or empty.



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Fig. 11: Horizontal orientation

1 EPD electrode for the detection of empty pipes (not with Promag H, DN 2...4)
2 Measurement electrodes for the signal acquisition
3 Reference electrode for the potential equalisation (not with Promag H)

Inlet and outlet runs
If possible, install the sensor well clear of fittings such as valves, T-pieces, elbows, etc. Compliance with the following requirements for the inlet and outlet runs is necessary in order to ensure measuring accuracy.
- Inlet run ≥ 5 x DN
- Outlet run ≥ 2 x DN

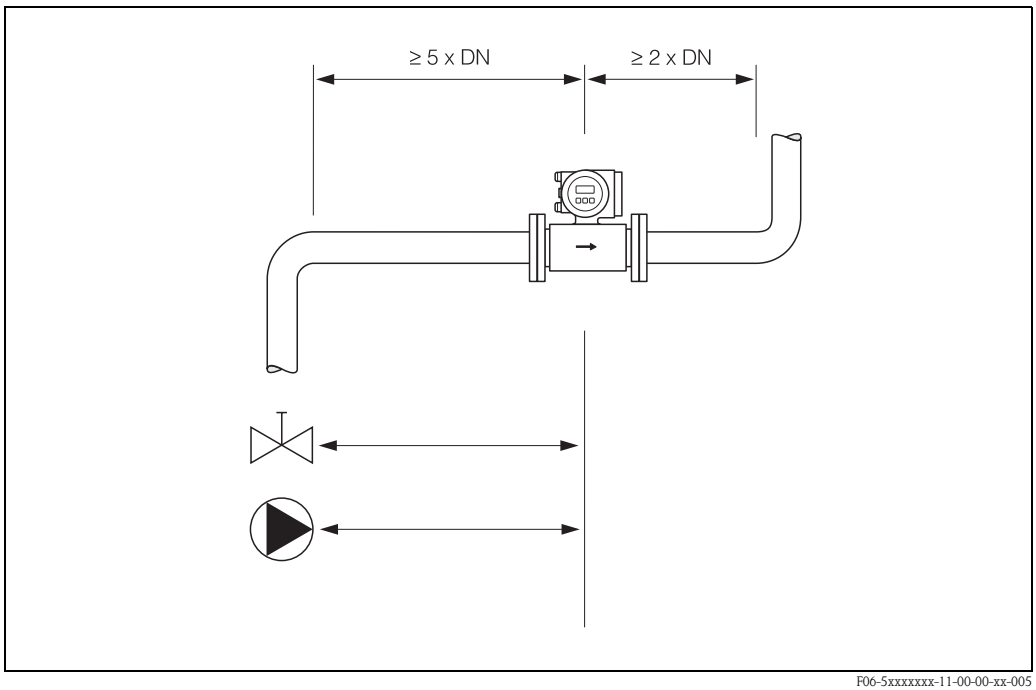


Fig. 12: Inlet and outlet runs

3.2.4 Vibrations

Secure the piping and the sensor if vibration is severe.

Caution!
It is advisable to install sensor and transmitter separately if vibration is excessively severe. Information on resistance to vibration and shock can be found on → Page 110.

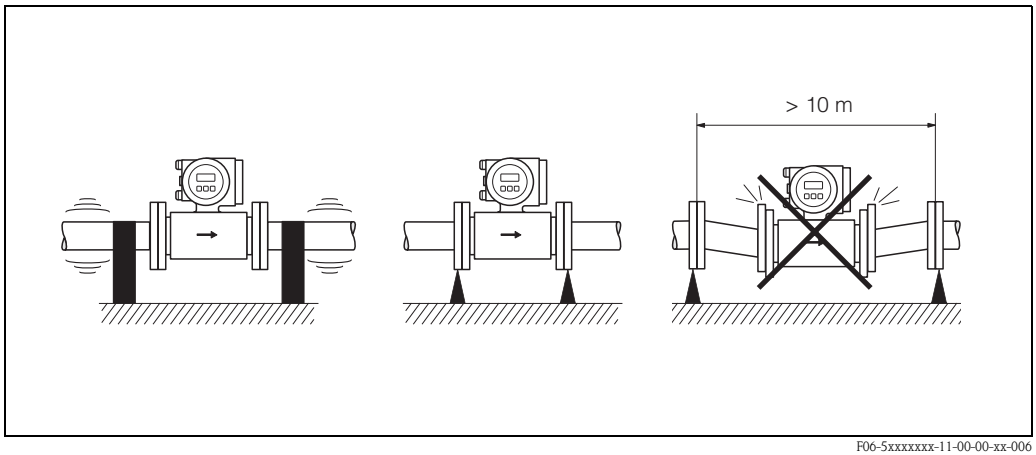
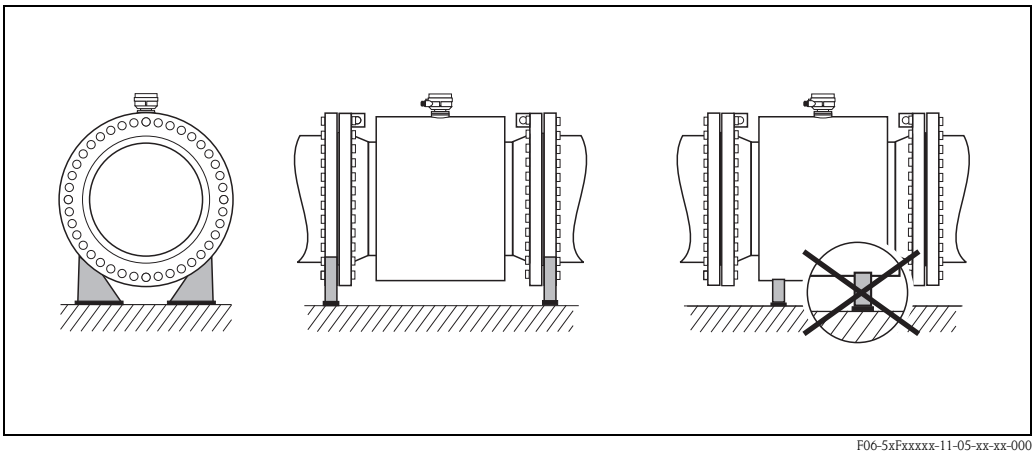


Fig. 13: Measures to prevent vibration of the measuring device

3.2.5 Foundations, supports

If the nominal diameter is DN ≥ 350, mount the transmitter on a foundation of adequate load-bearing strength.

Caution!
Risk of damage. Do not support the weight of the sensor on the metal casing: the casing would buckle and damage the internal magnetic coils.



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Fig. 14: Correct support for large nominal diameters (DN ≥ 350)

3.2.6 Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids.

The nomogram shown here can be used to calculate the pressure loss caused by cross-section reduction:

Note!
The nomogram applies to fluids of viscosity similar to water.

1. Calculate the ratio of the diameters d/D.
2. From the nomogram read off the pressure loss as a function of flow velocity (*downstream* from the reduction) and the d/D ratio.

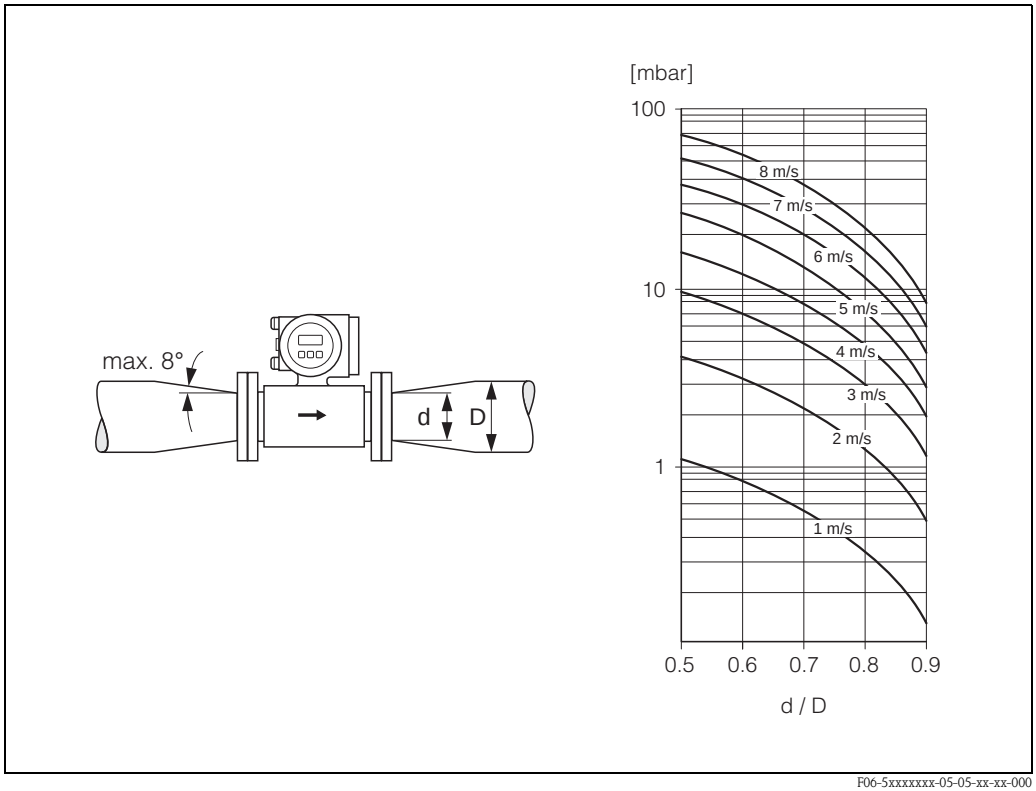


Fig. 15: Pressure loss due to adapters

3.2.7 Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor.
The optimum velocity of flow is 2...3 m/s. The velocity of flow (v), moreover, has to be matched to the physical properties of the fluid:
- v < 2 m/s: for abrasive fluids such as potter's clay, lime milk, ore slurry, etc.
- v > 2 m/s: for fluids producing build-up such as wastewater sludge, etc.

Note!
Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor (see Chap. 3.2.6).

Promag W

Flow rate characteristic values – Promag W (SI units)

Nominal diameter		Recommended flow rate	Factory setting		
[mm]	[inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
25	1"	9…300 dm^3/min	75 dm^3/min	0.50 dm^3	1 dm^3/min
32	1 1/4"	15…500 dm^3/min	125 dm^3/min	1.00 dm^3	2 dm^3/min
40	1 1/2"	25…700 dm^3/min	200 dm^3/min	1.50 dm^3	3 dm^3/min
50	2"	35…1100 dm^3/min	300 dm^3/min	2.50 dm^3	5 dm^3/min
65	2 1/2"	60…2000 dm^3/min	500 dm^3/min	5.00 dm^3	8 dm^3/min
80	3"	90…3000 dm^3/min	750 dm^3/min	5.00 dm^3	12 dm^3/min
100	4"	145…4700 dm^3/min	1200 dm^3/min	10.00 dm^3	20 dm^3/min
125	5"	220…7500 dm^3/min	1850 dm^3/min	15.00 dm^3	30 dm^3/min
150	6"	20…600 m^3/h	150 m^3/h	0.025 m^3	2.5 m^3/h
200	8"	35…1100 m^3/h	300 m^3/h	0.05 m^3	5.0 m^3/h
250	10"	55…1700 m^3/h	500 m^3/h	0.05 m^3	7.5 m^3/h
300	12"	80…2400 m^3/h	750 m^3/h	0.10 m^3	10 m^3/h
350	14"	110…3300 m^3/h	1000 m^3/h	0.10 m^3	15 m^3/h
400	16"	140…4200 m^3/h	1200 m^3/h	0.15 m^3	20 m^3/h
450	18"	180…5400 m^3/h	1500 m^3/h	0.25 m^3	25 m^3/h
500	20"	220…6600 m^3/h	2000 m^3/h	0.25 m^3	30 m^3/h
600	24"	310…9600 m^3/h	2500 m^3/h	0.30 m^3	40 m^3/h
700	28"	420…13500 m^3/h	3500 m^3/h	0.50 m^3	50 m^3/h
–	30"	480…15000 m^3/h	4000 m^3/h	0.50 m^3	60 m^3/h
800	32"	550…18000 m^3/h	4500 m^3/h	0.75 m^3	75 m^3/h
900	36"	690…22500 m^3/h	6000 m^3/h	0.75 m^3	100 m^3/h
1000	40"	850…28000 m^3/h	7000 m^3/h	1.00 m^3	125 m^3/h
–	42"	950…30000 m^3/h	8000 m^3/h	1.00 m^3	125 m^3/h
1200	48"	1250…40000 m^3/h	10000 m^3/h	1.50 m^3	150 m^3/h
–	54"	1550…50000 m^3/h	13000 m^3/h	1.50 m^3	200 m^3/h
1400	–	1700…55000 m^3/h	14000 m^3/h	2.00 m^3	225 m^3/h
–	60"	1950…60000 m^3/h	16000 m^3/h	2.00 m^3	250 m^3/h
1600	–	2200…70000 m^3/h	18000 m^3/h	2.50 m^3	300 m^3/h
–	66"	2500…80000 m^3/h	20500 m^3/h	2.50 m^3	325 m^3/h
1800	72"	2800…90000 m^3/h	23000 m^3/h	3.00 m^3	350 m^3/h
–	78"	3300…100000 m^3/h	28500 m^3/h	3.50 m^3	450 m^3/h
2000	–	3400…110000 m^3/h	28500 m^3/h	3.50 m^3	450 m^3/h

Flow rate characteristic values – Promag W (US units)

Nominal diameter		Recommended flow rate	Factory setting		
[inch]	[mm]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
1"	25	2.5…80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1 1/4"	32	4…130 gal/min	30 gal/min	0.20 gal	0.50 gal/min
1 1/2"	40	7…190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10…300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2 1/2"	65	16…500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	80	24…800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	100	40…1250 gal/min	300 gal/min	2 gal	4.0 gal/min
5"	125	60…1950 gal/min	450 gal/min	5 gal	7.0 gal/min
6"	150	90…2650 gal/min	600 gal/min	5 gal	12 gal/min
8"	200	155…4850 gal/min	1200 gal/min	10 gal	15 gal/min
10"	250	250…7500 gal/min	1500 gal/min	15 gal	30 gal/min
12"	300	350…10600 gal/min	2400 gal/min	25 gal	45 gal/min
14"	350	500…15000 gal/min	3600 gal/min	30 gal	60 gal/min
16"	400	600…19000 gal/min	4800 gal/min	50 gal	60 gal/min
18"	450	800…24000 gal/min	6000 gal/min	50 gal	90 gal/min
20"	500	1000…30000 gal/min	7500 gal/min	75 gal	120 gal/min
24"	600	1400…44000 gal/min	10500 gal/min	100 gal	180 gal/min
28"	700	1900…60000 gal/min	13500 gal/min	125 gal	210 gal/min
30"	–	2150…67000 gal/min	16500 gal/min	150 gal	270 gal/min
32"	800	2450…80000 gal/min	19500 gal/min	200 gal	300 gal/min
36"	900	3100…100000 gal/min	24000 gal/min	225 gal	360 gal/min
40"	1000	3800…125000 gal/min	30000 gal/min	250 gal	480 gal/min
42"	–	4200…135000 gal/min	33000 gal/min	250 gal	600 gal/min
48"	1200	5500…175000 gal/min	42000 gal/min	400 gal	600 gal/min
54"	–	9…300 Mgal/d	75 Mgal/d	0.0005 Mgal	1.3 Mgal/d
–	1400	10…340 Mgal/d	85 Mgal/d	0.0005 Mgal	1.3 Mgal/d
60"	–	12…380 Mgal/d	95 Mgal/d	0.0005 Mgal	1.3 Mgal/d
–	1600	13…450 Mgal/d	110 Mgal/d	0.0008 Mgal	1.7 Mgal/d
66"	–	14…500 Mgal/d	120 Mgal/d	0.0008 Mgal	2.2 Mgal/d
72"	1800	16…570 Mgal/d	140 Mgal/d	0.0008 Mgal	2.6 Mgal/d
78"	–	18…650 Mgal/d	175 Mgal/d	0.001 Mgal	3.0 Mgal/d
–	2000	20…700 Mgal/d	175 Mgal/d	0.001 Mgal	3.0 Mgal/d

Promag P

Flow rate characteristic values – Promag P (SI units)

Nominal diameter		Recommended flow rate	Factory setting		
[mm]	[inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
15	1/2"	4…100 dm^3/min	25 dm^3/min	0.20 dm^3	0.5 dm^3/min
25	1"	9…300 dm^3/min	75 dm^3/min	0.50 dm^3	1 dm^3/min
32	1 1/4"	15…500 dm^3/min	125 dm^3/min	1.00 dm^3	2 dm^3/min
40	1 1/2"	25…700 dm^3/min	200 dm^3/min	1.50 dm^3	3 dm^3/min
50	2"	35…1100 dm^3/min	300 dm^3/min	2.50 dm^3	5 dm^3/min
65	2 1/2"	60…2000 dm^3/min	500 dm^3/min	5.00 dm^3	8 dm^3/min
80	3"	90…3000 dm^3/min	750 dm^3/min	5.00 dm^3	12 dm^3/min
100	4"	145…4700 dm^3/min	1200 dm^3/min	10.00 dm^3	20 dm^3/min
125	5"	220…7500 dm^3/min	1850 dm^3/min	15.00 dm^3	30 dm^3/min
150	6"	20…600 m^3/h	150 m^3/h	0.025 m^3	2.5 m^3/h
200	8"	35…1100 m^3/h	300 m^3/h	0.05 m^3	5.0 m^3/h
250	10"	55…1700 m^3/h	500 m^3/h	0.05 m^3	7.5 m^3/h
300	12"	80…2400 m^3/h	750 m^3/h	0.10 m^3	10 m^3/h
350	14"	110…3300 m^3/h	1000 m^3/h	0.10 m^3	15 m^3/h
400	16"	140…4200 m^3/h	1200 m^3/h	0.15 m^3	20 m^3/h
450	18"	180…5400 m^3/h	1500 m^3/h	0.25 m^3	25 m^3/h
500	20"	220…6600 m^3/h	2000 m^3/h	0.25 m^3	30 m^3/h
600	24"	310…9600 m^3/h	2500 m^3/h	0.30 m^3	40 m^3/h

Flow rate characteristic values – Promag P (US units)

Nominal diameter		Recommended flow rate	Factory setting		
[inch]	[mm]	min./max. full scale value (v ~ 0.3 or ~ 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
1/2"	15	1.0…27 gal/min	6 gal/min	0.05 gal	0.10 gal/min
1"	25	2.5…80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1 1/4"	32	4…130 gal/min	30 gal/min	0.20 gal	0.50 gal/min
1 1/2"	40	7…190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10…300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2 1/2"	65	16…500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	80	24…800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	100	40…1250 gal/min	300 gal/min	2 gal	4.0 gal/min
5"	125	60…1950 gal/min	450 gal/min	5 gal	7.0 gal/min
6"	150	90…2650 gal/min	600 gal/min	5 gal	12 gal/min
8"	200	155…4850 gal/min	1200 gal/min	10 gal	15 gal/min
10"	250	250…7500 gal/min	1500 gal/min	15 gal	30 gal/min
12"	300	350…10600 gal/min	2400 gal/min	25 gal	45 gal/min
14"	350	500…15000 gal/min	3600 gal/min	30 gal	60 gal/min
16"	400	600…19000 gal/min	4800 gal/min	50 gal	60 gal/min
18"	450	800…24000 gal/min	6000 gal/min	50 gal	90 gal/min
20"	500	1000…30000 gal/min	7500 gal/min	75 gal	120 gal/min
24"	600	1400…44000 gal/min	10500 gal/min	100 gal	180 gal/min

Promag H

Flow rate characteristic values – Promag H (SI units)

Nominal diameter		Recommended flow rate	Factory settings		
[mm]	inch]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
2	1/12"	0.06…1.8 dm^3/min	0.5 dm^3/min	0.005 dm^3	0.01 dm^3/min
4	5/32"	0.25…7 dm^3/min	2 dm^3/min	0.025 dm^3	0.05 dm^3/min
8	5/16"	1…30 dm^3/min	8 dm^3/min	0.10 dm^3	0.1 dm^3/min
15	1/2"	4…100 dm^3/min	25 dm^3/min	0.20 dm^3	0.5 dm^3/min
25	1"	9…300 dm^3/min	75 dm^3/min	0.50 dm^3	1 dm^3/min
40	1 1/2"	25…700 dm^3/min	200 dm^3/min	1.50 dm^3	3 dm^3/min
50	2"	35…1100 dm^3/min	300 dm^3/min	2.50 dm^3	5 dm^3/min
65	2 1/2"	60…2000 dm^3/min	500 dm^3/min	5.00 dm^3	8 dm^3/min
80	3"	90…3000 dm^3/min	750 dm^3/min	5.00 dm^3	12 dm^3/min
100	4"	145…4700 dm^3/min	1200 dm^3/min	10.00 dm^3	20 dm^3/min

Flow rate characteristic values – Promag H (US units)

Nominal diameter		Recommended flow rate	Factory settings		
[inch]	[mm]	min./max. full scale value (v ~ 0.3 or 10 m/s)	Full scale value (v ~ 2.5 m/s)	Pulse value (~ 2 Pulse/s)	Low flow cutoff (v ~ 0.04 m/s)
1/12"	2	0.015…0.5 gal/min	0.1 gal/min	0.001 gal	0.002 gal/min
5/32"	4	0.07…2 gal/min	0.5 gal/min	0.005 gal	0.008 gal/min
5/16"	8	0.25…8 gal/min	2 gal/min	0.02 gal	0.025 gal/min
1/2"	15	1.0…27 gal/min	6 gal/min	0.05 gal	0.10 gal/min
1"	22	2.5…65 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1 1/2"	40	7…190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10…300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
2 1/2"	65	16…500 gal/min	130 gal/min	1 gal	2.0 gal/min
3"	80	24…800 gal/min	200 gal/min	2 gal	2.5 gal/min
4"	100	40…1250 gal/min	300 gal/min	2 gal	4.0 gal/min

3.2.8 Length of connecting cable

In order to ensure measuring accuracy, comply with the following instructions when installing the remote version:

- Secure the cable run or route the cable in a conduit. Movement of the cable can falsify the measuring signal, particularly if the fluid conductivity is low.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalisation between sensor and transmitter, if necessary.
- The permissible cable length Lmax depends on the fluid conductivity (Fig. 16).
  A minimum conductivity of 20 µS/cm is required for measuring demineralized water.

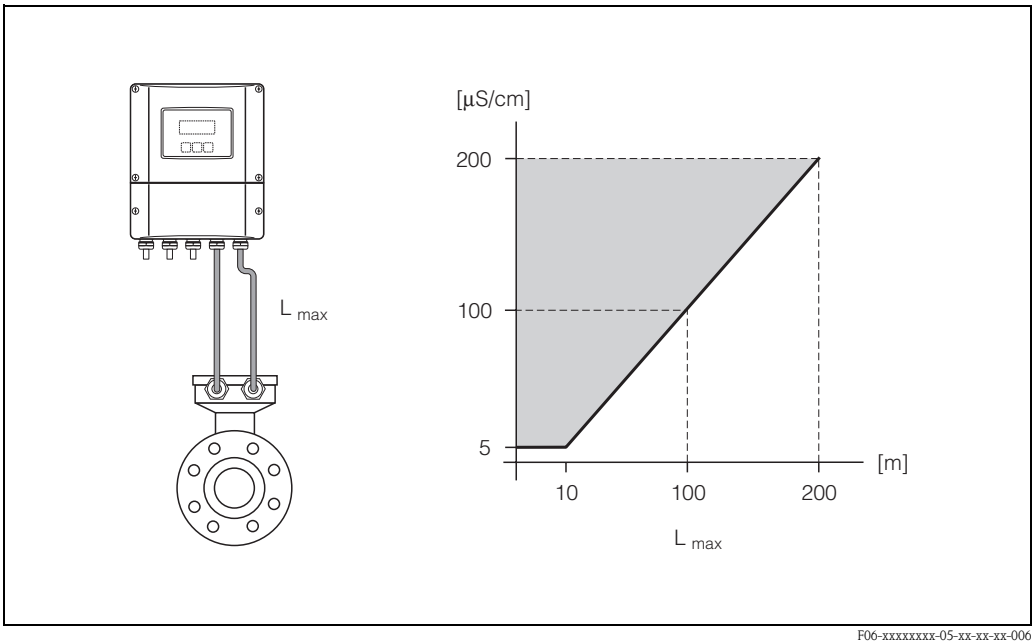


Fig. 16: Permissible cable length for the remote version

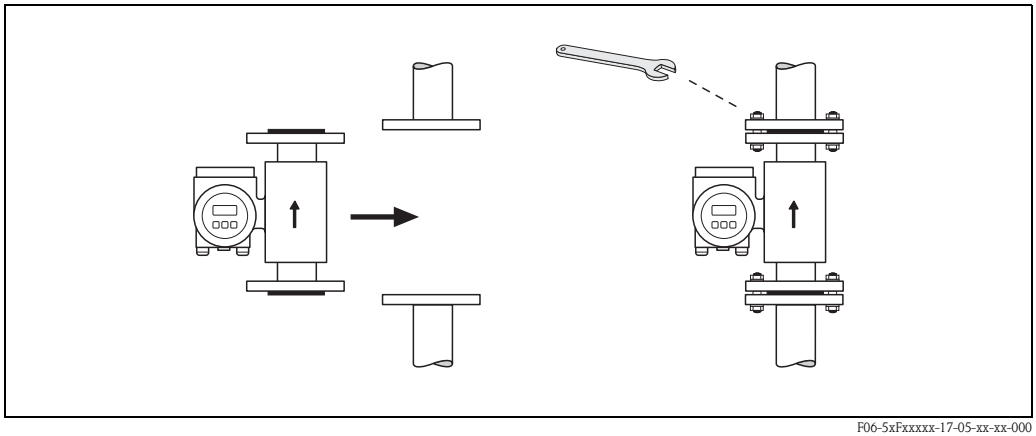
Gray shaded area = permissible range
Lmax = length of connecting cable in [m]
Fluid conductivity in [µS/cm]

3.3 Installation instructions

3.3.1 Installing the Promag W sensor

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges:
- Observe in any case the necessary screw tightening torques on Page 28 ff.
- The mounting of additional ground disks is described on Page 27.



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Fig. 17: Installing the Promag W sensor

Seals
Comply with the following instructions when installing seals:
- Hard rubber lining → additional seals are **always** necessary.
- Polyurethane lining → additional seals are recommended.
- For DIN flanges, use only seals according to DIN EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit. Do not use electrically conductive sealing compound such as graphite. An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable (DN 25…2000)
If necessary, the special ground cable for potential equalisation can be ordered as an accessory (see Page 85). Detailled assembly instructions → Page 57 ff.

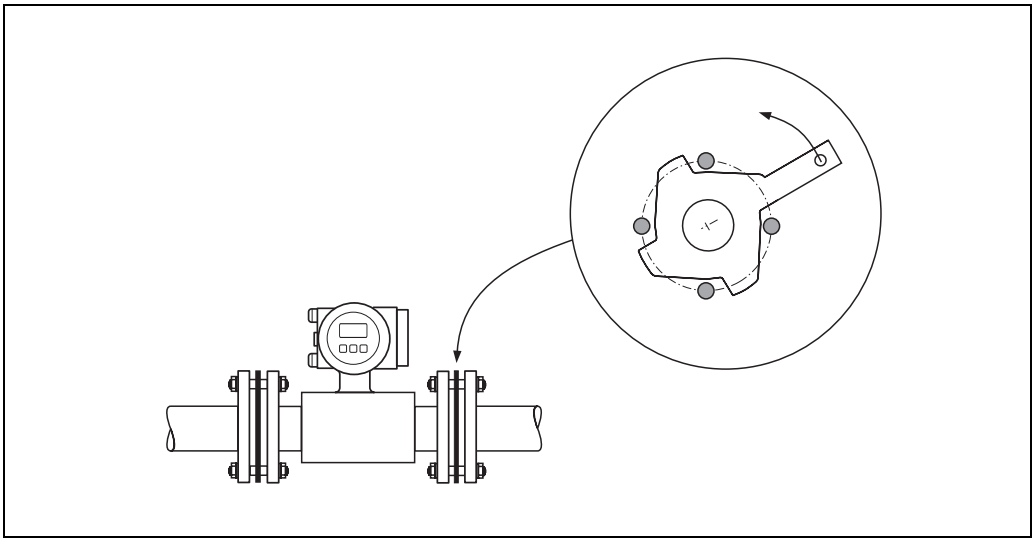
Assembly with ground disks (DN 25…300)

Depending on the application, e.g. with lined or ungrounded pipes (see Page 56 ff.), it may be necessary to mount ground disks between the sensor and the pipe flange for potential equalisation. Ground disks can be ordered separately as an accessory from Endress+Hauser (see Page 85).

Caution!

- In this case, when using ground disks (including seals) the total fitting length increases! All the dimensions are provided in the separate documentation "Technical Information"
- Hard rubber lining → install additional seals between the sensor and ground disk and between the ground disk and pipe flange.
- Polyurethane lining → only install additional seals between the ground disk and pipe flange.

1. Place the ground disk and additional seal(s) between the instrument and the pipe flange (Fig. 18).
2. Insert the bolts through the flange holes. Tighten the nuts so that they are still loose.
3. Now rotate the ground disk as shown in Fig. 18 until the handle strikes the bolts. This will center the ground disk automatically.
4. Now tighten the bolts to the required torque (see Page 28 ff.)
5. Connect the ground disk to ground → Page 58.



F06-5xFxxxxx-17-05-xx-xx-001

Fig. 18: Assembly with ground disks (Promag W, DN 25…300)

Screw tightening torques (Promag W)

Note the following points:

- The tightening torques listed below are for lubricated threads only.
- Always tighten threaded fasteners uniformly and in diagonally opposite sequence.
- Overtightening the fasteners will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Promag W Nominal diameter	EN (DIN) Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[bar]		Hard rubber	Polyurethane
25	PN 40	4 x M 12	–	15
32	PN 40	4 x M 16	–	24
40	PN 40	4 x M 16	–	31
50	PN 40	4 x M 16	–	40
65 *	PN 16	8 x M 16	32	27
65	PN 40	8 x M 16	32	27
80	PN 16	8 x M 16	40	34
80	PN 40	8 x M 16	40	34
100	PN 16	8 x M 16	43	36
100	PN 40	8 x M 20	59	50
125	PN 16	8 x M 16	56	48
125	PN 40	8 x M 24	83	71
150	PN 16	8 x M 20	74	63
150	PN 40	8 x M 24	104	88
200	PN 10	8 x M 20	106	91
200	PN 16	12 x M 20	70	61
200	PN 25	12 x M 24	104	92
250	PN 10	12 x M 20	82	71
250	PN 16	12 x M 24	98	85
250	PN 25	12 x M 27	150	134
300	PN 10	12 x M 20	94	81
300	PN 16	12 x M 24	134	118
300	PN 25	16 x M 27	153	138
350	PN 10	16 x M 20	112	118
350	PN 16	16 x M 24	152	165
350	PN 25	16 x M 30	227	252
400	PN 10	16 x M 24	151	167
400	PN 16	16 x M 27	193	215
400	PN 25	16 x M 33	289	326
450	PN 10	20 x M 24	153	133
450	PN 16	20 x M 27	198	196
450	PN 25	20 x M 33	256	253
500	PN 10	20 x M 24	155	171
500	PN 16	20 x M 30	275	300
500	PN 25	20 x M 33	317	360

Promag W Nominal diameter	EN (DIN) Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[bar]		Hard rubber	Polyurethane
600	PN 10	20 x M 27	206	219
600 *	PN 16	20 x M 33	415	443
600	PN 25	20 x M 36	431	516
700	PN 10	24 x M 27	246	246
700	PN 16	24 x M 33	278	318
700	PN 25	24 x M 39	449	507
800	PN 10	24 x M 30	331	316
800	PN 16	24 x M 36	369	385
800	PN 25	24 x M 45	664	721
900	PN 10	28 x M 30	316	307
900	PN 16	28 x M 36	353	398
900	PN 25	28 x M 45	690	716
1000	PN 10	28 x M 33	402	405
1000	PN 16	28 x M 39	502	518
1000	PN 25	28 x M 52	970	971
1200	PN 6	32 x M 30	319	299
1200	PN 10	32 x M 36	564	568
1200	PN 16	32 x M 45	701	753
1400	PN 6	36 x M 33	430	398
1400	PN 10	36 x M 39	654	618
1400	PN 16	36 x M 45	729	762
1600	PN 6	40 x M 33	440	417
1600	PN 10	40 x M 45	946	893
1600	PN 16	40 x M 52	1007	1100
1800	PN 6	44 x M 36	547	521
1800	PN 10	44 x M 45	961	895
1800	PN 16	44 x M 52	1108	1003
2000	PN 6	48 x M 39	629	605
2000	PN 10	48 x M 45	1047	1092
2000	PN 16	48 x M 56	1324	1261
* Designed acc. to EN 1092-1 (not to DIN 2501)				

Promag W Nominal diameter		AWWA Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[inch]			Hard rubber	Polyurethane
700	28"	Class D	28 x 1 1/4"	247	292
750	30"	Class D	28 x 1 1/4	287	302
800	32"	Class D	28 x 1 1/2"	394	422
900	36"	Class D	32 x 1 1/2"	419	430
1000	40"	Class D	36 x 1 1/2"	420	477
1050	42"	Class D	36 x 1 1/2"	528	518
1200	48"	Class D	44 x 1 1/2"	552	531
1350	54"	Class D	44 x 1 3/4"	730	633
1500	60"	Class D	52 x 1 3/4"	758	832
1650	66"	Class D	52 x 1 3/4"	946	955
1800	72"	Class D	60 x 1 3/4"	975	1087
2000	78"	Class D	64 x 2"	853	786

Promag W Nominal diameter		ANSI Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[inch]	[lbs]		Hard rubber	Polyurethane
25	1"	Class 150	4 x 1/2"	–	7
25	1"	Class 300	4 x 5/8"	–	8
40	1 1/2"	Class 150	4 x 1/2"	–	10
40	1 1/2"	Class 300	4 x 3/4"	–	15
50	2"	Class 150	4 x 5/8"	–	22
50	2"	Class 300	8 x 5/8"	–	11
80	3"	Class 150	4 x 5/8"	60	43
80	3"	Class 300	8 x 3/4"	38	26
100	4"	Class 150	8 x 5/8"	42	31
100	4"	Class 300	8 x 3/4"	58	40
150	6"	Class 150	8 x 3/4"	79	59
150	6"	Class 300	12 x 3/4"	70	51
200	8"	Class 150	8 x 3/4"	107	80
250	10"	Class 150	12 x 7/8"	101	75
300	12"	Class 150	12 x 7/8"	133	103
350	14"	Class 150	12 x 1"	135	158
400	16"	Class 150	16 x 1"	128	150
450	18"	Class 150	16 x 1 1/8"	204	234
500	20"	Class 150	20 x 1 1/8"	183	217
600	24"	Class 150	20 x 1 1/4"	268	307

Promag W Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
			Hard rubber	Polyurethane
25	10K	4 x M 16	–	19
25	20K	4 x M 16	–	19
32	10K	4 x M 16	–	22
32	20K	4 x M 16	–	22
40	10K	4 x M 16	–	24
40	20K	4 x M 16	–	24
50	10K	4 x M 16	–	33
50	20K	8 x M 16	–	17
65	10K	4 x M 16	55	45
65	20K	8 x M 16	28	23
80	10K	8 x M 16	29	23
80	20K	8 x M 20	42	35
100	10K	8 x M 16	35	29
100	20K	8 x M 20	56	48
125	10K	8 x M 20	60	51
125	20K	8 x M 22	91	79
150	10K	8 x M 20	75	63
150	20K	12 x M 22	81	72
200	10K	12 x M 20	61	52
200	20K	12 x M 22	91	80
250	10K	12 x M 22	100	87
250	20K	12 x M 24	159	144
300	10K	16 x M 22	74	63
300	20K	16 x M 24	138	124

Promag W Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque [Nm]
			Hard rubber
80	Table E	4 x M 16	49
100	Table E	8 x M 16	38
150	Table E	8 x M 20	64
200	Table E	8 x M 20	96
250	Table E	12 x M 20	98
300	Table E	12 x M 24	123
350	Table E	12 x M 24	203
400	Table E	12 x M 24	226
500	Table E	16 x M 24	271
600	Table E	16 x M 30	439

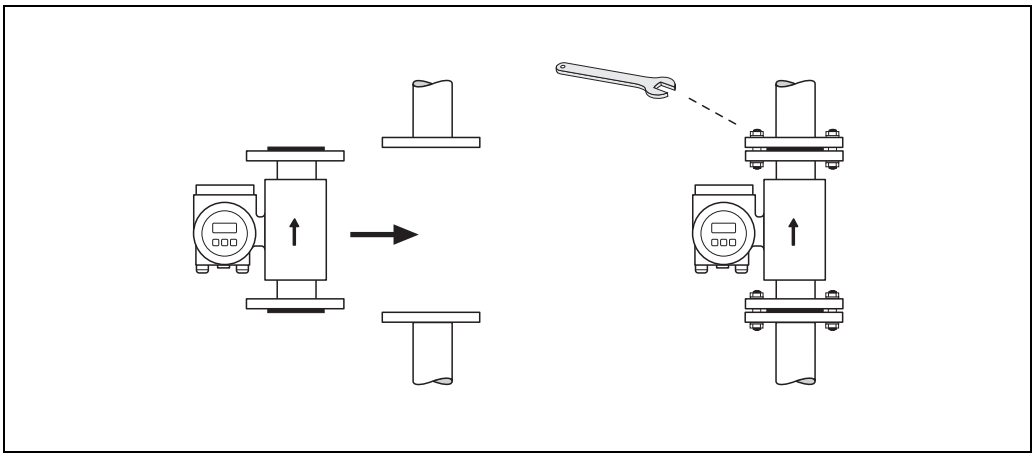
Promag W Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque [Nm] Hard rubber
80	Cl.14	4 x M 16	49
100 *	Cl.14	8 x M 16	38
150	Cl.14	8 x M 20	52
200	Cl.14	8 x M 20	77
250	Cl.14	8 x M 20	147
300	Cl.14	12 x M 24	103
350	Cl.14	12 x M 24	203
400	Cl.14	12 x M 24	226
500	Cl.14	16 x M 24	271
600	Cl.14	16 x M 30	393
* Designed acc. to EN 2129 (not to DIN 4087)			

3.3.2 Installing the Promag P sensor

Caution!
- The protective covers mounted on the two sensor flanges guard the PTFE lining, which is turned over the flanges. Consequently, do not remove these covers until *immediately before* the sensor is installed in the pipe.
- The covers must remain in place while the device is in storage.
- Make sure that the lining is not damaged or removed from the flanges.

Note!
Bolts, nuts, seals, etc. are not included in the scope of supply and must be supplied by the customer.

The sensor is designed for installation between the two piping flanges.
- Observe in any case the necessary screw tightening torques on Page 36 ff.
- The mounting of additional ground disks is described on Seite 34.



F-5xFxxxxx-17-05-xx-xx-000

Fig. 19: Installing the Promag P sensor

Seals
Comply with the following instructions when installing seals:
- Measuring tube linings with PFA or PTFE → **No** seals are required.
- In case you use seals with DIN flanges, use only seals according to DIN EN 1514-1.
- Make sure that the seals do not protrude into the piping cross-section.

Caution!
Risk of short circuit. Do not use electrically conductive sealing compound such as graphite. An electrically conductive layer could form on the inside of the measuring tube and short-circuit the measuring signal.

Ground cable (DN 15…600)
If necessary, a special ground cable for potential equalisation can be ordered as an accessory (see Page 85). Detailled assembly instructions → Page 57 ff.

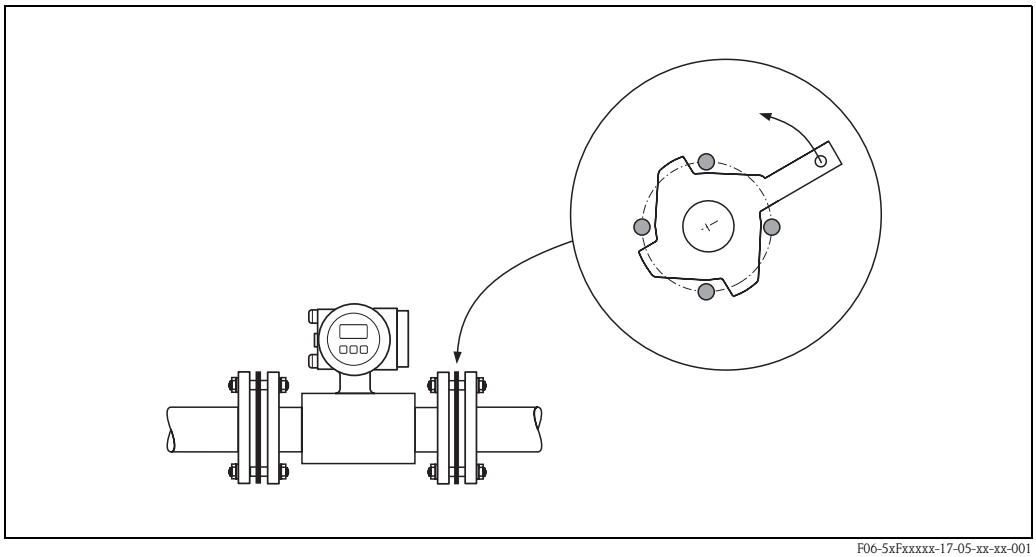
Assembly with ground disks (DN 15…300)

Depending on the application, e.g. with lined or ungrounded pipes (see Page 56 ff.), it may be necessary to mount ground disks between the sensor and the pipe flange for the potential equalisation. Ground disks can be ordered separately as an accessory from Endress+Hauser (see Page 85).

Caution!

- In this case, when using ground disks (including seals) the total fitting length increases! All the dimensions are provided in the separate documentation “Technical Information”.
- PTFE and PFA lining → only install additional seals between the ground disk and pipe flange.

1. Place the ground disk and the additional seal between the instrument and the pipe flange (Fig. 20).
2. Insert the bolts through the flange holes. Tighten the nuts so that they are still loose.
3. Now rotate the ground disk as shown in Fig. 20 until the handle strikes the bolts. This will center the ground disk automatically.
4. Now tighten the bolts to the required torque (see Page 36 ff.)
5. Connect the ground disk to ground → Page 58.



F06-5xFxxxxx-17-05-xx-xx-001

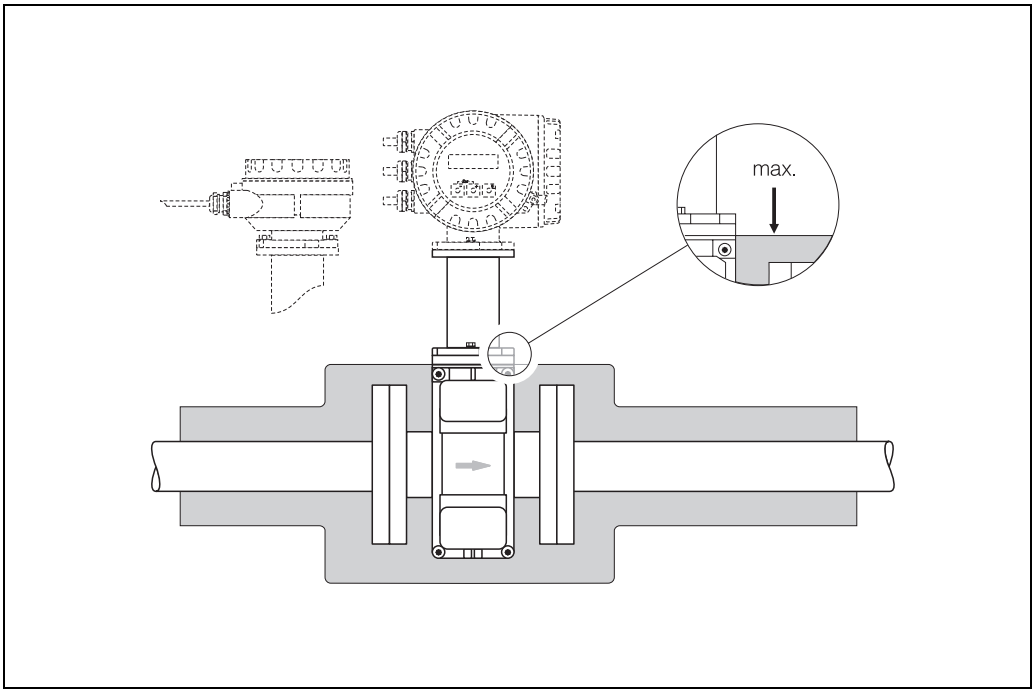
Fig. 20: Assembly with ground disks (Promag P, DN 15…300)

Installing the high-temperature version (with PFA lining)
The high-temperature version has a housing support for the thermal separation of sensor and transmitter. The high-temperature version is always used for applications
in which high ambient temperatures are encountered *in conjunction with* high fluid temperatures.
The high-temperature version is obligatory if the fluid temperature exceeds +150 °C.

Note!
You will find information on permissible temperature ranges on → Page 111

Insulation
Pipes generally have to be insulated if they carry very hot fluids, in order to avoid energy losses and to prevent accidental contact with pipes at temperatures that could cause injury. Guidelines regulating the insulation of pipes have to be taken into account.

Caution!
Risk of measuring electronics overheating. The housing support dissipates heat and its entire surface area must remain uncovered. Make sure that the sensor insulation does not extend past the top of the two sensor shells (Fig. 21).



F06-5xPxxxxx-17-05-00-xx-000

Fig. 21: Promag P (high-temperature version): Insulating the pipe

Tightening torques for threaded fasteners (Promag P)

Note the following points:

- The tightening torques listed below are for lubricated threads only.
- Always tighten threaded fasteners uniformly and in diagonally opposite sequence.
- Overtightening the fasteners will deform the sealing faces or damage the seals.
- The tightening torques listed below apply only to pipes not subjected to tensile stress.

Promag P Nominal diameter	EN (DIN) Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[bar]		PTFE	PFA
15	PN 40	4 x M 12	11	–
25	PN 40	4 x M 12	26	20
32	PN 40	4 x M 16	41	35
40	PN 40	4 x M 16	52	47
50	PN 40	4 x M 16	65	59
65 *	PN 16	8 x M 16	43	40
65	PN 40	8 x M 16	43	40
80	PN 16	8 x M 16	53	48
80	PN 40	8 x M 16	53	48
100	PN 16	8 x M 16	57	51
100	PN 40	8 x M 20	78	70
125	PN 16	8 x M 16	75	67
125	PN 40	8 x M 24	111	99
150	PN 16	8 x M 20	99	85
150	PN 40	8 x M 24	136	120
200	PN 10	8 x M 20	141	101
200	PN 16	12 x M 20	94	67
200	PN 25	12 x M 24	138	105
250	PN 10	12 x M 20	110	–
250	PN 16	12 x M 24	131	–
250	PN 25	12 x M 27	200	–
300	PN 10	12 x M 20	125	–
300	PN 16	12 x M 24	179	–
300	PN 25	16 x M 27	204	–
350	PN 10	16 x M 20	188	–
350	PN 16	16 x M 24	254	–
350	PN 25	16 x M 30	380	–
400	PN 10	16 x M 24	260	–
400	PN 16	16 x M 27	330	–
400	PN 25	16 x M 33	488	–
450	PN 10	20 x M 24	235	–
450	PN 16	20 x M 27	300	–
450	PN 25	20 x M 33	385	–
500	PN 10	20 x M 24	265	–
500	PN 16	20 x M 30	448	–

Promag P Nominal diameter	EN (DIN) Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[bar]		PTFE	PFA
500	PN 25	20 x M 33	533	–
600	PN 10	20 x M 27	345	–
600 *	PN 16	20 x M 33	658	–
600	PN 25	20 x M 36	731	–
* Designed acc. to EN 1092-1 (not to DIN 2501)				

Promag P Nominal diameter		ANSI Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
[mm]	[inch]	[lbs]		PTFE	PFA
15	1/2"	Class 150	4 x 1/2"	6	–
15	1/2"	Class 300	4 x 1/2"	6	–
25	1"	Class 150	4 x 1/2"	11	10
25	1"	Class 300	4 x 5/8"	14	12
40	1 1/2"	Class 150	4 x 1/2"	24	21
40	1 1/2"	Class 300	4 x 3/4"	34	31
50	2"	Class 150	4 x 5/8"	47	44
50	2"	Class 300	8 x 5/8"	23	22
80	3"	Class 150	4 x 5/8"	79	67
80	3"	Class 300	8 x 3/4"	47	42
100	4"	Class 150	8 x 5/8"	56	50
100	4"	Class 300	8 x 3/4"	67	59
150	6"	Class 150	8 x 3/4"	106	86
150	6"	Class 300	12 x 3/4"	73	67
200	8"	Class 150	8 x 3/4"	143	109
250	10"	Class 150	12 x 7/8"	135	–
300	12"	Class 150	12 x 7/8"	178	–
350	14"	Class 150	12 x 1"	260	–
400	16"	Class 150	16 x 1"	246	–
450	18"	Class 150	16 x 1 1/8"	371	–
500	20"	Class 150	20 x 1 1/8"	341	–
600	24"	Class 150	20 x 1 1/4"	477	–

Promag P Nominal diameter [mm]	JIS Pressure rating	Threaded fasteners	Max. tightening torque [Nm]	
			PTFE	PFA
15	10K	4 x M 12	16	–
15	20K	4 x M 12	16	–
25	10K	4 x M 16	32	–
25	20K	4 x M 16	32	–
32	10K	4 x M 16	38	–
32	20K	4 x M 16	38	–
40	10K	4 x M 16	41	–
40	20K	4 x M 16	41	–
50	10K	4 x M 16	54	–
50	20K	8 x M 16	27	–
65	10K	4 x M 16	74	–
65	20K	8 x M 16	37	–
80	10K	8 x M 16	38	–
80	20K	8 x M 20	57	–
100	10K	8 x M 16	47	–
100	20K	8 x M 20	75	–
125	10K	8 x M 20	80	–
125	20K	8 x M 22	121	–
150	10K	8 x M 20	99	–
150	20K	12 x M 22	108	–
200	10K	12 x M 20	82	–
200	20K	12 x M 22	121	–
250	10K	12 x M 22	133	–
250	20K	12 x M 24	212	–
300	10K	16 x M 22	99	–
300	20K	16 x M 24	183	–

Promag P Nominal diameter [mm]	AS 2129 Pressure rating	Threaded fasteners	Max. tightening torque [Nm]
			PTFE
25	Table E	4 x M 12	21
50	Table E	4 x M 16	42

Promag P Nominal diameter [mm]	AS 4087 Pressure rating	Threaded fasteners	Max. tightening torque [Nm]
			PTFE
50	Cl.14	4 x M 16	42

3.3.3 Installing the Promag H sensor

The Promag H is supplied to order, with or without pre-installed process connections.
Pre-installed process connections are secured to the sensor with hex-head threaded fasteners.

Caution!
- The sensor might require support or additional attachments, depending on the application and the length of the piping run. When plastic process connections are used, the sensor must be additionally supported mechanically. A wall-mounting kit can be ordered separately from Endress+Hauser as an accessory (see Page 85).

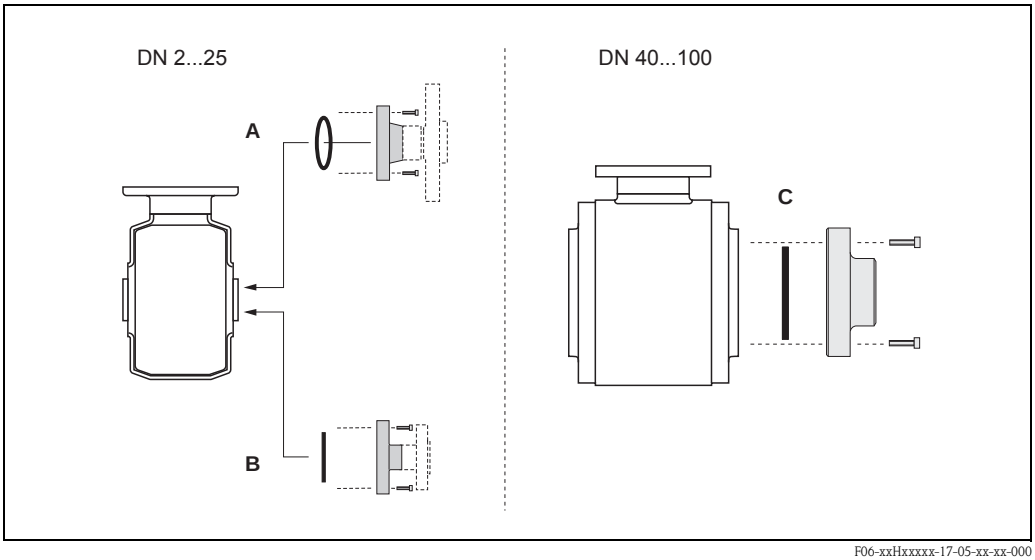


Fig. 22: Promag H process connections (DN 2...25, DN 40...100)

A: DN 2...25 / process connections with O-rings:
Welding flanges (DIN EN ISO 1127, ODT / SMS), flange (EN (DIN), ANSI, JIS), flange PVDF (EN (DIN), ANSI, JIS), external and internal pipe threads, hose connection, PVC adhesive fitting

B: DN 2...25 / process connections with aseptic gasket seals:
Weld nipples (DIN 11850, ODT / SMS), Clamp (ISO 2852, DIN 32676, L14 AM7), coupling (DIN 11851, DIN 11864-1, SMS 1145), flange DIN 11864-2

C: DN 40...100 / process connections with aseptic gasket seals:
Weld nipples (DIN 11850, ODT / SMS), Clamp (ISO 2852, DIN 32676), L14 AM7), coupling (DIN 11851, DIN 11864-1, ISO 2853, SMS 1145), flange DIN 11864-2

Seals
When installing the process connections, make sure that the seals are clean and correctly centered.

Caution!
- With metallic process connections, you must fully tighten the screws. The process connection forms a metallic connection with the sensor, which ensures a defined compression of the seal.
- With plastic process connections, note the max. torques for lubricated threads (7 Nm). With plastic flanges, always use seals between connection and counter flange.
- The seals must be replaced periodically, depending on the application, particularly in the case of gasket seals (aseptic version)! The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature.
  Replacement seals can be ordered as accessories → Page 85.

Usage and assembly of ground rings (DN 2…25)

In case the process connections are made of plastic (e.g. flanges or adhesive fittings), the potential between the sensor and the fluid must be equalised using additional ground rings.
If the ground rings are not installed this can affect the accuracy of the measurements or cause the destruction of the sensor through the electrochemical erosion of the electrodes.

Caution!

- Depending on the option ordered, plastic disks may be installed at the process connections instead of ground rings. These plastic disks serve only as spacers and have no potential equalization function. In addition, they provide a sealing function at the interface between the sensor and process connection. For this reason, with process connections without ground rings, these plastic disks/seals must not be removed, or must always be installed.
- Ground rings can be ordered separately from Endress+Hauser as accessories (see Page 85). When placing the order, make certain that the ground ring is compatible with the material used for the electrodes. Otherwise, there is a risk that the electrodes may be destroyed by electrochemical corrosion! Information about the materials can be found on Page 117.
- Ground rings, including the seals, are mounted within the process connections. Therefore, the fitting length is not affected.

1. Loosen the four hexagonal headed bolts (1) and remove the process connection from the sensor (5).
2. Remove the plastic disk (3), including the two O-ring seals (2, 4).
3. Place one seal (2) in the groove of the process connection.
4. Place the metal ground ring (3) on the process connection.
5. Now place the second seal (4) in the groove of the ground ring.
6. Finally, mount the process connection on the sensor again. With plastic process connections, note the max. torques for lubricated threads (7 Nm).

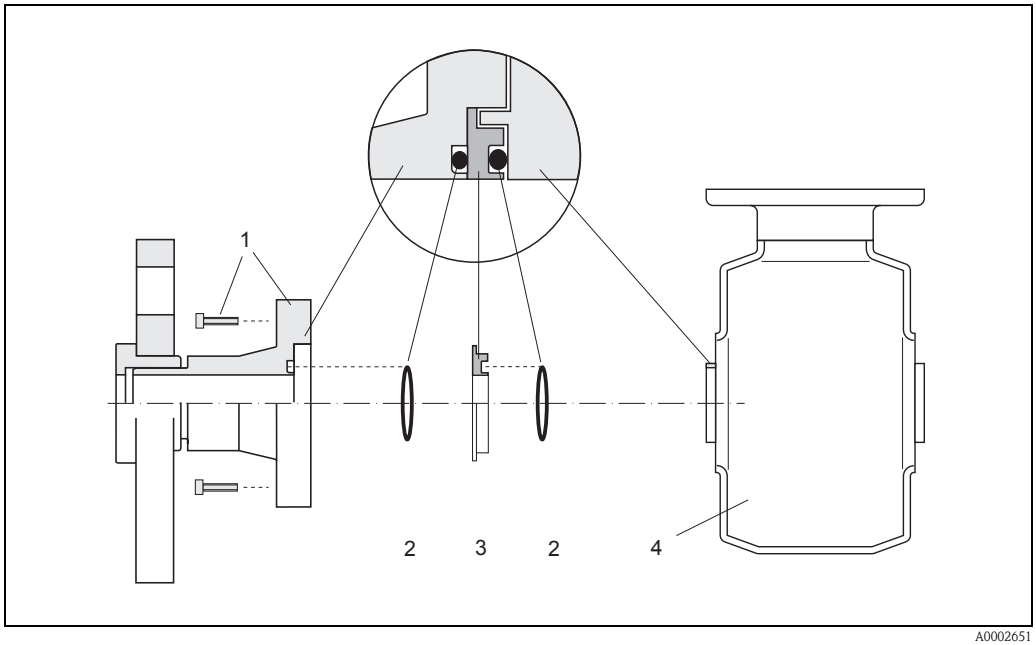


Fig. 23: Installing ground rings with a Promag H (DN 2…25)

1 = Hexagonal headed bolts (process connection)
2 = O-ring seals
3 = Ground ring or plastic disk (placeholder)
4 = Sensor Promag H

Welding the sensor into the piping (weld nipples)

Caution!
Risk of destroying the measuring electronics. Make sure that the welding machine is *not* grounded via the sensor or the transmitter.

1. Tack-weld the Promag H sensor into the pipe. A suitable welding jig can be ordered separately from Endress+Hauser as an accessory (see Page 85).
2. Remove the threaded fasteners from the process-connection flange. Remove the sensor complete with seal from the pipe.
3. Weld the process connection to the pipe.
4. Reinstall the sensor in the pipe. Make sure that everything is clean and that the seal is correctly seated.

Note!
- If thin-walled foodstuffs pipes are not welded correctly, the heat could damage the installed seal. It is therefore advisable to remove the sensor and the seal prior to welding.
- The pipe has to be spread approximately 8 mm to permit disassembly.

Cleaning with pigs

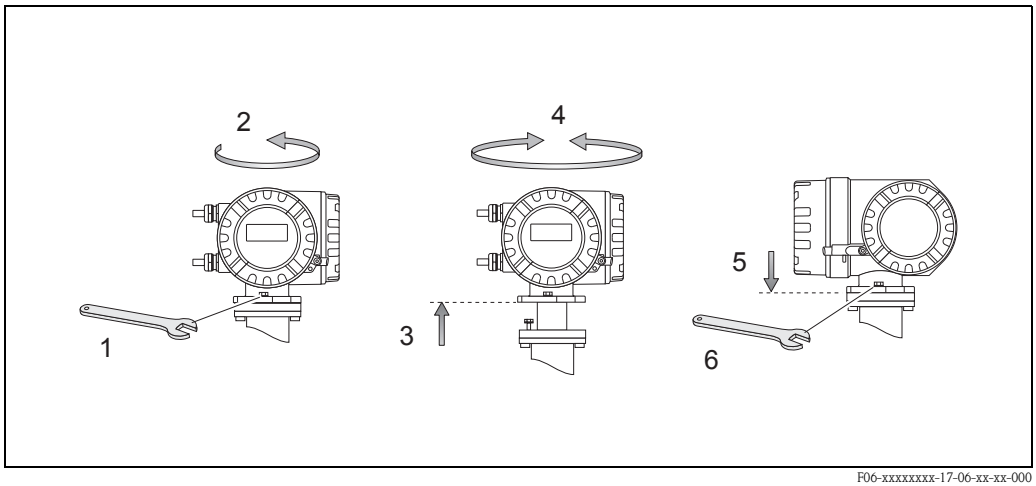
If pigs are used for cleaning, it is essential to take the inside diameters of measuring tube and process connection into account.
All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation “Technical Information”.

3.3.4 Turning the transmitter housing

Turning the aluminum field housing

⚠ Warning!
The turning mechanism in devices with EEx d/de or FM/CSA Cl. I Div. 1 classification is not the same as that described here. The procedure for turning these housings is described in the Ex-specific documentation.

1. Loosen the two securing screws.
2. Turn the bayonet catch as far as it will go.
3. Carefully lift the transmitter housing as far as it will go.
4. Turn the transmitter housing to the desired position (max. 2 x 90° in either direction).
5. Lower the housing into position and re-engage the bayonet catch.
6. Retighten the two securing screws.

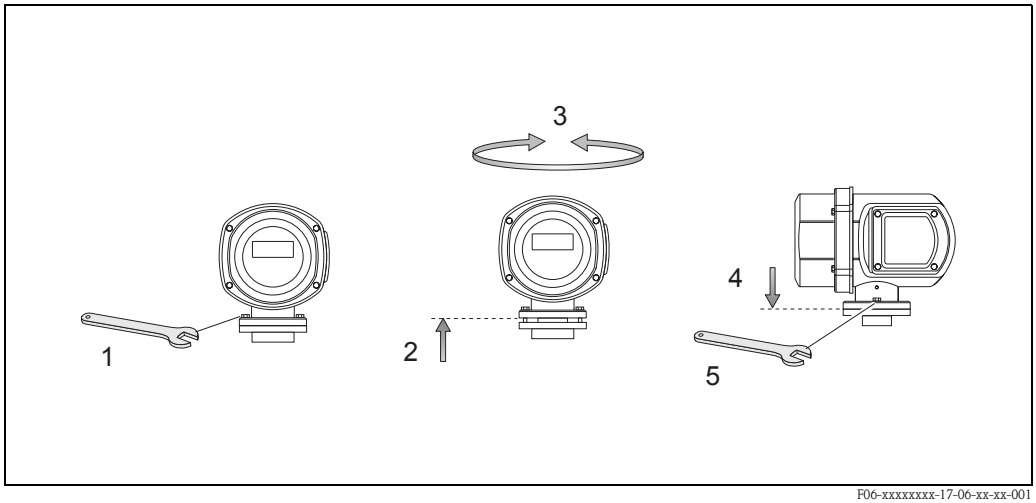


F06-xxxxxxxx-17-06-xx-xx-000

Fig. 24: Turning the transmitter housing (aluminum field housing)

Turning the stainless-steel field housing

1. Loosen the two securing screws.
2. Carefully lift the transmitter housing as far as it will go.
3. Turn the transmitter housing to the desired position (max. 2 x 90° in either direction).
4. Lower the housing into position.
5. Retighten the two securing screws.

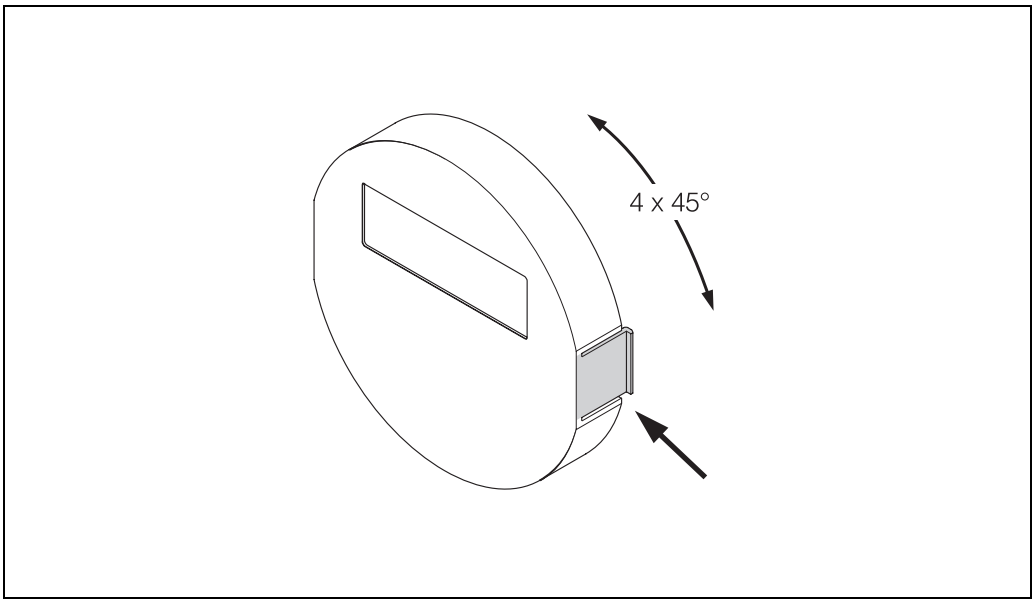


F06-xxxxxxxx-17-06-xx-xx-001

Fig. 25: Turning the transmitter housing (stainless-steel field housing)

3.3.5 Turning the local display

1. Remove the cover of the electronics compartment.
2. Press the side latches on the display module and remove it from the electronics compartment cover plate.
3. Rotate the display to the desired position (max. 4 x 45° in each direction), and place it back into the electronics compartment cover plate.
4. Screw the cover of the electronics compartment firmly onto the transmitter housing.



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Fig. 26: Turning the local display (field housing)

3.3.6 Installing the wall-mount transmitter housing

There are various ways of installing the wall-mount transmitter housing:
- Mounted directly on the wall
- Installation in control panel (with separate mounting kit, accessories → Page 85)
- Pipe mounting (with separate mounting kit, accessories → Page 85)

Caution!
- Make sure that ambient temperature does not exceed the permissible range (–20…+60 °C), (optional –40...+60 °C). Install the device at a shady location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

Direct wall mounting

1. Drill the holes as illustrated in Fig. 27.
2. Remove the cover of the connection compartment (a).
3. Push the two securing screws (b) through the appropriate bores (c) in the housing.
   – Securing screws (M6): max. Ø 6.5 mm
   – Screw head: max. Ø 10.5 mm
4. Secure the transmitter housing to the wall as indicated.
5. Screw the cover of the connection compartment (a) firmly onto the housing.

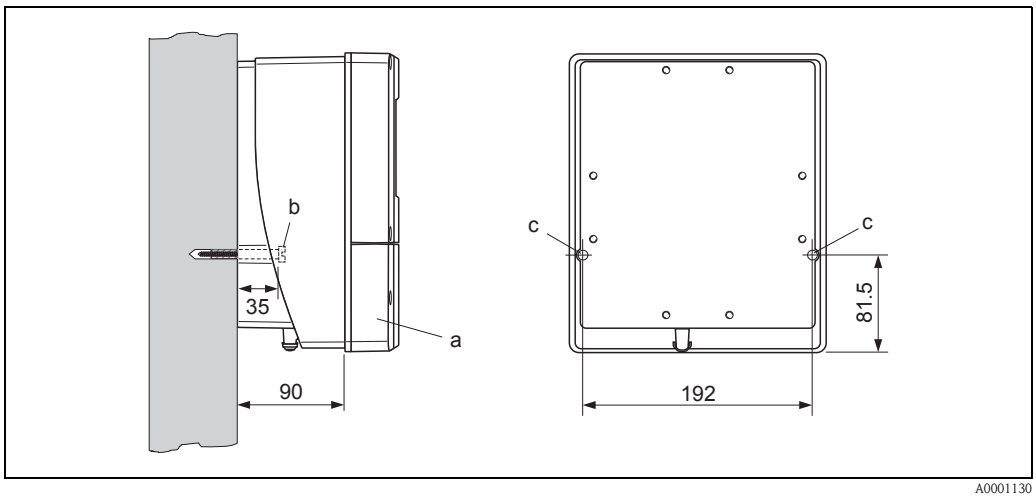


Fig. 27: Mounted directly on the wall

Panel installation

1. Prepare the opening in the panel (Fig. 28).
2. Slide the housing into the opening in the panel from the front.
3. Screw the fasteners onto the wall-mount housing.
4. Place the threaded rods in the fasteners and screw them down until the housing is seated tightly against the panel. Afterwards, tighten the locking nuts. Additional support is not necessary.

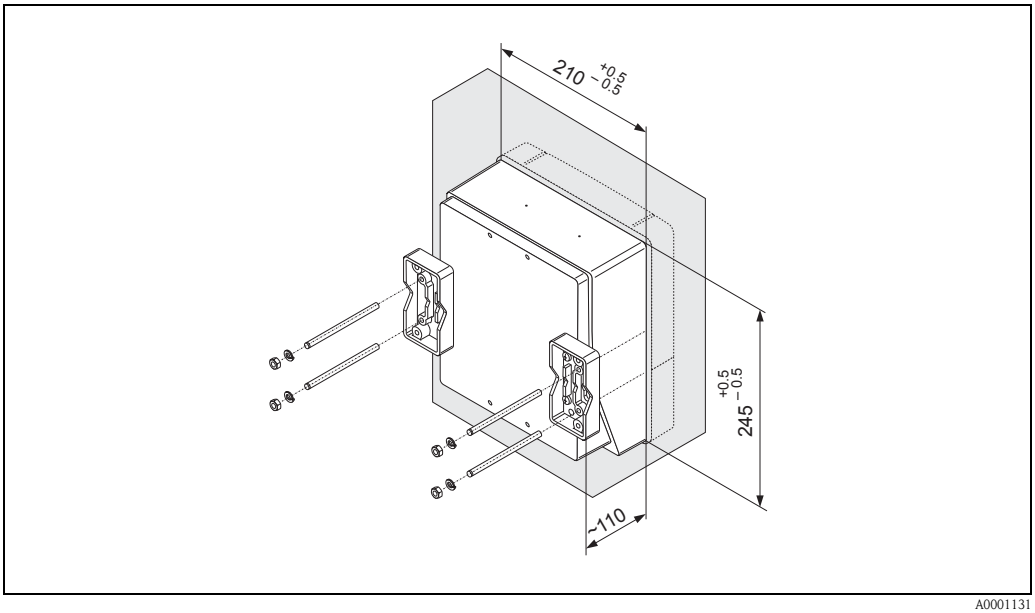


Fig. 28: Panel Installation (wall-mount housing)

Pipe mounting

The assembly should be performed by following the instructions in Fig. 29.

Caution!
If the device is mounted to a warm pipe, make certain that the housing temperature does not exceed +60 °C, which is the maximum permissible temperature.

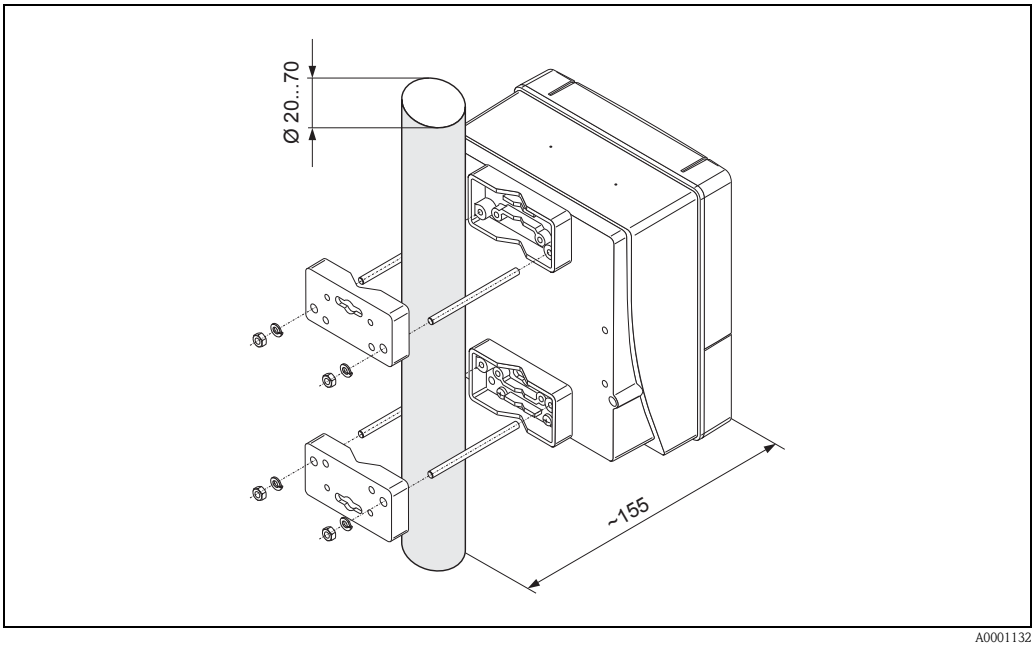


Fig. 29: Pipe mounting (wall-mount housing)

3.4 Installation check

Perform the following checks after installing the measuring device in the pipe:

Device condition and specifications	Notes
Is the device damaged (visual inspection)?	–
Does the device correspond to specifications at the measuring point, including process temperature and pressure, ambient temperature, minimum fluid conductivity, measuring range, etc.?	see Page 107 ff.
Installation	Notes
Does the arrow on the sensor nameplate match the direction of flow through the pipe?	–
Is the plane of the measuring-electrode axis correct?	Horizontal
Is the position of the Empty Pipe Detection (EPD) electrode correct?	see Page 17
Were all threaded fasteners tightened to the specified torques when the sensor was installed?	see Chap. 3.3
Were the correct seals installed (type, material, installation)?	Promag W → Page 26 Promag P → Page 33 Promag H → Page 39
Are the measuring-point number and labeling correct (visual inspection)?	–
Process environment / process conditions	Notes
Are the inlet and outlet runs to respected?	Inlet run ≥ 5 x DN Outlet run ≥ 2 x DN
Is the measuring device protected against moisture and direct sunlight?	–
Is the sensor adequately protected against vibration (attachment, support)?	Acceleration up to 2 g by analogy with IEC 600 68-2-6 (see Page 110)

4 Wiring

Warning!
- When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to this Operating Manual. Please do not hesitate to contact your Endress+Hauser representative if you have any questions.
- If you use remote versions, connect each sensor *only* to the transmitter having the same serial number. Measuring errors can occur if the devices are not connected in this way.

4.1 Connecting the remote version

4.1.1 Connecting Promag W / P / H

Warning!
- Risk of electric shock. Switch off the power supply before opening the device. Do not install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock. Connect the protective conductor to the ground terminal on the housing before the power supply is applied.

Procedure (Fig. 30, Fig. 31):

1. Transmitter: Loosen the screws and remove cover (a) from the connection compartment.
2. Sensor: Remove cover (b) from the connection housing.
3. Feed signal cable (c) and coil cable (d) through the appropriate cable entries.

   Caution!
   – Make sure the connecting cables are secured (see Page 25).
   – Risk of damaging the coil driver. Always switch off the power supply before connecting or disconnecting the coil cable.
4. Preterminate signal cable and coil current cable:
   Promag W, P → Refer to the information on Page 49
   Promag H → Refer to the information on Page 50
5. Establish the connections between sensor and transmitter in accordance with the wiring diagram:
   → Fig. 30, Fig. 31
   → wiring diagram inside the cover

   Caution!
   Insulate the shields of cables that are not connected to eliminate the risk of short-circuits with neighboring cable shields inside the sensor connection housing.
6. Transmitter: Secure cover (a) on the connection compartment.
7. Sensor: Secure cover (b) on the connection housing.

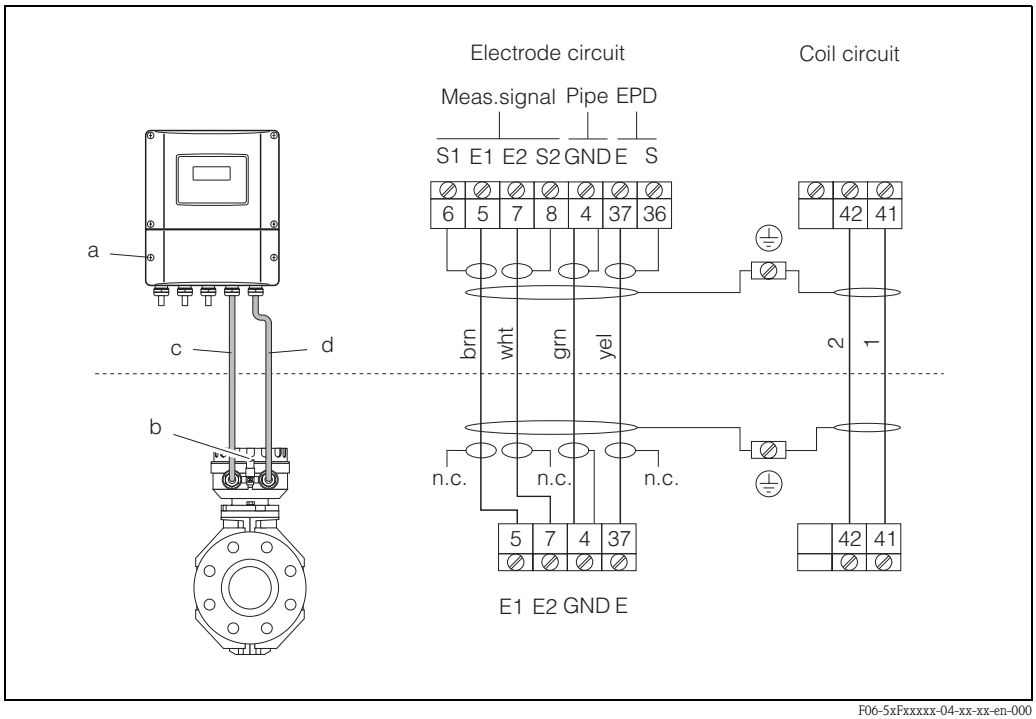


Fig. 30: Connecting the remote version of Promag W/P

a = cover of the connection compartment, b = cover of the sensor connection housing, c = signal cable, d = coil current cable, n.c. = not connected, insulated cable shields

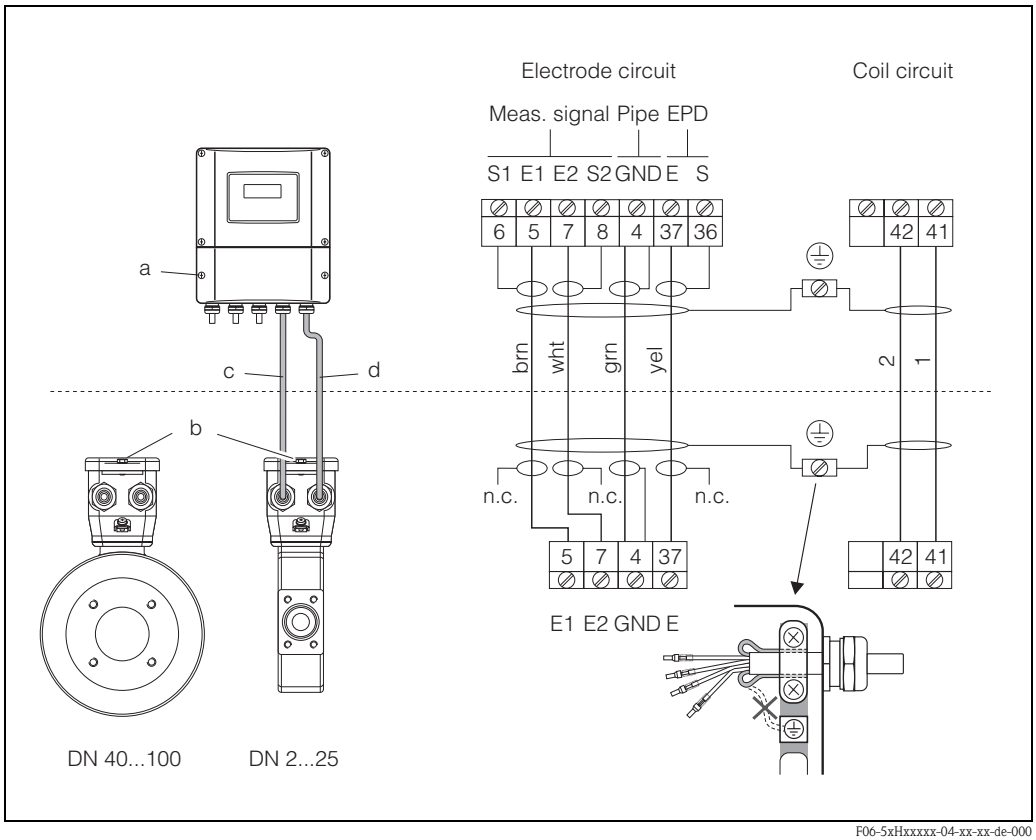


Fig. 31: Connecting the remote version of Promag H

a = cover of the connection compartment, b = cover of the sensor connection housing, c = signal cable, d = coil current cable, n.c. = not connected, insulated cable shields

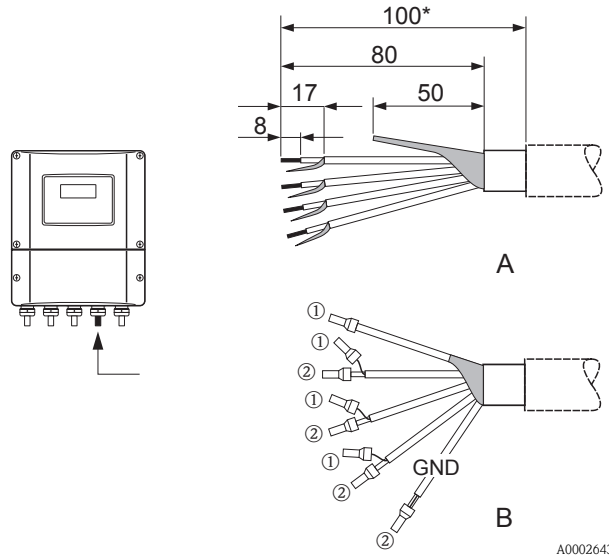
Cable termination for the remote version
Promag W / Promag P

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Fit the fine-wire cores with cable end sleeves (Detail B).

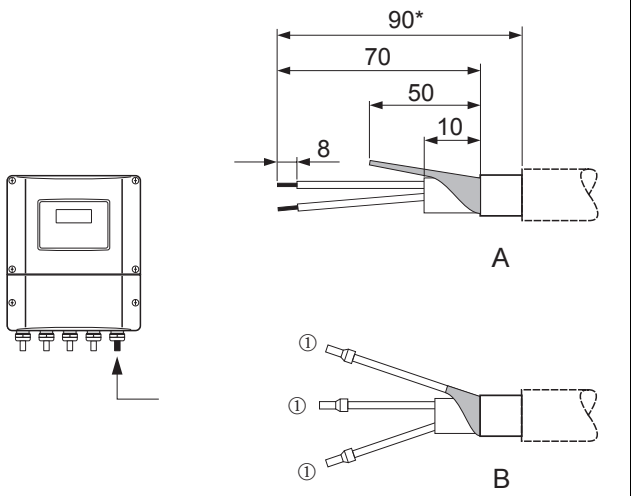
Caution!!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the cable end sleeves do not touch the wire shield on the sensor side. Minimum distance = 1 mm (exception "GND" = green cable).
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.

TRANSMITTER

Signal cable

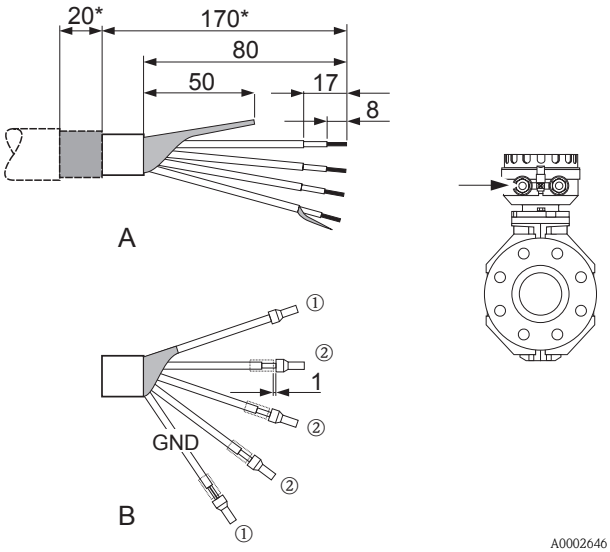


Coil current cable

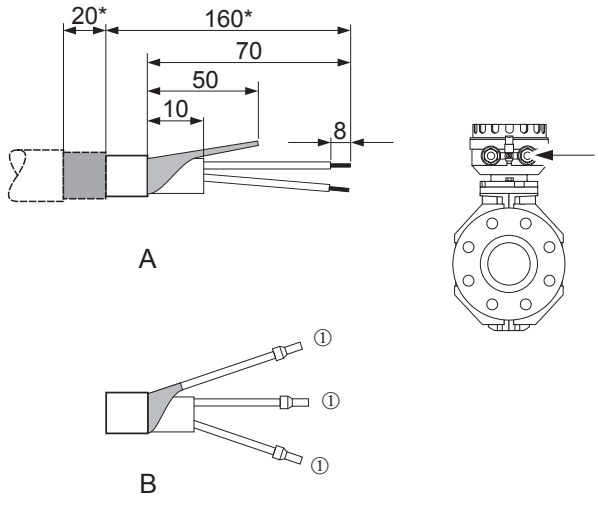


SENSOR

Signal cable



Coil current cable



① = Red cable sleeves ∅ 1.0 mm
② = White cable sleeves ∅ 0.5 mm
* = Stripping for armoured cables only

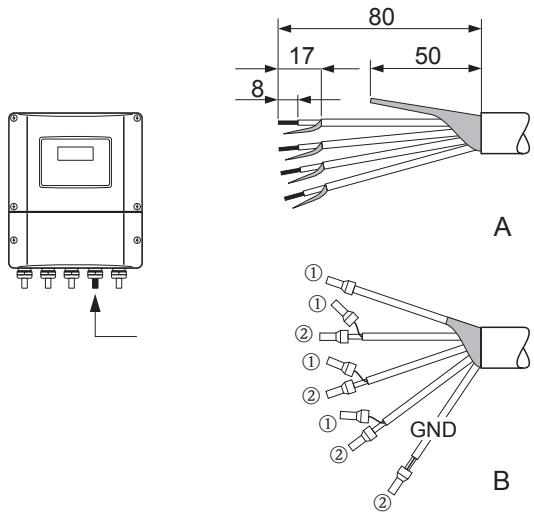
Cable termination for the remote version
Promag H

Terminate the signal and coil current cables as shown in the figure below (Detail A).
Fit the fine-wire cores with cable end sleeves (Detail B).

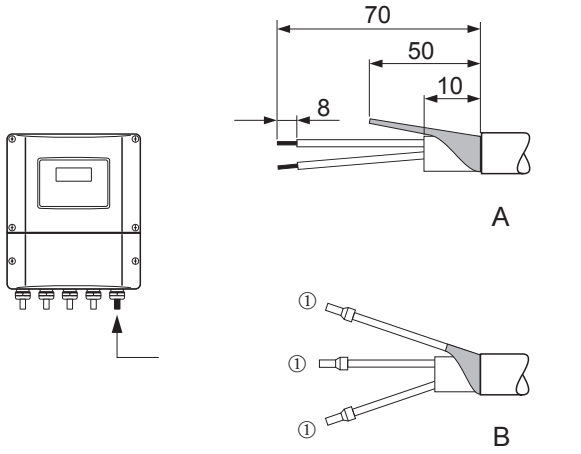
Caution!!
When fitting the connectors, pay attention to the following points:
- *Signal cable* → Make sure that the cable end sleeves do not touch the wire shield on the sensor side. Minimum distance = 1 mm (exception "GND" = green cable).
- *Coil current cable* → Insulate one core of the three-core wire at the level of the core reinforcement; you only require two cores for the connection.
- On the sensor side, reverse both cable shields approx. 15 mm over the outer jacket. The strain relief ensures an electrical connection with the connection housing.

TRANSMITTER

Signal cable

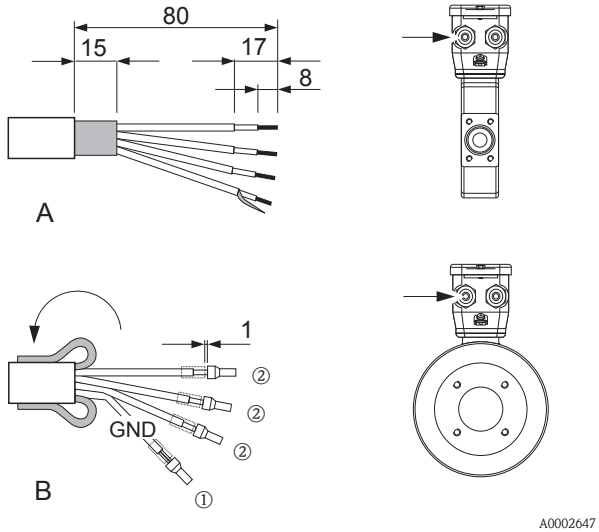


Coil current cable

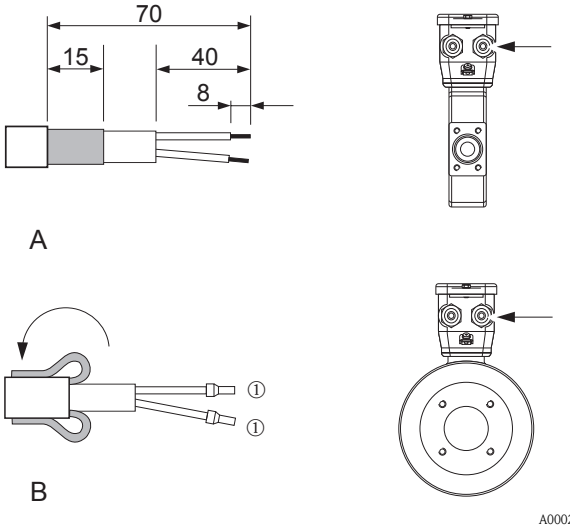


SENSOR

Signal cable



Coil current cable



① = Red cable sleeves ∅ 1.0 mm
② = White cable sleeves ∅ 0.5 mm

4.1.2 Cable specifications

Coil cable:
- 2 x 0.75 mm^2 PVC cable with common, braided copper shield (Ø approx. 7 mm)
- Conductor resistance: ≤ 37 Ω/km
- Capacitance: core/core, shield grounded: ≤ 120 pF/m
- Permanent operating temperature: –20...+80 °
- Cable cross-section: max. 2.5 mm^2

Signal cable:
- 3 x 0.38 mm^2 PVC cable with common, braided copper shield (Ø approx. 7 mm) and individually shielded cores
- With Empty Pipe Detection (EPD): 4 x 0.38 mm^2 PVC cable with common, braided copper shield (Ø approx. 7 mm) and individually shielded cores
- Conductor resistance: ≤ 50 Ω/km
- Capacitance: core/shield: ≤ 420 pF/m
- Permanent operating temperature: –20...+80 °C
- Cable cross-section: max. 2.5 mm^2

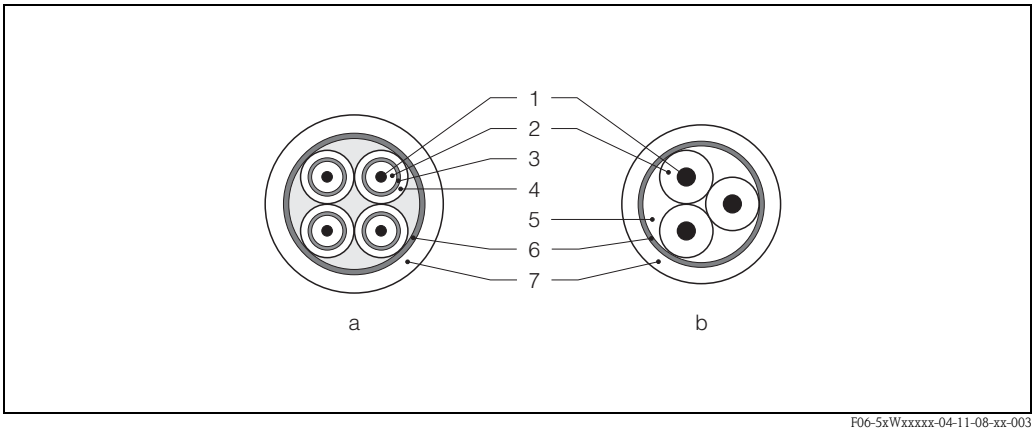


Fig. 32: Cable cross-section (a = Signal cable, b = Coil current cable)
1 = Core, 2 = Core insulation, 3 = Core shield, 4 = Core jacket, 5 = Core reinforcement, 6 = Cable shield, 7 = Outer jacket

As an option, Endress+Hauser can also deliver reinforced connecting cables with an additional, reinforcing metal braid. We recommend such cables for the following cases:
- Directly buried cable
- Cables endangered by rodents
- Device operation which should comply with the IP 68 standard of protection

Operation in zones of severe electrical interference:
The measuring device complies with the general safety requirements in accordance with EN 61010, the EMC requirements of EN 61326/A1, and NAMUR recommendation NE 21.

Caution!
Grounding is by means of the ground terminals provided for the purpose inside the connection housing. Keep the stripped and twisted lengths of cable shield to the terminals as short as possible.

4.2 Connecting the measuring unit

4.2.1 Transmitter

Warning!
- Risk of electric shock. Switch off the power supply before opening the device. Do not install or wire the device while it is connected to the power supply. Failure to comply with this precaution can result in irreparable damage to the electronics.
- Risk of electric shock. Connect the protective conductor to the ground terminal on the housing before the power supply is applied (not necessary if the power supply is galvanically isolated).
- Compare the specifications on the nameplate with the local voltage supply and frequency. The national regulations governing the installation of electrical equipment also apply.

1. Remove the cover of the connection compartment (f) from the transmitter housing.
2. Feed the power supply cable (a) and signal cables (b) through the appropriate cable entries.
3. Connect the cables in accordance with the wiring diagram:
   – Wiring diagram (aluminium housing) → Fig. 33
   – Wiring diagram (stainless steel housing) → Fig. 34
   – Wiring diagram (wall-mount housing) → Fig. 35
   – Terminal assignment → Page 54
4. Screw the cover of the connection compartment (f) firmly onto the transmitter housing.

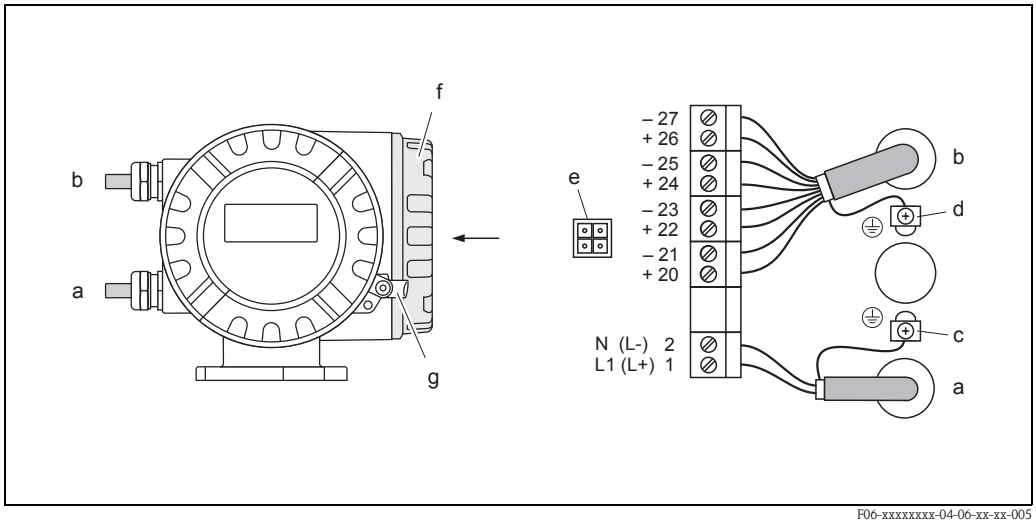
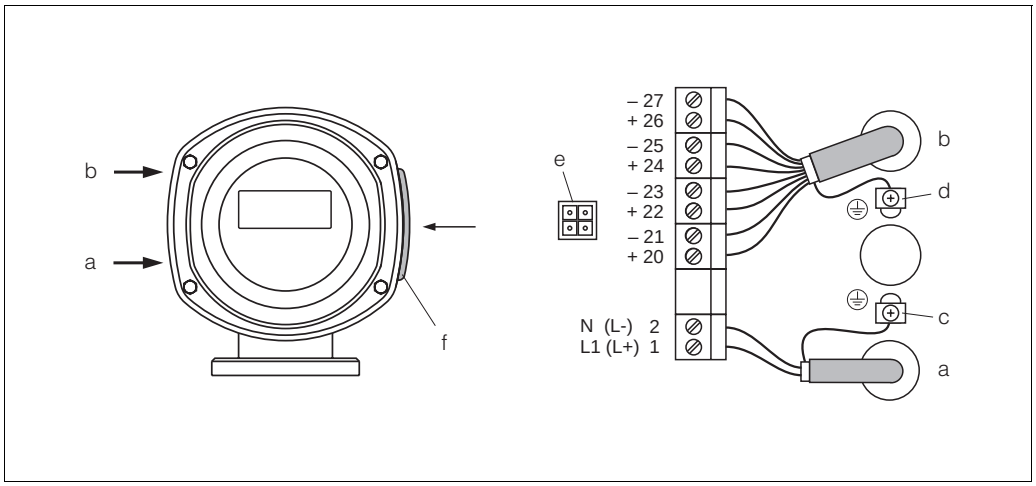


Fig. 33: Connecting the transmitter (aluminium field housing). Cable cross-section: max. 2.5 mm²

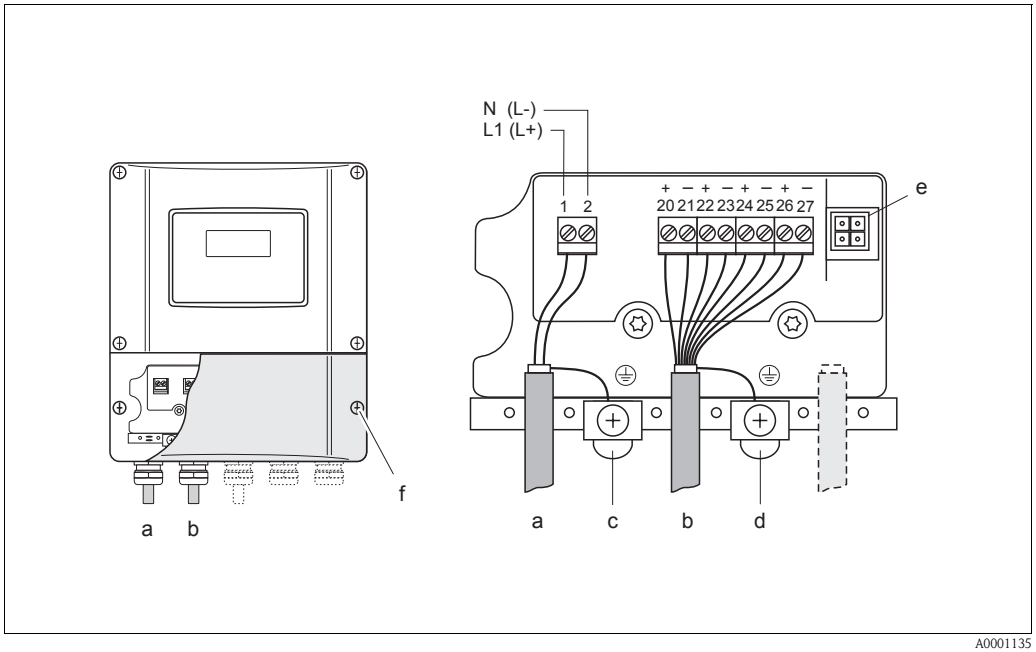
a Cable for power supply: 85…260 V AC, 20…55 V AC, 16…62 V DC
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L– for DC*
*b Signal cable: Terminals **Nos. 20–27** → Page 54*
c Ground terminal for protective conductor
d Ground terminal for signal cable shield
e Service adapter for connecting service interface FXA 193 (Fieldcheck, ToF Tool - Fieldtool Package)
f Cover of the connection compartment
g Securing clamp



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Fig. 34: Connecting the transmitter (stainless-steel field housing). Cable cross-section: max. 2.5 mm²

a Cable for power supply: 85…260 V AC, 20…55 V AC, 16…62 V DC
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L– for DC*
*b Signal cable: Terminals **Nos. 20–27** → Page 54*
c Ground terminal for protective conductor
d Ground terminal for signal cable shield
e Service adapter for connecting service interface FXA 193 (Fieldcheck, ToF Tool - Fieldtool Package)
f Cover of the connection compartment



A0001135

Fig. 35: Connecting the transmitter (wall-mount housing). Cable cross-section: max. 2.5 mm²

a Cable for power supply: 85…260 V AC, 20…55 V AC, 16…62 V DC
*Terminal **No. 1**: L1 for AC, L+ for DC*
*Terminal **No. 2**: N for AC, L– for DC*
*b Signal cable: Terminals **Nos. 20–27** → Page 54*
c Ground terminal for protective conductor
d Ground terminal for signal cable shield
e Service adapter for connecting service interface FXA 193 (Fieldcheck, ToF Tool - Fieldtool Package)
f Cover of the connection compartment

4.2.2 Terminal assignment

Order variant	Terminal No. (inputs / outputs)			
	20 (+) / 21 (–)	**22 (+) / 23 (–)**	**24 (+) / 25 (–)**	**26 (+) / 27 (–)**
50***-**********W	–	–	–	Current output HART
50***-**********A	–	–	Frequency output	Current output HART
50***-**********D	Status input	Status output	Frequency output	Current output HART
50***-**********S	–	–	Frequency output Ex i	Current output Ex i active, HART
50***-**********T	–	–	Frequency output Ex i	Current output Ex i passive, HART

Status input (auxiliary input)
galvanically isolated, 3...30 V DC, R_i = 5 kΩ

Status output
Open collector, max. 30 V DC / 250 mA, galvanically isolated, freely configurable

Frequency output (passive)
Open collector, galvanically isolated, full scale frequency 2...1000 Hz (f_{max} = 1.25 kHz)
30 V DC, 250 mA

Current output (active/passive)
galvanically isolated, active: 0/4...20 mA, R_L < 700 Ω (HART: $R_L \geq 250$ Ω)
passive: 4…20 mA, supply voltage V_S: 18...30 V DC, $R_i \geq 150$ Ω

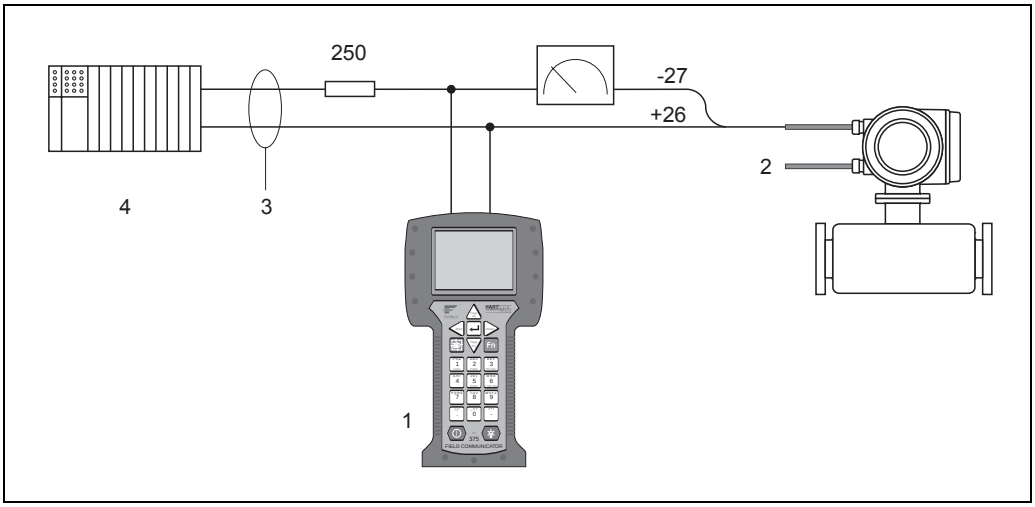
Ground connection, power supply → Page 52 ff.

4.2.3 HART connection

Users have the following connection options at their disposal:
- Direct connection to transmitter by means of terminals 26(+) / 27(–)
- Connection by means of the 4...20 mA circuit

Note!
- The measuring loop's minimum load must be at least 250 Ω.
- After commissioning, make the following settings:
  CURRENT SPAN function → "4–20 mA HART" or "4–20 mA (25 mA) HART"
- See also the documentation issued by the HART Communication Foundation, and in particular HCF LIT 20: "HART, a technical summary".

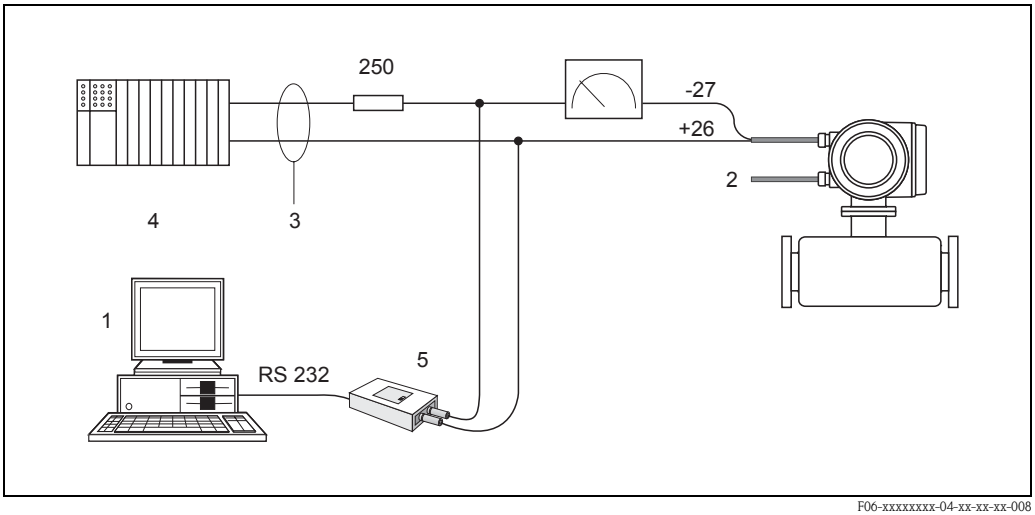
Connection of the HART handheld communicator



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Fig. 36: Electrical connection of the HART handheld communicator:
1 = HART communicator, 2 = power supply, 3 = shield, 4 = other evaluation devices or PLC with passive input

Connection of a PC with an operating software
In order to connect a PC with an operating software (e.g. "ToF Tool – Fieldtool Package"), a HART modem (e.g. "Commubox FXA 191") is needed.



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Fig. 37: Electrical connection of a PC with an operating software:
1 = PC with an operating software, 2 = power supply, 3 = shield, 4 = other evaluation devices or PLC with passive input, 5 = HART modem, e.g. Commubox FXA 191

4.3 Potential equalisation

4.3.1 Standard case

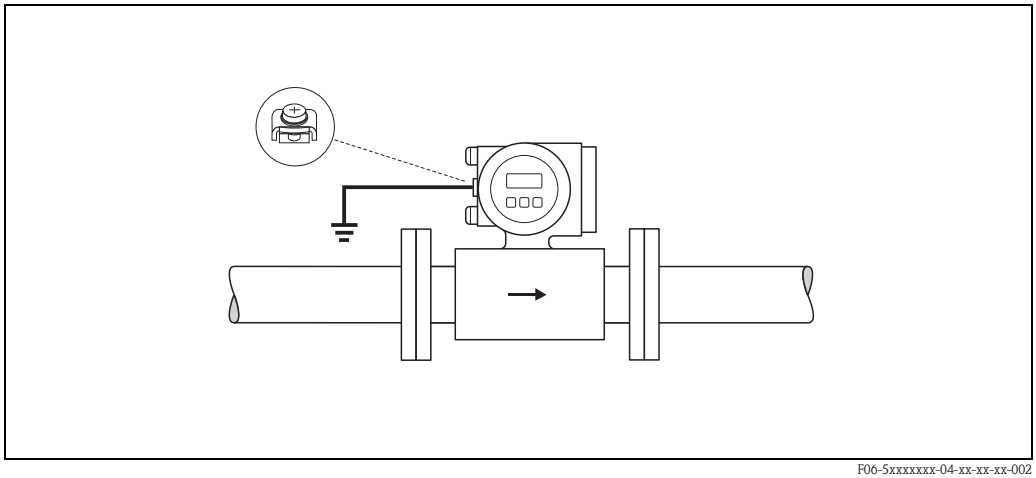
Perfect measurement is only ensured when the medium and the sensor have the same electrical potential. Most Promag sensors have a standard installed reference electrode which guarantees the required connection. This usually means that additional potential matching measures are unnecessary.

Promag W:
Reference electrode is standard

Promag P:
- Reference electrode is standard for electrode materials 1.4435, Alloy C-22 and tantalum.
- Reference electrode is optional for electrode material Pt/Rh.

Promag H:
- No reference electrode. The metallic process connection provides a permanent electrical connection to the fluid.
- If the process connections are made of a synthetic material, ground rings have to be used to ensure that potential is equalised (see Page 40). Ground rings can be ordered with the main product structure or as accessories → Page 85.

Note!
For installation in metal pipes, it is advisable to connect the ground terminal of the transmitter housing to the piping. Also, observe company-internal grounding guidelines.



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Fig. 38: Potential equalisation by means of the transmitter's ground terminal

Caution!
For sensors without reference electrodes or without metal process terminals, carry out potential equalisation as per the instructions for special cases described below. These special measures are particularly important when standard grounding practice cannot be ensured or extremely strong matching currents are expected.

4.3.2 Special cases

Metal, ungrounded piping
In order to prevent outside influences on measurement, it is advisable to use ground cables to connect each sensor flange to its corresponding pipe flange and ground the flanges. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose (Fig. 39).

Caution!
Also, observe company-internal grounding guidelines.

Note!
The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser → Page 85.
- DN ≤ 300: The ground cable is in direct connection with the conductive flange coating and is secured by the flange screws.
- DN ≥ 350: The ground cable connects directly to the metal transport bracket.

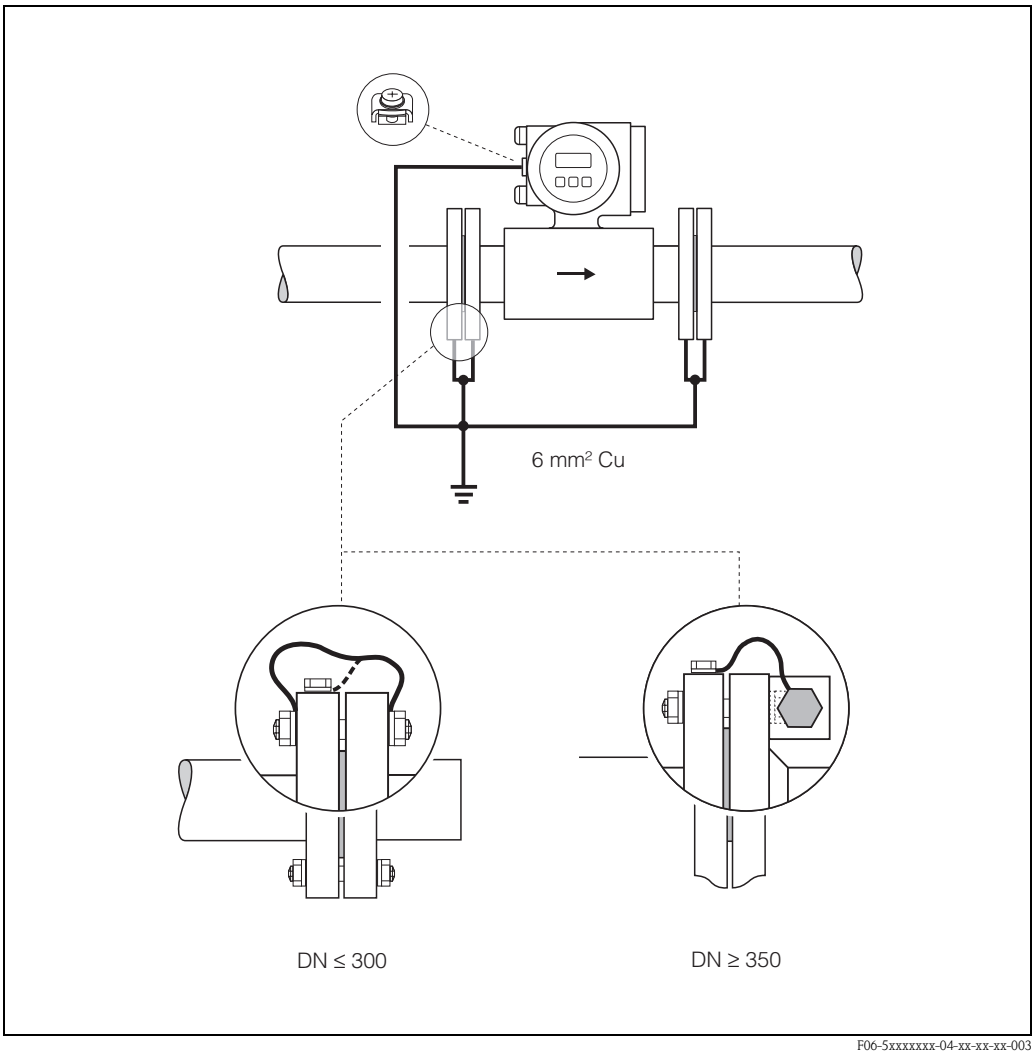


Fig. 39: Potential equalisation with equalising currents in metallic, non-grounded piping systems

Plastic pipes and isolating lined pipes
Normally, potential is matched using the reference electrodes in the measuring tube. However, in exceptional cases it is possible that, due to the grounding plan of a system, large matching currents flow over the reference electrodes. This can lead to destruction of the sensor, e.g. through electrochemical decomposition of the electrodes. In such cases, e.g. for fibre-glass or PVC piping, it is recommended that you use additional ground disks for potential matching (Fig. 40).

Mounting of ground disks → Page 27, 34

Caution!
- Risk of damage by electrochemical corrosion. Note the electrochemical insulation rating, if the ground disks and measuring electrodes are made of different materials.
- Also, observe company-internal grounding guidelines.

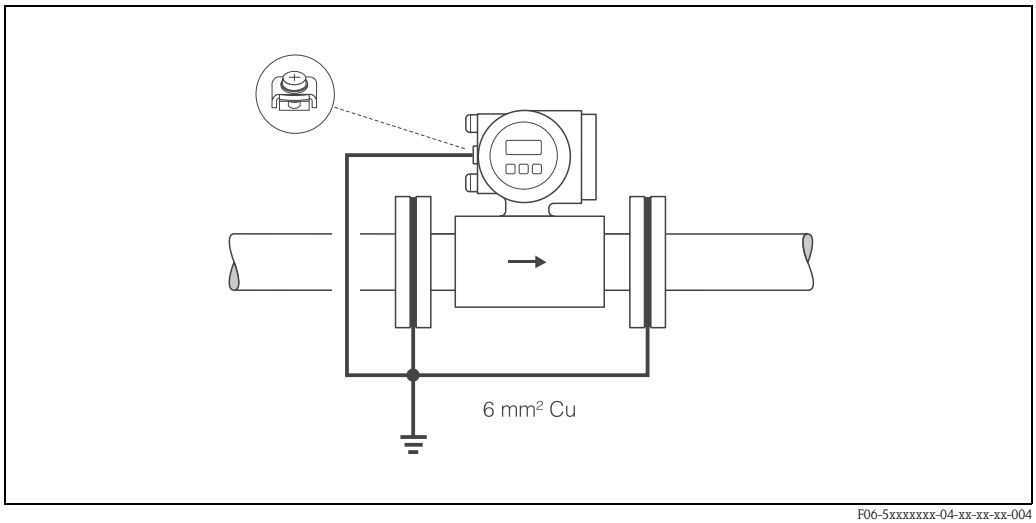


Fig. 40: Potential equalisation/ground disks with plastic pipes or lined pipes

Lined pipes (cathodic protection)
In such cases, install the measuring instrument without potential in the piping:
- When installing the measuring device, make sure that there is an electrical connection between the two piping runs (copper wire, 6 mm^2).
- Make sure that the installation materials do not establish a conductive connection to the measuring device and that the installation materials withstand the tightening torques applied when the threaded fasteners are tightened.
- Also comply with the regulations applicable to potential-free installation.

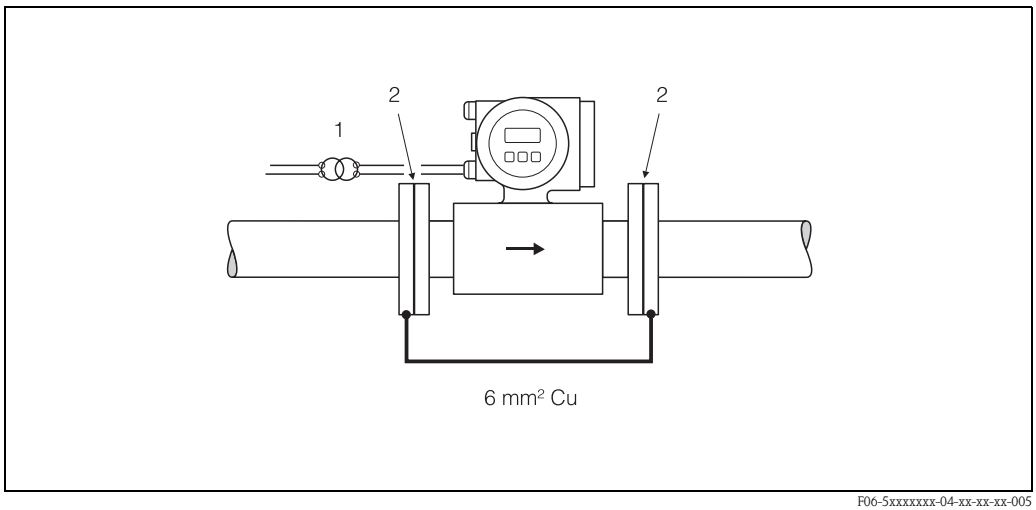
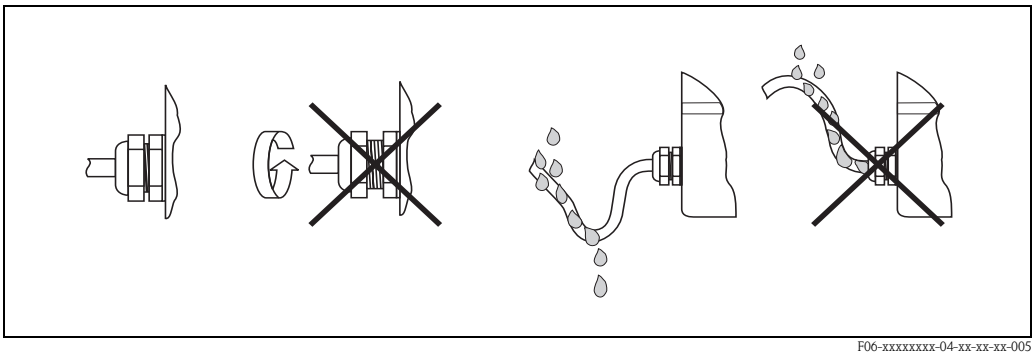


Fig. 41: Potential equalisation and cathode protection
1 = isolating transformer power supply, 2 = electrically insulated

4.4 Degree of protection

The devices fulfill all the requirements for IP 67. Compliance with the following points is mandatory following installation in the field or servicing, in order to ensure that IP 67 protection is maintained:

- The housing seals must be clean and undamaged when inserted into their grooves. The seals must be dried, cleaned or replaced if necessary.
- All threaded fasteners and screw covers must be firmly tightened.
- The cables used for connection must be of the specified outside diameter (see Page 108).
- Firmly tighten the cable entries (Fig. 42).
- The cables must loop down before they enter the cable entries (“water trap”, Fig. 42). This arrangement prevents moisture penetrating the entry. Always install the measuring device in such a way that the cable entries do not point up.
- Remove all unused cable entries and insert plugs instead.
- Do not remove the grommet from the cable entry.



F06-xxxxxxxx-04-xx-xx-xx-005

Fig. 42: Installation instructions, cable entries

Caution!
Do not loosen the threaded fasteners of the Promag sensor housing, as otherwise the degree of protection guaranteed by Endress+Hauser no longer applies.

Note!
The Promag W and Promag P sensors can be supplied with IP 68 rating (permanent immersion in water to a depth of 3 meters). In this case the transmitter must be installed remote from the sensor.

4.5 Electical connection check

Perform the following checks after completing electrical installation of the measuring device:

Device condition and specifications	Notes
Are cables or the device damaged (visual inspection)?	–
Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate?	85...260 V AC (45...65 Hz) 20...55 V AC (45...65 Hz) 16...62 V DC
Do the cables comply with the specifications?	see Page 51, 108
Do the cables have adequate strain relief?	–
Cables correctly segregated by type? Without loops and crossovers?	–
Are the power-supply and signal cables correctly connected?	See the wiring diagram inside the cover of the terminal compartment
Are all screw terminals firmly tightened?	–
Have the measures for grounding/potential equalisation been correctly implemented?	see Page 56 ff.
Are all cable entries installed, firmly tightened and correctly sealed? Cables looped as “water traps”?	see Page 59
Are all housing covers installed and firmly tightened?	–

5 Operation

5.1 Display and operating elements

The local display enables you to read all important parameters directly at the measuring point and configure the device.

The display area consists of two lines; this is where measured values are displayed, and/or status variables (direction of flow, partially filled pipe, bar graph, etc.). You can change the assignment of display lines to variables at will in order to customize the display to suit your needs and preferences (→ see the "Description of Device Functions" manual).

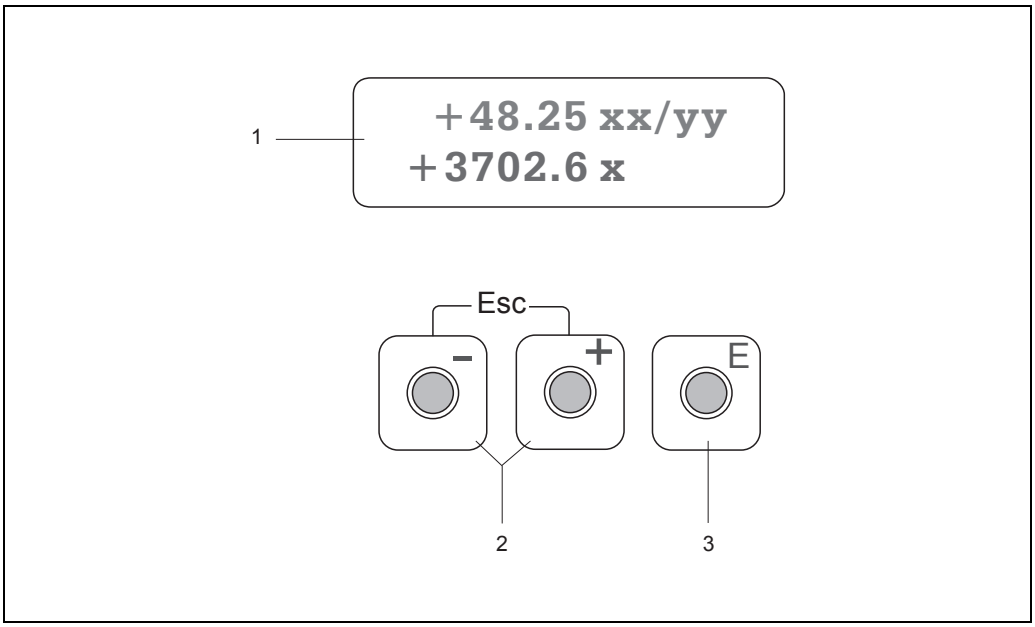


Fig. 43: Display and operating elements

Liquid-crystal display (1)
The backlit, two-line liquid-crystal display shows measured values, dialog texts, error messages and information messages. The display as it appears when normal measuring is in progress is known as the HOME position (operating mode).

Upper display line: Shows primary measured values, e.g. volume flow in [ml/min] or in [%].
Lower display line: Shows supplementary measured variables and status variables, e.g. totalizer reading in [m^3], bar graph, measuring point designation

Push buttons (2)
- *Enter numerical values, select parameters*
- *Select different function groups within the function matrix*

Press the +/– keys simultaneously to trigger the following functions:
- *Exit the function matrix step by step → HOME position*
- *Press and hold down +/– keys for longer than 3 seconds → Return directly to HOME position*
- *Cancel data entry*

Enter push button (3)
- *HOME position → Entry into the function matrix*
- *Save the numerical values you input or settings you change*

5.2 Brief operating instruction to the function matrix

Note!
- See the general notes on Page 63.
- Function descriptions → see the "Description of Device Functions" manual

1. HOME position → E → Enter the function matrix
2. Select a function group (e.g. CURRENT OUTPUT 1)
3. Select a function (e.g. TIME CONSTANT)

   Change parameter / enter numerical values:
   ± → select or enter enable code, parameters, numerical values
   E → save your entries

4. Exit the function matrix:
   – Press and hold down Esc key (Esc) for longer than 3 seconds → HOME position
   – Repeatedly press Esc key (Esc) → return step by step to HOME position

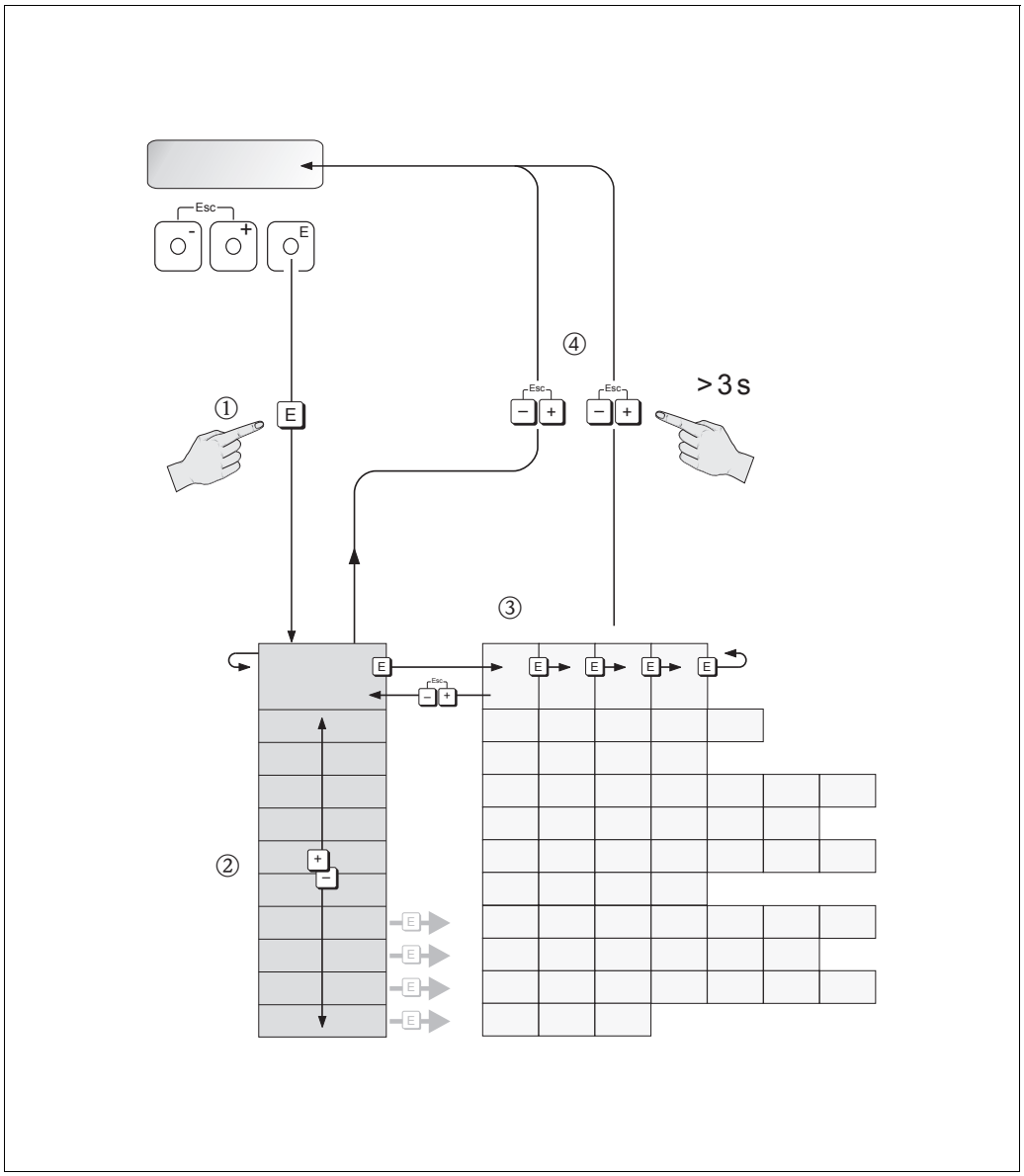


Fig. 44: Selecting functions and configuring parameters (function matrix)

5.2.1 General notes

The Quick Setup menu (see Page 80) is adequate for commissioning in most instances. Complex measuring operations on the other hand necessitate additional functions that you can configure as necessary and customize to suit your process parameters. The function matrix, therefore, comprises a multiplicity of additional functions which, for the sake of clarity, are arranged in a number of function groups.

Comply with the following instructions when configuring functions:
- You select functions as described on Page 62.
- You can switch off certain functions (OFF). If you do so, related functions in other function groups will no longer be displayed.
- Certain functions prompt you to confirm your data entries. Press ⊞ to select "SURE [YES]" and press Ⓔ again to confirm. This saves your setting or starts a function, as applicable.
- Return to the HOME position is automatic if no key is pressed for 5 minutes.

Note!
- The transmitter continues to measure while data entry is in progress, i.e. the current measured values are output via the signal outputs in the normal way.
- If the power supply fails, all preset and parameterized values remain safely stored in the EEPROM.

Caution!
All functions are described in detail, including the function matrix itself, in the **"Description of Device Functions"** manual, which is a separate part of this Operating Instruction.

5.2.2 Enabling the programming mode

The function matrix can be disabled. Disabling the function matrix rules out the possibility of inadvertent changes to device functions, numerical values or factory settings.
A numerical code (factory setting = 50) has to be entered before settings can be changed.
If you use a code number of your choice, you exclude the possibility of unauthorized persons accessing data (→ see the "Description of Device Functions" manual).

Comply with the following instructions when entering codes:
- If programming is disabled and the ⊞ key is pressed in any function, a prompt for the code automatically appears on the display.
- If "0" is entered as the customer's code, programming is always enabled.
- The Endress+Hauser service organisation can be of assistance if you mislay your personal code.

Caution!
Changing certain parameters such as all sensor characteristics, for example, influences numerous functions of the entire measuring system, particularly measuring accuracy.
There is no need to change these parameters under normal circumstances and consequently, they are protected by a special code known only to the Endress+Hauser service organization. Please contact Endress+Hauser if you have any questions.

5.2.3 Disabling the programming mode

Programming is disabled if you do not press a key within 60 seconds following automatic return to the HOME position.
You can also disable programming in the "ACCESS CODE" function by entering any number (other than the customer's code).

5.3 Error messages

Type of error
Errors which occur during commissioning or measuring operation are displayed immediately. If two or more system or process errors occur, the error with the highest priority is the one shown on the display.

The measuring system distinguishes between two types of error:
- *System errors:* This group comprises all device errors, e.g. communication errors, hardware faults, etc. → see Page 90
- *Process errors:* This group comprises all application errors, e.g. empty pipe, etc. → see Page 93

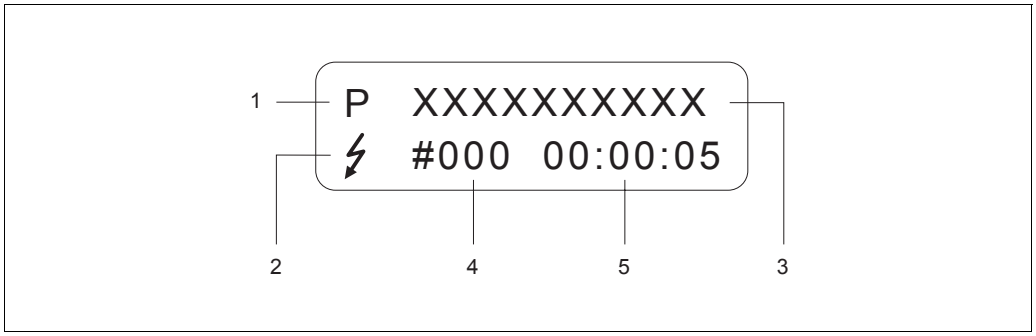


Fig. 45: Error messages on the display (example)

1 Error type: P = process error, S = system error
2 Error message type: ϟ = fault message; ! = notice message
3 Error designation: e.g. EMPTY PIPE = measuring tube is only partly filled or completely empty
4 Error number: e.g. #401
5 Duration of most recent error occurrence in hours / minutes / seconds

Error message types
Users have the option of weighting certain errors differently, in other words having them classed as **"Fault messages"** or **"Notice messages"**. You can define messages in this way with the aid of the function matrix → see the "Description of Device Functions" manual.
Serious system errors, e.g. module defects, are always identified and classed as "fault messages" by the measuring device.

Notice message (!)
- Displayed as → Exclamation mark (!), error type (S: system error, P: process error).
- The error in question has no effect on the outputs of the measuring device.

Fault message (ϟ)
- Displayed as → Lightning flash (ϟ), error type (S: system error, P: process error).
- The error in question has a direct effect on the outputs.
  The response of the outputs (failsafe mode) can be defined by means of functions in the function matrix (see Page 95).

✎ Note!
For security reasons, error messages should be output via the status output.

5.4 Communication

In addition to local operation, the measuring device can be configured and measured values can be obtained by means of the HART protocol. Digital communication takes place using the 4–20 mA current output HART (see Page 55).

The HART protocol allows the transfer of measuring and device data between the HART master and the field devices for configuration and diagnostics purposes. The HART master, e.g. a handheld terminal or PC-based operating programs (such as ToF Tool – Fieldtool Package), require device description (DD) files which are used to access all the information in a HART device.
Information is exclusively transferred using so-called “commands”. There are three different command groups:

Universal commands:
All HART device support and use universal commands. The following functionalities are linked to them:
- Identify HART devices
- Reading digital measured values (volume flow, totalizer, etc.)

Common practice commands:
Common practice commands offer functions which are supported and can be executed by most but not all field devices.

Device-specific commands:
These commands allow access to device-specific functions which are not HART standard. Such commands access individual field device information, amongst other things, such as empty/full pipe calibration values, low flow cutoff settings, etc.



Note!
Promag 50 has access to all three command classes. On Page 69, you will find a list with all the supported “Universal Commands” and “Common Practice Commands”.

5.4.1 Operating options

For the complete operation of the measuring device, including device-specific commands, there are DD files available to the user to provide the following operating aids and programs:



Note!
The HART protocol requires the "4…20 mA HART" setting (individual options see device function) in the CURRENT SPAN function (current output 1).

HART handheld terminal DXR 375
Selecting device functions with a HART Communicator is a process involving a number of menu levels and a special HART function matrix.
The HART manual in the carrying case of the HART Communicator contains more detailed information on the device.

Operating program "ToF Tool - Fieldtool Package"
Modular software package consisting of the service program "ToF Tool" for configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and evolution of pressure measuring instruments as well as the "Fieldtool" service program for the configuration and diagnosis of Proline flow measuring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA 193 or the HART protocol.

Contents of the "ToF Tool - Fieldtool Package":
- Commissioning, maintenance analysis
- Configuring flowmeters
- Service functions
- Visualisation of process data
- Trouble-shooting
- Controlling the "Fieldcheck" tester/simulator

Fieldcare
FieldCare is Endress+Hauser's FDT-based plant Asset Management Tool and allows the configuration and diagnosis of intelligent field devices. By using status information, you also have a simple but effective tool for monitoring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA 193.

Operating program "SIMATIC PDM" (Siemens)
SIMATIC PDM is a standardised, manufacturer-independent tool for the operation, configuration, maintenance and diagnosis of intelligent field devices.

Operating program "AMS" (Emerson Process Management)
AMS (Asset Management Solutions): program for operating and configuring devices

5.4.2 Current device description files

The following table illustrates the suitable device description file for the operating tool in question and then indicates where these can be obtained.

HART protocol:

Valid for software:	2.00.XX	→Function "Device software"
Device data HART Manufacturer ID: Device ID:	 11_{hex} (ENDRESS+HAUSER) 41_{hex}	 → Function "Manufacturer ID" → Function "Device ID"
HART version data:	Device Revison 6/ DD Revision 1	
Software release:	03.2005	

Operating program:	**Sources for obtaining device descriptions:**
Handheld terminal DXR 375	■ Use update function of handheld terminal
ToF Tool - Fieldtool Package	■ www.tof-fieldtool.endress.com (→ Download → Software → Device driver) ■ CD-ROM (Endress+Hauser order number 50097200)
Fieldcare / DTM	■ www.endress.com (→ Download → Software → Device driver) ■ CD-ROM (Endress+Hauser order number 50097200)
AMS	■ www.endress.com (→ Download → Software → Device driver) ■ CD-ROM (Endress+Hauser order number 50097200)
SIMATIC PDM	■ www.endress.com (→ Download → Software → Device driver) ■ CD-ROM (Endress+Hauser order number 50097200)

Operation via the service protocol

Valid for device software:	2.00.XX	→Function "Device software"
Software release:	03.2005	

Operating program:	**Sources for obtaining device descriptions:**
ToF Tool - Fieldtool Package	■ www.tof-fieldtool.endress.com (→ Download → Software → Device driver) ■ CD-ROM (Endress+Hauser order number 50097200)

Tester/simulator:	**Sources for obtaining device descriptions:**
Fieldcheck	■ Update by means of ToF Tool - Fieldtool Package via Fieldflash module

5.4.3 Device and process variables

Device variables:
The following device variables are available using the HART protocol:

Code (decimal)	Device variable
0	OFF (not assigned)
1	Volume flow
250	Totalizer 1
251	Totalizer 2

Process variables:
At the factory, the process variables are assigned to the following device variables:

- Primary process variable (PV) → Volume flow
- Second process variable (SV) → Totalizer 1
- Third process variable (TV) → not assigned
- Fourth process variable (FV) → not assigned

Note!
You can set or change the assignment of device variables to process variables using Command 51 (see Page 73).

5.4.4 Universal / Common practice HART commands

The following table contains all the universal and common practice commands supported by Promag 50.

Command No. **HART command / Access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
Universal Commands			
0	Read unique device identifier Access type = read	none	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 65 = Promag 50 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
1	Read primary process variable Access type = read	none	– Byte 0: HART unit code of the primary process variable – Bytes 1-4: Primary process variable *Factory setting:* Primary process variable = Volume flow ✎ Note! ■ You can set the assignment of device variables to process variables using Command 51. ■ Manufacturer-specific units are represented using the HART unit code “240”.
2	Read the primary process variable as current in mA and percentage of the set measuring range Access type = read	none	– Bytes 0-3: actual current of the primary process variable in mA – Bytes 4-7: Percentage of the set measuring range *Factory setting:* Primary process variable = Volume flow ✎ Note! You can set the assignment of device variables to process variables using Command 51.

Command No. **HART command / Access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
3	Read the primary process variable as current in mA and four (preset using Command 51) dynamic process variables Access type = read	none	24 bytes are sent as a response: – Bytes 0-3: primary process variable current in mA – Byte 4: HART unit code of the primary process variable – Bytes 5-8: Primary process variable – Byte 9: HART unit code of the second process variable – Bytes 10-13: Second process variable – Byte 14: HART unit code of the third process variable – Bytes 15-18: Third process variable – Byte 19: HART unit code of the fourth process variable – Bytes 20-23: Fourth process variable *Factory setting:* ■ Primary process variable = Volume flow ■ Second process variable = Totalizer 1 ■ Third process variable = not assigned ■ Fourth process variable = not assigned ✎ Note! ■ You can set the assignment of device variables to process variables using Command 51. ■ Manufacturer-specific units are represented using the HART unit code “240”.
6	Set HART shortform address Access type = write	Byte 0: desired address (0...15) *Factory setting:* 0 ✎ Note! With an address >0 (multidrop mode), the current output of the primary process variable is set to 4 mA.	Byte 0: active address
11	Read unique device identification using the TAG (measuring point designation) Access type = read	Bytes 0-5: TAG	Device identification delivers information on the device and the manufacturer. It cannot be changed. The response consists of a 12 byte device ID if the given TAG agrees with the one saved in the device: – Byte 0: fixed value 254 – Byte 1: Manufacturer ID, 17 = E+H – Byte 2: Device type ID, 65 = Promag 50 – Byte 3: Number of preambles – Byte 4: Universal commands rev. no. – Byte 5: Device-specific commands rev. no. – Byte 6: Software revision – Byte 7: Hardware revision – Byte 8: Additional device information – Bytes 9-11: Device identification
12	Read user message Access type = read	none	Bytes 0-24: User message ✎ Note! You can write the user message using Command 17.

Command No. **HART command / Access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
13	Read TAG, descriptor and date Access type = read	none	– Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date ✎ Note! You can write the TAG, descriptor and date using Command 18.
14	Read sensor information on primary process variable	none	– Bytes 0-2: Sensor serial number – Byte 3: HART unit code of sensor limits and measuring range of the primary process variable – Bytes 4-7: Upper sensor limit – Bytes 8-11: Lower sensor limit – Bytes 12-15: Minimum span ✎ Note! ■ The data relate to the primary process variable (= volume flow). ■ Manufacturer-specific units are represented using the HART unit code “240”.
15	Read output information of primary process variable Access type = read	none	– Byte 0: Alarm selection ID – Byte 1: Transfer function ID – Byte 2: HART unit code for the set measuring range of the primary process variable – Bytes 3-6: upper range, value for 20 mA – Bytes 7-10: lower range, value for 4 mA – Bytes 11-14: Damping constant in [s] – Byte 15: Write protection ID – Byte 16: OEM dealer ID, 17 = E+H *Factory setting:* Primary process variable = Volume flow ✎ Note! ■ You can set the assignment of device variables to process variables using Command 51. ■ Manufacturer-specific units are represented using the HART unit code “240”.
16	Read the device production number Access type = read	none	Bytes 0-2: Production number
17	Write user message Access = write	You can save any 32-character long text in the device under this parameter: Bytes 0-23: Desired user message	Displays the current user message in the device: Bytes 0-23: Current user message in the device
18	Write TAG, descriptor and date Access = write	With this parameter, you can store an 8 character TAG, a 16 character descriptor and a date: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date	Displays the current information in the device: – Bytes 0-5: TAG – Bytes 6-17: descriptor – Bytes 18-20: Date

Command No. **HART command / Access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
Common Practice Commands			
34	Write damping value for primary process variable Access = write	Bytes 0-3: Damping value of the primary process variable in seconds *Factory setting:* Primary process variable = Volume flow	Displays the current damping value in the device: Bytes 0-3: Damping value in seconds
35	Write measuring range of primary process variable Access = write	Write the desired measuring range: – Byte 0: HART unit code of the primary process variable – Bytes 1-4: upper range, value for 20 mA – Bytes 5-8: lower range, value for 4 mA *Factory setting:* Primary process variable = Volume flow ✎ Note! ■ You can set the assignment of device variables to process variables using Command 51. ■ If the HART unit code is not the correct one for the process variable, the device will continue with the last valid unit.	The currently set measuring range is displayed as a response: – Byte 0: HART unit code for the set measuring range of the primary process variable – Bytes 1-4: upper range, value for 20 mA – Bytes 5-8: lower range, value for 4 mA ✎ Note! Manufacturer-specific units are represented using the HART unit code “240”.
38	Device status reset (Configuration changed) Access = write	none	none
40	Simulate output current of primary process variable Access = write	Simulation of the desired output current of the primary process variable. An entry value of 0 exits the simulation mode: Bytes 0-3: Output current in mA *Factory setting:* Primary process variable = Volume flow ✎ Note! You can set the assignment of device variables to process variables using Command 51.	The momentary output current of the primary process variable is displayed as a response: Bytes 0-3: Output current in mA
42	Perform master reset Access = write	none	none
44	Write unit of primary process variable Access = write	Set unit of primary process variable. Only unit which are suitable for the process variable are transferred to the device: Byte 0: HART unit code *Factory setting:* Primary process variable = Volume flow ✎ Note! ■ If the written HART unit code is not the correct one for the process variable, the device will continue with the last valid unit. ■ If you change the unit of the primary process variable, this has no impact on the system units.	The current unit code of the primary process variable is displayed as a response: Byte 0: HART unit code ✎ Note! Manufacturer-specific units are represented using the HART unit code “240”.
48	Read additional device status Access = read	none	The device status is displayed in extended form as the response: Coding: see table on Page 74

Command No. **HART command / Access type**		**Command data** (numeric data in decimal form)	**Response data** (numeric data in decimal form)
50	Read assignment of the device variables to the four process variables Access = read	none	Display of the current variable assignment of the process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Factory setting:* ■ Primary process variable: Code 1 for volume flow ■ Second process variable: Code 250 for totalizer 1 ■ Third process variable: Code 0 for OFF (not assigned) ■ Fourth process variable: Code 0 for OFF (not assigned) ✎ Note! You can set or change the assignment of device variables to process variables using Command 51.
51	Write assignments of the device variables to the four process variables Access = write	Setting of the device variables to the four process variables: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable *Code of the supported device variables:* See data on Page 68 *Factory setting:* ■ Primary process variable = Volume flow ■ Second process variable = Totalizer 1 ■ Third process variable = OFF (not assigned) ■ Fourth process variable = OFF (not assigned)	The variable assignment of the process variables is displayed as a response: – Byte 0: Device variable code to the primary process variable – Byte 1: Device variable code to the second process variable – Byte 2: Device variable code to the third process variable – Byte 3: Device variable code to the fourth process variable
53	Write device variable unit Access = write	This command set the unit of the given device variables. Only those units which suit the device variable are transferred: – Byte 0: Device variable code – Byte 1: HART unit code *Code of the supported device variables:* See data on Page 68 ✎ Note! ■ If the written unit is not the correct one for the device variable, the device will continue with the last valid unit. ■ If you change the unit of the device variable, this has no impact on the system units.	The current unit of the device variables is displayed in the device as a response: – Byte 0: Device variable code – Byte 1: HART unit code ✎ Note! Manufacturer-specific units are represented using the HART unit code “240”.
59	Write number of preambles in response message Access = write	This parameter sets the number of preambles which are inserted in the response messages: Byte 0: Number of preambles (2...20)	As a response, the current number of the preambles is displayed in the response message: Byte 0: Number of preambles

5.4.5 Device status / Error messages

You can read the extended device status, in this case, current error messages, via Command “48”. The command delivers information which are partly coded in bits (see table below).

Note!
You can find a detailed explanation of the device status and error messages and their elimination on Page 90 ff.

Byte Bit	Error No.	Short error description (→ Page 90 ff.)
0-0	001	Serious device error
0-1	011	Measuring amplifier has faulty EEPROM
0-2	012	Error when accessing data of the measuring amplifier EEPROM
0-3	not assigned	–
0-4	not assigned	–
0-5	not assigned	–
0-6	not assigned	–
0-7	not assigned	–
1-0	not assigned	–
1-1	031	S-DAT: defective or missing
1-2	032	S-DAT: Error accessing saved values
1-3	not assigned	–
1-4	not assigned	–
1-5	051	I/O board and the amplifier board are not compatible.
1-6	not assigned	–
1-7	not assigned	–
2-0	not assigned	–
2-1	not assigned	–
2-2	not assigned	–
2-3	not assigned	–
2-4	not assigned	–
2-5	not assigned	–
2-6	not assigned	–
2-7	not assigned	–
3-0	not assigned	–
3-1	not assigned	–
3-2	not assigned	–
3-3	111	Totalizer checksum error
3-4	121	I/O board and the amplifier board are not compatible.
3-5	not assigned	–
3-6	not assigned	–
3-7	not assigned	–
4-0	not assigned	–
4-1	not assigned	–
4-2	not assigned	–
4-3	251	Internal communication fault on the amplifier board.
4-4	261	No data reception between amplifier and I/O board

Byte Bit	Error No.	Short error description (→ Page 90 ff.)
4-5	not assigned	–
4-6	not assigned	–
4-7	not assigned	–
5-0	321	Coil current of the sensor is outside the tolerance.
5-1	not assigned	–
5-2	not assigned	–
5-3	not assigned	–
5-4	not assigned	–
5-5	not assigned	–
5-6	not assigned	–
5-7	339	Flow buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6-0	340	
6-1	341	
6-2	342	
6-3	343	Frequency buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
6-4	344	
6-5	345	
6-6	346	
6-7	347	Pulse buffer: The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.
7-0	348	
7-1	349	
7-2	350	
7-3	351	Current output: flow is out of range.
7-4	352	
7-5	353	
7-6	354	
7-7	355	Frequency output: flow is out of range.
8-0	356	
8-1	357	
8-2	358	
8-3	359	Pulse output: the pulse output frequency is out of range.
8-4	360	
8-5	361	
8-6	362	
8-7	not assigned	–
9-0	not assigned	–
9-1	not assigned	–
9-2	not assigned	–
9-3	not assigned	–
9-4	not assigned	–
9-5	not assigned	–
9-6	not assigned	–
9-7	not assigned	–

Byte Bit	Error No.	Short error description (→ Page 90 ff.)
10-0	not assigned	–
10-1	not assigned	–
10-2	not assigned	–
10-3	not assigned	–
10-4	not assigned	–
10-5	not assigned	–
10-6	not assigned	–
10-7	401	Measuring tube partially filled or empty
11-0	not assigned	–
11-1	not assigned	–
11-2	461	EPD calibration not possible because the fluid's conductivity is either too low or too high.
11-3	not assigned	–
11-4	463	The EPD calibration values for empty pipe and full pipe are identical, therefore incorrect.
11-5	not assigned	–
11-6	not assigned	–
11-7	not assigned	–
12-0	not assigned	–
12-1	474	Maximum flow value entered is overshot.
12-2	not assigned	–
12-3	not assigned	–
12-4	not assigned	–
12-5	not assigned	–
12-6	not assigned	–
12-7	501	New amplifier software version is loaded. Currently no other commands are possible.
13-0	502	Upload and download of device files. Currently no other commands are possible.
13-1	not assigned	–
13-2	not assigned	–
13-3	not assigned	–
13-4	not assigned	–
13-5	not assigned	–
13-6	not assigned	–
13-7	not assigned	–
14-0	not assigned	–
14-1	not assigned	–
14-2	not assigned	–
14-3	601	Positive zero return active
14-4	not assigned	–
14-5	not assigned	–
14-6	not assigned	–

Byte Bit	Error No.	Short error description (→ Page 90 ff.)
14-7	611	Simulation current output active
15-0	612	
15-1	613	
15-2	614	
15-3	621	Simulation frequency output active
15-4	622	
15-5	623	
15-6	624	
15-7	631	Simulation pulse output active
16-0	632	
16-1	633	
16-2	634	
16-3	641	Simulation status output active
16-4	642	
16-5	643	
16-6	644	
16-7	not assigned	–
17-0	not assigned	–
17-1	not assigned	–
17-2	not assigned	–
17-3	not assigned	–
17-4	not assigned	–
17-5	not assigned	–
17-6	not assigned	–
17-7	671	Simulation status input active
18-0	672	Simulation status input active
18-1	673	Simulation status input active
18-2	674	Simulation status input active
18-3	691	Simulation of response to error (outputs) active
18-4	692	Simulation of volume flow active
18-5	not assigned	–
18-6	not assigned	–
18-7	not assigned	–

6 Commissioning

6.1 Function check

Make sure that all final checks have been completed before you start up your measuring point:
- Checklist for "Installation check" → Page 46
- Checklist for "Electrical connection check" → Page 60

6.1.1 Switching on the measuring device

Once the connection checks (see Page 60) have been successfully completed, it is time to switch on the power supply. The device is now operational.
The measuring device performs a number of post switch-on self-tests. As this procedure progresses the following sequence of messages appears on the local display:

PROMAG 50 **START UP ...**	Start-up message
▼	
DEVICE SOFTWARE **V XX.XX.XX**	Current software version
▼	
SYSTEM OK **→ OPERATION**	Beginning of normal measuring mode
▼	

Normal measuring mode commences as soon as start-up completes. Various measured-value and/or status variables (HOME position) appear on the display.

✎ Note!
If start-up fails, an error message indicating the cause is displayed.

6.2 Application-specific commissioning

In the case of measuring devices without a local display, the individual parameters and functions must be configured via the configuration program, e.g. ToF Tool – Fieldtool Package. If the measuring device is equipped with a local display, all the important device parameters for standard operation can be configured quickly and easily by means of the "Commissioning" Quick Setup menu.

- Quick Setup "Commissioning", → Page 3 ff.

6.2.1 "Commissioning" Quick Setup menu

This Quick Setup menu guides you systematically through the setup procedure for all the major device functions that have to be configured for standard measuring operation.

Note!
In the case of measuring devices **without** a local display, the individual parameters and functions must be configured by means of a configuration program, such as ToF Tool – Fieldtool Package from Endress+Hauser.

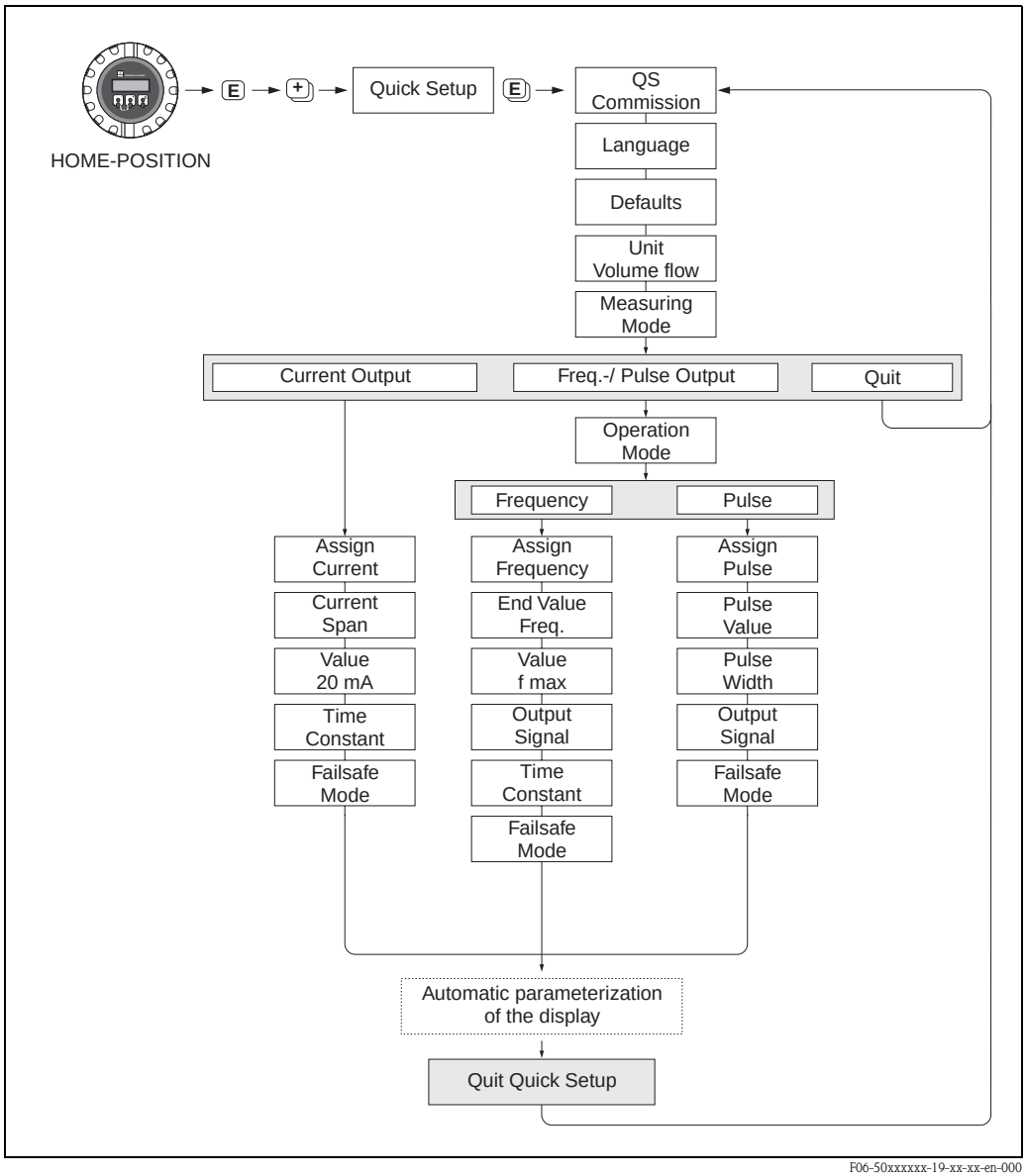


Fig. 46: Quick Setup for commissioning

6.2.2 Empty-pipe/full-pipe adjustment

Flow cannot be measured correctly unless the measuring tube is completely full. This status can be permanently monitored using the Empty Pipe Detection:
- EPD = Empty Pipe Detection (with the help of an EPD electrode)
- OED = Open Electrode Detection (Empty Pipe Detection with the help of the measuring electrodes, if the sensor is not equipped with an EPD electrode or the orientation is not suitable for using EPD).

Caution!
A detailed description and other helpful hints for the empty-pipe/full-pipe adjustment procedure can be found in the separate "Description of Device Functions" Manual:
- EPD/OED ADJUSTMENT → Carrying out the adjustment.
- EPD → Switching on and off EPD/OED.
- EPD RESPONSE TIME → Input of the response time for EPD/OED.

Note!
- The EPD function is not available unless the sensor is fitted with an EPD electrode.
- The devices are already calibrated at the factory with water (approx. 500 µS/cm). If the fluid conductivity differs from this reference, empty-pipe/full-pipe adjustment has to be performed again on site.
- The default setting for EPD/OED when the devices are delivered is OFF; the function has to be activated if required.
- The EPD/OED process error can be output by means of the configurable status output.

Performing empty-pipe and full-pipe adjustment (EPD/OED)

1. Select the appropriate function in the function matrix:
   HOME → E → + → PROCESS PARAMETER → E → + →
   EPD/OED ADJUSTMENT
2. Empty the piping. In case of an EPD adjustment, the wall of the measuring tube should be wetted with fluid for the adjustment procedure but this is not the case with an OED adjustment.
3. Start empty-pipe adjustment: Select "EMPTY PIPE ADJUST" or "OED EMPTY ADJUST" and press E to confirm.
4. After empty-pipe adjustment, fill the piping with fluid.
5. Start full-pipe adjustment: Select "FULL PIPE ADJUST" or "OED FULL ADJUST" and press E to confirm.
6. Having completed the adjustment, select the setting "OFF" and exit the function by pressing E .
7. Now select the "EPD" function. Switch on Empty Pipe Detection by selecting the following settings:
   – EPD → Select ON STANDARD or ON SPECIAL and press E to confirm.
   – OED → Select OED and confirm with E .

   Caution!
   The adjustment coefficients must be valid before you can activate the EPD/OED function. If adjustment is incorrect the following messages might appear on the display:
   – FULL = EMPTY
     The adjustment values for empty pipe and full pipe are identical. In cases of this nature you **must** repeat empty-pipe or full-pipe adjustment!
   – ADJUSTMENT NOT OK
     Adjustment is not possible because the fluid's conductivity is out of range.

6.2.3 Current output: active/passive

The current output is configured as “active” or “passive” by means of various jumpers on the I/O board.



Warning!
- Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Wait at least 10 minutes for heat to dissipate before opening an Ex-rated device.

1. Switch off power suppy.
2. Remove the I/O board → Page 98, 100
3. Position the jumper according to Fig. 47.



Caution!
Risk of destroying the measuring device. Set the jumpers exactly as shown in Fig. 47. Incorrectly set jumpers can cause overcurrents that would destroy either the measuring device or external devices connected to it.

4. Installation of the I/O board is the reverse of the removal procedure.

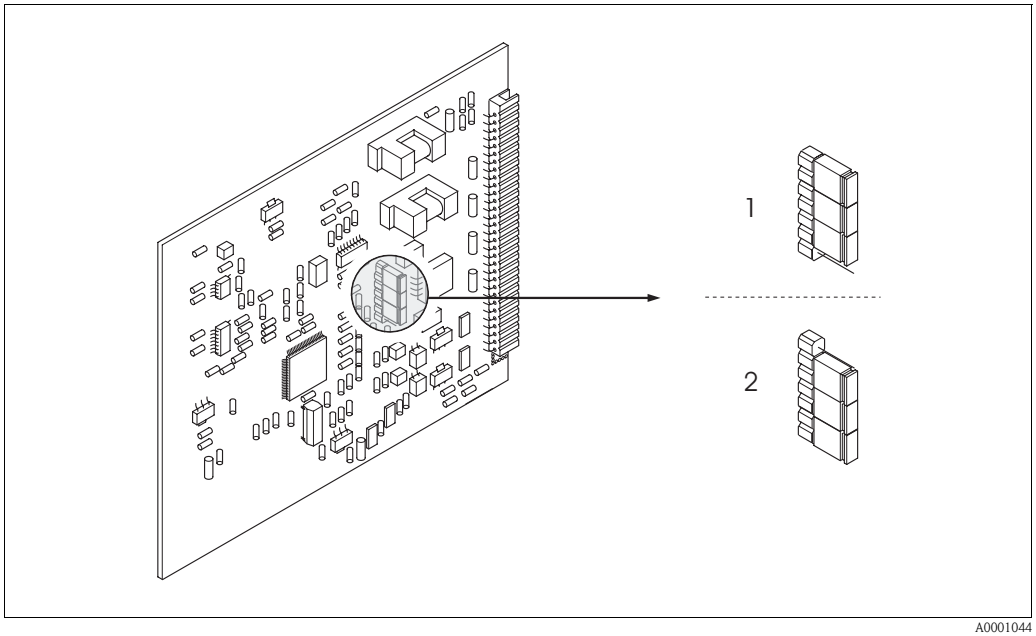


Fig. 47: Configuring the current output (I/O board)

1 Active current output (Factory setting)
2 Passive current output

6.3 Data storage device (HistoROM)

At Endress+Hauser, the term HistoROM refers to various types of data storage modules on which process and measuring device data are stored.

6.3.1 HistoROM/S-DAT (sensor-DAT)

The S-DAT is an exchangeable data storage device in which all sensor relevant parameters are stored, i.e., diameter, serial number, calibration factor, zero point.

7 Maintenance

The Promag 50 flow measuring system requires no special maintenance.

7.1 Exterior cleaning

When cleaning the exterior of measuring devices, always use cleaning agents that do not attack the surface of the housing and the seals.

7.2 Seals

The seals of the Promag H sensor must be replaced periodically, particularly in the case of gasket seals (aseptic version). The period between changes depends on the frequency of cleaning cycles, the cleaning temperature and the fluid temperature.

Replacement seals (accessories) → Page 85.

8 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. The Endress+Hauser service organisation can provide detailed information on the order codes of your choice.

8.1 Device-specific accessories

Accessory	Description	Order code
Transmitter Promag 50	Transmitter for replacement or for stock. Use the order code to define the following specifications: – Approvals – Degree of protection / version – Cable type for the remote version – Cable entries – Display / power supply / operation – Software – Outputs / inputs	50XXX – XXXXX * * * * * * * *

8.2 Measuring principle-specific accessories

Accessory	Description	Order code
Mounting kit for transmitter Promag 50/53	Mounting kit for wall-mounted housing (remote version). Suitable for: – Wall mounting – Post mounting – Installation in control panel Mounting set for aluminium housings. Suitable for pipe mounting (3/4"...32")	DK5WM – *
Cable for remote version	Coil and signal cables, various lengths. Reinforced cable on request.	DK5CA – * *
Ground cable for Promag W, P	A set consists of two ground cables.	DK5GC – * * *
Ground disk for Promag W, P	Ground disk for potential equalisation	DK5GD – * * *
Mounting kit for Promag H	Mounting kit for Promag H, comprising: – 2 process connections – Threaded fasteners – Seals	DKH * * – * * *
Adapter connection for Promag A, H	Adapter connections for installing Promag 50 H instead of Promag 30/33 A or Promag 30/33 H DN 25.	DK5HA – * * * * *
Ground rings for Promag H	If the process connections are made of PVC or PVDF, ground rings are necessary to ensure that potential is matched. Set of ground rings, comprising: – 2 ground rings	DK5HR – * * *
Set of seals for Promag H	For regular replacement of the seals of the Promag H sensor.	DK5HS – * * *
Wall-mounting kit for Promag H	Wall-mounting kit for the Promag H sensor	DK5HM – * *
Welding jig for Promag H	Weld nipple as process connection: welding jig for installation in pipe.	DK5HW – * * *

8.3 Communication-specific accessories

Accessory	Description	Order code
HART Communicator DXR 375 hand-held terminal	Hand-held terminal for remote parameterisation and for fetching measured values via the current output HART (4...20 mA). Contact your Endress+Hauser representative for more information.	DXR375 – * * * *

8.4 Communication-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and configuring flowmeters. Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC. Contact your Endress+Hauser representative for more information.	DKA80 - *
ToF Tool - Fieldtool Package	Modular software package consisting of the service program “ToF Tool” for configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and the "Fieldtool" service program for the configuration and diagnosis of Proline flow measuring devices. The Proline flow measuring devices are accessed via a service interface or via the service interface FXA 193. Contents of the “ToF Tool - Fieldtool Package”: – Commissioning, maintenance analysis – Configuring flowmeters – Service functions – Visualisation of process data – Trouble-shooting – Controlling the “Fieldcheck” tester/simulator Contact your Endress+Hauser representative for more information.	DXS10 - * * * * *
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the “ToF Tool - Fieldtool Package” software package, test results can be imported into a database, printed and used for official certification. Contact your Endress+Hauser representative for more information.	DXC10 – * *

9 Trouble-shooting

9.1 Trouble-shooting instructions

Always start trouble-shooting with the checklist below, if faults occur after start-up or during operation. The routine takes you directly to the cause of the problem and the appropriate remedial measures.

Check the display	
No display visible and no output signals present.	1. Check the power supply → terminals 1, 2 2. Check the power line fuse → Page 102 85...260 V AC: 0.8 A slow-blow / 250 V 20...55 V AC and 16...62 V DC: 2 A slow-blow / 250 V 3. Measuring electronics defective → order spare parts → Page 97
No display visible, but output signals are present.	1. Check whether the ribbon-cable connector of the display module is correctly plugged into the amplifier board → Page 99, 101 2. Display module defective → order spare parts → Page 97 3. Measuring electronics defective → order spare parts → Page 97
Display texts are in a foreign language.	Switch off power supply. Press and hold down both the ± buttons and switch on the measuring device. The display text will appear in English (default) and is displayed at maximum contrast.
Measured value indicated, but no signal at the current or pulse output	Measuring electronics defective → order spare parts → Page 97

▼

Error messages on display	
Errors which occur during commissioning or measuring operation are displayed immediately. Error messages consist of a variety of icons: the meanings of these icons are as follows (example): – Error type: **S** = system error, **P** = process error – Error message type: ϟ = fault message, **!** = notice message – **EMPTY PIPE** = Type of error, e.g. measuring tube is only partly filled or completely empty – **03:00:05** = duration of error occurrence (in hours, minutes and seconds) – **# 401** = error number ☞ Caution!! ■ See the information on Page 64! ■ The measuring system interprets simulations and positive zero return as system errors, but displays them as notice message only.	
Error number: No. 001 – 399 No. 501 – 699	System error (device error) has occurred → Page 90
Error number: No. 401 - 499	Process error (application error) has occurred → Page 93

▼

Other error (without error message)	
Some other error has occurred.	Diagnosis and rectification → Page 94

9.2 System error messages

Serious system errors are **always** recognised by the instrument as "Fault message", and are shown as a lightning flash (ϟ) on the display. Fault messages immediately affect the inputs and outputs. Simulations and positive zero return, on the other hand, are classed and displayed as notice messages.

Caution!
In the event of a serious fault, a flowmeter might have to be returned to the manufacturer for repair. The procedures on Page 8 must be carried out before you return a flowmeter to Endress+Hauser. Always enclose a duly completed "Declaration of contamination" form. You will find a preprinted blank of the this form at the back of this manual.

Note!
The listed error message types below correspond to the factory setting.
Also observe the information on Page 64 and 95.

No.	Error message / Type	Cause	Remedy / spare part
S = System error ϟ = Fault message (*with* an effect on the outputs) ! = Notice message (*without* an effect on the outputs)			
No. # 0xx → Hardware error			
001	S: CRITICAL FAILURE ϟ: # 001	Serious device error	Replace the amplifier board. Spare parts → Page 97
011	S: AMP HW EEPROM ϟ: # 011	Amplifier: Defective EEPROM	Replace the amplifier board. Spare parts → Page 97
012	S: AMP SW EEPROM ϟ: # 012	Amplifier: Error accessing EEPROM data	The EEPROM data blocks in which an error has occurred are displayed in the "TROUBLESHOOTING" function. Press Enter to acknowledge the errors in question; default values are automatically inserted instead of the errored parameter values. Note! The measuring device has to be restarted if an error has occurred in a totalizer block (see error No. 111 / CHECKSUM TOTAL).
031	S: SENSOR HW DAT ϟ: # 031	Sensor DAT: 1. S-DAT is defective. 2. S-DAT is not plugged into the amplifier board or is missing.	1. Replace the S-DAT. Spare parts → Page 97 Check the spare part set number to ensure that the new, replacement DAT is compatible with the measuring electronics. 2. Plug the S-DAT into the amplifier board → Page 99, 101
032	S: SENSOR SW DAT ϟ: # 032	Sensor: Error accessing the calibration values stored in the S-DAT.	1. Check whether the S-DAT is correctly plugged into the amplifier board → Page 99, 101 2. Replace the S-DAT if it is defective. Spare parts → Page 97. Before replacing the DAT, check that the new, replacement DAT is compatible with the measuring electronics. Check the: – Spare part set number – Hardware revision code 3. Replace measuring electronics boards if necessary. Spare parts → Page 97

No.	Error message / Type	Cause	Remedy / spare part
No. # 1xx → Software error			
101	S: GAIN ERROR AMP ϟ: # 101	Gain deviation compared to reference gain is greater than 2%.	Replace amplifier board. Spare parts → Page 97
111	S: CHECKSUM TOTAL ϟ: # 111	Totalizer checksum error	1. Restart the measuring device 2. Replace the amplifier board if necessary. Spare parts → Page 97
121	S: A / C COMPATIB. !: # 121	Due to different software versions, I/O board and amplifier board are only partially compatible (possibly restricted functionality). ✎ Note! – The indication on the display as notice message appears only for 30 seconds (with listing in "Previous system condition" function). – This condition can occur if only one electronics board has been exchanged; the extended software functionality is not available. The previously existing software functionality is still working and the measurement possible.	Module with lower software version has either to be actualizied by FieldTool with the required software version or the module has to be replaced. Spare parts → Page 97
No. # 2xx → Error in DAT / no communication			
251	S: COMMUNICATION I/O ϟ: # 251	Internal communication error on the amplifier board.	Remove the amplifier board. Spare parts → Page 97
261	S: COMMUNICATION I/O ϟ: # 261	No data reception between amplifier and I/O board or faulty internal data transfer.	Check the BUS contacts
No. # 3xx → System limits exceeded			
321	S: TOL. COIL CURR. ϟ: # 321	Sensor: Coil current is out of tolerance.	1. Remote version: Switch off the power supply before connecting or disconnecting the cable of the coil (terminals 41/42). 2. Remote version: Switch off power supply and check wiring of terminals 41/42 → Page 47 ff. 3. Switch off the power supply and check the connectors of the coil cable → Page 99, 101 4. Replace measuring electro-nics boards if necessary. Spare parts → Page 97
339 ... 342	S: STACK CUR OUT n !: # 339...342	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable. Recommendations in the event of fault category = FAULT MESSAGE (ϟ): – Configure the fault response of the output to "ACTUAL VALUE" (see Page 95), so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under Item 1.
343 ... 346	S: STACK FREQ. OUT n !: # 343...346		
347 ... 350	S: STACK PULSE OUT n !: # 347...350	The temporarily buffered flow portions (measuring mode for pulsating flow) could not be cleared or output within 60 seconds.	1. Increase the setting for pulse weighting 2. Increase the max. pulse frequency, if the totalizer can handle a higher number of pulses. 3. Reduce flow Recommendations in the event of fault category = FAULT MESSAGE (ϟ): – Configure the fault response of the output to "ACTUAL VALUE" (see Page 95), so that the temporary buffer can be cleared. – Clear the temporary buffer by the measures described under Item 1.

No.	Error message / Type	Cause	Remedy / spare part
351 ... 354	S: CURRENT RANGE n !: # 351...354	Current output: Flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
355 ... 358	S: FREQ. RANGE n !: # 355...358	Frequency output: Flow is out of range.	1. Change the upper or lower limit setting, as applicable. 2. Increase or reduce flow, as applicable.
359 ... 362	S: PULSE RANGE n !: # 359...362	Pulse output: Pulse output frequency is out of range.	1. Increase the setting for pulse weighting 2. When selecting the pulse width, choose a value that can still be processed by a connected counter (e.g. mechanical counter, PLC etc.). *Determine the pulse width:* – Variant 1: Enter the minimum duration that a pulse must be present at the connected counter to ensure its registration. – Variant 2: Enter the maximum (pulse) frequency as the half "reciprocal value" that a pulse must be present at the connected counter to ensure its registration. Example: The maximum input frequency of the connected counter is 10 Hz. The pulse width to be entered is: $\frac{1}{2 \cdot 10\ \text{Hz}} = 50\ \text{ms}$ 3. Reduce flow.
No. # 5xx → Application error			
501	S: SW.-UPDATE ACT. !: # 501	New amplifier or communication (I/O module) software version is loaded. Currently no other functions are possible.	Wait until the procedure is finished. The device will restart automatically.
502	S: UP-/DOWNLOAD ACT !: # 502	Up- or downloading the device data via configuration program. Currently no other functions are possible.	Wait until the procedure is finished.
No. # 6xx → Simulation mode active			
601	S: POS. ZERO-RETURN !: # 601	Positive zero return active Caution!! This message has the highest display priority!	Switch off positive zero return
611 ... 614	S: SIM. CURR. OUT. n !: # 611...614	Simulation current output active	Switch off simulation
621 ... 624	SIM. FREQ. OUT. n !: # 621...624	Simulation frequency output active	Switch off simulation
631 ... 634	S: SIM. PULSE n !: # 631...634	Simulation pulse output active	Switch off simulation
641 ... 644	S: SIM. STAT. OUT n !: # 641...644	Simulation status output active	Switch off simulation
671 ... 674	S: SIM. STATUS IN !: # 671...674	Simulation status input active	Switch off simulation

No.	Error message / Type	Cause	Remedy / spare part
691	S: SIM. FAILSAFE !: # 691	Simulation of response to error (outputs) active	Switch off simulation
692	S: SIM. VOL. FLOW !: # 692	Simulation of volume flow active	Switch off simulation
698	S: DEV. TEST ACT. !: # 698	The measuring device is being checked on site via the test and simulation device.	–

9.3 Process error messages

Process errors can be defined as either “Fault” or “Notice” messages and can thereby be weighted differently. Determination of this is done via the function matrix (see the “Description of Device Functions” Manual).

✎ Note!
The error types listed in the following correspond to the factory settings.
Also observe the information on Page 64 ff. and 95.

No.	Error message / Type	Cause	Remedy
P = Process error ϟ = Fault message (*with* an effect on the outputs) ! = Notice message (*without* an effect on the outputs)			
401	EMPTY PIPE ϟ: # 401	Measuring tube partially filled or empty	1. Check the process conditions of the plant 2. Fill the measuring tube
461	ADJ. NOT OK !: # 461	EPD/OED calibration not possible because the fluid's conductivity is either too low or too high.	The EPD/OED function cannot be used with fluids of this nature.
463	FULL = EMPTY ϟ: # 463	The EPD/OED calibration values for empty pipe and full pipe are identical, therefore incorrect.	Repeat calibration, making sure procedure is correct → Page 81

9.4 Process errors without messages

Symptoms	Rectification
Remark: You may have to change or correct certain settings in functions in the function matrix in order to rectify the fault. The functions outlined below, such as DISPLAY DAMPING, for example, are described in detail in the "Description of Device Functions" manual.	
Flow values are negative, even though the fluid is flowing forwards through the pipe.	1. Remote version: – Switch off the power supply and check the wiring → Page 47 ff. – If necessary, reverse the connections at terminals 41 and 42 2. Change the setting in the "INSTALLATION DIRECTION SENSOR" function accordingly
Measured-value reading fluctuates even though flow is steady.	1. Check grounding and potential equalization → Page 56 ff. 2. Check the fluid for presence of gas bubbles. 3. In the "TIME CONSTANT" function (current output) → increase the value 4. In the "DISPLAY DAMPING" function → increase the value
Measured-value reading shown on display, even though the fluid is at a standstill and the measuring tube is full.	1. Check grounding and potential equalization → Page 56 ff. 2. Check the fluid for presence of gas bubbles. 3. Activate the "LOW FLOW CUTOFF" function, i.e. enter or increase the value for the switching point.
Measured-value reading on display, even though measuring tube is empty.	1. Perform empty-pipe/full-pipe adjustment and then switch on Empty Pipe detection → Page 81 2. Remote version: Check the terminals of the EPD cable → Page 47 ff. 3. Fill the measuring tube.
The current output signal is always 4 mA, irrespective of the flow signal at any given time.	1. Select the "BUS ADDRESS" function and change the setting to "0". 2. Value for creepage too high. Reduce corresponding value in the "Low flow cutoff" functions (ON-/OFF-VALUE).
The fault cannot be rectified or some other fault not described above has arisen. In these instances, please contact your Endress+Hauser service organization.	The following options are available for tackling problems of this nature: **Request the services of an Endress+Hauser service technician** If you contact our service organization to have a service technician sent out, please be ready to quote the following information: – Brief description of the fault – Nameplate specifications (Page 9 ff.): order code, serial number **Returning devices to Endress+Hauser** The procedures on Page 8 must be carried out before you return a flowmeter requiring repair or calibration to Endress+Hauser. Always enclose a duly completed "Declaration of Conformity" form with the flowmeter. You will find a preprinted form at the back of this manual. **Replace transmitter electronics** Components in the measuring electronics defective → order spare parts → Page 97

9.5 Response of outputs to errors

Note!
The failsafe mode of totalizers, current, pulse and frequency outputs can be customized by means of various functions in the function matrix. You will find detailed information on these procedures in the "Description of Device Functions" manual.

Positive zero return and failsafe mode:
You can use positive zero return to set the signals of the current, pulse and frequency outputs to their fallback value, for example when measuring has to be interrupted while a pipe is being cleaned.
This function takes priority over all other device functions: simulations, for example, are suppressed.

Failsafe mode of outputs and totalizers		
	Process/system error is current	Positive zero return is activated
Caution!! System or process errors defined as "Notice messages" have no effect whatsoever on the inputs and outputs. See the information on Page 64 ff.		
Current output	*MINIMUM CURRENT* The current output will be set to the lower value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (see the "Description of Device Functions" manual). *MAXIMUM CURRENT* The current output will be set to the higher value of the signal on alarm level depending on the setting selected in the CURRENT SPAN (see the "Description of Device Functions" manual). *HOLD VALUE* Measured value display on the basis of the last saved value preceding occurrence of the fault. *ACTUAL VALUE* Measured value display on the basis of the current flow measurement. The fault is ignored.	Output signal corresponds to "zero flow"
Pulse output	*FALLBACK VALUE* Signal output → no pulses *ACTUAL VALUE* Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to "zero flow"

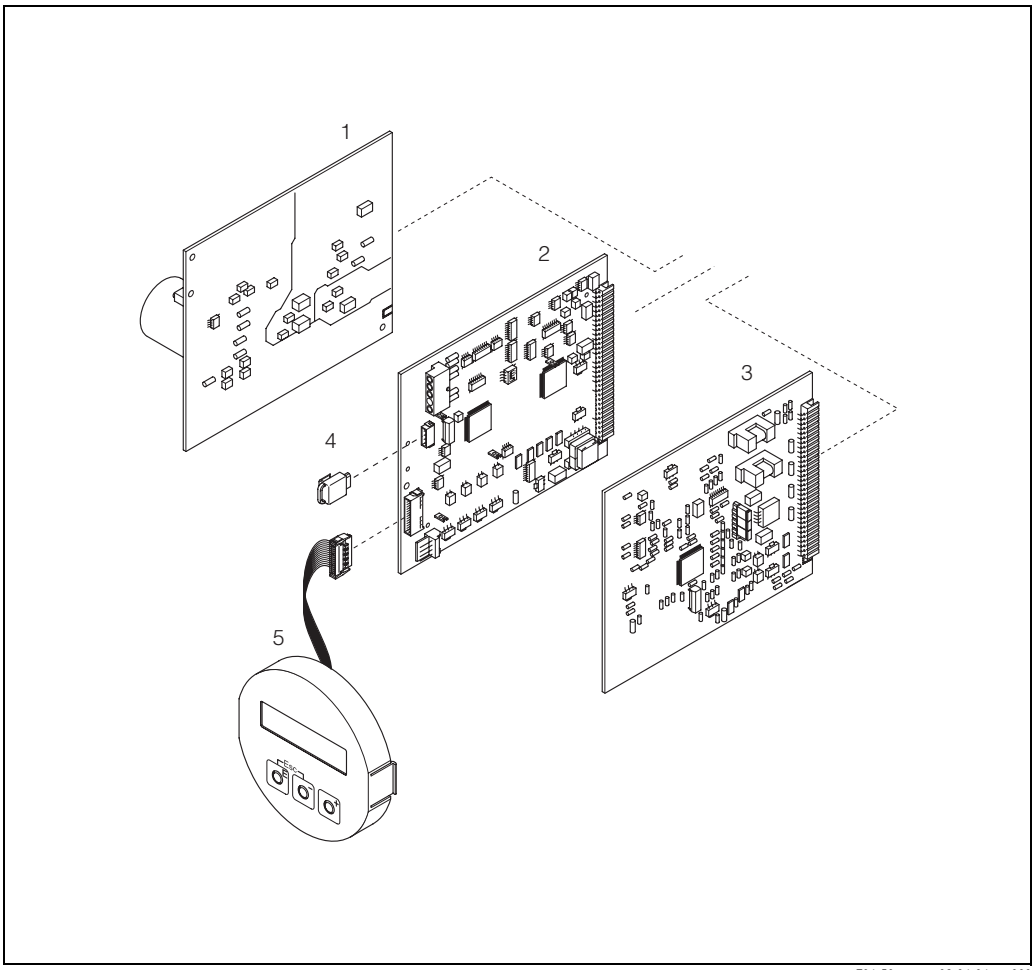
Failsafe mode of outputs and totalizers		
	Process/system error is current	Positive zero return is activated
Frequency output	*FALLBACK VALUE* Signal output → 0 Hz *FAILSAFE LEVEL* Output of the frequency specified in the FALÌLSAFE VALUE function. *HOLD VALUE* Last valid value (preceding occurrence of the fault) is output. *ACTUAL VALUE* Fault is ignored, i.e. normal measured-value output on the basis of ongoing flow measurement.	Output signal corresponds to “zero flow”
Totalizer	*STOP* The totalizers are paused until the error is rectified. *ACTUAL VALUE* The fault is ignored. The totalizers continue to count in accordance with the current flow value. *HOLD VALUE* The totalizers continue to count the flow in accordance with the last valid flow value (before the error occurred).	Totalizer stops
Status output	In the event of a fault or power supply failure: Status output → non-conductive	No effect on status output

9.6 Spare parts

Chap. 9.1 contains a detailed trouble-shooting guide. The measuring device, moreover, provides additional support in the form of continuous self-diagnosis and error messages. Fault rectification can entail replacing defective components with tested spare parts. The illustration below shows the available scope of spare parts.

Note!
You can order spare parts directly from your Endress+Hauser service organisation by providing the serial number printed on the transmitter's nameplate (Page 9 ff.).

Spare parts are shipped as sets comprising the following parts:
- Spare part
- Additional parts, small items (threaded fasteners, etc.)
- Mounting instructions
- Packaging



F06-50xxxxxx-03-06-06-xx-000

Fig. 48: Spare parts for Promag 50 transmitter (field and wall-mounted housings)

1 Power supply board (85...260 V AC, 20...55 V AC, 16...62 V DC)
2 Amplifier board
3 I/O board
4 S-DAT (sensor data memory)
5 Display module

9.7 Removing and installing printed circuit boards

Field housing: removing and installing printed circuit boards (Fig. 49)

Warning!
- Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface purpose-built for electrostatically sensitive devices!
- If you cannot guarantee that the dielectric strength of the device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.
- When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to these Operating Instructions.

1. Unscrew cover of the electronics compartment from the transmitter housing.
2. Remove the local display (1) as follows:
   – Press in the latches (1.1) at the side and remove the display module.
   – Disconnect the ribbon cable (1.2) of the display module from the amplifier board.
3. Remove the screws and remove the cover (2) from the electronics compartment.
4. Remove power supply board and I/O board (4, 6):
   Insert a suitable tool into the holes (3) provided for the purpose and pull the board clear of its holder.
5. Remove amplifier board (5):
   – Disconnect the plug of the electrode signal cable (5.1) including S-DAT (5.3) from the board.
   – Loosen the plug locking of the coil current cable (5.2) and gently disconnect the plug from the board, i.e. without moving it to and fro.
   – Insert a thin pin into the hole (3) provided for the purpose and pull the board clear of its holder.
6. Installation is the reverse of the removal procedure.

Caution!
Use only original Endress+Hauser parts.

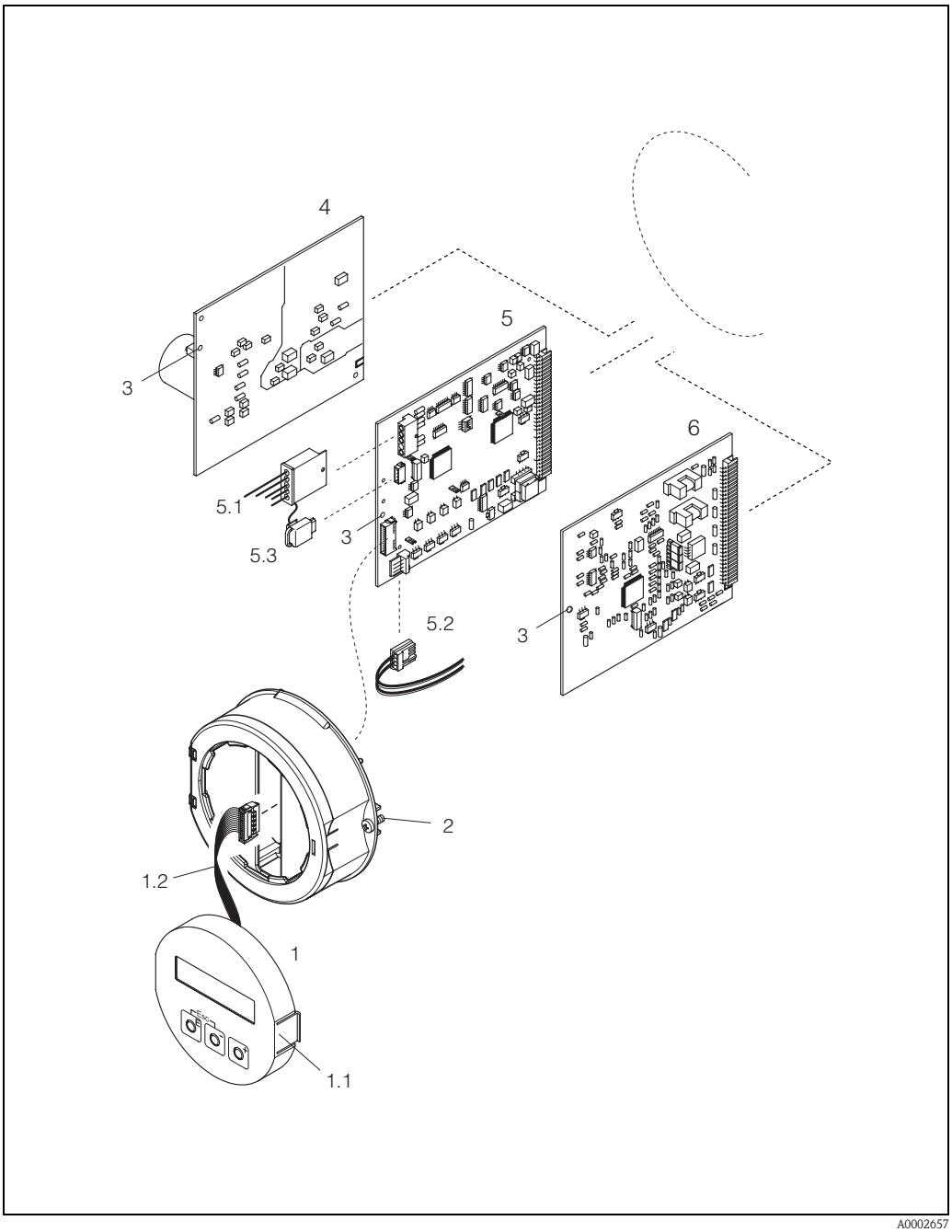


Fig. 49: Field housing: removing and installing printed circuit boards

1 Local display
1.1 Latch
1.2 Ribbon cable (display module)
2 Screws of electronics compartment cover
3 Aperture for tool, removal/installation
4 Power supply board
5 Amplifier board
5.1 Electrode signal cable (sensor)
5.2 Coil current cable (sensor)
5.3 S-DAT (sensor data memory)
6 I/O board

Wall-mounted housing: removing and installing printed circuit boards (Fig. 50)



Warning!
- Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.
- Risk of damaging electronic components (ESD protection). Static electricity can damage electronic components or impair their operability. Use a workplace with a grounded working surface, purpose-built for electrostatically sensitive devices.
- If you cannot guarantee that the dielectric strength of the device is maintained in the following steps, then an appropriate inspection must be carried out in accordance with the manufacturer's specifications.
- When connecting Ex-certified devices, see the notes and diagrams in the Ex-specific supplement to these Operating Instructions.

1. Remove the screws and open the hinged cover (1) of the housing.
2. Remove screws of the electronics module (2). Then push up electronics module and pull it as far as possible out of the wall-mounted housing.
3. Disconnect the following cable plugs from amplifier board (7):
   – Electrode signal cable plug (7.1) including S-DAT (7.3)
   – Plug of coil current cable (7.2). To do so, loosen the plug locking of the coil current cable and gently disconnect the plug from the board, i.e. without moving it to and fro.
   – Ribbon cable plug (3) of the display module
4. Remove the screws and remove the cover (4) from the electronics compartment.
5. Remove the boards (6, 7, 8):
   Insert a suitable tool into the hole (5) provided for the purpose and pull the board clear of its holder.
6. Installation is the reverse of the removal procedure.



Caution!
Use only original Endress+Hauser parts.

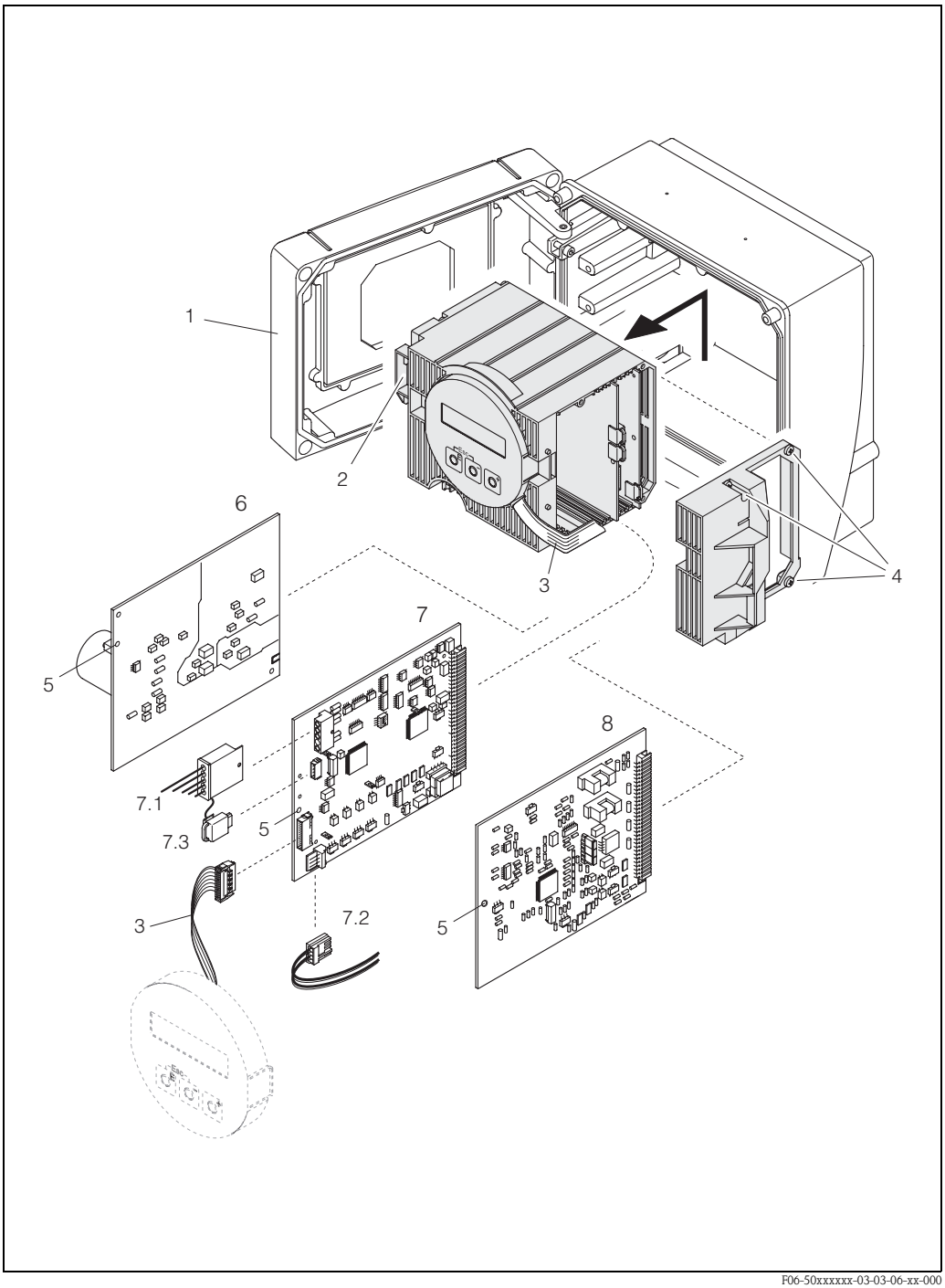


Fig. 50: Wall-mounted housing: removing and installing printed circuit boards

1 Housing cover
2 Electronics module
3 Ribbon cable (display module)
4 Cover of electronics compartment (3 screws)
5 Aperture for tool, removal/installation
6 Power supply board
7 Amplifier board
7.1 Electrode signal cable (sensor)
7.2 Coil current cable (sensor)
7.3 S-DAT (sensor data memory)
8 I/O board

9.8 Replacing the device fuse

⚠ Warning!
Risk of electric shock. Exposed components carry dangerous voltages. Make sure that the power supply is switched off before you remove the cover of the electronics compartment.

The main fuse is on the power supply board (Fig. 51).
The procedure for replacing the fuse is as follows:

1. Switch off power supply.
2. Remove the power supply board → Page 98, 100
3. Remove cap (1) and replace the device fuse (2).
   Use only fuses of the following type:
   – Power supply 20...55 V AC / 16...62 V DC → 2.0 A slow-blow / 250 V; 5.2 x 20 mm
   – Power supply 85...260 V AC → 0.8 A slow-blow / 250 V; 5.2 x 20 mm
   – Ex-rated devices → see the Ex documentation.
4. Assembly is the reverse of the disassembly procedure.

☝ Caution!
Use only original Endress+Hauser parts.

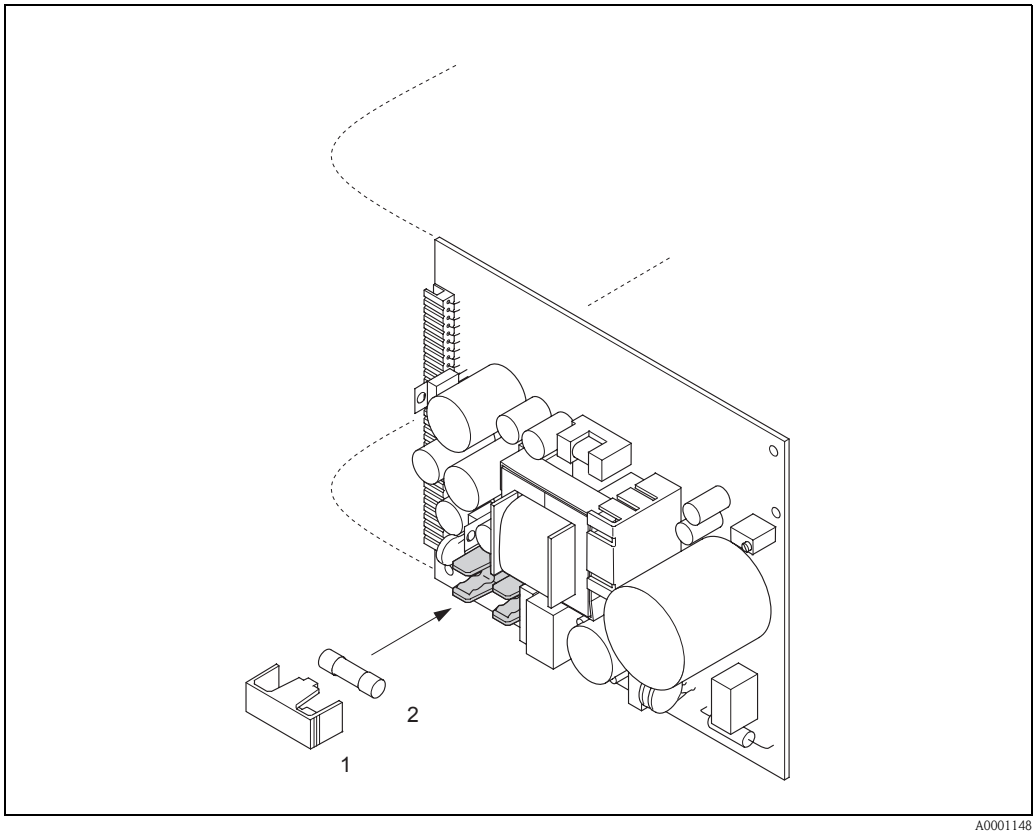
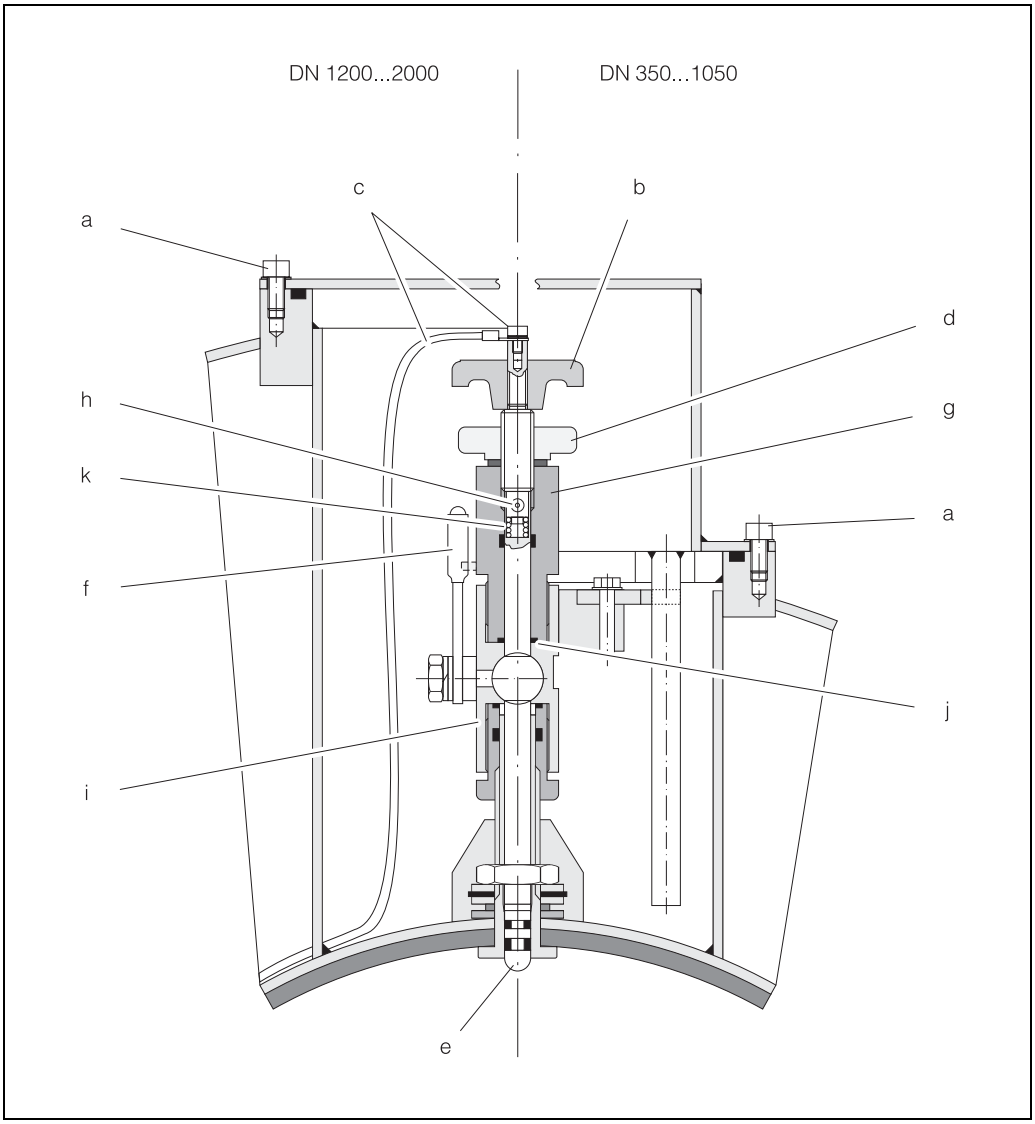


Fig. 51: Replacing the device fuse on the power supply board

1 Protective cap
2 Device fuse

9.9 Replacing exchangeable measuring electrodes

The Promag W sensor (DN 350...2000) is available with exchangeable measuring electrodes as an option. This design permits the measuring electrodes to be replaced or cleaned under process conditions (see Page 104).



F06-5xWxxxxx-00-05-xx-xx-000

Fig. 52: Apparatus for replacing exchangeable measuring electrodes (Replacing → Page 104)

a Allen screw
b Handle
c Electrode cable
d Knurled nut (locknut)
e Measuring electrode
f Stop cock
g Retaining cylinder
h Locking pin (for handle)
i Ball-valve housing
j Seal (retaining cylinder)
k Coil spring

Removing the electrode		Installing the electrode	
1	Loosen Allen screw (a) and remove the cover.	1	Insert new electrode (e) into retaining cylinder (g) from below. Make sure that the seals at the tip of the electrode are clean.
2	Remove electrode cable (c) secured to handle (b).	2	Mount handle (b) on the electrode and insert locking pin (h) to secure it in position. Caution!! Make sure that coil spring (k) is inserted. This is essential to ensure correct electrical contact and correct measuring signals.
2	Loosen knurled nut (d) by hand. This knurled nut acts as a locknut.	2	Pull the electrode back until the tip of the electrode no longer protrudes from retaining cylinder (g).
3	Remove electrode (e) by turning handle (b). The electrode can now be pulled out of retaining cylinder (g) as far as a defined stop. Warnung! Risk of injury. Under process conditions (pressure in the piping system) the electrode can recoil suddenly against its stop. Apply counter-pressure while releasing the electrode.	3	Screw the retaining cylinder (g) onto ball-valve housing (i) and tighten it by hand. Seal (j) on the cylinder must be correctly seated and clean. Note! Make sure that the rubber hoses on retaining cylinder (g) and stop cock (f) are of the same color (red or blue).
4	Close stop cock (f) after pulling out the electrode as far as it will go. Warnung! Do not subsequently open the stop cock, in order to prevent fluid escaping.	4	Open stop cock (f) and turn handle (b) to screw the electrode all the way into the retaining cylinder.
5	Remove the electrode complete with retaining cylinder (g).	5	Screw knurled nut (d) onto the retaining cylinder. This firmly locates the electrode in position.
6	Remove handle (b) from electrode (e) by pressing out locking pin (h). Take care not to lose coil spring (k).	6	Use the Allen screw to secure electrode cable (c) to handle (b). Caution!! Make sure that the machine screw securing the electrode cable is firmly tightened. This is essential to ensure correct electrical contact and correct measuring signals.
7	Remove the old electrode and insert the new electrode. Replacement electrodes can be ordered separately from Endress+Hauser.	7	Reinstall the cover and tighten (a) Allen screw.

9.10 Software history

Date	Software version	Changes to software	Operating Instructions
03.2005	2.00.XX	Software expansion: – New / revised functionalities New functionalities: – DEVICE SOFTWARE → Device software displayed (NAMUR-recommendation 53) – Unit US Kgal	50097090/03.05
11.2004	Amplifier: 1.06.01 Communication module: 1.04.00	Software update relevant only for production	50097090/10.03
10.2003	Amplifier: 1.06.00 Communication module: 1.03.00	Software expansion: – Language groups – Flow direction pulse output selectable New functionalities: – Second Totalizer – Adjustable backlight (display) – Operation hours counter – Simulation function for pulse output – Access code for counter – Reset function (fault history) – Up-/download with FieldTool	50097090/10.03
08.2003	Communication module: 1.02.01	Software expansion: – New / revised functionalities Special documentation: – Current span NAMUR NE 43 – Failsafe mode function – Trouble-shooting function – System and process error messages – Response of status output	50097090/08.03
08.2002	Amplifier: 1.04.00	Software expansion: – New / revised functionalities Special documentation: – Current span NAMUR NE 43 – EPD (new mode) – Failsafe mode function – Acknowledge fault function – Trouble-shooting function – System and process error messages – Response of status output	50097090/08.02
03.2002	Amplifier: 1.03.00	Software expansion: – Suitability for custody transfer measurement Promag 50/51	none
06.2001	Amplifier: 1.02.00 Communication module: 1.02.00	Software expansion: – New functionalities: New functionalities: – General instrument functions – “OED” software function – “Pulse width” software function	50097090/06.01

Date	Software version	Changes to software	Operating Instructions
09.2000	Amplifier: 1.01.01 Communication module: 1.01.00	Software expansion: – Functional adaptations	none
08.2000	Amplifier: 1.01.00	Software expansion: – Functional adaptations	none
04.2000	Amplifier: 1.00.00 Communication module: 1.00.00	Original software Compatible with: – FieldTool – Commuwin II (version 2.05.03 and higher) – HART Communicator DXR 275 (from OS 4.6) with Rev. 1, DD 1.	50097090/04.00



Note!
Usually, an upload or download between the different software versions is only possible with a special service software.

10 Technical data

10.1 Technical data at a glance

10.1.1 Application

Application	■ Measuring the flow rate of fluids in closed piping systems. ■ A minimum conductivity of ≥ 5 μS/cm is required for measuring; the minimum conductivity required in the case of demineralised water is ≥ 20 μS/cm. ■ Applications in measuring, control and regulation technology Liner specific applications: ■ Promag W (DN 25...2000): – Polyurethane lining for applications with cold water and for slightly abrasive fluids. – Hard rubber lining for all applications with water (especially for trinking water) ■ Promag P (DN 15...600): – PTFE lining for standard applications in chemical and process industries. – PFA lining for all applications in chemical and process industries; especially for high process temperatures and applications with temperature shocks. ■ Promag H (DN 2...100): PFA lining for all applications in chemical, process and food industries; especially for high process temperatures, for applications with temperature shocks and for applications with CIP or SIP cleaning processes.

10.1.2 Function and system design

Measuring principle	Electromagnetic flow measurement on the basis of Faraday's Law.
Measuring system	The measuring system consists of a transmitter and a sensor. Two versions are available: ■ Compact version: transmitter and sensor form a single mechanical unit. ■ Remote version: transmitter and sensor are installed separately. *Transmitter:* ■ Promag 50 *Sensor:* ■ Promag W (DN 25...2000) ■ Promag P (DN 15...600) ■ Promag H (DN 2...100)

10.1.3 Input

Measured variable	Flow rate (proportional to induced voltage)
Measuring range	Typically v = 0.01…10 m/s with the specified measuring accuracy
Operable flow range	Over 1000 : 1
Input signals	Status input (auxiliary input): U = 3…30 V DC, R_i = 5 kΩ, galvanically isolated Configurable for: totalizer reset, positive zero return

10.1.4 Output

Output signal	Current output: active/passive selectable, galvanically isolated, time constant selectable (0.01…100 s), full scale value selectable, temperature coefficient: typically 0.005% o.f.s./ °C; resolution: 0.5 µA ■ active: 0/4…20 mA, R_L < 700 Ω (for HART: $R_L \geq 250$ Ω) ■ passive: 4…20 mA, supply voltage V_s: 18...30 V DC, $R_i \geq 150$ Ω Pulse / frequency output: passive, open collector, 30 V DC, 250 mA, galvanically isolated ■ Frequency output: full scale frequency 2…1000 Hz (f_{max} = 1250 Hz), on/off ratio 1:1, pulse width max. 10 s ■ Pulse output: pulse value and pulse polarity selectable, pulse width configurable (0.5…2000 ms)
Signal on alarm	■ Current output → failsafe mode selectable (e.g. to NAMUR recommendation NE 43) ■ Pulse/frequency output → failsafe mode selectable ■ Status output → “non-conductive” by fault or power supply failure Details → Page 95
Load	see “output signal”
Switching output	Status output: Open collector, max. 30 V DC / 250 mA, galvanically isolated Configurable for: error messages, Empty Pipe Detection (EPD/OED), flow direction, limit values
Low flow cutoff	Switch points for low flow cutoff are selectable
Galvanic isolation	All circuits for inputs, outputs, and power supply are galvanically isolated from each other.

10.1.5 Power supply

Electrical connections	see Page 47 ff.
Cable entry	Power-supply and signal cables (inputs/outputs): ■ Cable entry M20 x 1.5 (8…12 mm) ■ Sensor cable entry for armoured cables M20 x 1.5 (9.5...16 mm) ■ Threads for cable entries 1/2" NPT, G 1/2" Connecting cable for remote version: ■ Cable entry M20 x 1.5 (8…12 mm) ■ Sensor cable entry for armoured cables M20 x 1.5 (9.5...16 mm) ■ Threads for cable entries 1/2" NPT, G 1/2"
Cable specifications	see Page 51
Supply voltage	85…260 V AC, 45…65 Hz 20…55 V AC, 45…65 Hz 16…62 V DC

Power consumption

AC: <15 VA (including sensor)
DC: <15 W (including sensor)

Switch-on current:
- max. 13.5 A (< 50 ms) at 24 V DC
- max. 3 A (< 5 ms) at 260 V AC

Power supply failure

Lasting min. 1 power cycle
- EEPROM saves measuring system data if power supply fails
- S-DAT: exchangeable data storage chip which stores the data of the sensor (nominal diameter, serial number, calibration factor, zero point, etc.)

Potential equalisation

see Page 56 ff.

10.1.6 Performance characteristics

Reference operating conditions

To DIN EN 29104 and VDI/VDE 2641:
- Fluid temperature: +28 °C ± 2 K
- Ambient temperature: +22 °C ± 2 K
- Warm-up time: 30 minutes

Installation:
- Inlet run >10 x DN
- Outlet run > 5 x DN
- Sensor and transmitter grounded.
- Sensor centered relative to the pipe.

Maximum measured error

Pulse output:
- ± 0.5% o.r. ± 1 mm/s (o.r. = of reading)
- Option: ± 0.2% o.r. ± 2 mm/s (o.r. = of reading)

Current output: plus typically ± 5 µA

Supply-voltage fluctuations have no effect within the specified range.

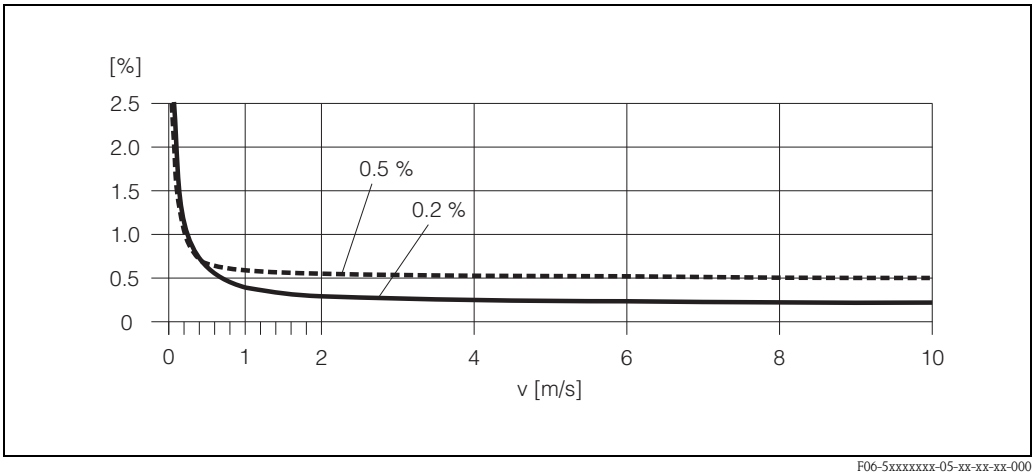


Fig. 53: Max. measured error in % of reading

Repeatability

max. ± 0.1% o.r. ± 0.5 mm/s (o.r. = of reading)

10.1.7 Operating conditions

Installation

Installation instructions	Any orientation (vertical, horizontal) Restrictions and additional installation instructions → see Page 15 ff.
Inlet and outlet runs	Inlet run: typically ≥ 5 x DN Outlet run: typically ≥ 2 x DN
Length of connecting cable	For the remote version the permissible cable length L_{max} depends on the conductivity of the medium → Page 25. A minimum conductivity of 20 μS/cm is required for measuring demineralized water.

Environment

Ambient temperature	Transmitter: ■ Standard: –20...+60 °C ■ Optional: –40...+60 °C Note! At ambient temperatures below –20 °C the readability of the display may be impaired. Sensor: ■ Flange material carbon steel: –10...+60 °C ■ Flange material stainless steel: –40...+60 °C Caution! It is not allowed to use the device beyond the min. and max. lining specified temperature values (→ “Medium temperature range”). Note the following points: ■ Install the device at a shady location. Avoid direct sunlight, particularly in warm climatic regions. ■ If both fluid and ambient temperatures are high, install the transmitter at a remote location from the sensor (→ “Medium temperature range”).
Storage temperature	The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.
Degree of protection	■ Standard: IP 67 (NEMA 4X) for transmitter and sensor ■ Optional: IP 68 (NEMA 6P) for remote version of Promag W and P sensor
Shock and vibration resistance	Acceleration up to 2 g by analogy with IEC 60068-2-6 (high-temperature version: no data available)
CIP cleaning	Promag W: not possible Promag P: possible (note max. temperature) Promag H: possible (note max. temperature)
SIP cleaning	Promag W: not possible Promag P: possible with PFA (note max. temperature) Promag H: possible (note max. temperature)
Electromagnetic compatibility (EMC)	To EN 61326/A1 and NAMUR recommendation NE 21.

Process

Medium temperature range

The permissible fluid temperature depends on the lining of the measuring tube:

Promag W
0…+80 °C for hard rubber (DN 65…2000)
–20…+50 °C for polyurethane (DN 25…2000)

Promag P
–40…+130 °C for PTFE (DN 15…600), for restrictions → refer to diagrams
–20…+180 °C for PFA (DN 25…200), for restrictions → refer to diagrams

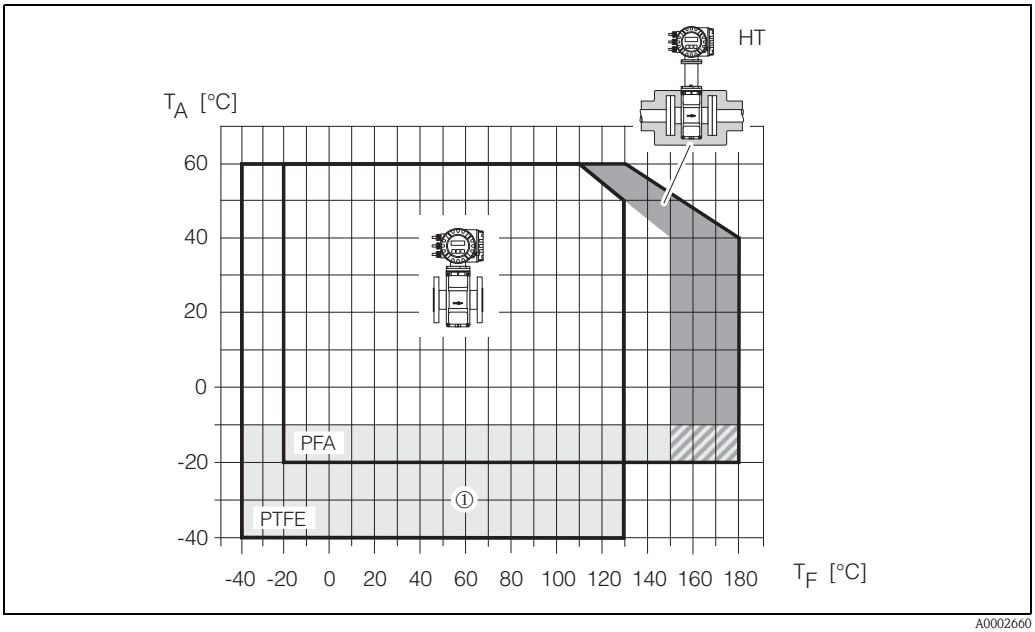


Fig. 54: Compact version Promag P (with PFA or PTFE lining)
T_A = ambient temperature, T_F = fluid temperature, HT = high-temperature version, with insulation
① = Temperature range from –10 °C to –40 °C is valid for stainless steel flanges only

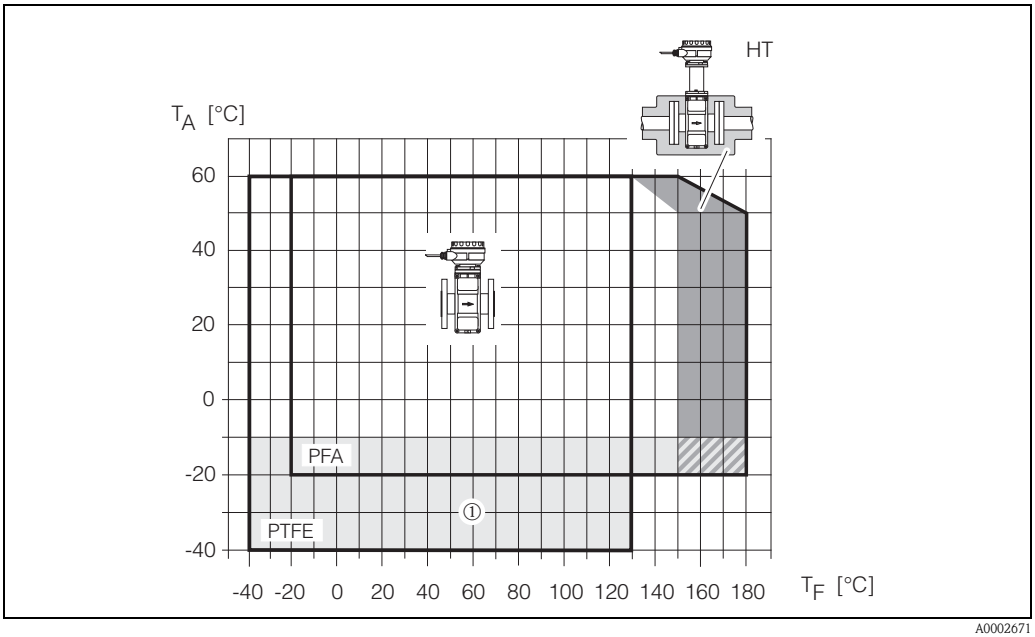


Fig. 55: Remote version Promag P (with PFA or PTFE lining)
T_A = ambient temperature, T_F = fluid temperature, HT = high-temperature version, with insulation
① = Temperature range from –10 °C to –40 °C is valid for stainless steel flanges only

Promag H
Sensor:
- DN 2…25: –20…+150 °C
- DN 40…100: –20…+150 °C

Seal:
- EPDM: –20…+130 °C
- Silicone: –20…+150 °C
- Viton: –20…+150 °C
- Kalrez: –20…+150 °C

Conductivity

Minimum conductivity:
- ≥ 5 µS/cm for fluids generally
- ≥ 20 µS/cm for demineralised water

Note that in the case of the remote version, the requisite conductivity is also influenced by the length of the connecting cable → Page 25.

Limiting medium pressure range (nominal pressure)

Promag W
- EN 1092-1 (DIN 2501): PN 6 (DN 1200…2000), PN 10 (DN 200…2000), PN 16 (DN 65…2000), PN 25 (DN 200…1000), PN 40 (DN 25…150)
- ANSI B16.5: Class 150 (1…24"), Class 300 (1…6")
- AWWA: Class D (28…78")
- JIS B2238: 10K (DN 50…300), 20K (DN 25…300)

Promag P
- EN 1092-1 (DIN 2501): PN 10 (DN 200…600), PN 16 (DN 65…600), PN 25 (DN 200…600), PN 40 (DN 15…150)
- ANSI B16.5: Class 150 (1/2…24"), Class 300 (1/2…6")
- JIS B2238: 10K (DN 50…300), 20K (DN 15…300)

Promag H:
The permissible nominal pressure depends on the process connection and seal:
- 40 bar: flange, weld nipple (with O-ring seal)
- 16 bar: all other process connections

Pressure tightness (liner)

Promag W Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] at various fluid temperatures						
[mm]	[inch]		25 °C	50 °C	80° C	100 °C	130 °C	150 °C	180 °C
25…1000	1…40"	Polyurethane	0	0	–	–	–	–	–
65…2000	3…78"	Hard rubber	0	0	0	–	–	–	–

Promag P Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] at various fluid temperatures					
[mm]	[inch]		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
15	1/2"	PTFE	0	0	0	100	–	–
25	1"	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
32	–	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
40	1 1/2"	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
50	2"	PTFE / PFA	0 / 0	0 / 0	0 / 0	100 / 0	– / 0	– / 0
65	–	PTFE / PFA	0 / 0	*	40 / 0	130 / 0	– / 0	– / 0
80	3"	PTFE / PFA	0 / 0	*	40 / 0	130 / 0	– / 0	– / 0
100	4"	PTFE / PFA	0 / 0	*	135 / 0	170 / 0	– / 0	– / 0
125	–	PTFE / PFA	135 / 0	*	240 / 0	385 / 0	– / 0	– / 0
150	6"	PTFE / PFA	135 / 0	*	240 / 0	385 / 0	– / 0	– / 0
200	8"	PTFE / PFA	200 / 0	*	290 / 0	410 / 0	– / 0	– / 0
250	10"	PTFE	330	*	400	530	–	–
300	12"	PTFE	400	*	500	630	–	–
350	14"	PTFE	470	*	600	730	–	–
400	16"	PTFE	540	*	670	800	–	–
450	18"	PTFE	Partial vacuum is impermissible					
500	20"	PTFE						
600	24"	PTFE						
* No value can be quoted.								

Promag H Nominal diameter		Measuring tube lining	Resistance of measuring tube lining to partial vacuum Limit values for abs. pressure [mbar] at various fluid temperatures					
[mm]	[inch]		25 °C	80 °C	100 °C	130 °C	150 °C	180 °C
2…100	1/12…4"	PFA	0	0	0	0	0	0

Limiting flow

see Page 20

Pressure loss

- No pressure loss if the sensor is installed in a pipe of the same nominal diameter (Promag H: only DN 8 and larger).
- Pressure losses for configurations incorporating adapters according to DIN EN 545 → Page 20

10.1.8 Mechanical construction

Design / dimensions

All the dimensions and lengths of the sensor and transmitter are provided in the separate documentation “Technical Information”.

Weight

Weight data of Promag W in kg

Nominal diameter		Compact version						Remote versin (without cable)						
								Sensor						Wall housing
[mm]	[inch]	EN (DIN) /AS*		JIS		ANSI/AWWA		EN (DIN) /AS*		JIS		ANSI/AWWA		
25	1"	PN 40	7.3	10K	7.3	Class 150	7.3	PN 40	5.3	10K	5.3	Class 150	5.3	6.0
32	1 1/4"		8.0		7.3		–		6.0		5.3		–	6.0
40	1 1/2"		9.4		8.3		9.4		7.4		6.3		7.4	6.0
50	2"		10.6		9.3		10.6		8.6		7.3		8.6	6.0
65	2 1/2"	PN 16	12.0		11.1		–	PN 16	10.0		9.1		–	6.0
80	3"		14.0		12.5		14.0		12.0		10.5		12.0	6.0
100	4"		16.0		14.7		16.0		14.0		12.7		14.0	6.0
125	5"		21.5		21.0		–		19.5		19.0		–	6.0
150	6"		25.5		24.5		25.5		23.5		22.5		23.5	6.0
200	8"	PN 10	45		41.9		45	PN 10	43		39.9		43	6.0
250	10"		65		69.4		75		63		67.4		73	6.0
300	12"		70		72.3		110		68		70.3		108	6.0
350	14"		115				175		113				173	6.0
400	16"		135				205		133				203	6.0
450	18"		175				255		173				253	6.0
500	20"		175				285		173				283	6.0
600	24"		235				405		233				403	6.0
700	28"		355			Class D	400		353			Class D	398	6.0
–	30"		–				460		–				458	6.0
800	32"		435				550		433				548	6.0
900	36"		575				800		573				798	6.0
1000	40"		700				900		698				898	6.0
–	42"	PN 6	–				1100	PN 6	–				1098	6.0
1200	48"		850				1400		848				1398	6.0
–	54"		–				2200		–				2198	6.0
1400	–		1300				–		1298				–	6.0
–	60"		–				2700		–				2698	6.0
1600	–		1700				–		1698				–	6.0
–	66"		–				3700		–				3698	6.0
1800	72"		2200				4100		2198				4098	6.0
–	78"		–				4600		–				4598	6.0
2000	–		2800				–		2798				–	6.0

Transmitter Promag (compact version): 3.4 kg
(Weight data valid for standard pressure ratings and without packaging material)
* Flanges according AS are only available for DN 80, 100, 150...400, 500 and 600

Weight data of Promag P in kg

Nominal diameter		Compact version						Remote version (without cable)						
								Sensor						Wall housing
[mm]	[inch]		EN (DIN) /AS*		JIS		ANSI		EN (DIN) /AS*		JIS		ANSI	
15	1/2"	PN 40	6.5	10K	6.5	Class 150	6.5	PN 40	4.5	10K	4.5	Class 150	4.5	6.0
25	1"		7.3		7.3		7.3		5.3		5.3		5.3	6.0
32	1 1/4"		8.0		7.3		–		6.0		5.3		–	6.0
40	1 1/2"		9.4		8.3		9.4		7.4		6.3		7.4	6.0
50	2"		10.6		9.3		10.6		8.6		7.3		8.6	6.0
65	2 1/2"	PN 16	12.0		11.1		–	PN 16	10.0		9.1		–	6.0
80	3"		14.0		12.5		14.0		12.0		10.5		12.0	6.0
100	4"		16.0		14.7		16.0		14.0		12.7		14.0	6.0
125	5"		21.5		21.0		–		19.5		19.0		–	6.0
150	6"		25.5		24.5		25.5		23.5		22.5		23.5	6.0
200	8"	PN 10	45		41.9		45	PN 10	43		39.9		43	6.0
250	10"		65		69.4		75		63		67.4		73	6.0
300	12"		70		72.3		110		68		70.3		108	6.0
350	14"		115				175		113				173	6.0
400	16"		135				205		133				203	6.0
450	18"		175				255		173				253	6.0
500	20"		175				285		173				283	6.0
600	24"		235				405		233				403	6.0

Transmitter Promag (compact version): 3.4 kg
High-temperature version: +1.5 kg
(Weight data valid for standard pressure ratings and without packaging material)
* Flanges according AS are only available for DN 25 and 50

Weight data of Promag H in kg

Nominal diameter		Compact version	Remote version (without cable)	
[mm]	[inch]	DIN	Sensor	Wall housing
2	1/12"	5.2	2.5	6.0
4	5/32"	5.2	2.5	6.0
8	5/16"	5.3	2.5	6.0
15	1/2"	5.4	2.6	6.0
25	1"	5.5	2.8	6.0
40	1 1/2"	6.5	4.5	6.0
50	2"	9.0	7.0	6.0
65	2 1/2"	9.5	7.5	6.0
80	3"	19.0	17.0	6.0
100	4"	18.5	16.5	6.0

Transmitter Promag (compact version): 3.4 kg
(Weight data valid for standard pressure ratings and without packaging material)

Materials

Promag W

Transmitter housing:
- Compact housing: powder coated die-cast aluminium
- Wall-mounted housing: powder coated die-cast aluminium

Sensor housing:
- DN 25…300: powder-coated die-cast aluminium
- DN 350…2000: painted steel (Amerlock 400)

Measuring tube:
- DN < 350: stainless steel 1.4301 or 1.4306/304L; non-stainless flange material with Al/Zn protective coating
- DN > 300: stainless steel 1.4301/304; non-stainless flange material with Amerlock 400 paint

Flange:
- EN 1092-1 (DIN 2501): 316L / 1.4571; RSt37-2 (S235JRG2) / C22 / FE 410W B (DN < 350: with Al/Zn protective coating; DN > 300 with Amerlock 400 paint)
- ANSI: A105, F316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- AWWA: 1.0425
- JIS: RSt37-2 (S235JRG2) / H II / 1.0425 / 316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- AS 2129: (DN 150, 200, 250, 300, 600) A105 or RSt37-2 (S235JRG2) (DN 80, 100, 350, 400, 500) A105 or St44-2 (S275JR)
- AS 4087: A105 or St44-2 (S275JR)

Ground disks: : 1.4435/316L or Alloy C-22
Electrodes: 1.4435 or Alloy C-22, tantalum
Seals: Seals to DIN EN 1514-1

Promag P

Transmitter housing:
- Compact housing: powder coated die-cast aluminium or stainless steel field housing
- Wall-mounted housing: powder coated die-cast aluminium

Sensor housing:
- DN 15…300: powder-coated die-cast aluminium
- DN 350…600: painted steel (Amerlock 400)

Measuring tube:
- DN < 350: stainless steel 1.4301 or 1.4306/304L; non-stainless flange material with AI/Zn protective coating
- DN > 300: stainless steel 1.4301/304; non-stainless flange material with Amerlock 400 paint

Flange:
- EN 1092-1 (DIN 2501): 316L / 1.4571; RSt37-2 (S235JRG2) / C22 / FE 410W B (DN < 350: with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- ANSI: A105, F316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- JIS: RSt37-2 (S235JRG2) / H II / 1.0425 / 316L (DN < 350 with Al/Zn protective coating, DN > 300 with Amerlock 400 paint)
- AS 2129: (DN 25) A105 or RSt37-2 (S235JRG2) (DN 50) A105 oder St44-2 (S275JR)
- AS 4087: A105 or St44-2 (S275JR)

Ground disks: 1.4435/316L or Alloy C-22
Electrodes: 1.4435, platinum/rhodium 80/20 or Alloy C-22, tantalum
Seals: Seals to DIN EN 1514-1

Promag H

Transmitter housing:
- Compact housing: powder coated die-cast aluminium or stainless-steel field housing 1.4301/316L
- Wall-mounted housing: powder coated die-cast aluminium

Sensor housing: 1.4301
Wall mounting (holder panel): 1.4301

Measuring tube: stainless steel 1.4301 or 1.4306/304L

Flange:
- All connections stainless-steel 1.4404/316L
- Flanges (EN (DIN), ANSI, JIS) made of PVDF
- Adhesive fitting made of PVC

Ground rings: 1.4435/316L, Option: tantalum, Alloy C-22

Electrodes:
- Standard: 1.4435
- Option: Alloy C-22, tantalum, platinum/rhodium 80/20 (up to DN 25 only)

Seals:
- DN 2…25: O-ring (EPDM, Viton, Kalrez) or gasket seal (EPDM, silicone, Viton)
- DN 40…100: gasket seal (EPDM, silicone)

Material load diagram

The material load diagrams (pressure-temperature graphs) for the process connections are to be found in the following documents:
- Technical Information “Promag 50/53W” (TI 046D/06/en)
- Technical Information “Promag 50/53P” (TI 047D/06/en)
- Technical Information “Promag 50/53H” (TI 048D/06/en)

Fitted electrodes

Promag W:
Measuring, reference and EPD electrodes
- Standard available with 1.4435, Alloy C-22, tantalum
- Optional: exchangeable measuring electrodes made of 1.4435 (DN 350…2000)

Promag P:
Measuring, reference and EPD electrodes
- Standard available with 1.4435, Alloy C-22, tantalum, platinum/rhodium 80/20
- Optional: measuring electrodes made of platinum/rhodium 80/20

Promag H:
Measuring electrodes and EPD electrodes
- Standard available with 1.4435, Alloy C-22, tantalum, platinum/rhodium 80/20
- DN 2…4: without EPD electrode

Process connections

Promag W:
Flange connection: EN 1092-1 (DIN 2501); DN 65 PN 16 and DN 600 PN 16 exclusively to EN 1092-1, ANSI, AWWA, JIS, AS

Promag P:
Flange connection: EN 1092-1 (DIN 2501); DN 65 PN 16 and DN 600 PN 16 exclusively to EN 1092-1, ANSI, JIS, AS

Promag H:
- With O-ring: weld nipples (DIN EN ISO 1127, ODT / SMS), flanges (EN (DIN), ANSI, JIS), PVDF flanges (EN (DIN), ANSI, JIS), external pipe thread, internal pipe thread, hose connection, PVC adhesive fittings
- With gasket seal: weld nipples (DIN 11850, ODT / SMS), clamps (ISO 2852, DIN 32676, L14 AM7), threaded fasteners (DIN 11851, DIN 11864-1, ISO 2853, SMS 1145), flanges (DIN 11864-2

Surface roughness

- PFA liner: ≤ 0.4 µm
- Electrodes:
  – 1.4435, Alloy C-22: 0.3...0.5 µm
  – Tantalum, platinum/rhodium: 0.3...0.5 µm
- Process connection Promag H: ≤ 0.8 µm

(all data relate to parts in contact with medium)

10.1.9 Human interface

Display elements

- Liquid-crystal display: illuminated, two lines with 16 characters per line
- Custom configurations for presenting different measured values and status variables
- 2 totalizers
- At ambient temperatures below –20 °C the readability of the display may be impaired

Operating elements

- Local operation with three push buttons (–, +, E)
- "Quick Setup" menus for straightforward commissioning

Language group

Language groups available for operation in different countries:
- Western Europe and America (WEA):
  English, German, Spanish, Italian, French, Dutch and Portuguese
- Eastern Europe and Scandinavia (EES):
  English, Russian, Polish, Norwegian, Finnish, Swedish and Czech
- South and east Asia (SEA):
  English, Japanese, Indonesian

You can change the language group via the operating program "ToF Tool – Fieldtool Package."

Remote operation

Operation via HART protocol

10.1.10 Certificates and approvals

Ex Approvals

Information about currently available Ex versions (ATEX, FM, CSA) can be supplied by your Endress+Hauser Sales Center on request. All explosion protection data are given in a separate documentation which is available upon request.

Sanitary compatibility	Promag W: No applicable approvals or certification Promag P: No applicable approvals or certification Promag H: ■ 3A authorization and EHEDG-tested ■ Seals in conformity with FDA (except Kalrez seals)
Pressure Equipment Directive	Measuring devices with a nominal diameter smaller than or equal to DN 25 correspond to Article 3(3) of the EC Directive 97/23/EC (Pressure Equipment Directive) and have been designed and manufactured according to good engineering practice. Where necessary (depending on the medium and process pressure), there are additional optional approvals to Category II/III for larger nominal diameters.
CE mark	The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.
Other standards and guide-lines	EN 60529 Degrees of protection by housing (IP code) EN 61010 Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures EN 61326/A1 (IEC 6326) Electromagne8tic compatibility (EMC requirements) NAMUR NE 21 Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment. NAMUR NE 43 Standardisation of the signal level for the breakdown information of digital transmitters with analogue output signal. NAMUR NE 53 Software of field devices and signal-processing devices with digital electronics.

10.1.11 Ordering information

The Endress+Hauser service organisation can provide detailed ordering information and information on specific order codes on request.

10.1.12 Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor (see Page 85). The Endress+Hauser service organisation can provide detailed information on request.

10.1.13 Supplementary documentation

- System Information Promag (SI 028D/06/en)
- Technical Information Promag 50/53W (TI 046D/06/en)
- Technical Information Promag 50/53P (TI 047D/06/en)
- Technical Information Promag 50/53H (TI 048D/06/en)
- Description of Device Functions Promag 50 (BA 049D/06/en)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA, etc.

11 Index

A

Accessories 85
Adapters (installation of sensors) 20
Ambient temperature 110
Application 107
Applicator (selection and configuration software) 87
Auxiliary input
see Status input

B

Boards 97, 99, 101

C

Cable entries
degree of protection 59
technical data 108
Cable specifications (remote version)
cable length, conductivity 25
Cable termination of Promag H 50
Cable termination Promag W, P 49
technical data 51
Calibration factor (default) 10
Cathode protection 58
CE mark (declaration of conformity) 11
CIP cleaning 110
Cleaning
CIP /SIP cleaning 110
exterior cleaning 83
Code entry (function matrix) 63
Commissioning 79
Commissioning Quick Setup menu 80
configure current output (active/passive) 82
empty pipe and full pipe calibration (EPD/OED) 81
Commubox FXA 191, electrical connection 55
Communication (HART) 65
Conditions for operation 110
Conductivity of fluid, minimum 112
Connection
see Electrical connection
Current output
configuration (active/passive) 82
electrical connection 54
technical data 108

D

Data storage (S-DAT) 82, 97
Declaration of conformity (CE mark) 11
Declaration of contamination 8
Degree of protection 59, 110
Designated use 7
Device description files 67
Device designation 9
Device functions
see “Description of Device Functions” manual
Device fuse, replacing 102
Display
display and operating elements 61
turning the display 43
Documentation for hazardous areas (Ex) 7
Down pipes 16

E

Electrical connection
cable specifications (remote version) 51
Commubox FXA 191 55
degree of protection 59
HART handheld communicator 55
length of connecting cable 25
post-connection check (checklist) 60
potential equalisation 56
remote version (connecting cable) 47
terminal assignment, transmitter 54
transmitter 52
Electrode Cleaning Circuitry
see “Description of Device Functions” manual
Electrodes
EPD electrode 17, 81
exchanging replaceable electrodes 103
fitted electrodes 117
measuring electrode plane 17
reference electrode (potential equalisation) 56
Electromagnetic compatibility (EMC) 51, 110
Electronics board 97, 99, 101
Empty Pipe Detection (EPD/OED)
empty-pipe/full-pipe adjustment 81
EPD electrode 17
general information 81
Error limits
see Measuring accuracy
Error messages
display mode 64
error message types 64
process errors (application errors) 94
system errors (device errors) 90
Error response of outputs / totalizers 95
Error types (system and process errors) 64
Ex certification 118
Ex documentation 7
Exchange
device fuse 102
measuring electrodes 103
printed circuit boards 98

F

Failsafe mode (failure response) 95
Fieldcare 66
FieldCheck (tester and simulator) 87
Flow rate / nominal diameter 20
Fluid conductivity, minimum 25
Fluid pressure range 112
Fluid temperature ranges 111
Foundations (for sensors with DN > 300) 19

Frequency output
electrical connection 54
technical data 108
Function descriptions
see “Description of Device Functions” manual
Function matrix 62
Functions, function groups 62
Fuse, replacing 102

G
Galvanic isolation 108
Ground cable 57
Ground disks 58
mounting (Promag P) 34
mounting (Promag W) 27
potential equalisation 58
Ground rings (Promag H)
mounting, application area 40
potential equalisation 56

H
HART
command groups 65
electrical connection 55
Handheld terminal 66
Hazardous substances 8
High-temperature version (Promag P)
installation 35
temperature ranges 111
HOME position (operating mode) 61

I
Incoming acceptance 13
Inlet runs 18
Input signals 107
Input variables 107
Installation 15
Installation dimensions 15, 27, 41
Installation check (checklist) 46
Installation conditions
adapters 20
down pipes 16
foundations (DN > 300) 19
inlet and outlet runs 18
installation of pumps 15
location 15
orientation (vertical, horizontal) 17
partially filled pipes, drains 16
vibrations 18
Installing sensor
adapters 20
foundations (DN > 300) 19
ground disks (Promag P) 34
ground disks (Promag W) 27
ground rings (Promag H) 40
Promag H 39
Promag H with weld nipples 41
Promag P 33
Promag P, high-temperature version 35
Promag W 26
Installing the wall-mount housing 44
Insulation of pipes (Promag P) 35

L
Limiting flow
see Measuring range 113
Local display
see Display
Low flow cutoff 108

M
Maintenance 83
Material load curves 117
Materials 116
Measured variable 107
Measuring accuracy
deviation 109
reference conditions 109
repeatability 109
Measuring electrodes
see electrodes
Measuring principle 107
Measuring range 107
Measuring system 107
Measuring tube
lining, resistance to partial vacuum 113
lining, temperature range 111
Medium
see Fluid ...

N
Nameplate
Connections 11
sensor 10
transmitter 9
Nominal diameter / flow rate 20
Nominal pressure
see Fluid pressure range

O
OED (Open Electrode Detection)
see Empty Pipe Detection 81
Operable flow range 107
Operating conditions 110
Operation
device description files 67
display and operating elements 61
Fieldcare 66
function matrix 62
HART commands 69
HART handheld terminal 66
ToF Tool - Fieldtool Package (configuration and service software) 66
Order code
Sensor 11
Ordering code
accessories 85
sensor 10
transmitter 9
Ordering information 119

Outlet runs 18
Output signal 108
Output variables 108
Outputs, response to errors 95

P

Partial vacuum, lining 113
Performance characteristics
see Measuring accuracy
Positive zero return 95
Potential equalisation 56
Power consumption 109
Power supply 108
Power supply failure 109
Pressure loss
adapters (reducers, expanders) 20
general information 113
resistance to partial vacuum, lining 113
Printed circuit boards, removing and installing 98
Process connections 118
Process error 64
error messages 93
process errors without message 94
Programming mode
disable 63
enable 63
Pumps, location 15

Q

Quick Setup menu for “Commissioning” 80

R

Registered trademarks 12
Registrierte Warenzeichen 12
Repair 8
Repeatability (measuring accuracy) 109
Returning devices 8

S

Safety icons 8
Safety instructions 7
Safety of operation 7
Safety regulation form (e.g. for repairs)
see Declaration of contamination
Sanitary compatibility 119
Screw tightening torques
for Promag H (with plastic process connections) 39
for Promag P 36
for Promag W 28
S-DAT 97
S-DAT (HistoROM) 82
Seals
Promag H 39
Promag P 33
Promag W 26
temperature ranges (Promag H) 112
Sensor installation
see Installing sensor
Serial number 9, 10, 11
Shock resistance 110
Signal on alarm 108
SIP cleaning 110
Software
amplifier display 79
versions (history) 105
Spare parts 97
Status input
electrical connection 54
technical data 107
Status output
electrical connection 54
technical data 108
Storage 14
Switching output 108
System error 64
definition 64
error messages 90

T

Technical data 107
Temperature ranges
ambient temperature 110
fluid temperature 111
storage temperature 110
ToF Tool - Fieldtool Package 66, 87
Transmitter
electrical connection 52
installing the wall-mount housing 44
length of connecting cable (remote version) 25
turning the field housing (aluminum) 42
turning the field housing (stainless steel) 42
Transporting the sensor 13
Trouble-shooting 89

V

Vibrations
measures to prevent vibrations 18
shock resistance 110

W

Wall-mount housing, installing 44
Weights 114
Welding work
grounding welding equipment 41
Promag H with weld nipples 41
Wiring
see Electrical connection

Declaration of Contamination
Erklärung zur Kontamination

Endress+Hauser
People for Process Automation

Because of legal regulations and for the safety of our employees and operating equipment, we need the "declaration of contamination", with your signature, before your order can be handled. Please make absolutely sure to include it with the shipping documents, or – even better – attach it to the outside of the packaging.
Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination", bevor Ihr Auftrag bearbeitet werden kann. Legen Sie diese unbedingt den Versandpapieren bei oder bringen Sie sie idealerweise außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

Process data/ *Prozessdaten*

Temperature / *Temperatur* _____ [°C] Pressure / *Druck* _____ [Pa]

Conductivity / *Leitfähigkeit* _____ [S] Viscosity / *Viskosität* _____ [mm^2/s]

Medium and warnings
Warnhinweise zum Medium



	Medium /concentration *Medium /Konzentration*	Identification CAS No.	flammable *entzündlich*	toxic *giftig*	corrosive *ätzend*	harmful/ irritant *gesundheits-schädlich/ reizend*	other * *sonstiges**	harmless *unbedenklich*
Process medium / *Medium im Prozess*								
Medium for process cleaning / *Medium zur Prozessreinigung*								
Returned part cleaned with / *Medium zur Endreinigung*								

* explosive; oxidising; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

Please tick should one of the above be applicable, include security sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Reason for return / *Grund zur Rücksendung* _____

_____

_____

Company data / *Angaben zum Absender*

Company / *Firma* _____
_____
Address / *Adresse*
_____
_____

Contact person / *Ansprechpartner* _____
Department / *Abteilung* _____
Phone number/ *Telefon* _____
Fax / E-Mail _____
Your order No. / *Ihre Auftragsnr.* _____

We hereby certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free from any residues in dangerous quantities.
Hiermit bestätigen wir, dass die zurückgesandten Teile sorgfältig gereinigt wurden, und nach unserem Wissen frei von Rückständen in gefahrbringender Menge sind.

P/SF/Konta VIII

_____
(place, date / *Ort, Datum*)

_____
(Company stamp and legally binding signature)
(Firmenstempel und rechtsverbindliche Unterschrift)

www.endress.com/worldwide

Endress+Hauser

People for Process Automation

BA046D/06/en/03.05
50097090
FM+SGML6.0

5 Generator

SUPPLIER: Eneraque
1937 Ipswich Road
Rocklea QLD 4106

Ph: 1800 636 744
Fax: (07) 3434 3593

MODEL: TRAILER MOUNTED DPAS50 GENSET
PERKINS/LEROY SOMER 34941

J&P RICHARDSON

TRAILER MOUNTED
DPAS 50 GENSET
PERKINS / LEROY SOMER
34941

eneraque

OPERATION & MAINTENANCE MANUAL

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Document Control

REVISION	DATE	PREPARED BY	APPROVED BY
A	19/03/2013	Noel Rosario	Ray Verburgt



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STANDBY SERIES GENERATOR SET

USERS MANUAL

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1.0 WELCOME 3

2.0 BASIC SAFETY RULES  4

3.0 DESCRIPTION OF GENERATOR SET 6

3.1 SOUND INSULATION 9

3.2 CONTROL PANEL 10

3.3 ELECTRICAL CONFIGURATION 11

3.4 RETENTION BATH 12

4.0 INSTALLATION OF THE GENERATOR SET 13

4.1 UNLOADING AND TRANSPORT 13

4.2 INSTALLATION PRINCIPLES 14

4.3 VENTILATION AND COOLING 16

4.4 FUEL 16

4.4.1 Automatic fuel transfer system 16

4.5 EXHAUST 16

4.6 GENERATOR SET STARTUP 17

4.7 ELECTRICAL CONNECTION  18

4.7.1.1 Installation of CONTROL section: 20

4.7.1.2 Installation of ELECTRICAL POWER section: 22

4.7.1.3 Earthing: 23

4.7.1.4 Motorized changeover switches: 23

STORAGE 24

5.0 STARTUP 25

5.1 POWER FACTOR AND GENERATOR SETS 26

5.2 LIGH LOAD OPERATION ON DIESEL ENGINES 26

6.0 OPERATION MANUAL 27

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6.1 CONTROL PANEL COMPONENTS 27
6.2 GECO ANALOG CONTROL MODULE 29
6.3 GPM-2 ANALOG CONTROL MODULE 36
6.4 DEEP SEA 7310/7320 DIGITAL CONTROL MODULE 42
6.5 DEEP SEA 5510/5520 DIGITAL CONTROL MODULE 59
6.6 INTELIGEN^{NT} DIGITAL CONTROL MODULE 77
7.0 MAINTENANCE OF GENERATOR SET 86
7.1 PRIOR TO MAINTENANCE 86
7.2 DURING MAINTENANCE 86
7.3 MAINTENANCE CHART 88
8.0 TROUBLESHOOTING 89
9.0 PROTECTION FROM THE ENVIRONMENT 90
10.0 WARRANTY 91
11.0 NOISE LEVEL 91
12.0 DECLARATION OF CONFORMITY CE 92
13.0 APPENDIX 1: FIGURES 92
14.0 APPENDIX 2: IMAGE INDEX 95
15.0 APPENDIX 3: PRE-DELIVERY INSPECTION DOCUMENT 97
16.0 APPENDIX 4: FIGURES IN DEEP SEA CONTROL CARDS. 99
17.0 APPENDIX 5: NOISE EMISSIONS 101

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1.0 WELCOME

Thank you for choosing an Eneraque generator set.

The purpose of this manual is to familiarize the user on how to use and work with the electrical generator, its components and maintenance.

We recommend a carefully reading this document prior to working with the equipment to ensure its correct use.

Save this manual for future reference and if the generator set is resold be sure to include the manual along with the unit.

The following is a general description of the unit and the information necessary for installation, operation and preventive maintenance.

Additionally, you should have received a specific user manual for the Engine and Alternator, electrical setup, a set of keys, ATS (upon order), silencer or exhaust tube and flexible tube (supplied separately for open-skid units).

Should you have any problem with the equipment provided, please contact the distributor directly.

Eneraque, in a constant effort towards product improvement, shall revise its manuals and include improvements made to the supplied units. Thus the information contained in this document is subject to change without prior notice and without obligation to update.

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2.0 BASIC SAFETY RULES

Safety precautions and recommendations for handling the Electrical Generator supplied by Eneraque

1. Do not allow the unit to be used by non-authorized personnel or minors not accompanied by an adult.
2. Use the necessary individual protection equipment.
3. Ground the machine and ATS panel.
4. Make sure there is sufficient lighting on the genset and on the control panels.
5. Do not install the open-skid electrical generator outdoors: risk of electrocution and non-functioning.
6. The connection should be made by a qualified electrician in accordance with current norms and regulations. An incorrectly made connection can cause electrical feedback with electrocution hazards for anyone working with the mains power supply. The mains connection should always be made using an automatic transfer switch (ATS); if none has been supplied, contact your distributor or Eneraque.
7. The supply line between the generator set and the consumers should be protected by means of a differential relay for protection against earth leakage.
8. The electrical installation between the generator unit and ATS should be protected using electromagnetic circuit breaker for protection against short circuits and overcurrents. The circuit breaker is supplied optionally by Eneraque.
9. Do not operate the unit with the doors open: risk of electrocution, burns or entrapment.
10. The exhaust system produces enough heat to ignite certain materials.
11. Do not inhale exhaust gases produced by the unit.
12. Do not touch the engine or the exhaust while the generator set is operating as this could produce serious burns.
13. Ensure proper ventilation in the area where the generator is installed in order to guarantee sufficient flow of cooling air.
14. Do not refuel while the engine is running or in poorly ventilated areas.
15. Know how to stop the unit in case of emergency.
16. The fuel used is flammable and volatile.
17. Do not overfill the tank and make sure it is closed properly after filling. Use extreme precaution if fuel is spilled: the vapors and the fuel itself are flammable. Clean the area completely before starting up the unit.
18. Do not smoke or bring any flames or sparks in the vicinity of the electrical generator: risk of explosions.
19. If you notice abnormal behavior by the generator set, stop the unit, locate, examine and resolve the potential failure of the unit prior to restarting. Contact our technical services department if needed.

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20. Keep the unit at least one meter away from buildings or other units.
21. Be cautious when switching or installing batteries as they contain acids which are highly hazardous. Avoid spills and use protection to avoid contact with the skin and eyes. In case of contact, rinse thoroughly with water and contact a doctor immediately.
22. In case of ingestion of battery acid, drink large amounts of water and milk and contact a doctor immediately.
23. Use only distilled water in the battery: tap water reduces its life expectancy.
24. If a battery is filled above the maximum level, the electrolytes will spill out; if this happens, clean the area quickly to avoid corrosion of the parts it has come in contact with.
25. Frequently clean the unit to avoid obstructions or the entry of foreign elements into the unit (dust, moisture, etc.).
26. Regularly inspect the unit's electrical cables.
27. Prolonged contact with used oil can cause skin cancer. Wash your hands after working with the generator.
28. Avoid oil spills on both the inside and outside of the generator. In case of an oil spill on the inside of the unit, clean it properly as it could potentially become a flammable material.

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3.0 DESCRIPTION OF GENERATOR SET

General overview of the generator set and its different configurations manufactured by Eneraque.

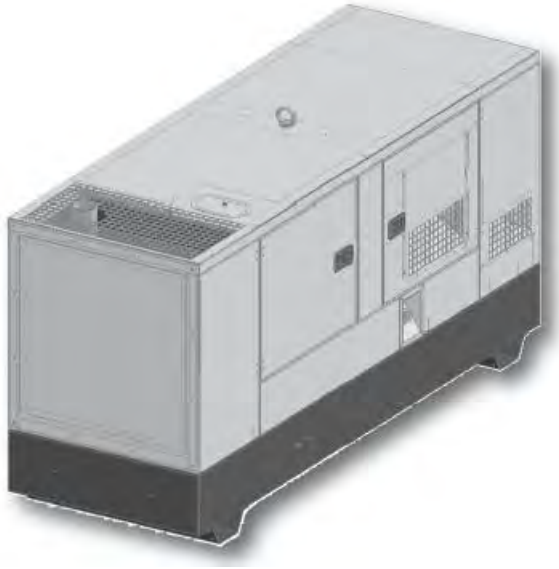


Image 1- Generator set with sound proof canopy.

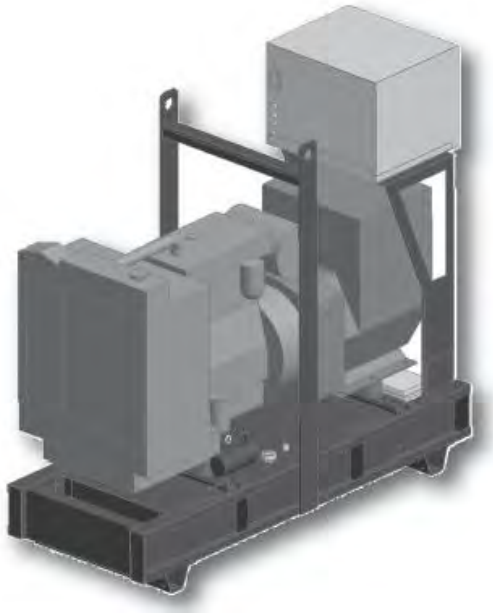


Image 2- Generator set without canopy

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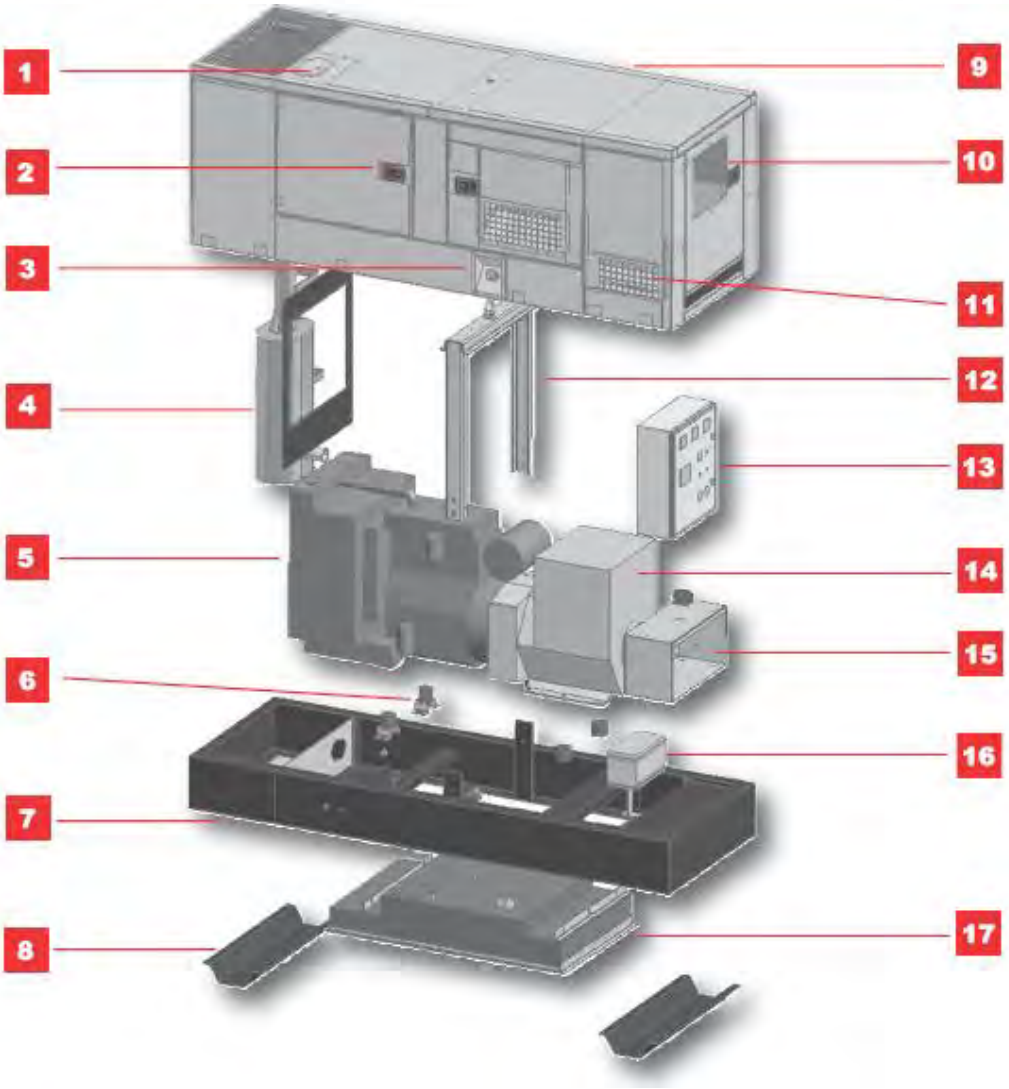


Image 3- Detailed view of Image 1

1) Coolant tank hatch
2) Side access door
3) Fuel tank cap
4) Exhaust silencer
5) Engine
6) Shock absorbers
7) Base frame
8) Base support
9) Canopy
10) Electrical Panel Doors
11) Ventilation grill
12) Lifting frame and eyebolt
13) Control panel
14) Alternator
15) Electrical power panel
16) Battery
17) Fuel tank

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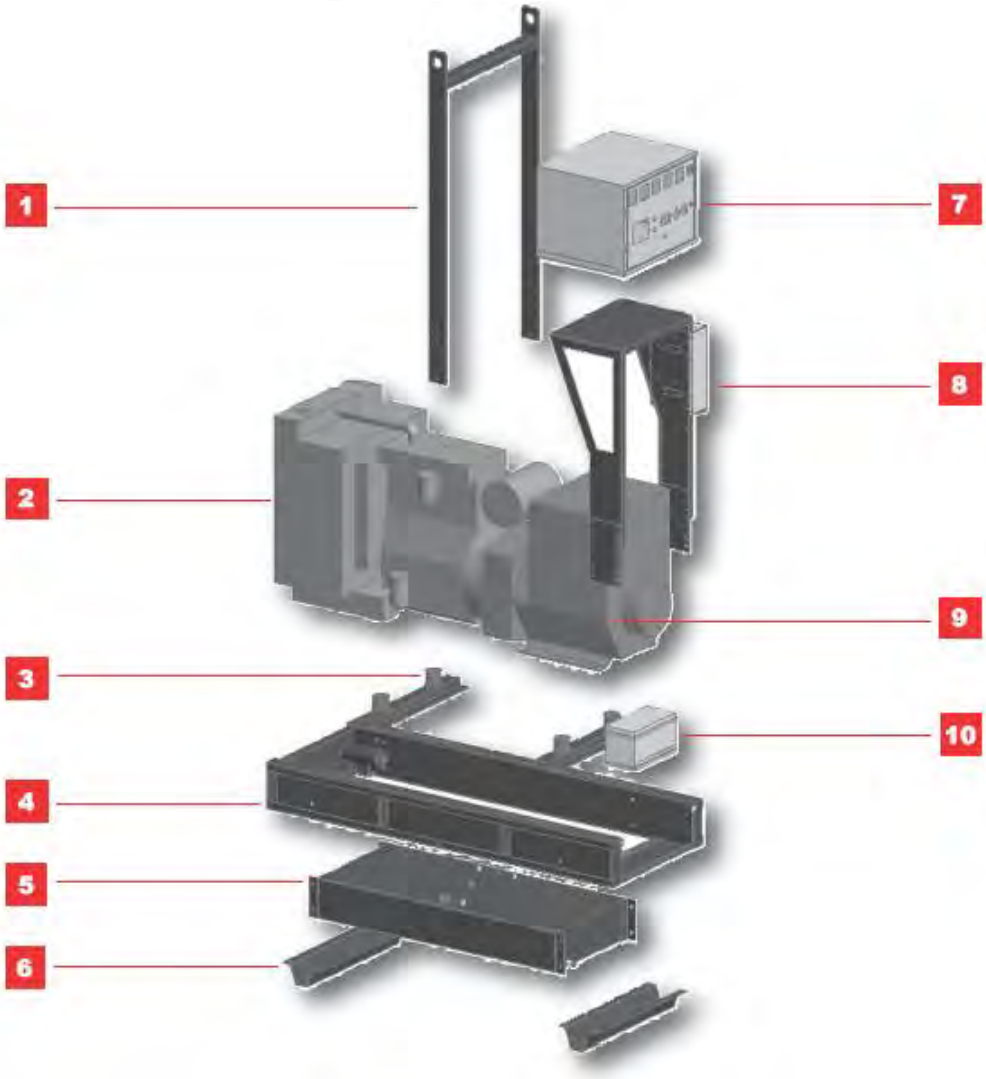


Image 4- Detailed view of Image 2

1) Lifting frame
2) Engine
3) Shock absorbers
4) Base frame
5) Fuel tank
6) Base support
7) Control panel
8) Electrical power panel (optional)
9) Alternator
10) Battery

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3.1 SOUND INSULATION

The supplied unit may be:

- **Soundproofed**. Includes sound-insulating canopy.
- **Open skid.** Please keep in mind that in compliance with current regulations may require that proper room sound insulation will be provided for this model. (See 4.2 INSTALLATION)

Each Electrical Generator is provided with a sticker indicating the level of noise output produced and the need to use hearing protection.

		
Noise output 90 dBA	*Noise output 114 dBA*	*Use of hearing protection required.*

The noise level has been measured according to the European directive 2000/14/EC and in compliance with the maximum levels established by directive 2005/88/EC.

Please consider the local and national regulations that could be more restribe. In any case it the intaller and owner responsabity to comply with the current legislation

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3.2 CONTROL Panel

The unit provided may be controlled by different modules depending on the type of function it has been designed to perform.

The following is an example of a control panel with Inteligen NT which contains all of the electrical and mechanical options available.

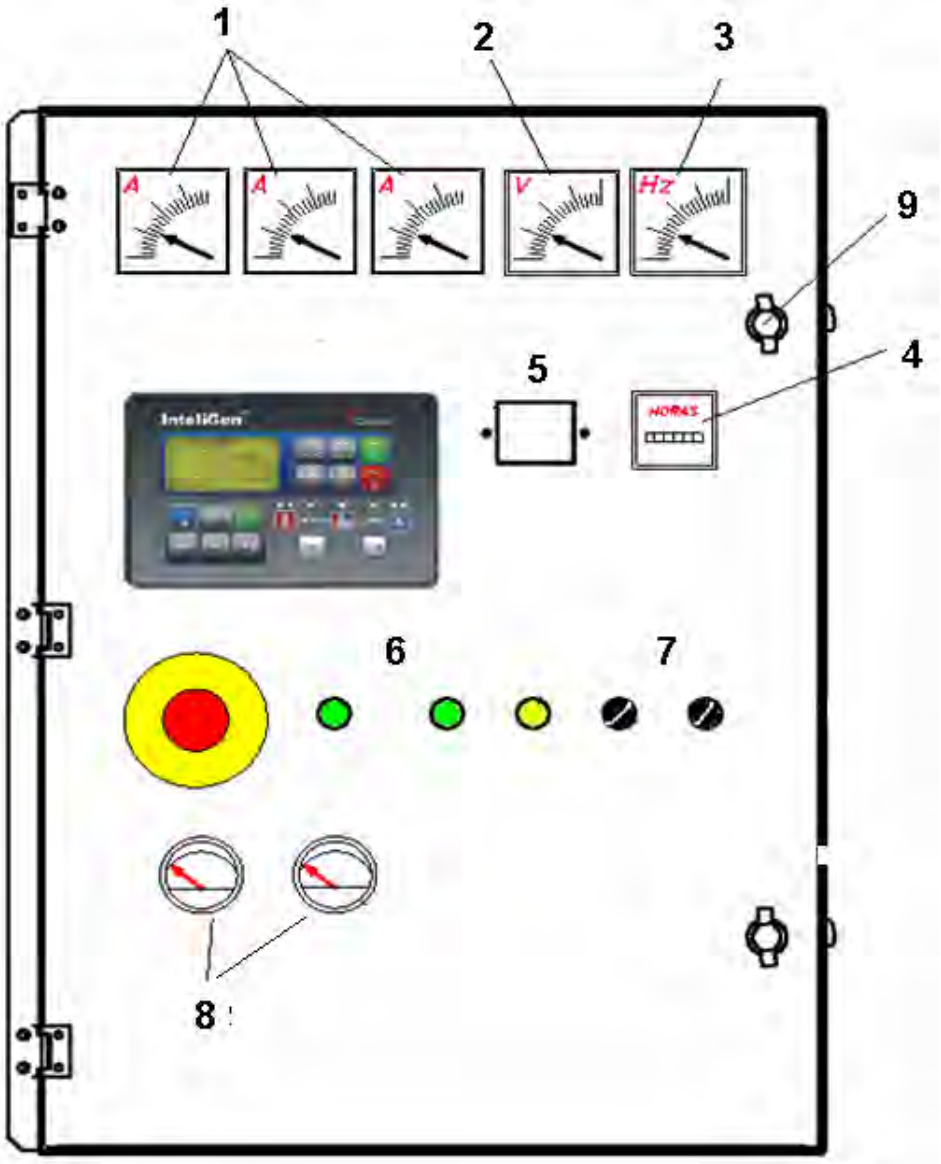


Image 5- Generic Control Panel

1-3 →.Electrical Gaugues

4→ Hour meter

5→ Earth elakage relay (It may be installed inside the electrical panel)

6→ Indication lamps (green, red, yellow)

7→ Mode Swicht

8→-> Engien Gaugues

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3.3 ELECTRICAL CONFIGURATION

The supplied unit may be one of three types:

- The generator unit is supplied **with automatic transfer switch (ATS).**
- The generator unit is supplied **without ATS**. Note that its installation is required.

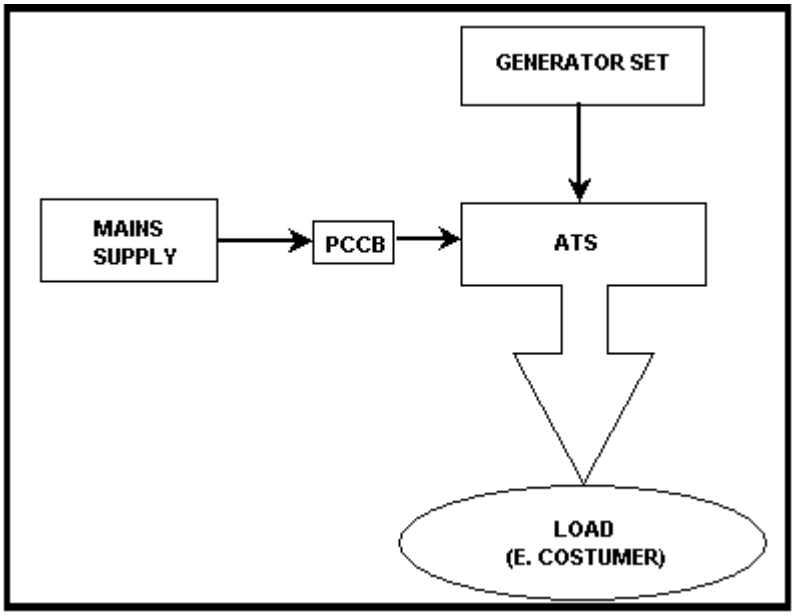


Image 6- Load Transfer diagram

Note: PCCB = Power Control Circuit Breaker

ATS may be with contactors, motorized changeover switch or motorized circuit breakers

- **Standby by signal.** The Electrical Generator is supplied without ATS stands idle until it receives a signal from an autonomous external system which monitors the mains and controls the automatic transfer switch for startup.

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3.4 retention bath

The generator set may include a built-in retention bath to prevent spills from the unit—such as fuel, oil or coolant—with a capacity of 110% with respect to the total volume of liquids.

It is the responsibility ot the installer and the owner to take the

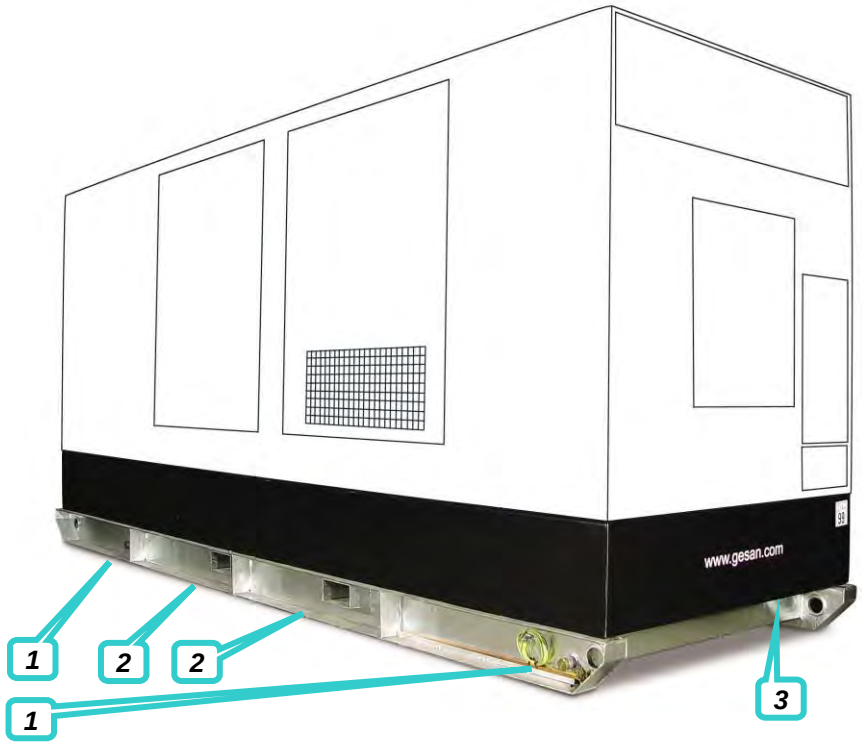


Image 7- Retention Bath

1) 4 drain plugs, 2 on each side of the pan

2) Slots for inserting forklift arms

3) Retention bath level senders (optional)

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4.0 INSTALLATION OF THE GENERATOR SET

In this part of the manual it is described how to install a “generic” generator set composed of a diesel engine, alternator and electrical panel. Please follow the current regulations when installing a generator set.

4.1 UNLOADING AND TRANSPORT

When unloading an generator set, certain minimum conditions should be observed in terms of safety and efficiency. The loading and transport of the unit should be done by qualified personnel.

- The floor must be capable of supporting the full weight of the Generator and the forklift.
- Make sure that the battery is disconnected.
- Make sure that the fuel tank is empty.
- Place the arms of the forklift below the chassis at an equal distance with respect to the lifting frame.
- With a hoist, raise the unit using the lifting frame eyebolt.

The image below shows a drawing of a generator unit which includes a frame with a single lifting point.

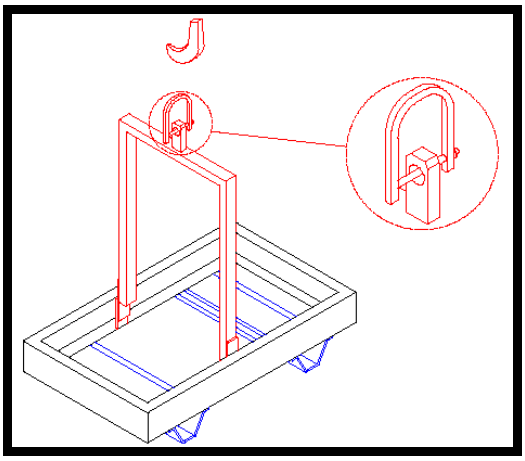


Image 8- Lifting frame

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4.2 Installation Principles

- Premises

The following considerations must be kept in mind: the fuel supply, ventilation of the premises, the output and direction of the exhaust gases and the noise produced.

- Dimensions

The dimensions should allow for the various required maintenance or disassembly operations. A minimum of one meter should be left on all sides of the generator to allow for the doors to be opened.

- Openings

The premises should have an entrance that is large enough for the generator to pass through and openings large enough for ventilation (fresh-air intake and radiator hot air outlet), with the appropriate surface area based on the generator's output, the premises' cooling system and the soundproofing system used.

Eneraque does not recommend installing canopied units in closed spaces.

If the unit must be installed in a enclosed space, it is recommended to use an open-skid model and soundproof the work area, in keeping with the current fire-prevention regulations.

The following image shows a typical installation of an open-skid unit in a closed space.

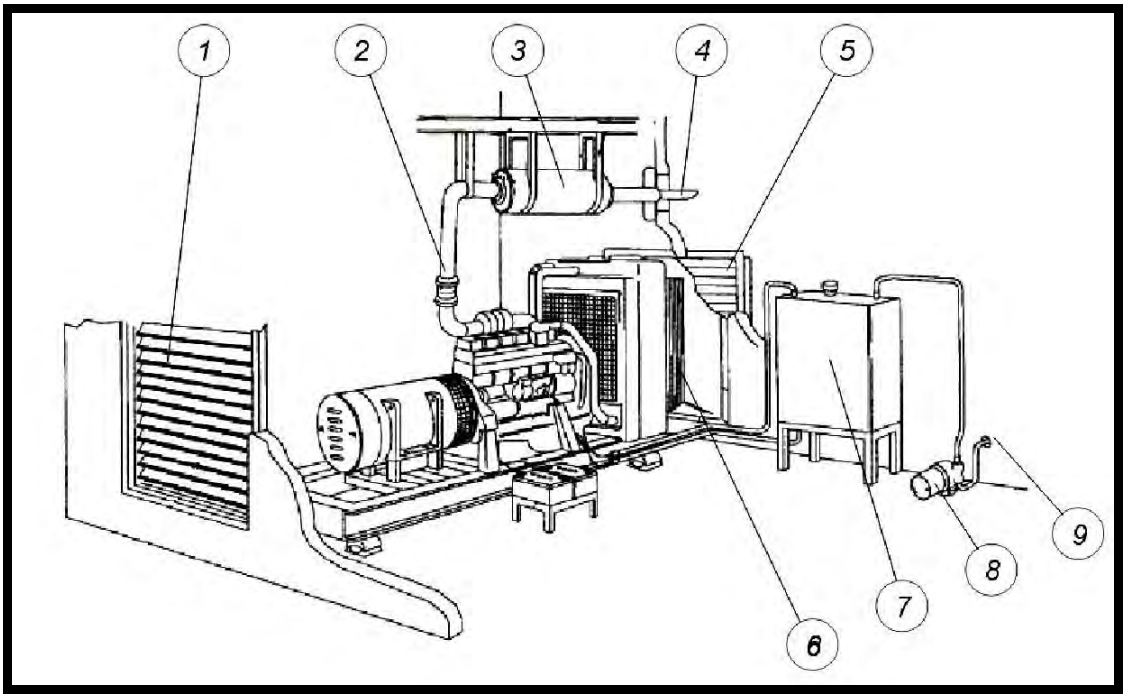


Image 9- Detailed view of installation of an open-skid unit

- Air intake grill. Will be at least 1.4 times the surface area of the engine's radiator panel.
- Smoke exhaust line. This will be explained in more detail later.

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- Silencer. Must be firmly installed and fastened to a stable structure.
- Smoke exhaust outlet. Smoke must flow out through a point which impedes its reentry into the space where the working unit is installed.
- Radiator air outlet grill. Will be at least 1.25 times the surface area of the engine's radiator panel.
- Cooling air channel. Prevents re-entry of hot air into the space where the unit is installed.
- Optional external fuel tank. The tank may or may not be supplied by Eneraque.
- Auxiliary fuel pump, SAB-BE-EV system. Optional accessory for filling of the generator set day tank from an external large-capacity tank.
- Fuel line, adequate for transporting fuel and complies with current regulations.

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4.3 Ventilation and cooling

The heat produced by the generator's thermal engine must be evacuated from the premises.

The heat is generated by the cooling of the cylinders, the radiation from the engine block, the exhaust pipe, the cooling of the alternator and the radiator air output.

Insufficient ventilation could produce an increase in the ambient temperature of the premises and cause the generator to lose engine power or even shut down.

4.4 Fuel

In keeping with current regulations, special attention should be paid to the storage of fuel, which is classified as a hazardous product. The installation of the generator will include a day tank and an optional fuel storage tank.

Depending on the output of the generator, the fuel tank may be external instead of being built into the base frame.

The tank should be installed within a maximum distance (see the Engine manufacturer's manual). The installation will be carried out according to current regulations.

4.4.1 Automatic fuel transfer system

The unit may include a self-suction, eccentric fuel transfer pump (SAB-BE) with self-adjusting blades. Includes a recirculation bypass valve. The pump has an internal removable 352 micron filter, which must be used.

If the unit is positioned beyond the recommended distance to the fuel storage tank, the pump should be dismounted and placed near the external tank.

The pump will function if the generator set is running; it has an OFF/AUTO switch located on the door of the unit's control panel.

4.5 Exhaust

Pressure drop, insulation, suspension and sound levels should all be taken into account.

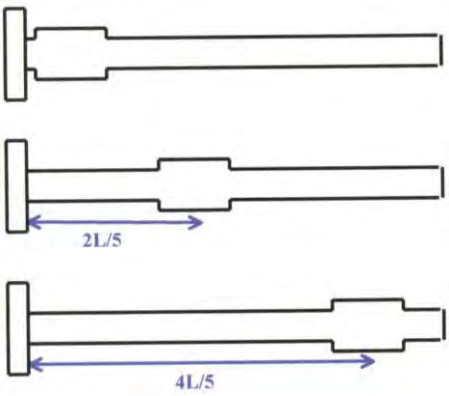
The compensators and flexible pipes used in the installation will absorb the displacement of the unit (due to dilations and vibrations).

The units supplied by ENerqaue may or may not include a rain cap. The units are equipped with two holes on the underside to prevent internal water accumulation.

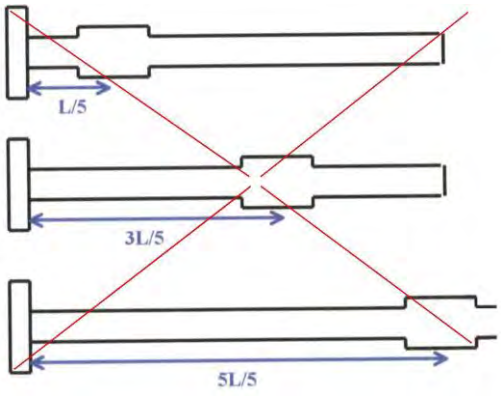
The optimun muffler locations are, first, directly behind the exhaust manifold, and secondly at 2/5 or 4/5 of the total exhaust system length. The reason for this are the existing standing waves, especially for long exhaust systems, when the natural pipe frequency is in resonance with the fundamental engine frequency or one of its harmonics. The worst muffler locations in order of valve are 1/3, 3/5 or at the end of the system.

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The best muffler locations in order of values are



The worst muffler locations in order of value are



L = total exhaust system length (elbows may be considered as straight portions).

Note: In installations where it is required, the exhaust pipe diameter must be increased. If the installation isn´t correct, seriously engine damage can be caused.

4.6 Generator set startup

The startup system used by the generator set is electrical and consists of a 12 or 24 V electric engine powered by one or more batteries, usually lead.

Low temperatures make engine cranking difficult. Startup failure (three attempts without success) entails the stopping of the motor and, as a result, of the entire generator unit. In order to avoid it, and to ensure correct startup of the generator set at any temperature, preheating of the entire unit is made (heating of coolant water) by means of a boiler powered by mains. This system will work automatically, by a thermostat (setup in factory from 40 to 60ºC) and it will be correctly indicated on the control panel by a lamp..

Sometimes the unit can be supplied with dry batteries. The placement into service of the this batteries should be done by removing the vent caps and filling each cell using sulfuric acid with a density of 1.28 (or 1.23 in tropical countries). Let it sit for at least 20 minutes and check the electrolyte level (25 mm above the plates; never fill to the brim). Finally put the caps back on.

⚠ *It is recommended that protective eyewear and gloves be worn when adding battery acid. Make sure that there is nearby access to tap water in order to wash any areas that come into contact with the acid.*

⚠ *All operations must be performed with the utmost precaution and safety as indicated in this Manual. (Be especially careful with potential short circuits that could occur when coming in contact with the unit's metallic objects).*

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4.7 Electrical connection

These connections should be made while following a number of safety measures:

- Use the proper individual protection equipment to ensure complete safety while performing the electrical installation.
- Set the control module switch to the OFF position.
- Make sure the emergency button has been pressed.
- Verify that the battery is disconnected.
- Swich off main power
- Before beginning the installation of the unit provided, make sure that it meets your particular needs for voltage and frequency.
- Handle cables with maximum precaution as they could be live voltaged.
- The ground installation of the generator set and ATS must be performed correctly. Ground onnections should be identified by the following icon: ⏚.

The unit manufactured by Eneraque may or may not be supplied with ATS (depends on electrical configuration: see section 3.3); if it is not supplied, it must be added by the customer.

The ATS is comprised of electrical switchgear. The ATS will prevent simultaneous supply by the mains and the generator set.

There are three kinds of different control switchgear used in GESAN automatic transfer switch systems:

- Contactors: mechanically and electrically interlocked to control mains and generator set output. They are manufactured from 40A to 125A.
- Motor operated changeover switches: built by two mechanical interlocked switches. They are manufactured from 160A to 3150A.
- Motor operated circuit breakers: two mechanical and electrical interlocked circuit breakers. They are supplied only on customer request.

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The following diagram shows a basic ATS setup.

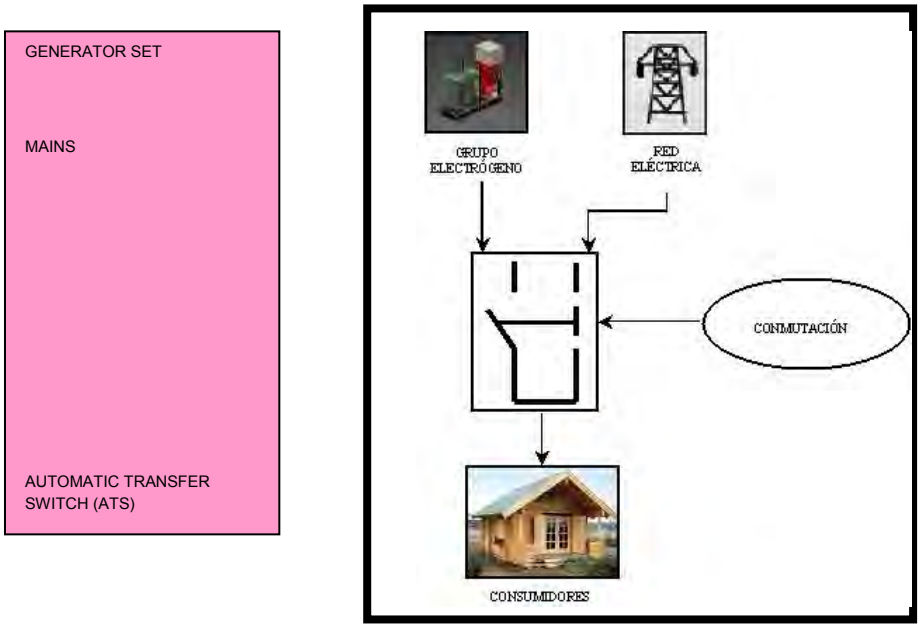


Image 10- ATS setup

The electrical installation of the ATS is performed in two separate steps: first, the installation of the CONTROL section (control and management of mains and ATS) and second, the ELECTRICAL POWER section (transmission of electrical energy).

The following diagram shows the connections of a typical ATS manufactured by Eneraque.

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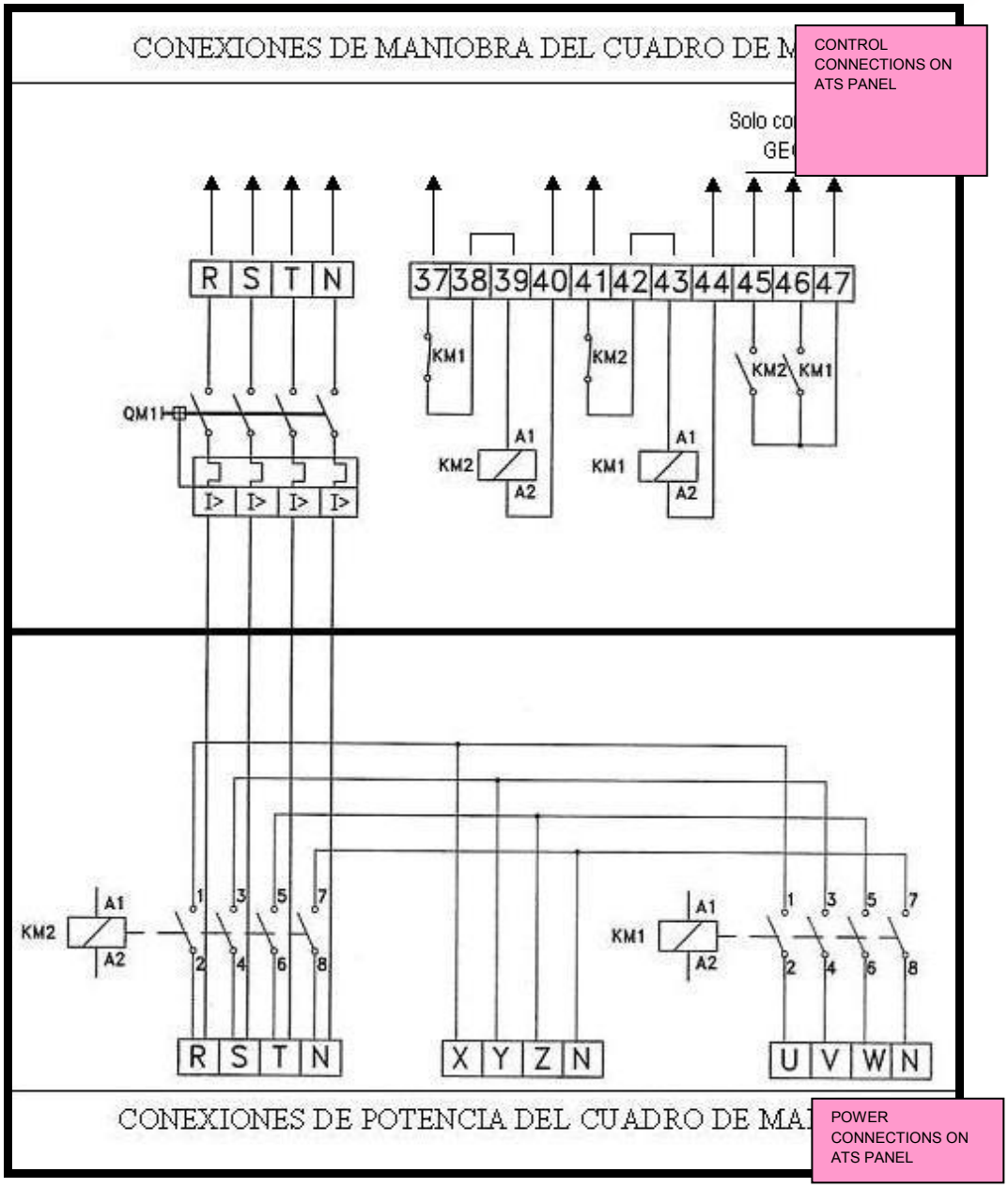


Image 11- Diagram of ATS Panel

4.7.1.1 Installation of CONTROL section:

The installation of the Control section can be done in three different ways:

1) ATS supplied by Eneraque.

2) ATS not supplied by Eneraque.

3) Unit is a “Standby by signal” type.

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1) ATS provided by Eneraque.

Connect the terminals R S T N on the control panel installed on the generator and the terminals numbered 37, 40, 41 and 44 (for the GECO module, also connect 45, 46 and 47) to the terminals on the ATS panel with the same numbering.

CAUTION: Do not mistake control terminals R S T N with the electrical power terminals R S T N (see the connections diagram preceding the installation instructions for the control and electrical power sections).

In making these connections, you must use an 8-wire conductor (or 11-wire for the GECO module) of 1.5mm²,. This cable is not provided with the generator set. The maximum distance between the control panel and the ATS panel should be 25m for a 1.5mm² cross section and a generator set power of 650 kVA. In case of higher power or distance, increase the cross section to avoid excessive voltage drop.

2) ATS not supplied by Eneraque.

Check the user manual of the corresponding ATS and follow these steps:

- Connect the terminals R S T N of the control panel (referential mains voltage) to the input of the electric company mains.
- Connect the terminals numbered 37 to 47 to the ATS control panel (check the electrical setup on the generator set control panel).
- Make sure that the electrical and mechanical interlocking is completed correctly. Also make sure that the ATS that you want to install is compatible with the generator unit provided. Assembly is typically done with contactors; for motorized switches please check with Enerque.
- The cable cross section must be appropriate for your installation.

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3) **Generator unit is "Standby by signal" type:**

Neither the generator set will monitor the mains nor control the ATS: these must be controlled by the user's management system.

The terminals through which the generator set receives the startup signal are 184 and 185, which should be volt-free.

The generator set uses terminals 120 and 121 to return a volt-free signal when the voltage and frequency of the generator set are correct.

Terminals R S T N should be connected to a mains input prior to the ATS, as these terminals provide the power supply for the engine block heater and battery maintainer. The cable cross section should be appropriate for your installation.

4.7.1.2 Installation of ELECTRICAL POWER section:

A diagram of a connection can be seen in image 17.

The ELECTRICAL POWER installation may be done in two ways:

1) **ATS supplied by Eneraque**

- Connect the generator's current output terminals U V W N to the ATS terminals U V W N.
- Connect the electric company's power control switch (PCS) to terminals R S T N.
- Then connect terminals X Y Z N to the installation for which you want to guarantee electrical power.

2) **ATS not supplied by Eneraque or the generator set is the "Standby via signal" type.**

- Connect the generator's current output terminals U V W N to the input of the ATS on the generator set. Check the manual of your ATS.

This installation should be performed by qualified personnel, who should determine the conductor section to be used.

Remember that you must ground the unit according to the current regulations in effect where the installation is performed.

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4.7.1.3 Earthing:

Ensure that the generator set, including mobile ones, is effectively grounded (earthed) in accordance with every relevant regulation, electrical code, standard or other requirement, prior to start operations.

The electrical resistant of earthing installation must be enough low in order to allow earth leakage protection systems to work properly and to limit the voltage in exposed conductive parts, to avoid dangers to people or goods. Check regularly this value to avoid its increasing.

To avoid the transfer of currents or voltages from other electrical systems (for example, high voltage network), independence between grounding systems must be guaranteed.

4.7.1.4 Motorized changeover switches:

Mototized changeover switches are a kind of special designed control switchgear for electrical networks transfer, which simplify the equipment and control wiring needed.

Motorized changeover switches can also be manually operated. They include a handle key to network switching in case of emergency when any power source is available.

For security purposes, the changeover switch can be padlocked in position 0 (then manual operations are impossible and electrical controls are disabled).

For additional information, please consult manufacturer manual.

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STORAGE

If you think your generator will be inactive for a long period of time, follow these instructions:

- Switch the control module to the OFF position.
- Press the emergency stop button to avoid future involuntary startups when connecting.
- Empty the fuel tank.
- Leave the battery disconnected.
- Avoid storing the unit in spaces with high dust accumulation or excessive humidity.
- Do not use pressurized water when cleaning the unit.
- Check your engine manual for care instructions; the manual has been provided together with this document.
- Check your alternator manual for maintenance instructions; the manual has been provided together with this document.

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5.0 STARTUP

Prior to start up the generator set, follow these steps listed below:

- Check levels: oil, coolant and fuel.
- Turn the battery isolator switch to the ON position.
- Release the emergency push button if it has been pressed.
- Connect to the mains power and verify that the voltage indicator is giving an adequate reading.
- Check circuit breaker is on
- After completing the pre-startup tasks, make sure that the generator's control module switch is in the desired position. For this reason, the user should carefully read about the operation of the control module in section 6 of the OPERATION MANUAL.
- It is recommendable to run a simulation of mains failure to verify that the unit is functioning properly.

Prior to start up the generator set or after changing generator set location, follow these steps listed below:

- Check the genset right mechanical balance and the right contact of every base support with the floor.
- Check and retighten, when necessary, engine-alternator coupling to base frame screws.
- Check and retighten, when necessary, radiator to base frame and radiator to motor screws.
- Check and adjust, when necessary, the fan belt and battery charger alternator belt alignment. If generator set output is over 750 kVA, this recommendation turns into mandatory. Please, contact with your distributor to request specific information to make this task.
- Check canopy sealing material, especially in the roof. Clean and reseal when necessary.
- Check battery connections, and retighten, clean and grease when necessary.

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5.1 POWER FACTOR AND GENERATOR SETS

The power factor (cos φ) of the generator set loads must be determined. Lagging power factor below 0,8 can overload the generator. It can work properly from 0,8 to 1 lagging power factor.

Special attention must be given to installation with power factor corrections equipment (based on capacitors) in order to avoid leading power factor. This could prompt the generator set to voltage instability and could result in dangerous overvoltages. Whenever generator set is supplying the load, any power factor correction equipment must be switched off.

5.2 LIGH LOAD OPERATION ON DIESEL ENGINES

If an engine is operated on a load less than 25-30% of it's rated output, certain symptoms will be observed which may be cause for concern. The engine is designed to run up to a maximum power and so the size of the piston, the wall loading of the piston rings, etc., are designed for this.

When an engine is run at light load then the energy put into the cylinder is low and cnsequently the cylinder pressure is lower and so is the temperature. The result is the piston to bore clearance is increased allowing more oil to pass the piston and be burnt, which is indicated by high oil consumption.

With lower preasures the sealing capacity of the rings is lower, also it is not ideal for bedding in the rings and can cause bore glazing, which reduces oil control.

Oil will start to appear from the manifolds from the bearing arrangement in the turbocharger.

Turbochargers are fitted to an engine to increase power by supplying more air to the cylinders. When running a turbocharger, air is sucked in, which can have vacuum levels up to 500 mm H2O, with pressure ratios of 3:1. The compressor seals are designed to work most efficiently when the turbocharger compressor is operating at its' most efficient point. If the engine is running at low powers then the turbocharger is running at low speed (no energy from the exhaust because the fuel inlet to the engine is low) and the inlet vacuum is low resulting in poor turbocharger seal loading and pull over of oil from the bearing assembly. This oil is mixed with the air and pumped into the manifolds where some separates from the air when it collides with the inside of the manifold. The manifold gaskets will become impregnated with oil, eventually this will show as an oil leak from the manifold mating surfaces.

Black smoke will be produced from the exhaust outlets, due to poor combustion at light load, as excess fuel is pumped through into the exhaust system, resulting in soot being expelled into the exhaust system.

A further result is that of abnormal carbon build-up on the valves, piston crowns and exhaust ports. Thus the normal service interval of 2500 hours between top overhauls may be reduced. Fuel dilution of the lubricating oil will also occure.

It is therefore recommended that the following precautions are observed :-

- Running on light load should be avoided or reduced to a minimum period. If weekly exercising on no load is carried out, the running period should be kept down to maximum 15 minutes or until the battery charge rate returns to normal.
- Every year the engine / generating set should be run on full load for four (4) hours, to burn off accumulations of carbon in the engine and exhaust system. This may require a "dummy" load. The load should be built-up gradually from zero over the four hour run.

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6.0 OPERATION MANUAL

The generator set you purchased was designed for standby use, which means that it will mainly be operational when the mains voltage is inadequate.

Therefore it is necessary to connect the mains to the unit's ATS as well as to the generator set (see section 4 – Installation).

The following is a description of the different variable elements, according to the generator set chosen.

6.1 CONTROL panel components



Ammeter:

Measures the current (A), by means of a switch, of the different phases of the generator set.



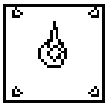
Frequency meter:

Indicates the frequency of the generator set (Hz).



Voltmeter:

Indicates the voltage (V) of the main power supply or generator set, depending on the position of the voltmeter switch (Ph-Ph, Ph-N).


Voltmeter Switch

This switch allows for voltage measurement by phase of the main power supply or the generator set.



Hour meter:

Indicates number of hours worked by the generator set.

The two digits in red on the right indicate hundredths of hours. Hours are indicated in white from the third digit on.

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 Battery voltmeter.

Indicates current voltage of battery.

 Engine block heater lamp (warming up):

Amber light. Indicates engine block heating system is turned on. Turns on and off automatically according to the setup of the thermostat.

 Battery voltage failure lamp (GECO module only).

Red light. Indicates alternator battery charge failure.

 Emergency stop button:

Pressing this button brings the generator set to an immediate stop. To cancel, turn to the left, when the end of the emergency situation has been confirmed.

 Gauges indicating engine parameters:

Oil Pressure

Battery charger current

Engine Temperature

Fuel Level

Activated by temperature and fuel button when generator set is stopped. When the generator is operating, the gauges show the corresponding levels.

 Diagnostic Button:

Allows engine parameters to be checked when generator set is stopped (electronically controlled engines). Also gives a readout of the generator's different alarms.

 Differential:

Protection against earth leakage of one phase, switching off the generator set circuit breaker.

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6.2 GECO Analog Control Module

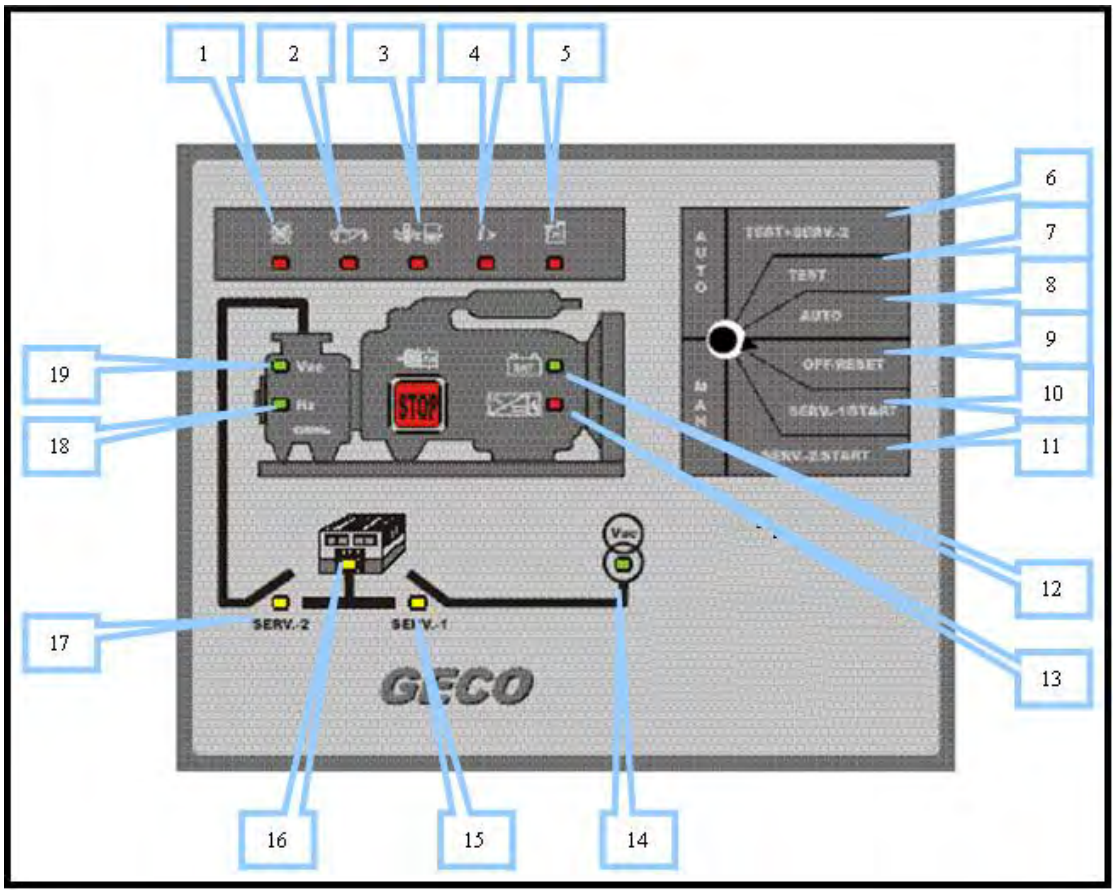


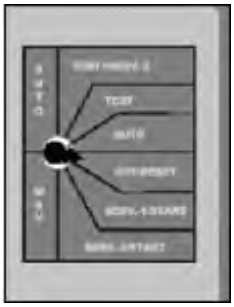
Image 12- GECO Digital Control Module

The following is an explanation of each of the items shown on the GECO control module; this module is for generator units with/without ATS:

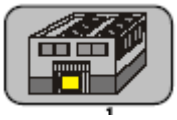
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NUMBER	SYMBOL	DESCRIPTION	IDENTIFICATION
(1)		Startup failure/No voltage or frequency detected/Emergency button pushed	Red LED
(2)		Low oil pressure	Red LED
(3)		High temperature/Low coolant level	Red LED
(4)		Overload	Red LED
(5)		Low fuel level	Red LED
(6)		Load test mode	Different module operational modes
(7)		Test mode	
(8)		Automatic mode	
(9)		OFF/RESET mode	
(10)		SERV-1/START mode	
(11)		SERV-2/START mode	
(12)		Battery voltage OK	Green LED
(13)		Battery charging	Constant red: batteries charging/Flashing red light: batteries fully charged.
(14)		Mains correct	Green LED
(15)		Mains contactor	Yellow LED on indicates contactor closed

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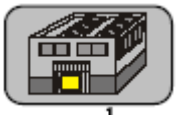
(16)		Power supply to loads	Yellow LED on indicates supply to loads
(17)		Generator Contactor	Yellow LED on indicates contactor closed
(18)		Generator voltage and frequency correct	Green LED indicates correct voltage and frequency
(19)			

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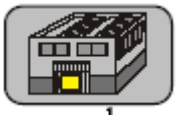
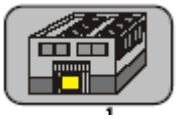
The GECO module has six operating modes, differentiated in automatic mode (AUTO) and manual mode (MAN), which can be configured using the module switch (numbers 6-11 on the control module's descriptive panel).

- **AUTOMATIC mode (8), (normal operating mode):**

When mains failure occurs, the GECO module registers this by turning off LED indicators  (13) and  (14), at which point the mains contactor closes, LED indicator  (15) turns off and the command is sent to turn on the unit. There will be a maximum of three startup attempts lasting 20 seconds each, with a 10 second pause between each.

Once the unit has started up, if the generator set voltage is correct LED indicators  (18) and (19) will be turned on, at which point the electrical generator's contactor closes and LED indicators  (16) and  (17) will be turned on, and the customer's installation receives a power supply until the mains power returns.

If all three startup attempts have been unsuccessful, LED indicator  (1) will be lit and an acoustic signal will be given, lasting 120 seconds.

Upon return of the mains power, LED indicator  (14) on the control module will be lit and the unit's shutdown sequence begins, which lasts approximately 60 seconds (in order to check the stability of the mains power) following the return of the mains power, the generator set contactor will be disconnected, which in turn shuts off LED indicators  (16) and  (17), followed by the closing of the mains power contactor and the illuminating of LED indicators  (16) and  (17).

From this moment, the unit will continue operating for 120 seconds at no load before stopping completely to cool the engine.

If the mains power fails during the shutdown sequence, the operating cycle will be repeated, thus guaranteeing adequate electrical supply.

On this control module in automatic mode, two additional selections can be made (in addition to the automatic option, seen previously):

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- LOAD TEST mode (6): with the switch turned to this position, a simulation is made of mains failure and the load is transferred to the generator set. If the switch is turned to another option while correct voltage and frequency levels exist, the loads will be transferred to the mains power.

- NO LOAD TEST mode (7): this option simulates a mains failure: no loads are transferred to the generator set. If a mains failure occurs during this operation, the loads will be transferred to the generator unit. This mode will terminate if another option is selected.

Note: For terminating test modes, it is recommendable to turn the switch to OFF/RESET and then turn the switch to the AUTO position.

- **MANUAL mode (3 different modes)**

- OFF/RESET mode performs two functions, the first of which is to stop the unit whether it is in manual mode (MAN) or automatic mode (AUTO); the second function is to cancel the active alarms, allowing for a new startup of the generator set.

- SERV-1/START mode (10): when turning the switch to this option, the unit startup is ordered (manual operation of the generator unit); if it is operating in this mode and a mains failure occurs, the generator set will not supply energy to the loads.

- SERV-2/START mode (11): when turning the switch to this option, the unit startup is ordered (manual operation of the generator unit) and LED (17) is lit. If the generator stops in this mode, the loads would not be transferred to the mains power. The alarms are automatically set.

If a TEST has been run, both in automatic mode (AUTO) or in manual mode (MAN), to stop the generator set turn the control module switch to the OFF mode (9); once the engine is stopped the switch can be set to a new operating mode.

Finally, if the red STOP button is pressed, an emergency stop will take place. If the switch is turned to a position other than OFF, LED indicators  (1) and 

(15) will light up and an acoustic signal will be activated.

Note: If the emergency stop button is pushed while the generator unit is stopped (in the OFF position of the control module), the GECO control module will not give any indication of this, however the unit will not start up.

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INDICATOR LIGHTS:



(12)

This control module includes a 2 ampere battery charger; receives power supply from external transformer connected to the mains power. LED will turn on when battery voltage is correct.


(13)

LED is lit while batteries are charging. Lit only when connection with the mains power exists. LED illuminated intermittently when battery voltage is correct.

ALARMS:

The alarms of the GECO module are showed by means of LED indicators. There are two alarm types, one which issues the stop command and one which does not; if it is the first of these, move the switch to the OFF position (9) and fix whatever caused the alarm and select the desired option.


(1)

Indicates startup failure. Either voltage or frequency is not detected or the emergency stop button has been pressed; in both cases the LED indicator (1) will turn on and the control module will issue a stop command to the generator unit. To stop the alarm, turn the control module switch to the OFF/RESET position (9).


(2)

Indicates low oil pressure. LED indicator (2) will turn on and the control module will issue a stop command to the generator unit. To stop the alarm, turn the control module switch to the OFF/RESET position (9).


(3)

Indicates high engine coolant temperature or low coolant level. LED indicator (3) will turn on and the control module will issue a stop command to the generator unit. To stop the alarm, turn the control module switch to the OFF/RESET position (9).

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 (4)

Indicates overload of the generator unit. LED indicator (4) will light up and the control module will issue a stop command to the generator unit.

To stop the alarm, turn the control module switch to the OFF/RESET position (9).

Open the electrical panel door and check the status of the circuit breaker. Check the reason for the overload and reset. Close the electrical panel door.

Put the module in AUTO mode.

 (5)

Indicates low fuel level; LED indicator (5) will be lit. System warning; must respond accordingly.

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6.3 GPM-2 Analog Control Module

This module is for “Standby by signal” type generators.

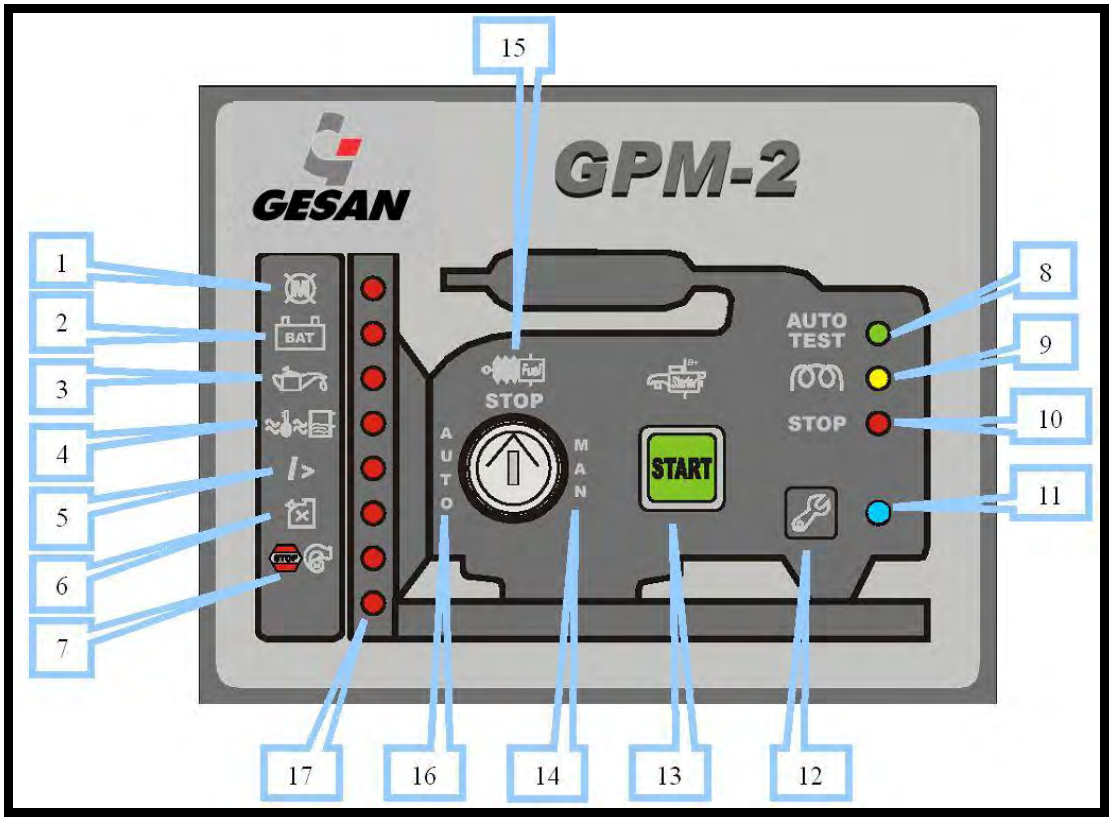
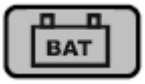


Image 13- GPM-2 Control Module

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NUMBER	SYMBOL	DESCRIPTION	IDENTIFICATION
(1)		Unit startup failure / Alternator failure	Flashing red light: three startup failures. Continuous red light: voltage failure or low frequency.
(2)		Battery charge failure	Flashing red light: charge failed. Continuous red light: unit stopped.
(3)		Low oil level	Flashing red light: low oil level. Continuous red light: unit stopped.
(4)		Low level / High coolant temperature	Flashing red light: high temperature. Continuous red light; low level.
(5)		Overload	Flashing red light: unit overload.
(6)		Low fuel level	Flashing red light: low fuel level.
(7)		Emergency stop / Overspeed	Flashing red light: emergency stop. Continous red light: overspeed.
(8)		Remote startup mode	Green LED
(9)		Unit warming up	Yellow LED
(10)		Stop signal	Flashing red light: cool-down time. Continuous red light: stop command issued.
(11)		Maintenance signal	Flashing blue light: maintenance required
(12)		Maintenance reset button / Ignition button	Button
(13)		Unit startup button	Button
(14)		Manual Mode	MAN

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(15)		Key position for stopping unit	STOP
(16)		Automatic mode	AUTO
(17)		Programmable alarm	Flashing or continuous red light: user-defined.

The GPM-2 control module has three positions: STOP, automatic (AUTO) and manual (MAN). Key selectable (numbers 14 through 16 of the descriptive chart on the control module).



- **AUTOMATIC mode (AUTO):**

When key is turned to the automatic mode position, unit will sit idle until receiving an external startup command. If mains failure occurs, the external mains monitoring system will issue a signal to the generator set, which will begin to operate, supplying the necessary electric power..

At the moment in which the external startup signal is received, while the key is in the AUTO position, the LED indicator for low oil level  will light up, as well as the alternator battery voltage indicator 

and AUTO TEST LED 

(numbers 3, 2 and 8 of the descriptive panel on the control module, respectively).

There will be a maximum of three startup attempts lasting 10 seconds each, with a 10 second pause between each.

After three unsuccessful startup attempts, LED indicator (1) will turn on.

If the unit was operating in automatic mode and the mains failure is resolved, once the external signal disappears 60 seconds will pass in order for the engine to be cooled; during these 60 seconds the LED indicator 

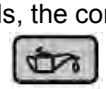
(10) will flash and later it will be continuously displayed and the engine will stop, with the LED indicator light remaining for 20 seconds.

If the mains power fails during the shutdown sequence, the operating cycle will be repeated, thus guaranteeing adequate electrical supply.

- **NO LOAD TEST mode (Manual):**

When key is turned to the manual mode, LED indicators for low oil level  (3) and alternator battery charge indicator 

(2) will be turned on. To start up the unit, press the START button 

(13). If the key selection has been made on the generator unit and this button is not pushed in 20 seconds, the control module will shut off the system; the startup signal will be cut off when LED indicators for low oil level  (3) and alternator battery charge 

(2) turn on; the startup signal will also be cut off when the frequency exceeds 20 Hz.

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LOAD TEST mode (Manual):

It must be done using the external ATS controller with the control module in automatic mode.

INDICATOR LIGHTS:



(8)

Indicates remote startup; continuous green light turns on when unit is operating remotely.


(9)

Indicates unit is warming up; continuous yellow light turns on when unit is being heated.



(10)

Indicates stop signal.

- Flashing: indicates engine cooling time.
- Continuous: control module issues a stop command to the Engine; stays lit for 20 seconds following the complete stopping of the engine.


(11)

Indicates maintenance. Flashing light; the first time the light turns on after 50 operating hours and afterwards every 150 hours.

To reset the maintenance hour meter, the generator set must be running; turn the key to the STOP position while pressing down the button  (12) until the control module becomes completely deactivated.


(12)

Ignition button.

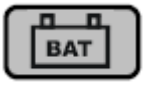
When key is turned to manual mode and START button is not pushed before 20 seconds, the control module will shut off the system in order to avoid battery discharging. But some engine maintenance tasks require electrical supply from battery to electronic engine components when the engine is not running. To get it, with the key in STOP position, press the button  (12) and without releasing it turn the key to the MAN position

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ALARMS:

The following is a chart describing the possible alarms of the GPM-2 module:

NUMBER	SYMBOL	DESCRIPTION	IDENTIFICATION
(1)		Unit startup failure / Alternator failure	If the light is flashing, generator is shut down.
			If light is continuous, indicates low frequency. If it unit runs below rated frequency for more than 30 seconds, it is shut down.
(2)		Alternator battery charge failure	If light is continuous and the engine is stopped, indicates ignition.
			If light is flashing, indicates failure and the control module issues unit stop command.
(3)		Low oil pressure	If light is continuous and the engine is stopped, indicates ignition.
			If light is flashing, indicates failure and the control module issues unit stop command.
(4)		Low level / High coolant temperature	If light is continuous, indicates low coolant level and module issues unit stop command.
			If light is flashing, indicates high coolant temperature and the control module issues unit stop command.
(5)		Overload	Light will flash and indicate that the circuit breaker is tripped; module issues stop unit command.
(6)		Low fuel level	If light is flashing, indicated WARNING.
			If light is continuous, module issues unit stop command.
(7)		Emergency stop / Overspeed	If light is continuous, module issues unit stop command, indicating an emergency stop (emergency button activated).
			If the light is flashing, module issues unit stop command, indicating engine high speed.

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(17)		Programmable alarm	If the light is continuous, indicates WARNING.
			If light is flashing, module issues unit stop command.
Note: If at any point 3 or more LED indicators turn on, it could indicate low battery level.			

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6.4 DEEP SEA 7310/7320 Digital Control Module

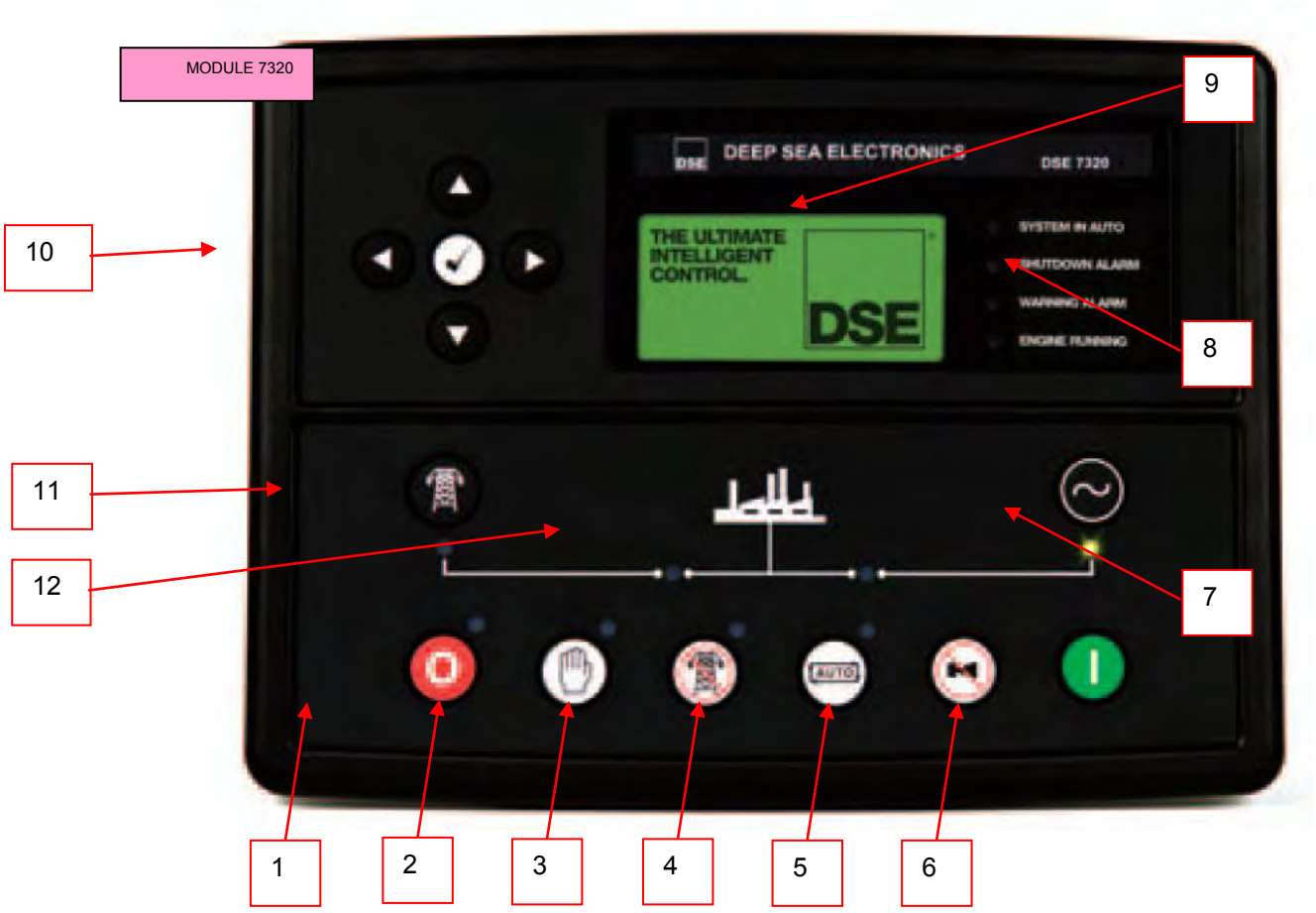


Image 14- Deep Sea 7320 Control Module

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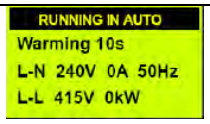
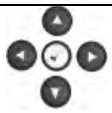
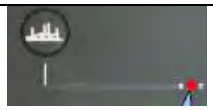
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Image 15- Deep Sea 7310 Control Module

NUMBER	SYMBOL	DESCRIPTION	IDENTIFICATION
(1)		Stop button.	Red LED
(2)		MANUAL mode button	Red LED
(3)		TEST mode button	Green LED (available on model 7320 only)
(4)		AUTOMATIC mode button	Red LED
(5)		Mute alarm / Lamp test button	

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(6)		Generator set start up button	
(7)		“Transfer to generator” button	Green LED on when generator set is available
(8)		Configurable LED indicators.	Red LED
(9)		Status generator set display.	
(10)		Menu navigator	
(11)		”Transfer to mains” button	Green LED (available on Model 7320 only)
(12)		Status of ATS for mains and generator set.	Left LED on: mains closed / Right LED on: generator closed.
(A)		“Open generator” button	LED on: generator set is supplying loads.

Deep Sea **7320** is an automatic control module that monitors the main power supply; if a mains failure occurs, generator set will start up and loads are transferred. This control module also allows the option of manual startup. The user can also control all of the generator unit’s parameters as well as the status of mains power supply. This model is supplied with standby generator sets with or without ATS.

Deep Sea 7310 control module is supplied with “standby by signal” type units.

- **AUTOMATIC mode (AUTO):**

This is the normal operating mode.

The automatic mode is activated by pressing the button 

(4), at which point the LED at the top of the button will turn on, indicating that it is operational.

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(**7320)** If the mains power supply fails for longer than the unit's programmed period, the LED  (11) indicating that the mains power is available will be turned off.

(**7310**) If a mains failure occurs, the external management system should send a startup signal to the generator set, at which point the LED indicating remote startup active (8) turns on and the startup process of the generator set begins.

The engine will start; if it should fail, there will be a maximum number of startup attempts (3). If all three startup attempts have been unsuccessful, the information screen will display a startup alarm:



When mains power is restored (or when the remote startup signal disappears) there will be a period of time in which the engine will continue operating at no load to cool down before stopping completely.

If a mains failure occurs or remote startup signal appears again during the no-load operating period (cool-down period), the generator set would begin the startup process again.

Press  (1) or the emergency stop button to intentionally stop the unit.

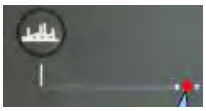
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- ***MANUAL mode:***

The manual mode is activated by pressing the button  (2), at which point the LED at the top of the button will turn on, indicating that it is operational.

Press  (6) to start up the unit.

If a mains failure occurs, a remote startup signal is received or “transfer to generator” button (7)  is pressed, loads will be transferred to the generator set. Once the load has been transferred to the generator, It will not be automatically transferred back to the mains supply.

Loads can be manually transfer back to mains pressing “transfer to mains” button  (11) (7320) or pressing “open generator” button  (A) (7310).

To terminate this mode, press the button  (4).

Once button (4) is pressed and there is adequate mains power supply (without the remote startup signal activated), the shutdown sequence will begin as described in the automatic mode.

Press  (1) or the emergency stop button to intentionally stop the unit.

- ***LOAD TEST mode (7320):***

A test for proper functioning of the generator set can be done pressing  (3).

To start up, press the start button  (6).

In this operating mode, a mains failure is simulated, with the loads being transferred to the generator set.

To terminate this mode, press the button  (4).

Once button  (4) is pressed and there is adequate mains power supply (without the remote startup signal activated), the shutdown sequence will begin as described in the automatic mode. After this period of time, the load will be carried by the mains power.

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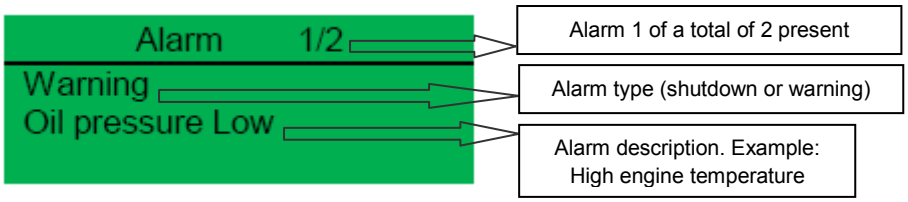
Press  (1) or the emergency stop button to intentionally stop the unit.

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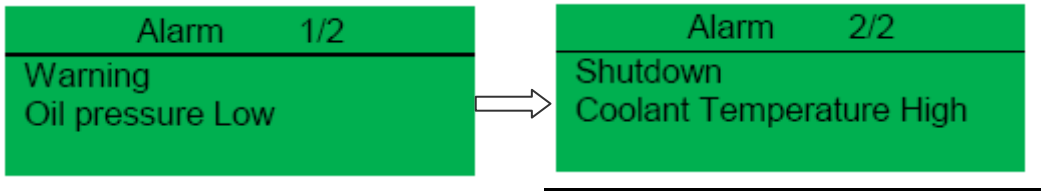
ALARMS:

Press  (5) to silence the audible alarm and acknowledge the common alarm LED.

By default, the information screen will show the status screen and if an alarm occurs, the screen will display the following:



If shutdown occurs while a warning is active, the screen will cycle through the active alarms:



The warnings do not entail generator unit shutdown.

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INCIDENT	ALARM DESCRIPTIONS
ALARM Warning Charge failure	Charge alternator voltage not detected
ALARM Warning Battery under voltage	Battery voltage beyond established limits
ALARM Warning Battery over voltage	
ALARM Warning Fail to Stop	After shutdown command, engine continues running. Could also indicate faulty oil pressure sender
ALARM Warning Auxiliary inputs	Auxiliary inputs can be configured and will display the message as written by the user
ALARM Warning Low fuel level	Fuel level below established limits
ALARM Warning CAN ECU error	Engine ECU has detected a warning alarm. The exact error is also indicated on module display (only for electronic engines).
ALARM Warning kW overload	The total kW are above the warning setting.
ALARM Warning Earth fault	The earth fault current is above alarm settings (only under customer request)
ALARM	Indicates “out of balance” current loading of the generator set.

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Warning Negative phase sequence	
ALARM Warning Low oil Pressure	Low oil pressure, below established limit
ALARM Warning Engine high temperature	Engine temperature beyond established limits
ALARM Warning Engine low temperature	
ALARM Warning Underspeed	Engine speed beyond established limits
ALARM Warning Overspeed	
ALARM Warning Generator over frequency	Generator set frequency beyond established limits
ALARM Warning Generator under frequency	
ALARM Warning Generator over voltage	Generator set voltage beyond established limit
ALARM Warning Generator under voltage	
ALARM Warning	Current of the generator set output beyond established limits

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High Current	

INCIDENT	DESCRIPTION OF SHUTDOWNS
ALARM Shutdown Earth fault	The earth fault current is above shutdown settings (only under customer request)
ALARM Shutdown Failed to Start	Engine does not start, three attempts made.
ALARM Shutdown Emergency stop	Controlled shutdown of the unit. It will not be functional until the emergency stop button has been reset.
ALARM Shutdown Low oil pressure	Oil pressure below established limit
ALARM Shutdown High temperature	Engine temperature above established limit
ALARM Shutdown Phase rotation	The phase rotation is different to the configured direction
ALARM Shutdown Overspeed	Engine speed beyond established limits
ALARM Shutdown Underspeed	
ALARM Shutdown Generator over frequency	Generator set frequency beyond established limits

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ALARM Shutdown Generatp or under frequency	
ALARM Shutdown Generator over voltage	Generator set voltage beyond established limit
ALARM Shutdown Generator under voltage	
ALARM Shutdown Oil pressure sender open circuit	Faulty oil pressure sender
ALARM Shutdown Auxiliary input	An active auxiliary input configured as a shutdown will cause the engine to shutdown. The display shows the text as configured by the user.
ALARM Shutdown Loss o speed signal	The speed signal from magnetic pick up as not received by the module.
ALARM Shutdown ECU data fail	The module conficured for CAN operation and doesn´t detect data on datalink
ALARM Shutdown ECU shutdown	Engine ECU has detected a shutdown alarm. The exact error is also indicated on module display (only for electronic engines).
ALARM Shutdown kW overload	The total kW are above the shutdown setting.
ALARM Shutdown Negative phase sequence	Indicates “out of balance” current loading of the generator set.
ALARM	Current of the generator set output beyond established limits

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Shutdown High Current trip	
Note: If the established limit for shutdown is exceeded, a corresponding alarm screen will be displayed and on the configurable LED indicator (8) the Common Shutdown alarm will appear.	

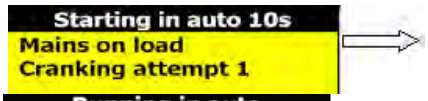
INCIDENT	DESCRIPTION OF ELECTRICAL TRIPS
ALARM Electrical trip Generator over current	Generator set current above electrical trip setting.
ALARM Electrical trip Auxiliary inputs	Auxiliary inputs can be configured and will display the message as written by the user
ALARM Electrical trip kW overload	The total kW are above electrical trip setting.
ALARM Electrical trip Earth fault	The earth fault current is above electrical trip settings (only under customer request)
ALARM Electrical trip Negative phase sequence	Indicates “out of balance” current loading of the generator set.
Note: Electrical trips are latching and stop the generator set but in a controlled manner. Firstly de-energise the “close generator” output to remove the load from the generator set, and later, cool down and shutdown the unit.	

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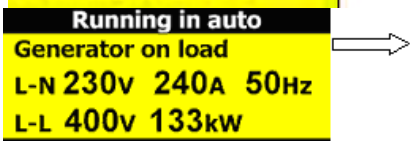
- **Typical LCD Display Screens**



Indicates that the generator set will respond to either a mains failure or an active remote start.



Indicates that generator set is in automatic mode and has been initiated after a mains failure has been detected.



Indicates generator set running normally in automatic mode. Also indicates the average line to neutral voltage (L-N), the highest of the three phase currents, the rated frequency, average line-to-line voltage (L-L) and total kilowatts.

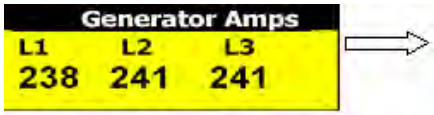
- **Measurement Parameter Display Screens:**



Coolant temperature in degrees (ºC) Celsius and degrees Fahrenheit (ºF)



Displays engine oil pressure in Bar, PSI and kPa.

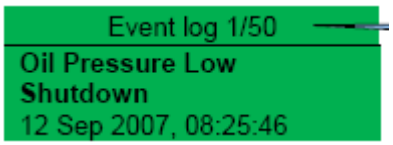


All three generator line currents.

- **Event Log:**

To view the event log, press the following button repeatedly  until the LCD display the event log.

It registers the shutdown alarms occurring in the generator unit. A screen similar to this is shown:



"On September 12, 2007, at 08:25:46, the unit detected that the oil pressure was below the minimum level and has shut down the generator. It´s the event 1 of a total of 50 logged events"

To move from one event to the next, press  .

To exit the main screen, press  .

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Note: Warning alarms are not logged.

- Displaying information:

Pressing this button:  .

Page order:

- Status display
- Instrument display (engine, generator and mains)
- Alarms display
- ECU DTCs (electronic engines only)
- Event Log
- Scheduler (if enabled)
- About

It is possible to scroll through the different display screens by pressing the next page button:  . Once selected, the page will remain on the screen until the user selects a different page or after a period of inactivity for the control module, at which point the status display appears.

If no buttons are pressed upon entering an instrumentation page, the instruments will be displayed automatically.

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Alternatively, by pressing on  or  buttons, the user can scroll through all the instruments on a particular screen. This disables autoscroll. When autoscroll is disabled, if no buttons are pressed the display will return to the status page. To re-enable autoscroll, press on  or  buttons to scroll to the title of the instrument page.

If an alarm becomes activated while viewing instruments, the Alarms page will be automatically displayed.

Instrument page content:

Engine

- Engine speed
- Oil pressure
- Coolant temperature
- Engine battery volts
- Run time
- Oil temperature*
- Coolant temperature*
- Inlet temperature*
- Exhaust temperature*
- Fuel temperature*
- Turbo pressure*
- Fuel pressure*
- Fuel consumption*
- Fuel used*
- Fuel level*
- Auxiliary sensors (if fitted and configured)
- Engine mantenience due (if configured)
- Engine ECU link*

** When connected to suitably configured and compatible engine ECU.*

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Generator

- Generator AC voltage L-N
- Generator AC voltage L-L
- Generator frequency
- Generator current
- Generator earth current (under customer request)
- Generator load (kW)
- Generator load (kVA)
- Generator power factor
- Generator load (kVAr)
- Generator load (kWh, kWAh, kVArh)
- Generator phase sequence

Mains (DSE 7320 only)

- Mains voltage L-N
- Mains voltage L-L
- Mains frequency

About

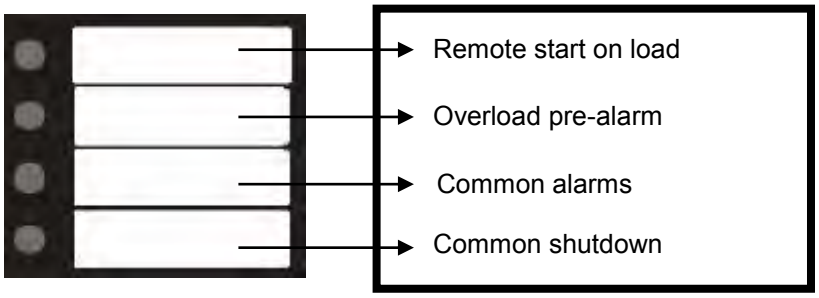
- Module type
- Application version
- USB ID – unique identifier for PC USB connection
- Analogue measurements version
- Firmware update bootloader version

If the following appears in an instrument display: *****, this means that the engine can't provide this parameter; the control module, however, does provide this option.

If the following appears in an instrument display: ####### with the generator set in OFF/AUTOMATIC mode (with the engine stopped), this means that the control module is not connected to the engine. Press this button  (6) to display the given value.

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- **Alarm LED:**



–

- **Editing the current Date and Time:**

The date and time are adjustable. When the battery is disconnected, the date and time are frozen; when the battery is reconnected, the date and time shown will be from the last time the battery was disconnected.

The date and time reflected in the Event Log will be taken from the configuration according to the following steps:

Press  and  simultaneously, then enter the correct PIN number using  or  buttons to select the right figure, and using  and  to move from one figure to another. Finally press  button

Press  until the Display seccion. Press  until “Current date and time”.

When “Current Date and Time” appears, press the  button. The figures will start to flash. Press  or  to adjust to the desired values.

Press the  button to confirm the value entered.

Press and hold  to exit the editor at any time.

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6.5 DEEP SEA 5510/5520 Digital Control Module



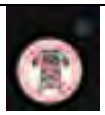
Image 16- Deep Sea 5520 Control Module

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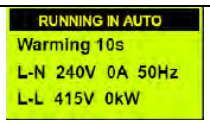
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Image 17- Deep Sea 5510 Control Module

NUMBER	SYMBOL	DESCRIPTION	IDENTIFICATION
(1)		Stop button.	Red LED
(2)		MANUAL mode button	Red LED
(3)		TEST mode button	Green LED (available on Model 7320 only)
(4)		AUTOMATIC mode button	Red LED
(5)		Mute alarm button	

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(6)		Generator set start up button	
(7)		“Transfer to generator” button	Green LED on when generator set is available
(8)		Configurable LED indicators.	Red LED
(9)		Status generator set display.	
(10)		Menu navigator	
(11)		”Transfer to mains” button	Green LED (available on Model 7320 only)
(12)		Status of ATS for mains and generator set.	Left LED on: mains closed / Right LED on: generator closed.
(A)		“Open generator” button	LED on: generator set is supplying loads.

Deep Sea **5520** is an automatic control module that monitors the main power supply; if a mains failure occurs, generator set will start up and loads are transferred to generator, synchronising and paralleling with mains when it is correct again. This control module also allows the option of manual startup. The user can also control all of the generator unit’s parameters as well as the status of mains power supply. This model is supplied with standby generator sets which need synchronise and parallel with mains, with or without ATS.

Deep Sea 5510 control module is supplied with generator set design for multi-set systems (several genset working in parallel. Another control device must monitor the mains and order the switch.

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- **AUTOMATIC mode (AUTO):**

This is the normal operating mode.

The automatic mode is activated by pressing the button 

(4), at which point the LED at the top of the button will turn on, indicating that it is operational.

(**5520)** If the mains power supply fails for longer than the unit's programmed time, the LED  (11) indicating that the mains power is available will be turned off.

(**5510**) If a remote start signal gets to the generator set, the LED indicating remote startup active (8) turns on and the startup process of the generator set begins.

The engine will start; if it should fail, there will be a maximum number of startup attempts (3). If all three startup attempts have been unsuccessful, the information screen will display a startup alarm: 

Once the engine is running and stabilized the mains breaker is opened and generator breaker is closed (5520).

Once the engine is running and stabilized, the generator set will first synchronise to the bus before closing generator breaker (5510).

When mains power is restored, the generator set is synchronised and paralleled with the mains. When parallel time is expired, the generator set will ramp the remaining load to the mains, and generator breaker is opened. There will be a period of time in which the engine will continue operating at no load to cool down before stopping completely (5520).

When remote start is removed the generator set will ramp the load to remaining sets. The generator breaker will be opened. There will be a period of time in which the engine will continue operating at no load to cool down before stopping completely (5510).

If a mains failure occurs or remote startup signal appears again during the no-load operating period (cool-down period), the generator set would begin the startup process again.

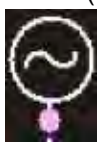
Press  (1) or the emergency stop button to intentionally stop the unit.

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- **MANUAL mode:**

The manual mode is activated by pressing the button  (2), at which point the LED at the top of the button will turn on, indicating that it is operational.

Press  (6) to start up the unit. When engine is running and stabilized, the generator available led is on.

If a mains failure occurs or “transfer to generator” button  (7) is pressed, the generator set is synchronized and paralleled with mains. If “transfer to generator” button  (7) is pressed while in parallel, the loads will be ramped to the generator set and mains breaker will be opened. If later “transfer to mains” button  (11) is pressed, the generator set is re-synchronised with the mains and return to parallel operation. If “transfer to mains” button  (11) is pressed while in parallel, the generator breaker will be open and loads transferred to the mains (5520).

If a remote start signal is applied or “transfer to generator” button  (7) is pressed, the generator is synchronised to the bus and then generator breaker is closed. If “open generator” button  (A) is pressed, the load is ramped on the remaining generators and the generator circuit is opened (5510).

To terminate this mode, press the button  (4).

Once button (4) is pressed and there is adequate mains power supply or without the remote startup signal activated, the shutdown sequence will begin as described in the automatic mode.

Press  (1) or the emergency stop button to intentionally stop the unit.

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- **LOAD TEST Mode (5520):**

Press  (3) to test for proper functioning of the generator set.

To start up, press the start button  (6). When the engine is running and stabilized, the generator set is synchronized with the mains and the generator breaker is closed. The loads will then be ramped from mains to the generator set.

To terminate this mode, press the button  (4).

Once button  (4) is pressed and there is adequate mains power supply, the shutdown sequence will begin as described in the automatic mode. After this period of time, the load will be carried by the mains power.

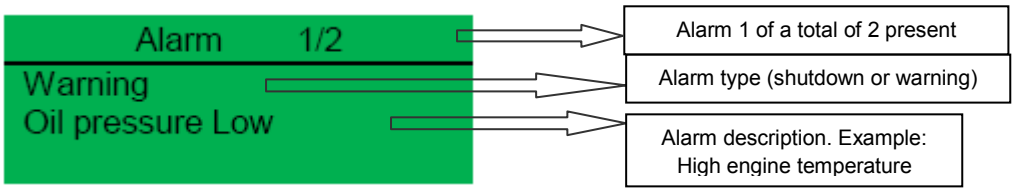
Press  (1) or the emergency stop button to intentionally stop the unit.

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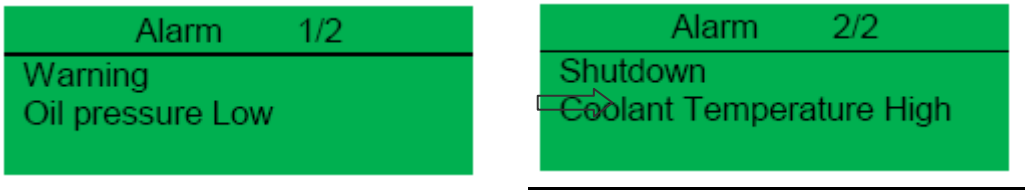
ALARMS:

Press  (5) to silence the audible alarm and acknowledge the common alarm LED.

By default, the information screen will show the status screen and if an alarm occurs, the screen will display the following:



If shutdown occurs while a warning is active, the screen will cycle through the active alarms:



The warnings do not entail generator unit shutdown.

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INCIDENT	ALARM DESCRIPTIONS
ALARM Warning Charge failure	Charge alternator voltage not detected
ALARM Warning Battery low voltage	Battery voltage beyond established limits
ALARM Warning Battery high voltage	
Alarm **Fail to stop**	After shutdown command, engine continues running. Could also indicate faulty oil pressure sender
ALARM Warning Auxiliary inputs	Auxiliary inputs can be configured and will display the message as written by the user
Alarm **Warning** **Low fuel level**	Fuel level below established limits
ALARM Warning Engine low temperature	Engine coolant temperature below warning setting.
ALARM Warning Generator failed to open	Feedback doesn´t confirm that generator breaker is opened.
ALARM Warning Mains failed to open	Feedback doesn´t confirm that mains breaker is opened.
ALARM Warning	Feedback doesn´t confirm that mains breaker is closed.

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Mains failed to close	
ALARM Warning Maintenance due	The setting time without maintenance has been exceed.
ALARM Warning Failed to synchronise	The generator set can´t synchronise
ALARM Warning Generator phase sequence wrong	A bus phase rotaion error has been detected.
ALARM Warning Mains phase sequence wrong	A mains phase rotation error has been detected.
ALARM Warning Negative phase sequence	Indicates “out of balance” current loading of the generator set.
ALARM Warning MSC data error	MSC link doesn´t allow modules communicate correctly.
ALARM Warning MSC too few sets	The number of modules on the MSC link is below the warning setting.
ALARM Warning CAN ECU error	Engine ECU has detected a warning alarm. The exact error is also indicated on module display (only for electronic engines).
Alarm **Warning** **Low oil pressure**	Low oil pressure, below established limit
ALARM Warning Engine high temperature	Engine temperature beyond established limits

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ALARM Warning Engine low temperature	
Alarm **Warning** **Overspeed**	Engine speed beyond established limits
Alarm **Warning** **Underspeed**	
ALARM Warning Generator over frequency	Generator set frequency beyond established limits
ALARM Warning Generator under frequency	
ALARM Warning Generator over voltage	Generator set voltage beyond established limit
ALARM Warning Generator under voltage	
ALARM Warning Loss of excitation	Loss of excitation on the alternator
ALARM Warning Insufficient capacity	The generator set is overloaded when paralleling with mains.
Alarm **Warning** **High current**	Current of the generator set output beyond established limits

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INCIDENT	DESCRIPTION OF SHUTDOWNS
Alarm **Shutdown** **Failed to start**	Engine does not start, three attempts made.
Alarm **Shutdown** **Emergency stop**	Controlled shutdown of the unit. It will not be functional until the emergency stop button has been reset.
Alarm **Shutdown** **Low oil pressure**	Oil pressure below established limit
Alarm **Shutdown** **High temperature**	Engine temperature above established limit
Alarm **Shutdown** **Overspeed**	Engine speed beyond established limits
Alarm **Shutdown** **Underspeed**	
ALARM Shutdown Generator over frequency	Generator set frequency beyond established limits
ALARM Shutdown Generator under frequency	
ALARM Shutdown Generator over voltage	Generator set voltage beyond established limit
ALARM Shutdown Generator under voltage	
ALARM Shutdown Oil pressure sender open circuit	Faulty oil pressure sender

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ALARM Shutdown Auxiliary input	An active auxiliary input configured as a shutdown will cause the engine to shutdown. The display shows the text as configured by the user.
ALARM Shutdown Magnetic pickup open circuit	The speed signal from magnetic pick up as not received by the module.
ALARM Shutdown Loss of speed signal	The speed signal is not received by the module during cranking.
ALARM Shutdown CAN data fail	The module conficured for CAN operation and doesn´t detect data on datalink
ALARM Shutdown CAN ECU fail	Engine ECU has issued a shutdown alarm.
ALARM Shutdown kW overload	The total kW are above the shutdown setting.
ALARM Shutdown Generator earth fault	Earth fault current is above the shutdown settings.
ALARM Shutdown Air flap closed	Engine air intake flap is closed.
ALARM Shutdown Negative phase sequence	Inbalance in the load current of each phase above shutdown setting.
ALARM Shutdown MSC old units on bus	An incompatible module on the MSC link.
ALARM Shutdown	ID error on MSC link.

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MSC ID error	
ALARM Shutdown MSC failure	MSC link is not detected.
ALARM Shutdown Loss of excitation	Loss of excitation on alternator.
Note: If the established limit for shutdown is exceeded, a corresponding alarm screen will be displayed and on the configurable LED indicator (8) the Common Shutdown alarm will appear.	

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INCIDENT	DESCRIPTION OF ELECTRICAL TRIPS
ALARM Electrical trip Auxiliary inputs	Auxiliary inputs can be configured and will display the message as written by th user
ALARM Electrical trip Generator high current	Output current above the electrical trip setting.
ALARM Electrical trip Generator reverse power	Reverse power current above the electrical trip setting.
ALARM Electrical trip Generator short circuit	A generator short circuit has been detected.
ALARM Electrical trip Mains reverse power	The power exported to the mains is above the setting.
ALARM Electrical trip	Loss of excitation on alternator.

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Loss of excitation	
ALARM Electrical trip Insufficient capacity	The generator set is overloaded when paralleling with mains.
ALARM Electrical trip Generator failed to close	Feedback doesn´t confirm that generator breaker is closed.
ALARM Electrical trip Negative phase sequence	Indicates “out of balance” current loading of the generator set.
Note: Electrical trips are latching and stop the generator set but in a controlled manner. Firstly de-energise the “close generator” output to remove the load from the generator set ,and later, cool down and shutdown the unit.	

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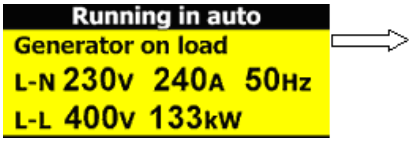
- **Typical LCD Display Screens**



Indicates that the generator set will respond to either a mains failure or an active remote start.



Indicates that generator set is in automatic mode and has been initiated after a mains failure has been detected.



Indicates generator set running normally in automatic mode. Also indicates the average line to neutral voltage (L-N), the highest of the three phase currents, the rated frequency, average line-to-line voltage (L-L) and total kilowatts.

- **Measurement parameter display screens:**

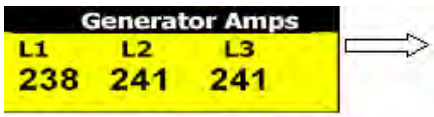


Coolant temperature In degrees (ºC) celsius and degrees fahrenheit (ºF)

Displays engine oil pressure in Bar, PSI and



kPa.

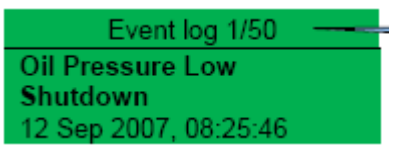


All three generator line currents.

- **Event Log:**

To view the event log, press the page button  repeatedly until the LCD display the event log. The records will be automatically scrolled down.

The event log registers the shutdown alarms occurring in the generator unit. A screen similar to this is shown:



"On September 12, 2007, at 08:25:46, the unit detected that the oil pressure was below the minimum level and has shut down the generator. It´s the event 1 of a total of 50 logged events". To exit the another page, press  .

Note: Warning alarms are not logged.

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- **Displaying Information:**

Press the button  to move to the required page. The LCD display the page title and then automatically start scrolling the various instruments until the user change to another page. It is also possible to scroll to different instruments using  or  buttons.

Instrument page content:

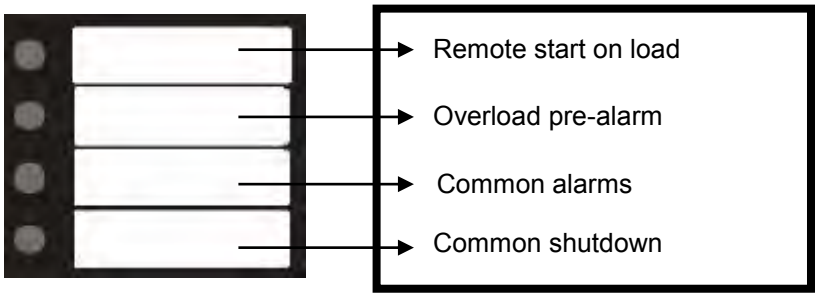
- Engine speed
- Oil pressure
- Coolant temperature
- Fuel level
- Battery voltage/charge alt volts
- Engine run time/number of starts
- Next maintenance (if enable)
- Generator AC voltage L-N
- Generator AC voltage L-L
- Generator frequency
- Generator current
- Generator earth current (under customer request)
- Generator load (kW)
- Generator load (kVA)
- Generator power factor
- Generator load (kVAr)
- Generator load (kWh, kWAh, kVArh)
- Generator phase sequence
- Mains voltage L-N
- Mains voltage L-L
- Mains frequency

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Enhance engine instrumentation (when supported by electronic engine ECU):

- Oil temperature*
- Coolant temperature*
- Inlet manifold temperature*
- Exhaust temperature*
- Turbo pressure*
- Fuel pressure*
- Fuel consumption*
- Total fuel used*

- **Alarm LED:**



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– **Editing the current Date and Time:**

The date and time are adjustable. When the battery is disconnected, the date and time are frozen; when the battery is reconnected, the date and time shown will be from the time the battery was disconnected.

The date and time reflected in the Event Log will be taken from the configuration according to the following steps:

Press  and  simultaneously, then enter the correct PIN number using + or - buttons and then press  to select the next figure.

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The LCD will then display: CONFIGURATION. To view the different configuration functions press the + or – buttons. Pressing the  button will enter in edit mode. The parameter being changed will flash. Pressing + or – buttons will change the parameter to the desired value. Press  to save the change.

Press and hold  to exit the editor at any time.

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6.6 INTELIGEN^{NT} Digital Control Module



Image 18- INTELIGEN^{NT} Digital Control Module

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#	SYMBOL	DESCRIPTION	IDENTIFICATION
(1)		Scrolls through different operating modes	OFF←MAN←AUT←TEST
(2)			OFF→MAN→AUT→TEST
(3)		Deactivates audible alarm	
(4)		Fault reset	Acknowledges faults and alarms
(5)		Start button	In manual mode
(6)		Stop button	In manual mode
(7)		MCB ON/OFF	Opens and closes MCB in manual mode
(8)		GCB ON/OFF	Opens and closes GCB in manual mode
(9)		Exit from atual screen (without save changes if editing)	
(10)		Selects on-screen value, setpoint, history record or increase/decrease setpoint value	Increases value
(11)			Decreases value
(12)		Moves history record displayed columns to the right/left, 5% increase/decrease of edited setpoint,s value or go out/into alarm list	Increases value
(13)			Decreases value
(14)		Enter button	Confirms on-screen value

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(15)		Mains power status	Green if mains power correct
(16)		Mains failure	Red light flashes if mains failure occurs and generator set doesn´t run; continuous if generator is operating, turns off when Mains power restored.
(17)		Generator voltage present	Green led is on if unit voltage is present and within limits.
(18)		Generator set failure	Flashing Red LED indicates alarm
(19)		State of GCB	Green led is on if GCB is closed. Flashes during synchronization with mains.
(20)		State of MCB	Green led is on if MCB is closed Flashes during reverse synchronization with mains.
(21)		State of bus	Green led is on if bus voltage is correct

NOTE: GCB = Generator Circuit Breaker; MCB = Mains Circuit Breaker.

The InteliGen^{NT} module contains a main menu screen and the following seven submenu screens:

- Alarmlist
- Measurement
- Measurement I/O
- History
- Setpoints
- User/Password
- Languages

Pressing several times the main menu is displayed. To enter in a submenu, scroll up and down using  (10) or  (11) buttons and press 

(14) button. To display the different instruments or parameters on each

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screen menu, press  (10) or  (11) buttons. To come back to a previous menu screen, press . 

(9) button.

The alarmlist screen display the alarms detected by the module. Pressing 

button (4) faultls and alarms are aknowledged.

The measurement screen displays the parameters measured on the engine; if the engine uses an electronic management system, many additional parameters can be displayed. In addition to these parameters, measurements can be displayed for fuel level, oil pressure, current, voltage, frequency, run hours and battery charge level.

The measurement I/O screen display the status of digital inputs and outputs and the measured parameter of analogue inputs (senders).

The history screen menu displays the log of alarms that have occurred in the generator unit. It also logs the opening and closing of the mains circuit breaker as well as the starting and shutting down of the generator unit.

The setpoints menu screen displays the adjustment parameters already configured; it is not necessary to edit any of these.

The users/password screen allows to define users and passwords. The languages screen allows to change the display language

- **AUTOMATIC mode (AUTO):**

If a mains failure is detected, the InteliGen^{NT} module will open the MCB (main circuit breaker). Startup command is issued to generator set. If generator voltage is within the established limits, the LED indicator  (17) will be on and the control module closes the GCB (generator circuit breaker). Once mains power has been restored, synchronization between mains and generator occurs; then the MCB is closed, causing the generator to discharge, followed by the opening of the GCB. When mains power is restored, there will be a period of time during which the engine continues operating at no load to cool down before stopping completely.

Note: If 

(4) is pressed following a disconnection alarm, the engine could automatically start without any warning.

- **NO-LOAD TEST mode (MANUAL):**

Press the START button 

(5) to start up the generator set. When the generator voltage is within the established limits, the LED indicator  (17) will be on. To stop the unit, press STOP 

(6).

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- **LOAD TEST mode (TEST):**

This operating mode is used for generator set start test is the mains is OK or to transfer the load to the generator set when a mains failure is announced in advance. To stop this mode, change to another mode by means of the buttons 

(1) or (2).

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- **OFF mode:**

The generator set will not start. Even if we press the buttons START 

(5), STOP (6) 

, GCB ON/OFF 

(8), the generator will not respond.

ALARMS:

The InteliGenNT control module includes the following warnings:

INCIDENT	STORED IN HISTORY RECORD
Startup sequence initiated	Startup of Gen-Set
Shutdown of the Gen-Set	Gen-Set stops
Electrical Generator circuit breaker closed	GCB connected
Electrical Generator circuit breaker opened	GCB disconnected
Some GCB in group was opened (in MINT)	Other GCB trip
Mains circuit breaker closed	MCB connected
Mains circuit breaker opened	MCB disconnected
Time mode has been changed	TimeModeChngd
STARTUP INFO	
AMF Startup	GenSetMF start
AMF Stop	GenSetMF stop
Remote startup by binary input (SPM, SPtM)	GenSetRemStart
Remote stop by binary input (SPM, SPtM)	GenSetRemStop
System startup by binary input (MINT, MEXT)	GenSetSysStart
System stop by binary input (MINT, MEXT)	GenSetSysStop
Peak start (SPtM)	GenSet PKstart
Peak stop (SPtM)	GenSet PKstop

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ENGINE		
EVENT SPECIFICATION	**ALARM**	**HISTORY**
Electrical Generator Startup failure	Sd Start Fail	Sd Start Fail
Electrical Generator Overspeed	Sd Overspeed	Sd Overspeed
Electrical Generator Underspeed	Sd Underspeed	Sd Underspeed
SD Stop fail	Sd Stop Fail	Sd Stop Fail
Emergency Stop	Emergency Stop	Emergency Stop
RPM Pickup fail	SdPickupFail	SdPickupFail
Battery voltage warning	Wrn Batt volt	Wrn Batt volt
Battery is discharged	Sd Batt flat	0

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GENERATOR	
EVENT SPECIFICATION	**HISTORY**
Generator phase 1 overvoltage	Unl Vg1 Over
Generator phase 1 undervoltage	Unl Vg1 Under
Generator phase 2 overvoltage	Unl Vg2 Over
Generator phase 2 undervoltage	Unl Vg2 Under
Generator phase 3 overvoltage	Unl Vg3 Over
Generator phase 3 undervoltage	Unl Vg3 Under
Generator Overfrequency	Unl Fgen Over
Generator Underfrequency	Unl Fgen Under
Generator voltage unbalance	Unl Vgen Unbal
Generator overload	UnlGen Overload
Load surge protection	LoadSurge
Reverse power	Unl Rev Pwr
Synchronization timeout	Stp SyncTO
Ground fault protection	Unl EarthFltC
Failure of generator circuit breaker	GCB fail
Generator short circuit protection	Unl Short Igen
Generator IDMT protection	Unl IDMT
Generator current unbalance	Unl Igen Unbal
Voltage on mains terminals (SPM)	UnlCounterVolt
Bus voltage error (MINT)	Unl BusMeasErr

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PHASE SEQUENCE		
EVENT SPECIFICATION	**ALARM**	**HISTORY**
Generator phase L1 is inverted	GEN L1 neg	0
Generator phase L2 is inverted	GEN L2 neg	0
Generator phase L3 is inverted	GEN L3 neg	0
Wrong generator phase sequence	G ph opposed	0
Wrong generator phase sequence and phase L1 is inverted	G ph + L1 neg	0
Wrong generator phase sequence and phase L2 is inverted	G ph + L2 neg	0
Wrong generator phase sequence and phase L3 is inverted	G ph + L3 neg	0
Mains phase L1 is inverted	B L1 neg	0
Mains phase L2 is inverted	B L2 neg	0
Mains phase L3 is inverted	B L3 neg	0
Wrong mains phase sequence	B ph opposed	0
Wrong mains phase sequence and phase L1 is inverted	B ph + L1 neg	0
Wrong mains phase sequence and phase L2 is inverted	B ph + L2 neg	0
Wrong mains phase sequence and phase L3 is inverted	B ph + L3 neg	0

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7.0 MAINTENANCE OF GENERATOR SET

You must make sure that the person who will perform this duty is qualified to do so and uses the appropriate individual protection equipment.

7.1 prior to maintenance

You must first:

- Switch Control Module to the OFF position.
- Press the emergency stop button.
- Disconnect the battery; use the battery isolator switch.

To cut Mains voltage, switch off the 10 A circuit breaker in the ATS panel supplied by Eneraquw. If made by another manufacturer, make sure that this cut is done properly before handling the unit.

7.2 during maintenance

Preventive maintenance tasks are necessary to preserve the unit; doing so will result in optimum performance. Be sure to verify the following items:

- While the engine is cold, the oil level should be between the minimum and maximum values. If it is below the minimum, add Engine oil. *NOTE: With the GPM-2 and InteliGen^{NT} modules, at 50 hours run notice will be given to change the oil. The recommended oil is 15W40.*
- The radiator water level should be adequate.
- The fuel level in the tank should be sufficient for the service to be performed. The generator control panel is equipped with a fuel gauge, which will be functional whenever the electrical panel is receiving power.
- Always refuel in a well ventilated area with the engine stopped.
- Closely inspect the connections and the electrical circuit, for both the mechanical and electrical sections.
- Check carefully for possible liquid leaks. If a leak is detected, find its source and resolve the problem. If your unit has a retention bath, drain it (see section 3.4 RETENTION BATH).
- The air inlet and outlet vents should be completely unobstructed to allow for free circulation of cooling air.
- Check the state of the unit's radiator and clean if necessary.
- Make sure the exhaust tube is not obstructed.
- Check the battery's connection terminals and electrolyte level (if necessary, add demineralized or distilled water). Acid should never be added. The battery should be recharged if the terminal voltage is below 12.3 V.

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- If the battery needs recharging after being taken out of the unit, remove the vent caps and charge battery with direct current only. Connect the charger's positive (+) cable to the battery's positive (+) terminal and the charger's negative (-) cable to the battery's negative (-) terminal. Recharge battery with a current equivalent to 1/10 the rated capacity (Ah). Battery is fully charged when acid density is 1.28. Before completing recharging process: turn off charger before disconnecting battery and check electrolyte level.

- If the battery is discharged and you want to perform an emergency startup with the battery from another generator, first check the tightness of the discharged battery's terminals. Stop the engines of both units and connect the two positive terminals of the batteries first and then connect the negative terminal of the charged battery to a metal area on the disabled unit (ground). Start up the auxiliary unit and then the unit being repaired. Disconnect the cables in reverse order to avoid a short circuit. Finally, fully charge the battery.

While performing preventive maintenance tasks it is advisable to wear protective eyewear and gloves during all operations involving the handling of battery acid. Make sure there is nearby access to tap water in order to wash all potentially affected areas.

Remember to always perform all operations with the utmost precaution and safety as indicated in this Manual. (Pay special attention to the risk of short circuits that could be caused by coming in contact with the unit's metallic objects.)

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7.3 maintenance chart

FREQUENCY	MAINTENANCE OPERATION
MONTHLY	Perform a mains failure simulation; the unit should supply power to consumers for one hour.
	For parallel units, check the connection and the load sharing.
	Review the connections of the startup battery, clean and cover with vaseline.
	Make sure the battery charger is functioning properly.
	Make sure fuel pump is functioning properly.
	Check fuel level on the main fuel tank.
	Check coolant and oil levels.
	Make sure smoke extractor is functioning properly.
	Make sure all of the electrical panel lights are functioning properly.
	Make sure the ATS functions properly in transfers.
	Check the state of all of the gauges and indicators on the electrical panel.
	Check the engine manufacturer's manual for specific tasks.
EVERY 6 MONTHS	Start up the engine manually three times, noting each time the voltage and density readings for each of the battery's elements. If any of the voltage readings varies significantly from those of the battery's other elements, do not perform the remaining manual engine startups.
	Fully charge the battery and check the electrolyte level.
	Make sure there are no leaks in the coolant tubes.
	Make sure that all of the unit's alarms display correctly.
	Check the engine manufacturer's manual for specific tasks.
YEARLY	Clean the outside of the fuel tank and check the diesel pipes.
	Clean radiator, change antifreeze.
	Clean and lube the water pump and fan.
	Make sure meters are correct.
	Clean control panel and tighten the panel's connections.
	Verify that the antivibration feet, fittings and belts are in proper condition.

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	Make sure that vibration and noise levels comply with the current regulations.
	Make sure noise emission level is compliant with the current regulations.
	Check the engine manufacturer's manual for specific tasks.
EVERY 3 YEARS	Replace startup batteries.

8.0 TROUBLESHOOTING

INCIDENT			LIKELY CAUSE	SOLUTION
In the electrical panel	Engine does not start	Starter does not turn	1.-Defective battery	1.-Replace battery
			2.-Defective starting system	2.-Replace starting system
				3.-Contact technical service.
		Starter functioning properly	1.-Faulty voltage detector on control module	1.-Contact technical service.
			2.-Low fuel level	2.-Refill fuel tank
	Engine starts	Stops with cause	1.-Emergency has occurred	1.-Take appropriate measures
		Stops for no apparent reason	1.-Emergency not indicated due to faulty LED indicator	1.-Contact technical service.
		Does not stop when emergency occurs	1.-Defective stopping system	1.-Press emergency stop button
				2.-Contact technical service.
		Generator does not stop when in stop position	1.-Faulty control unit	1.-Press emergency stop button
			2.-Defective Stopping System	2.-Contact technical service.
interior	Unit in operation	High voltage at no load	1.-Overspeed	1.-Contact technical service.
			2.-Alternator failure	
		Low voltage at no load	1.-Underspeed	1.-Contact technical service.
			2.-Alternator failure	
		Correct voltage but low when on load	1.-Heavy load	1.-Reduce power of loads
			2.-Underspeed on load	2.-Contact technical service.

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			3.-Alternator failure	
		Voltage unstable	1.-Voltage meter damaged	1.-Contact technical service.
			2.-Engine unsteady	
			3.-AVR damaged	
		Strange noise inside the unit	1.-Various causes	1.-Make sure nothing is preventing the unit from functioning properly.
				2.-Contact technical service.

9.0 PROTECTION FROM THE ENVIRONMENT

Once the generator set has been installed, it is necessary to remove the packaging, accessories, electrical tools, etc., that were used during the installation process.

When it is time to dispose of the batteries, in keeping with environmental regulations it is advisable to take them to an authorized recycling center.

For a cleaner environment, recycle all possible items and be sure to not throw electrical components in with the regular garbage so as to comply with european directive 2002/96/EC. These items should be stored separately until being taken for ecological recycling.

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10.0 WARRANTY

- The electrical generator warranty covers an entire year, starting from the date it is installed. This should be communicated to Eneraque. (hereinafter “the manufacturer”), in writing, via fax or email. The following information must be included: MODEL, SERIAL NUMBER and INSTALLATION DATE.
- If the manufacturer is not informed of the installation within a maximum of sixty days from the invoice date, the latter shall be considered the effective start date of the warranty period. If for any reason the installation is not possible within the first sixty days following the invoice date, the manufacturer must be informed thereof in writing. Thus no warranty claims shall be accepted if the manufacturer is not in possession of the aforementioned correspondence.
- The warranty of the electrical generator will cover any faulty components or assembly not caused by improper use, handling or modification. The warranty does not cover breakdowns caused by connecting the electrical generator to devices not installed or supplied by the manufacturer. Also excluded are breakdowns and damages caused by prolonged or improper storage; should this occur, please see the manufacturer’s user manuals.
- The warranty for the electrical generator shall cover ONLY the replacement parts and labor necessary for the repair of the generator by personnel authorized by the manufacturer. Traveling, kilometers traveled and other expenses deriving from the repair of a generator under warranty are excluded from the warranty coverage and in no case shall the manufacturer be responsible for these covering these expenses, which shall be paid in cash.
- The decision to accept or reject a warranty shall be made by the manufacturer. In the case of engine and alternator breakdowns, the warranty shall be granted by the provider of said components, according to the particular warranty conditions of those components. The manufacturer reserves the option to request that the faulty element be returned. In such case, all costs related to said return shall be covered by the customer.
- The warranty for a repair made during the warranty period shall have the same expiration date as the warranty for the electrical generator.
- The warranty does not cover damage caused by terrorist attacks, natural disasters, sabotage or incidents of a similar nature.
- If any of the provisions set out does not comply with the legislation of a certain country, the importer is required to notify the manufacturer thereof prior to carrying out the sale transaction.

11.0 NOISE LEVEL

Generator sets manufactured by Eneraque produce different acoustic levels depending on the output and soundproofing of the generator set. The noise output is indicated on a sticker affixed to the unit’s base frame.

Note: If you work near the unit for any extended period of time, it is advisable to use hearing protection.

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12.0 DECLARATION OF CONFORMITY CE

Eneraque shall deliver a CE “declaration of conformity” form along with the unit, in compliance with the referenced regulations or standardized documents.

13.0 APPENDIX 1: FIGURES

Detail of the unit’s Identification Label:

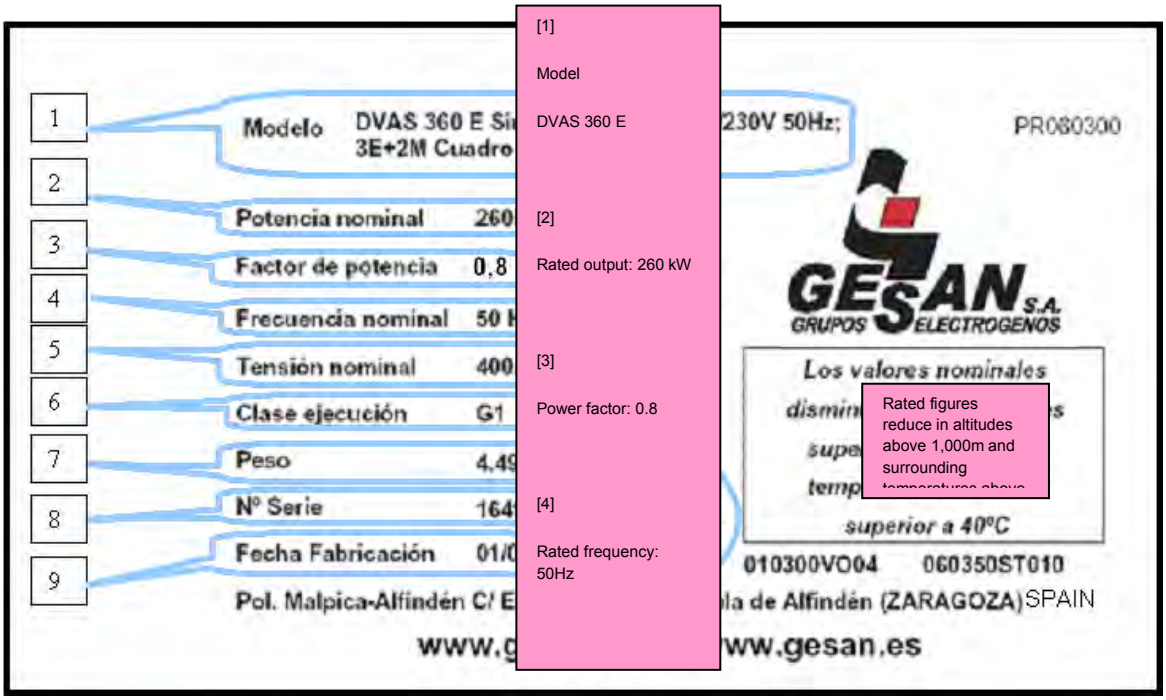


Image 19- Identification Label

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#	LABELED ITEM	DESCRIPTION
(1)	DVAS 360 E	D => Engine uses Diesel fuel at 1500/1800 rpm
		V => Engine manufacturer is (V)olvo, (P)erkins, (C)ummins, Mitsubis(H)I or M(T)U.
		W => The generator set is designed to operate at 60 Hz
		A => The generator set is automatic
		S => The generator set is soundproofed
		360 => Commercial name
		E => Indicates generator set is standby type
(2)	Rated power	Rated power of generator set expressed in kW.
(3)	Power factor	Indicates power factor of generator set
(4)	Rated frequency	Rated frequency of generator set (Hertz)
(5)	Rated voltage	Rated voltage of generator set (Volts)
(6)	Product class	When withstanding a load, engine will perform according to catalogued response times per ISO 8528
(7)	Weight	Total weight of generator set
(8)	Serial no.	Serial number of generator manufacture
(9)	Manufacture date	Manufacture date of generator set
(10)	CE	CE marking indicates that generator set complies with the relevant directives

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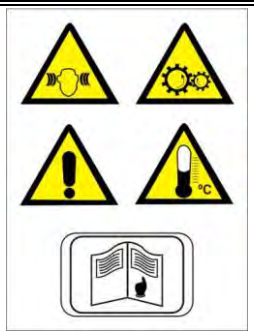
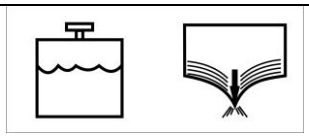
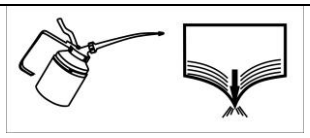
		
Image 20 Placing in operation	*Image 21 Caution with generat*	*Image 22 General warning*
		
Im *No*	*Image 24 Electrical Hazard 230 Volts*	*Image 25 Electrical Hazard 400 Volts*
		
Image 26 Lifting point	*Image 27 Possible battery leakage*	*Image 28 Electrical grounding*
		
Image 29 Noise output 90 dB	*Image 30 Noise output 114 dB*	*Image 31 Use of hearing protection required*
		
Image 32 Coolant Flush	*Image 33 Oil draining*	*Image 34 Battery Isolator*

Image 26:

IMPORTANT

PLACING IN OPERATION:

1.-Make sure "Battery Shutoff" switch is CLOSED

2.-Check engine's water and oil levels.

Image 27:

CAUTION

BATTERY ISOLATOR

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14.0 APPENDIX 2: IMAGE INDEX

Image 1- Generator set with sound proof canopy. 6
Image 3- Detailed view of Image 1 7
Image 4- Detailed view of Image 2 8
Image 5- Interior of a soundproofed Electrical Generator ..... ***Error! Bookmark not defined.***
Image 6- Generic Control Panel 10
Image 7- Control Panel of GECO Control Module ..... ***Error! Bookmark not defined.***
Image 8- Control Panel of the GPM-2 Control Module ..... ***Error! Bookmark not defined.***
Image 9- Control Panel of the Deep Sea Control Module ..... ***Error! Bookmark not defined.***
Image 10- Control Panel of the InteliGen^{NT} Control Module ..... ***Error! Bookmark not defined.***
Image 11- Load Transfer diagram 11
Image 13- Lifting frame 13
Image 14- Detailed view of installation of an open-skid unit 14
Image 15- SAB-BE Pump ..... ***Error! Bookmark not defined.***
Image 16- ATS setup 19
Image 17- Diagram of ATS Panel 20
Image 18- GECO Digital Control Module 29
Image 19- GPM-2 Control Module 36
Image 20- Deep Sea 7320 Control Module 42
Image 21- Deep Sea 7310 Control Module 43
Image 22- Deep Sea 5520 Control Module 59
Image 23- Deep Sea 5510 Control Module 60
Image 24- INTELIGEN^{NT} Digital Control Module 77
Image 25- Identification Label 92
Image 26 Placing in operation 94
Image 27 Caution with generator startup 94
Image 28 General warning 94
Image 29 Undefined Warning Notice 94
Image 30 Electrical Hazard 230 Volts 94
Image 31 Electrical Hazard 400 Volts 94
Image 32 Lifting point 94
Image 33 Possible battery leakage 94

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Image 34 Electrical grounding *94*
Image 35 Noise output 90 dB *94*
Image 36 Noise output 114 dB *94*
Image 37 Use of hearing protection required *94*
Image 38 Coolant Flush *94*
Image 39 Oil draining *94*
Image 40 Battery Isolator *94*

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15.0 APPENDIX 3: PRE-DELIVERY INSPECTION DOCUMENT

ITEMS TO BE CHECKED	OK	LP (OK)	KO
First checks			
Verify the right positioning of the genset			
Verify that air inlet is enough and according			
Verify that the hot air outlet from the engine is forwarded outside			
Verify that the exhaust outlet is piped outside			
Verify that the genset identifying plate is legible			
Verify that the alternator identifying plate is legible			
Verify that the engine identifying plate is legible			
Verify stickers and warning labels			
Verify the cabling and genset connexions			
Verify the earthling of the equipment			
Before starting the equipment			
Verify oil level and its conditions			
Verify fuel level			
Verify coolant level			
Verify air filter conditions			
Verify bolts, nuts and its tightness			
Verify lights and LEDs from the control panel			
Verify Battery isolator			
Verify and re*tight battery terminals			
Starting of the genset			
Verify exhaust emission colour			
Verify there is not strange noises from engine/alternator			
Verify fuel pipes and flanges			

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Verify that the control card is operating OK			
Verify phase sequence from genset is equal to Mains			
Mains Failure			
Verify the genset start when Mains is cut			
Verify the ATS closes genset contactor			
Verify that the genset keeps frequency and voltage on load			
Verify that, when Mains is back, the control card detects voltage			
Verify Mains contactors closed			
Verify genset stops after cooling period			
END			
Working mode and installation is OK			
Explain to the user the working mode			

Genset Voltage w/o load:	Genset Frequency w/o load
Remarks	

Leyend: Ok = Accepted, OK LP = Low problem, OK KO = Remove from service

R = Repaired N/A = Not applicable

In case that an installation is faulty the client must be informed, so the faults can be solved

Predelivery inspection done by	Final User:
Company:	Company:
Signed:	Signed:
ID:	ID:

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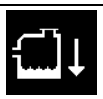
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16.0 APPENDIX 4: FIGURES IN DEEP SEA CONTROL CARDS.

DEEP SEA PICTOGRAMS

Pictograms	Descripcion
	Remote Start
	Auto Start inhibit
	Common Alarm
	Common Shutdown
	Overcurrent Pre-alarm
	GCB Trip
	Differential Trip
	GCB-Differential Trip

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	Low coolant level
	Low fuel level
	High Engine Temperature
	Frecuency 60Hz
	Remote Stop
	Fuel Filter Alarm

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17.0 APPENDIX 5: NOISE EMISSIONS

Model	Sound Pressure (dB) at 10 m.	Sound Power (dB)
DCAS 700 E	77	105
DCAS 860 E	77	105
DPAS 10 E	70	90
DPAS 10 E MF	70	90
DPAS 110 E	69	97
DPAS 15 E	70	90
DPAS 15 E MF	70	90
DPAS 150 E NC	69	97
DPAS 230 E	69	97
DPAS 25 E	70	90
DPAS 25 E MF	70	90
DPAS 275 E	69	97
DPAS 35 E MF NC	62	90
DPAS 400 E	69	97
DPAS 450 E	70	98
DPAS 50 E NC	66	94
DPAS 500 E	66	94
DPAS 550 E	75	103
DPAS 65 E NC	66	94
DPAS 700 E	77	105
DPAS 90 E NC	66	94
DVAS 140 E	69	97
DVAS 165 E	69	97

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DVAS 200 E	69	97
DVAS 220 E	69	97
DVAS 275 E	69	97
DVAS 330 E	69	97
DVAS 360 E	69	97
DVAS 410 E	69	97
DVAS 450 E	70	98
DVAS 505 E	66	94
DVAS 550 E	66	94
DVAS 630 E	69	97
DVAS 700 E	69	97
DZAS 165 E	69	97
DZAS 25 E	66	94
DZAS 35 E	66	94
DZAS 45 E	66	94

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Perkins®

SEBU7833-03
September 2008

Operation and Maintenance Manual

1103 and 1104 Industrial Engines

DC (Engine)
DD (Engine)
DJ (Engine)
DK (Engine)
RE (Engine)
RG (Engine)
RJ (Engine)
RR (Engine)
RS (Engine)
RT (Engine)
DF (Engine)
DG (Engine)

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Important Safety Information

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

The hazards are identified by the "Safety Alert Symbol" and followed by a "Signal Word" such as "DANGER", "WARNING" or "CAUTION". The Safety Alert "WARNING" label is shown below.

⚠ WARNING

The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

Operations that may cause product damage are identified by "NOTICE" labels on the product and in this publication.

Perkins cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. If a tool, procedure, work method or operating technique that is not specifically recommended by Perkins is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that the product will not be damaged or be made unsafe by the operation, lubrication, maintenance or repair procedures that you choose.

The information, specifications, and illustrations in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service that is given to the product. Obtain the complete and most current information before you start any job. Perkins dealers or Perkins distributors have the most current information available.

⚠ WARNING

When replacement parts are required for this product Perkins recommends using Perkins replacement parts.

Failure to heed this warning can lead to premature failures, product damage, personal injury or death.

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Table of Contents

Foreword 4

Safety Section

Safety Messages 5

General Hazard Information 6

Burn Prevention 7

Fire Prevention and Explosion Prevention 8

Crushing Prevention and Cutting Prevention 10

Mounting and Dismounting 10

Before Starting Engine 10

Engine Starting 11

Engine Stopping 11

Electrical System 11

Product Information Section

Model Views 13

Product Identification Information 19

Operation Section

Lifting and Storage 24

Gauges and Indicators 27

Engine Starting 28

Engine Operation 31

Engine Stopping 32

Cold Weather Operation 33

Maintenance Section

Refill Capacities 37

Maintenance Interval Schedule 51

Warranty Section

Warranty Information 79

Index Section

Index 80

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Foreword

Literature Information

This manual contains safety, operation instructions, lubrication and maintenance information. This manual should be stored in or near the engine area in a literature holder or literature storage area. Read, study and keep it with the literature and engine information.

English is the primary language for all Perkins publications. The English used facilitates translation and consistency.

Some photographs or illustrations in this manual show details or attachments that may be different from your engine. Guards and covers may have been removed for illustrative purposes. Continuing improvement and advancement of product design may have caused changes to your engine which are not included in this manual. Whenever a question arises regarding your engine, or this manual, please consult with your Perkins dealer or your Perkins distributor for the latest available information.

Safety

This safety section lists basic safety precautions. In addition, this section identifies hazardous, warning situations. Read and understand the basic precautions listed in the safety section before operating or performing lubrication, maintenance and repair on this product.

Operation

Operating techniques outlined in this manual are basic. They assist with developing the skills and techniques required to operate the engine more efficiently and economically. Skill and techniques develop as the operator gains knowledge of the engine and its capabilities.

The operation section is a reference for operators. Photographs and illustrations guide the operator through procedures of inspecting, starting, operating and stopping the engine. This section also includes a discussion of electronic diagnostic information.

Maintenance

The maintenance section is a guide to engine care. The illustrated, step-by-step instructions are grouped by service hours and/or calendar time maintenance intervals. Items in the maintenance schedule are referenced to detailed instructions that follow.

Recommended service should be performed at the appropriate intervals as indicated in the Maintenance Interval Schedule. The actual operating environment of the engine also governs the Maintenance Interval Schedule. Therefore, under extremely severe, dusty, wet or freezing cold operating conditions, more frequent lubrication and maintenance than is specified in the Maintenance Interval Schedule may be necessary.

The maintenance schedule items are organized for a preventive maintenance management program. If the preventive maintenance program is followed, a periodic tune-up is not required. The implementation of a preventive maintenance management program should minimize operating costs through cost avoidances resulting from reductions in unscheduled downtime and failures.

Maintenance Intervals

Perform maintenance on items at multiples of the original requirement. We recommend that the maintenance schedules be reproduced and displayed near the engine as a convenient reminder. We also recommend that a maintenance record be maintained as part of the engine's permanent record.

Your authorized Perkins dealer or your Perkins distributor can assist you in adjusting your maintenance schedule to meet the needs of your operating environment.

Overhaul

Major engine overhaul details are not covered in the Operation and Maintenance Manual except for the interval and the maintenance items in that interval. Major repairs should only be carried out by Perkins authorized personnel. Your Perkins dealer or your Perkins distributor offers a variety of options regarding overhaul programs. If you experience a major engine failure, there are also numerous after failure overhaul options available. Consult with your Perkins dealer or your Perkins distributor for information regarding these options.

California Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. Battery posts, terminals and related accessories contain lead and lead compounds. **Wash hands after handling.**

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Safety Section

i03299360

Safety Messages

There may be several specific warning signs on an engine. The exact location of the hazards and the description of the hazards are reviewed in this section. Please become familiar with all warning signs.

Ensure that all of the warning signs are legible. Clean the warning signs or replace the warning signs if the words cannot be read or if the pictures are not visible. When the warning signs are cleaned, use a cloth, water, and soap. Do not use solvent, gasoline, or other harsh chemicals to clean the warning signs. Solvents, gasoline, or harsh chemicals could loosen the adhesive that secures the warning signs. The warning signs that are loosened could drop off of the engine.

Replace any damaged warning signs or missing warning signs. If a warning sign is attached to a part of the engine that is replaced, install a new warning sign on the replacement part. Perkins dealers or Perkins distributors can provide new warning signs.

Do not work on the engine and do not operate the engine unless the instructions and warnings in the Operation and Maintenance Manual are understood. Correct care is your responsibility. Failure to follow the instructions or failure to heed the warnings could result in injury or in death.

(1) Universal Warning

⚠ WARNING

Do not operate or work on this equipment unless you have read and understand the instructions and warnings in the Operation and Maintenance Manuals. Failure to follow the instructions or heed the warnings could result in serious injury or death.



Illustration 1 g01154807
Typical example

The Universal Warning label (1) may be located on the valve mechanism cover or the inlet manifold. Refer to illustration 2.

Note: The location of this label will depend on the application of the engine.

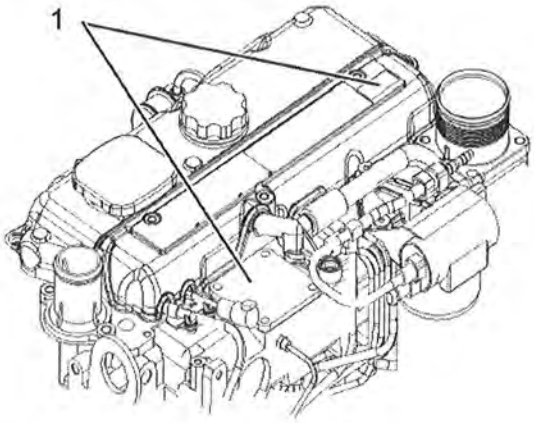


Illustration 2 g01682734
Typical example

(2) Ether

⚠ WARNING

Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.

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Illustration 3 g01682820

The ether warning label (2) is located on the cover of the inlet manifold. Refer to illustration 4.

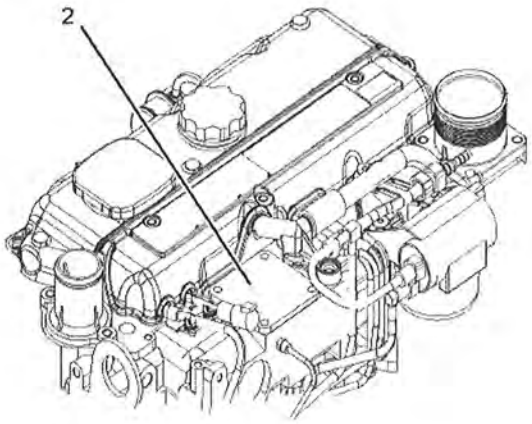


Illustration 4 g01682833
Typical example

i02328435

General Hazard Information



Illustration 5 g00104545

Attach a "Do Not Operate" warning tag or a similar warning tag to the start switch or to the controls before you service the equipment or before you repair the equipment.



Illustration 6 g00702020

Wear a hard hat, protective glasses, and other protective equipment, as required.

Do not wear loose clothing or jewelry that can snag on controls or on other parts of the engine.

Make sure that all protective guards and all covers are secured in place on the engine.

Keep the engine free from foreign material. Remove debris, oil, tools, and other items from the deck, from walkways, and from steps.

Never put maintenance fluids into glass containers. Drain all liquids into a suitable container.

Obey all local regulations for the disposal of liquids.

Use all cleaning solutions with care.

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Report all necessary repairs.

Do not allow unauthorized personnel on the equipment.

Ensure that the power supply is disconnected before you work on the bus bar or the glow plugs.

Perform maintenance on the engine with the equipment in the servicing position. Refer to the OEM information for the procedure for placing the equipment in the servicing position.

Pressure Air and Water

Pressurized air and/or water can cause debris and/or hot water to be blown out. This could result in personal injury.

The direct application of pressurized air or pressurized water to the body could result in personal injury.

When pressurized air and/or water is used for cleaning, wear protective clothing, protective shoes, and eye protection. Eye protection includes goggles or a protective face shield.

The maximum air pressure for cleaning purposes must be below 205 kPa (30 psi). The maximum water pressure for cleaning purposes must be below 275 kPa (40 psi).

Fluid Penetration

Pressure can be trapped in the hydraulic circuit long after the engine has been stopped. The pressure can cause hydraulic fluid or items such as pipe plugs to escape rapidly if the pressure is not relieved correctly.

Do not remove any hydraulic components or parts until pressure has been relieved or personal injury may occur. Do not disassemble any hydraulic components or parts until pressure has been relieved or personal injury may occur. Refer to the OEM information for any procedures that are required to relieve the hydraulic pressure.

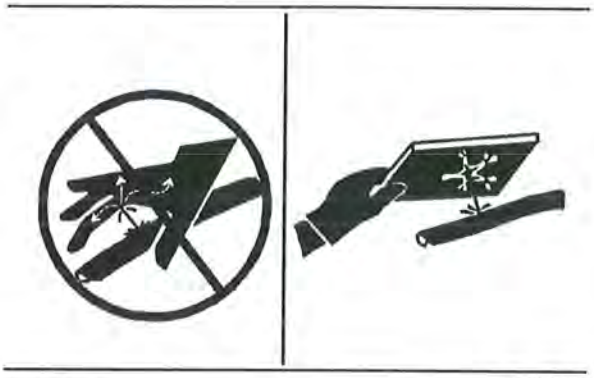


Illustration 7 g00687600

Always use a board or cardboard when you check for a leak. Leaking fluid that is under pressure can penetrate body tissue. Fluid penetration can cause serious injury and possible death. A pin hole leak can cause severe injury. If fluid is injected into your skin, you must get treatment immediately. Seek treatment from a doctor that is familiar with this type of injury.

Containing Fluid Spillage

Care must be taken in order to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the engine. Make provision to collect the fluid with a suitable container before any compartment is opened or before any component is disassembled.

- Only use the tools that are suitable for collecting fluids and equipment that is suitable for collecting fluids.
- Only use the tools that are suitable for containing fluids and equipment that is suitable for containing fluids.

Obey all local regulations for the disposal of liquids.

i02143195

Burn Prevention

Do not touch any part of an operating engine. Allow the engine to cool before any maintenance is performed on the engine. Relieve all pressure in the air system, in the hydraulic system, in the lubrication system, in the fuel system, or in the cooling system before any lines, fittings or related items are disconnected.

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Coolant

When the engine is at operating temperature, the engine coolant is hot. The coolant is also under pressure. The radiator and all lines to the heaters or to the engine contain hot coolant.

Any contact with hot coolant or with steam can cause severe burns. Allow cooling system components to cool before the cooling system is drained.

Check the coolant level after the engine has stopped and the engine has been allowed to cool.

Ensure that the filler cap is cool before removing the filler cap. The filler cap must be cool enough to touch with a bare hand. Remove the filler cap slowly in order to relieve pressure.

Cooling system conditioner contains alkali. Alkali can cause personal injury. Do not allow alkali to contact the skin, the eyes, or the mouth.

Oils

Hot oil and hot lubricating components can cause personal injury. Do not allow hot oil to contact the skin. Also, do not allow hot components to contact the skin.

Batteries

Electrolyte is an acid. Electrolyte can cause personal injury. Do not allow electrolyte to contact the skin or the eyes. Always wear protective glasses for servicing batteries. Wash hands after touching the batteries and connectors. Use of gloves is recommended.

i02813488

Fire Prevention and Explosion Prevention



Illustration 8 g00704000

All fuels, most lubricants, and some coolant mixtures are flammable.

Flammable fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause a fire. Fire may cause personal injury and property damage.

A flash fire may result if the covers for the engine crankcase are removed within fifteen minutes after an emergency shutdown.

Determine whether the engine will be operated in an environment that allows combustible gases to be drawn into the air inlet system. These gases could cause the engine to overspeed. Personal injury, property damage, or engine damage could result.

If the application involves the presence of combustible gases, consult your Perkins dealer and/or your Perkins distributor for additional information about suitable protection devices.

Remove all flammable combustible materials or conductive materials such as fuel, oil, and debris from the engine. Do not allow any flammable combustible materials or conductive materials to accumulate on the engine.

Store fuels and lubricants in correctly marked containers away from unauthorized persons. Store oily rags and any flammable materials in protective containers. Do not smoke in areas that are used for storing flammable materials.

Do not expose the engine to any flame.

Exhaust shields (if equipped) protect hot exhaust components from oil or fuel spray in case of a line, a tube, or a seal failure. Exhaust shields must be installed correctly.

Do not weld on lines or tanks that contain flammable fluids. Do not flame cut lines or tanks that contain flammable fluid. Clean any such lines or tanks thoroughly with a nonflammable solvent prior to welding or flame cutting.

Wiring must be kept in good condition. All electrical wires must be correctly routed and securely attached. Check all electrical wires daily. Repair any wires that are loose or frayed before you operate the engine. Clean all electrical connections and tighten all electrical connections.

Eliminate all wiring that is unattached or unnecessary. Do not use any wires or cables that are smaller than the recommended gauge. Do not bypass any fuses and/or circuit breakers.

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Arcing or sparking could cause a fire. Secure connections, recommended wiring, and correctly maintained battery cables will help to prevent arcing or sparking.

Inspect all lines and hoses for wear or for deterioration. The hoses must be correctly routed. The lines and hoses must have adequate support and secure clamps. Tighten all connections to the recommended torque. Leaks can cause fires.

Oil filters and fuel filters must be correctly installed. The filter housings must be tightened to the correct torque.



Illustration 9 g00704059

Use caution when you are refueling an engine. Do not smoke while you are refueling an engine. Do not refuel an engine near open flames or sparks. Always stop the engine before refueling.



Illustration 10 g00704135

Gases from a battery can explode. Keep any open flames or sparks away from the top of a battery. Do not smoke in battery charging areas.

Never check the battery charge by placing a metal object across the terminal posts. Use a voltmeter or a hydrometer.

Incorrect jumper cable connections can cause an explosion that can result in injury. Refer to the Operation Section of this manual for specific instructions.

Do not charge a frozen battery. This may cause an explosion.

The batteries must be kept clean. The covers (if equipped) must be kept on the cells. Use the recommended cables, connections, and battery box covers when the engine is operated.

Fire Extinguisher

Make sure that a fire extinguisher is available. Be familiar with the operation of the fire extinguisher. Inspect the fire extinguisher and service the fire extinguisher regularly. Obey the recommendations on the instruction plate.

Lines, Tubes and Hoses

Do not bend high pressure lines. Do not strike high pressure lines. Do not install any lines that are bent or damaged. Do not clip any other items to the high pressure lines.

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Repair any lines that are loose or damaged. Leaks can cause fires. Consult your Perkins dealer or your Perkins distributor for repair or for replacement parts.

Check lines, tubes and hoses carefully. Do not use your bare hand to check for leaks. Use a board or cardboard to check for leaks. Tighten all connections to the recommended torque.

Replace the parts if any of the following conditions are present:

- End fittings are damaged or leaking.
- Outer coverings are chafed or cut.
- Wires are exposed.
- Outer coverings are ballooning.
- Flexible part of the hoses are kinked.
- Outer covers have embedded armoring.
- End fittings are displaced.

Make sure that all clamps, guards, and heat shields are installed correctly. During engine operation, this will help to prevent vibration, rubbing against other parts, and excessive heat.

i02143194

Crushing Prevention and Cutting Prevention

Support the component correctly when work beneath the component is performed.

Unless other maintenance instructions are provided, never attempt adjustments while the engine is running.

Stay clear of all rotating parts and of all moving parts. Leave the guards in place until maintenance is performed. After the maintenance is performed, reinstall the guards.

Keep objects away from moving fan blades. The fan blades will throw objects or cut objects.

When objects are struck, wear protective glasses in order to avoid injury to the eyes.

Chips or other debris may fly off objects when objects are struck. Before objects are struck, ensure that no one will be injured by flying debris.

i01372247

Mounting and Dismounting

Inspect the steps, the handholds, and the work area before mounting the engine. Keep these items clean and keep these items in good repair.

Mount the engine and dismount the engine only at locations that have steps and/or handholds. Do not climb on the engine, and do not jump off the engine.

Face the engine in order to mount the engine or dismount the engine. Maintain a three-point contact with the steps and handholds. Use two feet and one hand or use one foot and two hands. Do not use any controls as handholds.

Do not stand on components which cannot support your weight. Use an adequate ladder or use a work platform. Secure the climbing equipment so that the equipment will not move.

Do not carry tools or supplies when you mount the engine or when you dismount the engine. Use a hand line to raise and lower tools or supplies.

i02813489

Before Starting Engine

Before the initial start-up of an engine that is new, serviced or repaired, make provision to shut the engine off, in order to stop an overspeed. This may be accomplished by shutting off the air and/or fuel supply to the engine.

Overspeed shutdown should occur automatically for engines that are controlled electronically. If automatic shutdown does not occur, press the emergency stop button in order to cut the fuel and/or air to the engine.

Inspect the engine for potential hazards.

Before starting the engine, ensure that no one is on, underneath, or close to the engine. Ensure that the area is free of personnel.

If equipped, ensure that the lighting system for the engine is suitable for the conditions. Ensure that all lights work correctly, if equipped.

All protective guards and all protective covers must be installed if the engine must be started in order to perform service procedures. To help prevent an accident that is caused by parts in rotation, work around the parts carefully.

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Do not bypass the automatic shutoff circuits. Do not disable the automatic shutoff circuits. The circuits are provided in order to help prevent personal injury. The circuits are also provided in order to help prevent engine damage.

See the Service Manual for repairs and for adjustments.

i02207232

Engine Starting

⚠ WARNING

Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.

If a warning tag is attached to the engine start switch or to the controls, DO NOT start the engine or move the controls. Consult with the person that attached the warning tag before the engine is started.

All protective guards and all protective covers must be installed if the engine must be started in order to perform service procedures. To help prevent an accident that is caused by parts in rotation, work around the parts carefully.

Start the engine from the operator's compartment or from the engine start switch.

Always start the engine according to the procedure that is described in the Operation and Maintenance Manual, "Engine Starting" topic in the Operation Section. Knowing the correct procedure will help to prevent major damage to the engine components. Knowing the procedure will also help to prevent personal injury.

To ensure that the jacket water heater (if equipped) and/or the lube oil heater (if equipped) is working correctly, check the water temperature gauge and the oil temperature gauge during the heater operation.

Engine exhaust contains products of combustion which can be harmful to your health. Always start the engine and operate the engine in a well ventilated area. If the engine is started in an enclosed area, vent the engine exhaust to the outside.

Note: The engine is equipped with an automatic device for cold starting for normal conditions of operation. If the engine will be operated in very cold conditions, then an extra cold starting aid may be required. Normally, the engine will be equipped with the correct type of starting aid for your region of operation.

The engines are equipped with a glow plug starting aid in each individual cylinder that heats the intake air in order to improve starting.

i01928905

Engine Stopping

Stop the engine according to the procedure in the Operation and Maintenance Manual, "Engine Stopping (Operation Section)" in order to avoid overheating of the engine and accelerated wear of the engine components.

Use the Emergency Stop Button (if equipped) ONLY in an emergency situation. Do not use the Emergency Stop Button for normal engine stopping. After an emergency stop, DO NOT start the engine until the problem that caused the emergency stop has been corrected.

Stop the engine if an overspeed condition occurs during the initial start-up of a new engine or an engine that has been overhauled. This may be accomplished by shutting off the fuel supply to the engine and/or shutting off the air supply to the engine.

i02176668

Electrical System

Never disconnect any charging unit circuit or battery circuit cable from the battery when the charging unit is operating. A spark can cause the combustible gases that are produced by some batteries to ignite.

To help prevent sparks from igniting combustible gases that are produced by some batteries, the negative "–" jump start cable should be connected last from the external power source to the negative "–" terminal of the starting motor. If the starting motor is not equipped with a negative "–" terminal, connect the jump start cable to the engine block.

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Check the electrical wires daily for wires that are loose or frayed. Tighten all loose electrical wires before the engine is started. Repair all frayed electrical wires before the engine is started. See the Operation and Maintenance Manual for specific starting instructions.

Grounding Practices

Correct grounding for the engine electrical system is necessary for optimum engine performance and reliability. Incorrect grounding will result in uncontrolled electrical circuit paths and in unreliable electrical circuit paths.

Uncontrolled electrical circuit paths can result in damage to main bearings, to crankshaft bearing journal surfaces, and to aluminum components.

Engines that are installed without engine-to-frame ground straps can be damaged by electrical discharge.

To ensure that the engine and the engine electrical systems function correctly, an engine-to-frame ground strap with a direct path to the battery must be used. This path may be provided by way of a direct engine ground to the frame.

All grounds should be tight and free of corrosion. The engine alternator must be grounded to the negative "-" battery terminal with a wire that is adequate to handle the full charging current of the alternator.

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Product Information Section

Model Views

i01928892

Model View Illustrations

1104 Engine Model Views

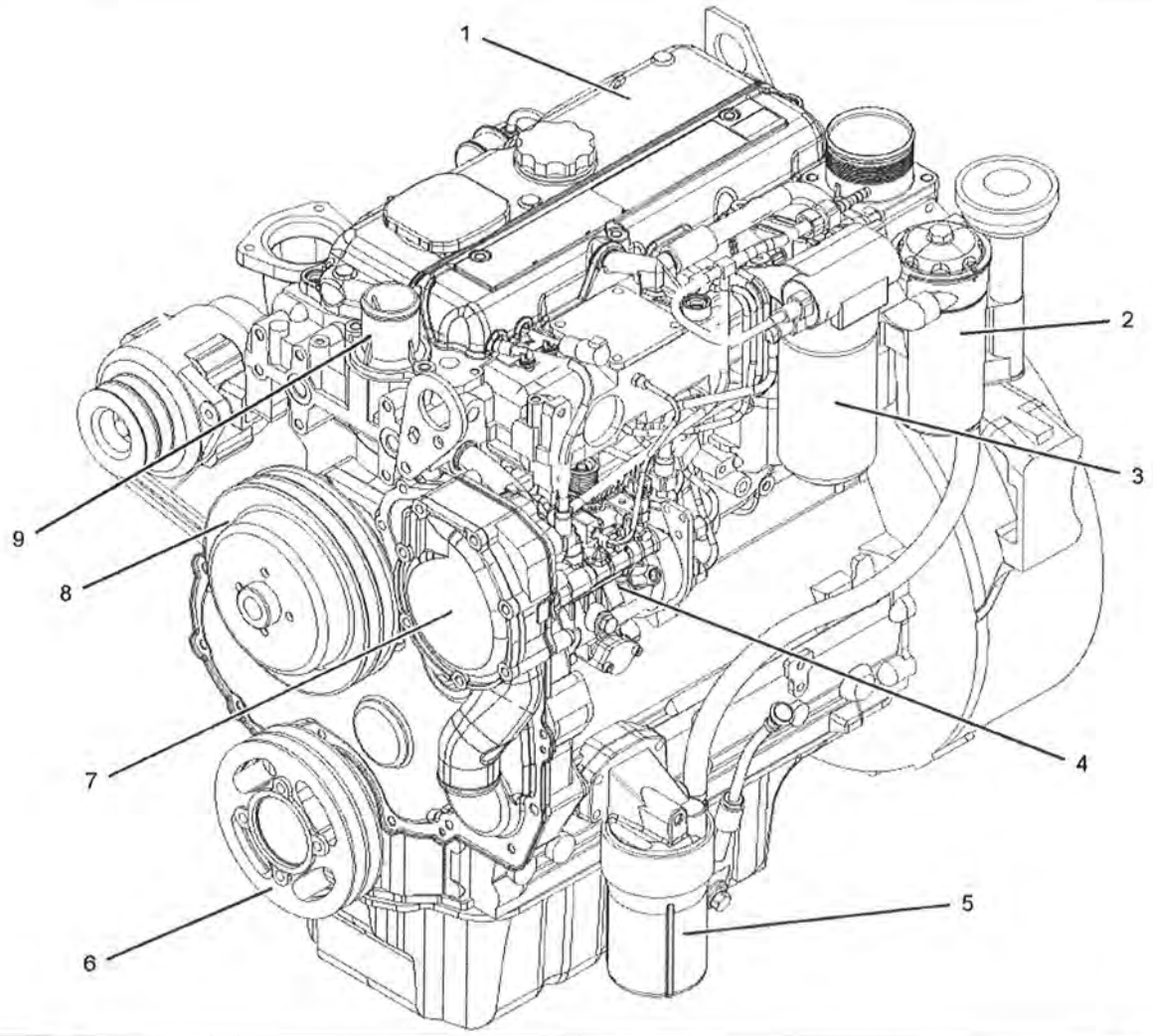
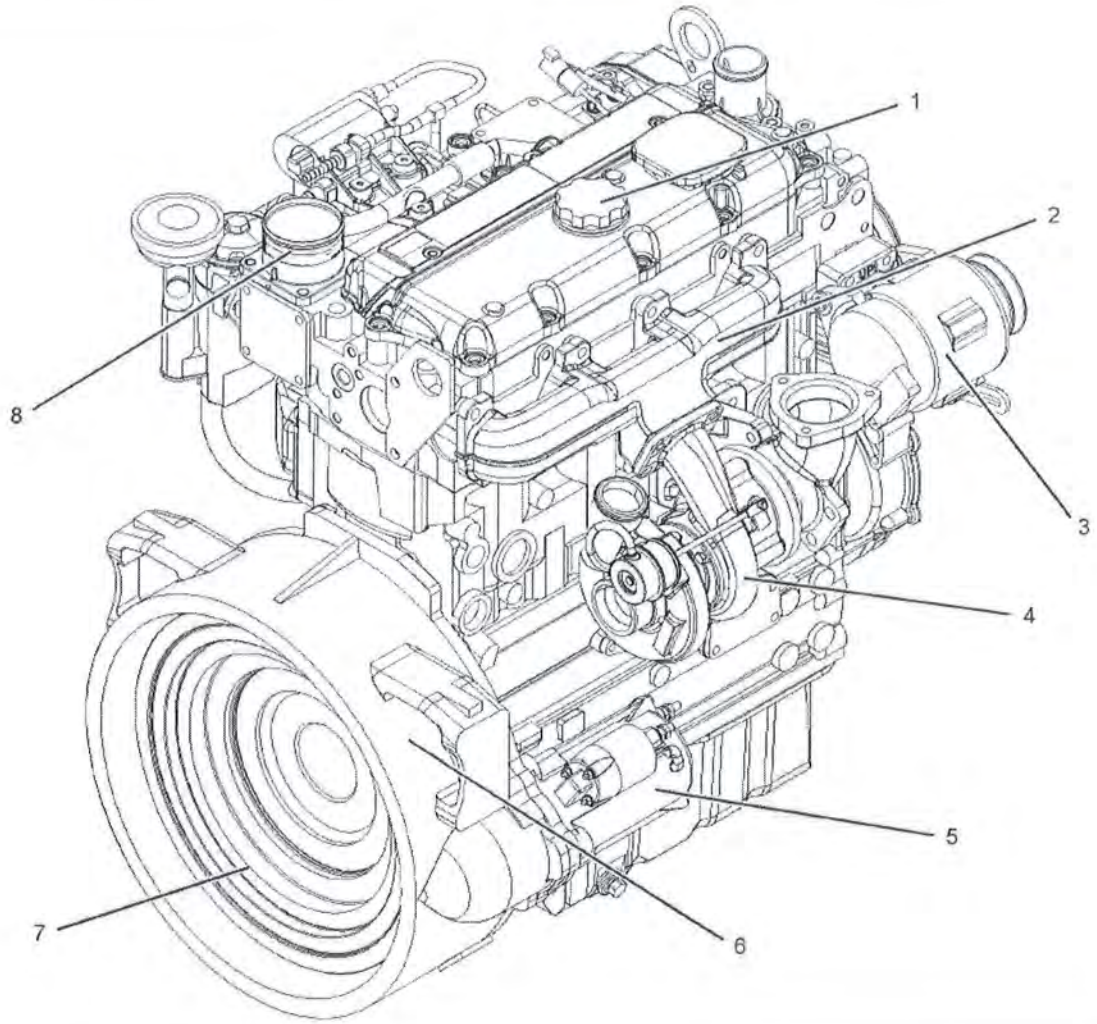


Illustration 11 g01012280

(1) Valve mechanism cover
(2) Crankcase breather
(3) Fuel filter
(4) Fuel injection pump
(5) Engine oil filter
(6) Crankshaft pulley
(7) Water pump
(8) Fan pulley
(9) Water temperature regulator housing

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g01012281

Illustration 12

(1) Oil filler cap
(2) Exhaust manifold
(3) Alternator
(4) Turbocharger
(5) Starter motor
(6) Flywheel housing
(7) Flywheel
(8) Air intake

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1103 Engine Model Views

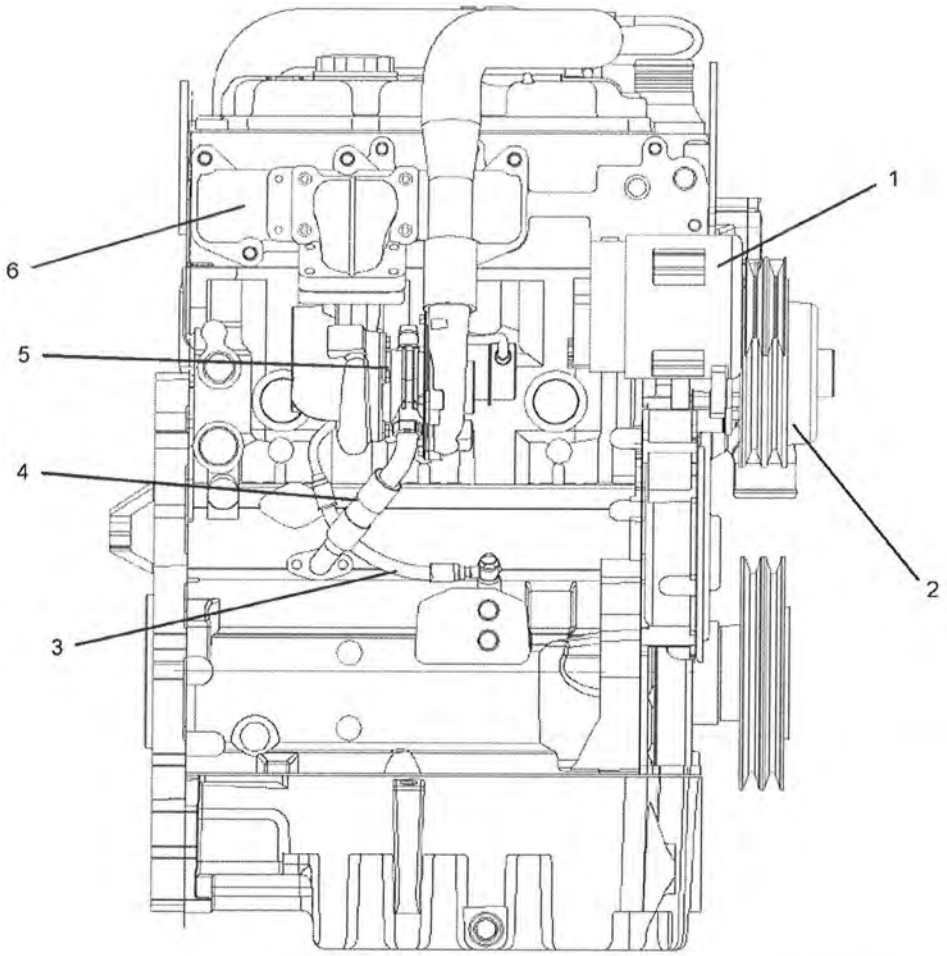
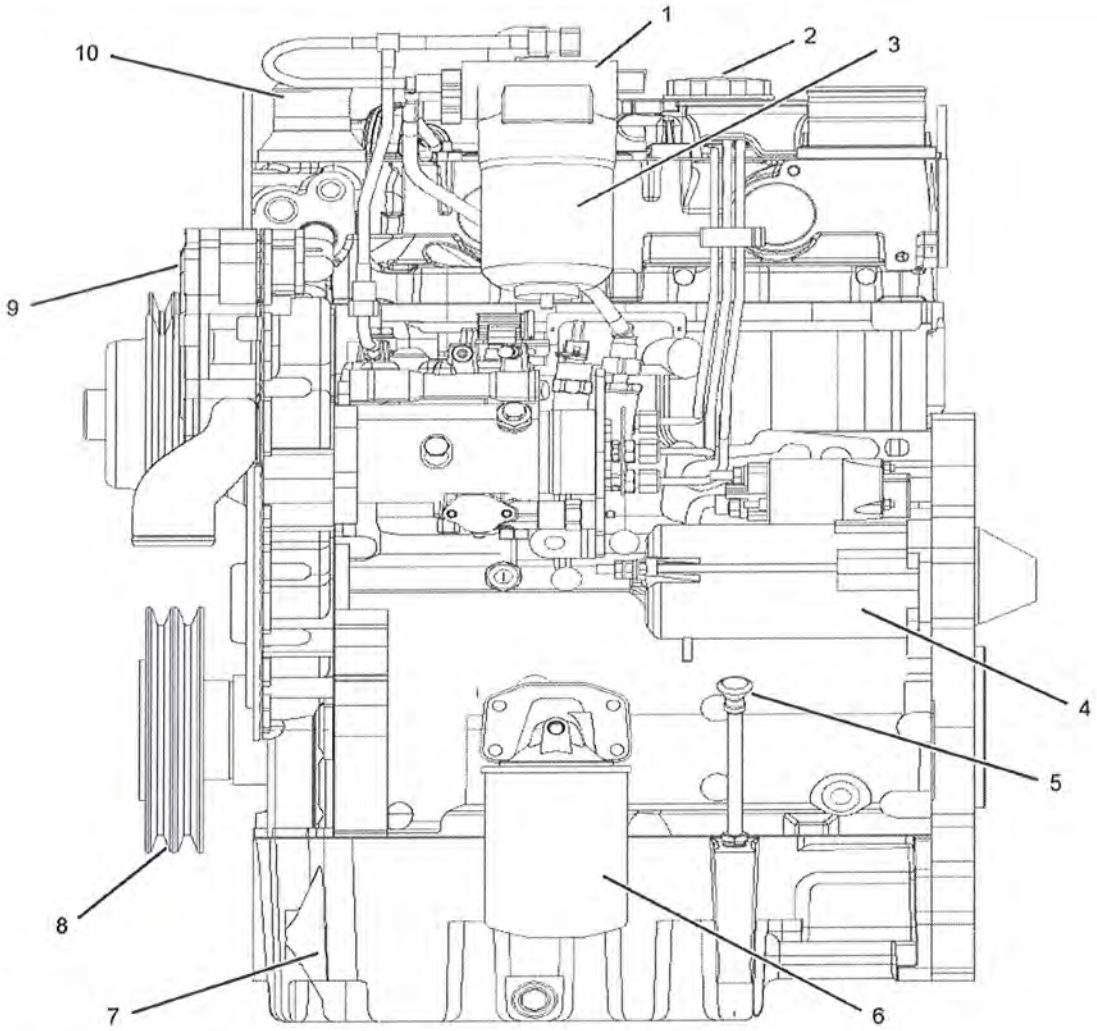


Illustration 13 g01011348

(1) Alternator
(2) Fan pulley
(3) Turbocharger oil supply
(4) Turbocharger oil drain
(5) Turbocharger
(6) exhaust manifold

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g01011349

Illustration 14

(1) Fuel transfer pump
(2) Oil filler cap
(3) Fuel filter
(4) Starter motor
(5) Dipstick
(6) Oil filter
(7) Oil pan
(8) Crankshaft pulley
(9) Water pump
(10) Water temperature regulator housing

i02196981

Engine Description

Perkins Engines are designed for the following applications: machine, genset, and industrial mobile equipment. The engines are available in the following types of aspiration:

- Turbocharged aftercooled
- Turbocharged
- Naturally aspirated

Engine Specifications

Note: The front end of the engine is opposite the flywheel end of the engine. The left and the right sides of the engine are determined from the flywheel end. The number 1 cylinder is the front cylinder.

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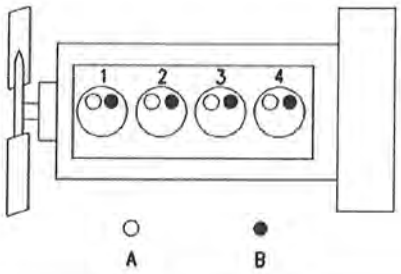


Illustration 15 g00984281

A typical example of the layout of the valves

(A) Inlet valves
(B) Exhaust valves

Table 1

1104 Industrial Engine Specifications	
Number of Cylinders	4 In-Line
Bore	105 mm (4.134 inch)
Stroke	127 mm (5.0 inch)
Aspiration	Turbocharged aftercooled Turbocharged Naturally aspirated
Compression Ratio	NA 19.25:1 NA T 18.23:1 T, TA
Displacement	4.4 L (268 in ³)
Firing Order	1 3 4 2
Rotation (flywheel end)	Counterclockwise
Valve Lash Setting (Inlet)	0.20 mm (0.008 inch)
Valve Lash Setting (Exhaust)	0.45 mm (0.018 inch)

Table 2

1103 Industrial Engine Specifications	
Number of Cylinders	3 In-Line
Bore	105 mm (4.134 inch)
Stroke	127 mm (5.0 inch)
Aspiration	Turbocharged Naturally aspirated
Compression Ratio	NA 19.25:1 T 18.25:1
Displacement	3.3 L (201 in³)
Firing Order	1 2 3
Rotation (flywheel end)	Counterclockwise
Valve Lash Setting (Inlet)	0.20 mm (0.008 inch)
Valve Lash Setting (Exhaust)	0.45 mm (0.018 inch)

Table 3

1104 Genset Specifications	
Number of Cylinders	4 In-Line
Bore	105 mm (4.134 inch)
Stroke	127 mm (5.0 inch)
Aspiration	Turbocharged aftercooled Turbocharged Naturally aspirated
Compression Ratios	NA 19.25:1 T 17.25:1, T 18.23:1, TA 18.23:1
Displacement	4.4 L (268 in ³)
Firing Order	1 3 4 2
Rotation (flywheel end)	Counterclockwise
Valve Lash Setting (Inlet)	0.20 mm (0.008 inch)
Valve Lash Setting (Exhaust)	0.45 mm (0.018 inch)

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Table 4

1103 Genset Specifications	
Number of Cylinders	3 In-Line
Bore	105 mm (4.134 inch)
Stroke	127 mm (5.0 inch)
Aspiration	Turbocharged Naturally aspirated
Compression Ratio	NA 19.25:1 T 17.25:1
Displacement	3.3 L (201 in^3)
Firing Order	1 2 3
Rotation (flywheel end)	Counterclockwise
Valve Lash Setting (Inlet)	0.20 mm (0.008 inch)
Valve Lash Setting (Exhaust)	0.45 mm (0.018 inch)

Engine Cooling and Lubrication

The cooling system consists of the following components:

- Gear-driven centrifugal water pump
- Water temperature regulator which regulates the engine coolant temperature
- Gear-driven oil pump (gear type)
- Oil cooler

The engine lubricating oil is supplied by a gear type pump. The engine lubricating oil is cooled and the engine lubricating oil is filtered. Bypass valves provide unrestricted flow of lubrication oil to the engine parts when oil viscosity is high. Bypass valves can also provide unrestricted flow of lubrication oil to the engine parts if the oil cooler should become plugged or if the oil filter element should become plugged.

Engine efficiency, efficiency of emission controls, and engine performance depend on adherence to proper operation and maintenance recommendations. Engine performance and efficiency also depend on the use of recommended fuels, lubrication oils, and coolants. Refer to the Operation and Maintenance Manual, "Maintenance Interval Schedule" for more information on maintenance items.

Engine Service Life

Engine efficiency and maximum utilization of engine performance depend on the adherence to proper operation and maintenance recommendations. In addition, use recommended fuels, coolants and lubricants. Use the Operation and Maintenance Manual as a guide for required engine maintenance.

Expected engine life is generally predicted by the average power that is demanded. The average power that is demanded is based on fuel consumption of the engine over a period of time. Reduced hours of operation at full throttle and/or operating at reduced throttle settings result in a lower average power demand. Reduced hours of operation will increase the length of operating time before an engine overhaul is required.

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Product Identification Information

i02280116

Engine Identification

Perkins engines are identified by a serial number. This number is shown on a serial number plate that is mounted on the left hand side of the engine block.

An example of an engine number is RE12345U090001H.

RE _____ Type of engine

RE12345 _____ Engine List Number

U _____ Built in the United Kingdom

090001 _____ Engine Serial Number

H _____ Year of Manufacture

Perkins dealers need these numbers in order to determine the components that were included with the engine. This permits accurate identification of replacement part numbers.

i01940474

Serial Number Plate

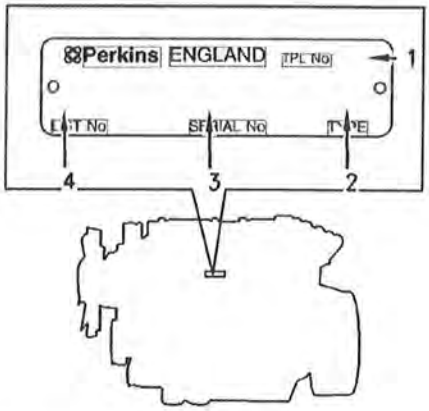


Illustration 16 g00994966

Typical serial number plate

(1) Temporary Parts List number
(2) Type
(3) Serial number
(4) List number

The Serial Number Plate is located on the left side of the cylinder block behind the high pressure pipes of the Fuel injection pump.

The following information is stamped on the Serial Number Plate: Engine serial number, Model, and Arrangement number.

i02164876

Reference Numbers

Information for the following items may be needed to order parts. Locate the information for your engine. Record the information in the appropriate space. Make a copy of this list for a record. Keep the information for future reference.

Record for Reference

Engine Model _____

Engine Serial number _____

Engine Low Idle rpm _____

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Engine Full Load rpm _____

Primary Fuel Filter _____

Water Separator Element _____

Secondary Fuel Filter Element _____

Lubrication Oil Filter Element _____

Auxiliary Oil Filter Element _____

Total Lubrication System Capacity _____

Total Cooling System Capacity _____

Air Cleaner Element _____

Fan Drive Belt _____

Alternator Belt _____

i02758852

Emissions Certification Film

Label for compliant engines

Typical examples of emissions labels

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IMPORTANT ENGINE INFORMATION Perkins		Engine Type
Engine Family: 5PKXL04.4RH2 List: Displacement: 4.4 List: RH37881	E11 Refer to Manufacturer	Factory setting / Reset if Applicable
EPA Family Max Values Advertised kw:86. Fuel Rate: **.0 mm3/stk Init. Timing:* DEG ATDC idle RPM: ****	e11*97/68FA* 2001/63*0247*00	☐ 2372/2500 ☐ ☒ 2372/2500 ☐ ☐ ☐ ☐ ☐
Settings are to be made with engine at normal operating temperature with transmission in neutral. This engine conforms to 2004 U.S. EPA non - road and California off - road Regulations for large C.I. engines and is certified to operate on commercially available diesel fuel.		
Emission Control System: **** ** ECM	Valve Lash Cold (inch): Exhaust 0.0** Inlet 0.00*	Engine Label
Hanger No.	position (**)	Label No. 3181A081
		Use Service Tool to verify current engine settings

Illustration 17 g01173630

This typical example of a label is installed on engines that have electronic fuel injection systems and installed on engines that have electronic fuel injection pumps.

IMPORTANT ENGINE INFORMATION Perkins		
Engine Family: 5PKXL04.0AJ1 List: RE81372 Engine Type: 2160/2200 Displacement: 4.400	E11 Refer to Manufacturer	
Advertised kw:62 @ RPM: 2200 Fuel Rate at adv kw: 64.2 mm3/stk Init. Timing:* DEG BTDC idle RPM: ****	e11*97/68CA*00*000*0089*01	
Settings are to be made with engine at normal operating temperature with transmission in neutral. This engine conforms to 2005 U.S. EPA non - road and California off - road Regulations for large C.I. engines and is certified to operate on commercially available diesel fuel.		
Emission Control System: DDI	Valve Lash Cold (inch): Exhaust 0.0** Inlet 0.00*	Engine Label
Hanger No.	position	Label No. 3181A081

Illustration 18 g01156733

This typical example of a label is installed on engines that have mechanical fuel injection pumps.

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Label for engines that comply with MSHA emissions

Perkins®	LABEL NUMBER 3181	
MSHA APPR NO.		
ENGINE MODEL		
CURVE NO.		
RATED HP RATED kW	AT	rpm
HIGH IDLE		rpm
MAX ALT.		m
VENT RATE		cfm

g01381316

Illustration 19

Typical example

The label that is shown in illustration 19 is for engines that operate in underground coal mines in North America. The label is installed on engines that comply with the Mine Safety and Health Administration (MSHA) emissions. Approved diesel engines shall be identified by an approved mark that is legible and permanent. The approved mark is scribed with the approved MSHA number. The label should be securely attached to the diesel engine.

Label for engines that do not comply with emissions

EMISSIONS CONTROL INFORMATION — Perkins

ENGINE FAMILY: ******
ENGINE DISPLACEMENT: *****
MODEL YEAR: 2005

This non - road engine may be used as a REPLACEMENT engine within the EU, as per the provisions of Directive 97/68/EC

INFORMATION APPLICABLE TO USA ONLY

This non - road engine does not comply with either federal non - road or California off - road engine emission regulation requirements. Sale or installation of this engine is a violation of federal and Californian law subject to civil penalty for any purpose other than as an EXPORT - ONLY or REPLACEMENT engine.
Export - only engine is indicated by an additional attached tag.

Hanger No** Position **** Label No. 3181A081

g01156734

Illustration 20

This typical example of a label is installed on engines that do not comply with emissions.

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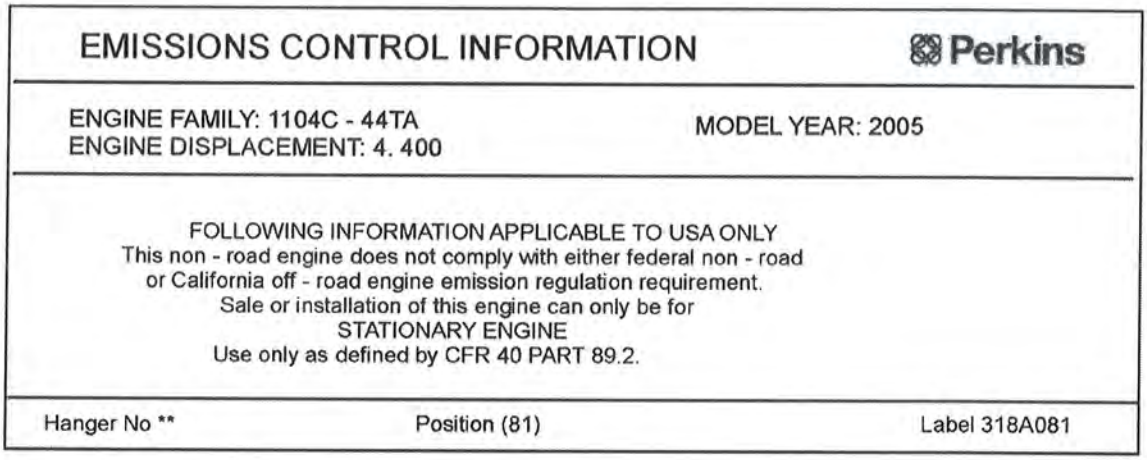


Illustration 21 g01157127

This typical example of a label is installed on engines that are stationary engines.

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Operation Section

Lifting and Storage

i02164186

Engine Lifting

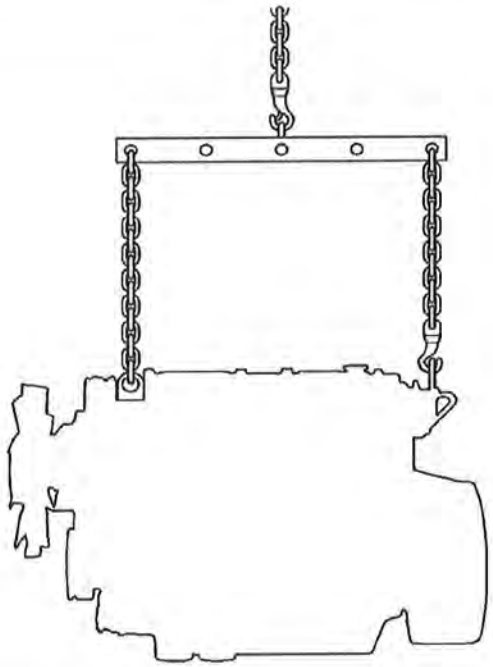


Illustration 22 g01097527

NOTICE
Never bend the eyebolts and the brackets. Only load the eyebolts and the brackets under tension. Remember that the capacity of an eyebolt is less as the angle between the supporting members and the object becomes less than 90 degrees.

When it is necessary to remove a component at an angle, only use a link bracket that is properly rated for the weight.

Use a hoist to remove heavy components. Use an adjustable lifting beam to lift the engine. All supporting members (chains and cables) should be parallel to each other. The chains and cables should be perpendicular to the top of the object that is being lifted.

Some removals require lifting the fixtures in order to obtain correct balance and safety.

To remove the engine ONLY, use the lifting eyes that are on the engine.

Lifting eyes are designed and installed for specific engine arrangements. Alterations to the lifting eyes and/or the engine make the lifting eyes and the lifting fixtures obsolete. If alterations are made, ensure that correct lifting devices are provided. Consult your Perkins dealer or your Perkins distributor for information regarding fixtures for correct engine lifting.

i01930351

Engine Storage

If the engine will not be started for several weeks, the lubricating oil will drain from the cylinder walls and from the piston rings. Rust can form on the cylinder walls. Rust on the cylinder walls will cause increased engine wear and a reduction in engine service life.

Lubrication System

To help prevent excessive engine wear, use the following guidelines:

Complete all of the lubrication recommendations that are listed in this Operation and Maintenance Manual, "Maintenance Interval Schedule" (Maintenance Section).

If an engine is out of operation and if use of the engine is not planned, special precautions should be made. If the engine will be stored for more than one month, a complete protection procedure is recommended.

Use the following guidelines :

- Completely clean the outside of the engine.
- Drain the fuel system completely and refill the system with preservative fuel.1772204 POWERPART Lay-Up 1 can be mixed with the normal fuel in order to change the fuel into preservative fuel.
- If preservative fuel is not available, the fuel system can be filled with normal fuel. This fuel must be discarded at the end of the storage period together with the fuel filter elements.
- Operate the engine until the engine reaches normal operating temperature. Stop any leaks from fuel, lubricating oil or air systems. Stop the engine and drain the lubricating oil from the oil pan.

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- Renew the canister(s) of the lubricating oil filter.
- Fill the oil pan to the Full Mark on the dipstick with new, clean lubricating oil. Add 1762811 POWERPART Lay-Up 2 to the oil in order to protect the engine against corrosion. If 1762811 POWERPART Lay-Up 2 is not available, use a preservative of the correct specification instead of the lubricating oil. If a preservative is used, this must be drained completely at the end of the storage period and the oil pan must be refilled to the correct level with normal lubricating oil.

Cooling System

To help prevent excessive engine wear, use the following guidelines:

NOTICE
Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.

If freezing temperatures are expected, check the cooling system for adequate protection against freezing. See this Operation and Maintenance Manual, "General Coolant Information" (Maintenance Section).

NOTICE
To prevent frost damage, ensure that all the coolant is removed from the engine. This is important if the system is drained after it has been flushed with water, or if an antifreeze solution too weak to protect the system from frost has been used.

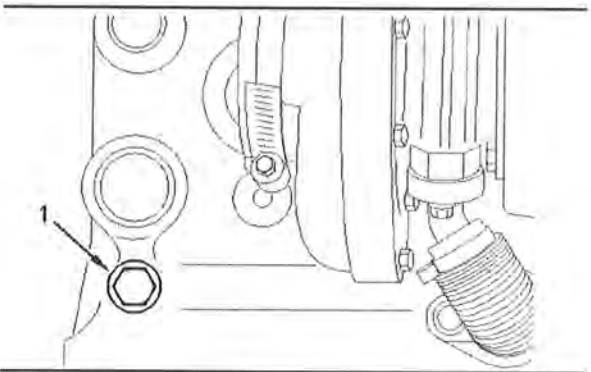


Illustration 23 g01003928

1. Ensure that the vehicle is on level ground.
2. Remove the filler cap of the cooling system.
3. Remove the drain plug (1) from the side of the cylinder block in order to drain the engine. Ensure that the drain hole is not restricted.
4. Open the tap or remove the drain plug at the bottom of the radiator in order to drain the radiator. If the radiator does not have a tap or a drain plug, disconnect the hose at the bottom of the radiator.
5. Flush the cooling system with clean water.
6. Fit the drain plugs and the filler cap. Close the tap or connect the radiator hose.
7. Fill the cooling system with an approved antifreeze mixture because this gives protection against corrosion. The maximum flow rate is 1 L (0.2200 Imp gal) per minute in order to fill the system.

Note: Certain corrosion inhibitors could cause damage to some engine components. Contact the Service Department of Perkins for advice.

8. Operate the engine for a short period in order to circulate the lubricating oil and the coolant in the engine.
9. Disconnect the battery. Put the battery into safe storage in a fully charged condition. Before the battery is put into storage, protect the terminals against corrosion.1734115 POWERPART Lay-Up 3 can be used on the terminals.
10. Clean the crankcase breather if one is installed. Seal the end of the pipe.
11. Remove the fuel injector nozzles and spray 1762811 POWERPART Lay-Up 2 for one or two seconds into each cylinder bore with the piston at BDC.
12. Slowly rotate the crankshaft for one complete revolution and then replace the fuel injector nozzles.

Induction System

- Remove the air filter assembly. If necessary, remove the pipes that are installed between the air filter assembly and the turbocharger. Spray 1762811 POWERPART Lay-Up 2 into the turbocharger. The duration of the spray is printed on the container. Seal the turbocharger with waterproof tape.

Exhaust System

- Remove the exhaust pipe. Spray 1762811 POWERPART Lay-Up 2 into the turbocharger. The duration of the spray is printed on the container. Seal the turbocharger with waterproof tape.

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General Items

- If the lubricating oil filler is installed on the rocker cover, remove the filler cap. If the lubricating oil filler cap is not installed on the rocker cover, remove the rocker cover. Spray 1762811 POWERPART Lay-Up 2 around the rocker shaft assembly. Replace the filler cap or the rocker cover.
- Seal the vent of the fuel tank or the fuel filler cap with waterproof tape.
- Remove the alternator drive belts and put the drive belts into storage.
- In order to prevent corrosion, spray the engine with 1734115 POWERPART Lay-Up 3. Do not spray the area inside the alternator.

When the engine protection has been completed in accordance with these instructions, this ensures that no corrosion will occur. Perkins are not responsible for damage which may occur when an engine is in storage after a period in service.

Your Perkins dealer or your Perkins distributor can assist in preparing the engine for extended storage periods.

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Gauges and Indicators

i02164190

Gauges and Indicators

Your engine may not have the same gauges or all of the gauges that are described. For more information about the gauge package, see the OEM information.

Gauges provide indications of engine performance. Ensure that the gauges are in good working order. Determine the normal operating range by observing the gauges over a period of time.

Noticeable changes in gauge readings indicate potential gauge or engine problems. Problems may also be indicated by gauge readings that change even if the readings are within specifications. Determine and correct the cause of any significant change in the readings. Consult your Perkins dealer or your Perkins distributor for assistance.

NOTICE
If no oil pressure is indicated, STOP the engine. If maximum coolant temperature is exceeded, STOP the engine. Engine damage can result.



Engine Oil Pressure – The oil pressure should be greatest after a cold engine is started. The typical engine oil pressure with SAE10W30 is 207 to 413 kPa (30 to 60 psi) at rated rpm.

A lower oil pressure is normal at low idle. If the load is stable and the gauge reading changes, perform the following procedure:

1. Remove the load.
2. Reduce engine speed to low idle.
3. Check and maintain the oil level.



Jacket Water Coolant Temperature – Typical temperature range is 71 to 96°C (160 to 205°F). The maximum allowable temperature with the pressurized cooling system at 48 kPa (7 psi) is 110°C (230°F). Higher temperatures may occur under certain conditions. The water temperature reading may vary according to load. The reading should never exceed the boiling point for the pressurized system that is being used.

If the engine is operating above the normal range and steam becomes apparent, perform the following procedure:

1. Reduce the load and the engine rpm.
2. Inspect the cooling system for leaks.
3. Determine if the engine must be shut down immediately or if the engine can be cooled by reducing the load.



Tachometer – This gauge indicates engine speed (rpm). When the throttle control lever is moved to the full throttle position without load, the engine is running at high idle. The engine is running at the full load rpm when the throttle control lever is at the full throttle position with maximum rated load.

NOTICE
To help prevent engine damage, never exceed the high idle rpm. Overspeeding can result in serious damage to the engine. The engine can be operated at high idle without damage, but should never be allowed to exceed high idle rpm.



Ammeter – This gauge indicates the amount of charge or discharge in the battery charging circuit. Operation of the indicator should be to the right side of "0" (zero).



Fuel Level – This gauge indicates the fuel level in the fuel tank. The fuel level gauge operates when the "START/STOP" switch is in the "ON" position.



Service Hour Meter – The gauge indicates operating time of the engine.

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Engine Starting

i02194223

Before Starting Engine

Before the engine is started, perform the required daily maintenance and any other periodic maintenance that is due. Refer to the Operation and Maintenance Manual, "Maintenance Interval Schedule" for more information.

- For the maximum service life of the engine, make a thorough inspection within the engine compartment before the engine is started. Look for the following items: oil leaks, coolant leaks, loose bolts, and excessive dirt and/or grease. Remove any excess dirt and/or grease buildup. Repair any faults that were identified during the inspection.
- Inspect the cooling system hoses for cracks and for loose clamps.
- Inspect the alternator and accessory drive belts for cracks, breaks, and other damage.
- Inspect the wiring for loose connections and for worn wires or frayed wires.
- Check the fuel supply. Drain water from the water separator (if equipped). Open the fuel supply valve (if equipped).

NOTICE
All valves in the fuel return line must be open before and during engine operation to help prevent high fuel pressure. High fuel pressure may cause filter housing failure or other damage.

If the engine has not been started for several weeks, fuel may have drained from the fuel system. Air may have entered the filter housing. Also, when fuel filters have been changed, some air pockets will be trapped in the engine. In these instances, prime the fuel system. Refer to the Operation and Maintenance Manual, "Fuel System - Prime" for more information on priming the fuel system.

⚠ WARNING

Engine exhaust contains products of combustion which may be harmful to your health. Always start and operate the engine in a well ventilated area and, if in an enclosed area, vent the exhaust to the outside.

- Do not start the engine or move any of the controls if there is a "DO NOT OPERATE" warning tag or similar warning tag attached to the start switch or to the controls.
- Ensure that the areas around the rotating parts are clear.
- All of the guards must be put in place. Check for damaged guards or for missing guards. Repair any damaged guards. Replace damaged guards and/or missing guards.
- Disconnect any battery chargers that are not protected against the high current drain that is created when the electric starting motor is engaged. Check electrical cables and check the battery for poor connections and for corrosion.
- Reset all of the shutoffs or alarm components (if equipped).
- Check the engine lubrication oil level. Maintain the oil level between the "ADD" mark and the "FULL" mark on the engine oil level gauge.
- Check the coolant level. Observe the coolant level in the header tank (if equipped). Maintain the coolant level to the "FULL" mark on the header tank.
- If the engine is not equipped with a header tank maintain the coolant level within 13 mm (0.5 inch) of the bottom of the filler pipe. If the engine is equipped with a sight glass, maintain the coolant level in the sight glass.
- Observe the air cleaner service indicator (if equipped). Service the air cleaner when the yellow diaphragm enters the red zone, or when the red piston locks in the visible position.
- Ensure that any equipment that is driven by the engine has been disengaged from the engine. Minimize electrical loads or remove any electrical loads.

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i02198348

Starting the Engine

⚠ WARNING

Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.

Refer to the OMM for your type of controls. Use the following procedure to start the engine.

1. If equipped, move the throttle lever to the full throttle position before you start the engine.

NOTICE
Do not crank the engine for more than 30 seconds. Allow the electric starting motor to cool for two minutes before cranking the engine again.

2. Turn the engine start switch to the START position. Hold the engine start switch in the START position and crank the engine.
3. When the engine starts, release the engine start switch.
4. If equipped, slowly move the throttle lever to the low idle position and allow the engine to idle. Refer to the Operation and Maintenance Manual, "After Starting Engine" topic.
5. If the engine does not start, release the engine start switch and allow the electric starting motor to cool. Then, repeat steps 2 through step 4.
6. Turn the engine start switch to the OFF position in order to stop the engine.

i02198092

Cold Weather Starting

⚠ WARNING

Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.

Startability will be improved at temperatures below −18 °C (0 °F) from the use of a jacket water heater or extra battery capacity.

When Group 2 diesel fuel is used, the following items provide a means of minimizing starting problems and fuel problems in cold weather: engine oil pan heaters, jacket water heaters, fuel heaters, and fuel line insulation.

Use the procedure that follows for cold weather starting.

1. If equipped, move the throttle lever to the full throttle position before you start the engine.
2. If equipped, turn the engine start switch to the HEAT position. Hold the engine start switch in the HEAT position for 6 seconds until the glow plug indicator light illuminates. This will activate the glow plugs and aid in the starting of the engine.

NOTICE
Do not crank the engine for more than 30 seconds. Allow the electric starting motor to cool for two minutes before cranking the engine again.

3. While the glow plug indicator light is illuminated, turn the engine start switch to the START position and crank the engine.

Note: If the glow plug indicator light illuminates rapidly for 2 to 3 seconds, or if the glow plug indicator light fails to illuminate, a malfunction exists in the cold start system. Do not use ether or other starting fluids to start the engine.

4. When the engine starts, release the engine start switch key.
5. If the engine does not start, release the engine start switch and allow the starter motor to cool. Then, repeat steps 2 through step 4.
6. If the engine is equipped with a throttle allow the engine to idle for three to five minutes, or allow the engine to idle until the water temperature indicator begins to rise. The engine should run at low idle smoothly until speed is gradually increased to high idle. Allow the white smoke to disperse before proceeding with normal operation.
7. Operate the engine at low load until all systems reach operating temperature. Check the gauges during the warm-up period.
8. Turn the engine start switch to the OFF position in order to stop the engine.

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i02177935

Starting with Jump Start Cables

⚠ WARNING

Improper jump start cable connections can cause an explosion resulting in personal injury.

Prevent sparks near the batteries. Sparks could cause vapors to explode. Do not allow jump start cable ends to contact each other or the engine.

Note: If it is possible, first diagnose the reason for the starting failure. Make any necessary repairs. If the engine will not start only due to the condition of the battery, either charge the battery, or start the engine with jump start cables. The condition of the battery can be rechecked after the engine has been switched OFF.

NOTICE

Using a battery source with the same voltage as the electric starting motor. Use ONLY equal voltage for jump starting. The use of higher voltage will damage the electrical system.

Do not reverse the battery cables. The alternator can be damaged. Attach ground cable last and remove first.

When using an external electrical source to start the engine, turn the generator set control switch to the "OFF" position. Turn all electrical accessories OFF before attaching the jump start cables.

Ensure that the main power switch is in the OFF position before attaching the jump start cables to the engine being started.

1. Turn the start switch to the OFF position. Turn off all the engine's accessories.
2. Connect one positive end of the jump start cable to the positive cable terminal of the discharged battery. Connect the other positive end of the jump start cable to the positive cable terminal of the electrical source.
3. Connect one negative end of the jump start cable to the negative cable terminal of the electrical source. Connect the other negative end of the jump start cable to the engine block or to the chassis ground. This procedure helps to prevent potential sparks from igniting the combustible gases that are produced by some batteries.
4. Start the engine.
5. Immediately after the stalled engine is started, disconnect the jump start cables in reverse order.

After jump starting, the alternator may not be able to fully recharge batteries that are severely discharged. The batteries must be replaced or charged to the correct voltage with a battery charger after the engine is stopped. Many batteries which are considered unusable are still rechargeable. Refer to Operation and Maintenance Manual, "Battery - Replace" and Testing and Adjusting Manual, "Battery - Test".

i01903609

After Starting Engine

Note: In temperatures from 0 to 60°C (32 to 140°F), the warm-up time is approximately three minutes. In temperatures below 0°C (32°F), additional warm-up time may be required.

When the engine idles during warm-up, observe the following conditions:

- Check for any fluid or for any air leaks at idle rpm and at one-half full rpm (no load on the engine) before operating the engine under load. This is not possible in some applications.
- Operate the engine at low idle until all systems achieve operating temperatures. Check all gauges during the warm-up period.

Note: Gauge readings should be observed and the data should be recorded frequently while the engine is operating. Comparing the data over time will help to determine normal readings for each gauge. Comparing data over time will also help detect abnormal operating developments. Significant changes in the readings should be investigated.

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Engine Operation

i02176671

Engine Operation

Correct operation and maintenance are key factors in obtaining the maximum life and economy of the engine. If the directions in the Operation and Maintenance Manual are followed, costs can be minimized and engine service life can be maximized.

The engine can be operated at the rated rpm after the engine reaches operating temperature. The engine will reach normal operating temperature sooner during a low engine speed (rpm) and during a low power demand. This procedure is more effective than idling the engine at no load. The engine should reach operating temperature in a few minutes.

Gauge readings should be observed and the data should be recorded frequently while the engine is operating. Comparing the data over time will help to determine normal readings for each gauge. Comparing data over time will also help detect abnormal operating developments. Significant changes in the readings should be investigated.

i01929404

Engine Warm-up

1. Run the engine at low idle for three to five minutes, or run the engine at low idle until the jacket water temperature starts to rise.

   More time may be necessary when the temperature is below −18°C (0°F).

2. Check all of the gauges during the warm-up period.

3. Perform a walk-around inspection. Check the engine for fluid leaks and air leaks.

4. Increase the rpm to the rated rpm. Check for fluid leaks and air leaks. The engine may be operated at full rated rpm and at full load when the temperature of the water jacket reaches 60°C (140°F).

i02330149

Fuel Conservation Practices

The efficiency of the engine can affect the fuel economy. Perkins design and technology in manufacturing provides maximum fuel efficiency in all applications. Follow the recommended procedures in order to attain optimum performance for the life of the engine.

- Avoid spilling fuel.

Fuel expands when the fuel is warmed up. The fuel may overflow from the fuel tank. Inspect fuel lines for leaks. Repair the fuel lines, as needed.

- Be aware of the properties of the different fuels. Use only the recommended fuels.

- Avoid unnecessary idling.

Shut off the engine rather than idle for long periods of time.

- Observe the air cleaner service indicator frequently. Keep the air cleaner elements clean.

- Maintain the electrical systems.

One damaged battery cell will overwork the alternator. This will consume excess power and excess fuel.

- Ensure that the drive belts are correctly adjusted. The drive belts should be in good condition.

- Ensure that all of the connections of the hoses are tight. The connections should not leak.

- Ensure that the driven equipment is in good working order.

- Cold engines consume excess fuel. Utilize heat from the jacket water system and the exhaust system, when possible. Keep cooling system components clean and keep cooling system components in good repair. Never operate the engine without water temperature regulators. All of these items will help maintain operating temperatures.

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Engine Stopping

i01929389

Stopping the Engine

NOTICE
Stopping the engine immediately after it has been working under load can result in overheating and accelerated wear of the engine components.

If the engine has been operating at high rpm and/or high loads, run at low idle for at least three minutes to reduce and stabilize internal engine temperature before stopping the engine.

Avoiding hot engine shutdowns will maximize turbocharger shaft and bearing life.

Prior to stopping an engine that is being operated at low loads, operate the engine at low idle for 30 seconds before stopping. If the engine has been operating at highway speeds and/or at high loads, operate the engine at low idle for at least three minutes. This procedure will cause the internal engine temperature to be reduced and stabilized.

Ensure that the engine stopping procedure is understood. Stop the engine according to the shutoff system on the engine or refer to the instructions that are provided by the OEM.

- To stop the engine, turn the ignition key switch to the OFF position.

i01903586

Emergency Stopping

NOTICE
Emergency shutoff controls are for EMERGENCY use ONLY. DO NOT use emergency shutoff devices or controls for normal stopping procedure.

The OEM may have equipped the application with an emergency stop button. For more information about the emergency stop button, refer to the OEM information.

Ensure that any components for the external system that support the engine operation are secured after the engine is stopped.

i01903608

After Stopping Engine

Note: Before you check the engine oil, do not operate the engine for at least 10 minutes in order to allow the engine oil to return to the oil pan.

- Check the crankcase oil level. Maintain the oil level between the "ADD" mark and the "FULL" mark on the oil level dipstick.
- If necessary, perform minor adjustments. Repair any leaks and tighten any loose bolts.
- Note the required service interval. Perform the maintenance that is in the Operation and Maintenance Manual, "Maintenance Interval Schedule".
- Fill the fuel tank in order to help prevent accumulation of moisture in the fuel. Do not overfill the fuel tank.

NOTICE
Only use antifreeze/coolant mixtures recommended in the Coolant Specifications that are in the Operation and Maintenance Manual. Failure to do so can cause engine damage.

- Allow the engine to cool. Check the coolant level.
- If freezing temperatures are expected, check the coolant for the correct antifreeze protection. The cooling system must be protected against freezing to the lowest expected outside temperature. Add the correct coolant/water mixture, if necessary.
- Perform all required periodic maintenance on all driven equipment. This maintenance is outlined in the instructions from the OEM.

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Cold Weather Operation

i02717265

Cold Weather Operation

Perkins Diesel Engines can operate effectively in cold weather. During cold weather, the starting and the operation of the diesel engine is dependent on the following items:

- The type of fuel that is used
- The viscosity of the engine oil
- The operation of the glow plugs
- Optional Cold starting aid
- Battery condition

This section will cover the following information:

- Potential problems that are caused by cold weather operation
- Suggest steps which can be taken in order to minimize starting problems and operating problems when the ambient air temperature is between 0° to−40 °C (32° to 40 °F).

The operation and maintenance of an engine in freezing temperatures is complex . This is because of the following conditions:

- Weather conditions
- Engine applications

Recommendations from your Perkins dealer or your Perkins distributor are based on past proven practices. The information that is contained in this section provides guidelines for cold weather operation.

Hints for Cold Weather Operation

- If the engine will start, operate the engine until a minimum operating temperature of 81 °C (177.8 °F) is achieved. Achieving operating temperature will help prevent the intake valves and exhaust valves from sticking.
- The cooling system and the lubrication system for the engine do not lose heat immediately upon shutdown. This means that an engine can be shut down for a period of time and the engine can still have the ability to start readily.
- Install the correct specification of engine lubricant before the beginning of cold weather.
- Check all rubber parts (hoses, fan drive belts, etc) weekly.
- Check all electrical wiring and connections for any fraying or damaged insulation.
- Keep all batteries fully charged and warm.
- Fill the fuel tank at the end of each shift.
- Check the air cleaners and the air intake daily. Check the air intake more often when you operate in snow.
- Ensure that the glow plugs are in working order. Refer to Testing and Adjusting Manual, "Glow Plug - Test".

⚠ WARNING

Personal injury or property damage can result from alcohol or starting fluids.

Alcohol or starting fluids are highly flammable and toxic and if improperly stored could result in injury or property damage.

⚠ WARNING

Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.

- For jump starting with cables in cold weather, refer to the Operation and Maintenance Manual, "Starting with Jump Start Cables." for instructions.

Viscosity of the Engine Lubrication Oil

Correct engine oil viscosity is essential. Oil viscosity affects the amount of torque that is needed to crank the engine. Refer to this Operation and Maintenance Manual, "Fluid Recommendations" for the recommended viscosity of oil.

Recommendations for the Coolant

Provide cooling system protection for the lowest expected outside temperature. Refer to this Operation and Maintenance Manual, "Fluid Recommendations" for the recommended coolant mixture.

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In cold weather, check the coolant often for the correct glycol concentration in order to ensure adequate freeze protection.

Engine Block Heaters

Engine block heaters (if equipped) heat the engine jacket water that surrounds the combustion chambers. This provides the following functions:

- Startability is improved.
- Warm up time is reduced.

An electric block heater can be activated once the engine is stopped. An effective block heater is typically a 1250/1500 W unit. Consult your Perkins dealer or your Perkins distributor for more information.

Idling the Engine

When idling after the engine is started in cold weather, increase the engine rpm from 1000 to 1200 rpm. This will warm up the engine more quickly. Maintaining an elevated low idle speed for extended periods will be easier with the installation of a hand throttle. The engine should not be "raced" in order to speed up the warm up process.

While the engine is idling, the application of a light load (parasitic load) will assist in achieving the minimum operating temperature. The minimum operating temperature is 82 °C (179.6 °F).

Recommendations for Coolant Warm Up

Warm up an engine that has cooled below normal operating temperatures due to inactivity. This should be performed before the engine is returned to full operation. During operation in very cold temperature conditions, damage to engine valve mechanisms can result from engine operation for short intervals. This can happen if the engine is started and the engine is stopped many times without being operated in order to warm up completely.

When the engine is operated below normal operating temperatures, fuel and oil are not completely burned in the combustion chamber. This fuel and oil causes soft carbon deposits to form on the valve stems. Generally, the deposits do not cause problems and the deposits are burned off during operation at normal engine operating temperatures.

When the engine is started and the engine is stopped many times without being operated in order to warm up completely, the carbon deposits become thicker. This can cause the following problems:

- Free operation of the valves is prevented.
- Valves become stuck.
- Pushrods may become bent.
- Other damage to valve train components can result.

For this reason, when the engine is started, the engine must be operated until the coolant temperature is 71 °C (160 °F) minimum. Carbon deposits on the valve stems will be kept at a minimum and the free operation of the valves and the valve components will be maintained.

In addition, the engine must be thoroughly warmed in order to keep other engine parts in better condition and the service life of the engine will be generally extended. Lubrication will be improved. There will be less acid and less sludge in the oil. This will provide longer service life for the engine bearings, the piston rings, and other parts. However, limit unnecessary idle time to ten minutes in order to reduce wear and unnecessary fuel consumption.

The Water Temperature Regulator and Insulated Heater Lines

The engine is equipped with a water temperature regulator. When the engine coolant is below the correct operating temperature jacket water circulates through the engine cylinder block and into the engine cylinder head. The coolant then returns to the cylinder block via an internal passage that bypasses the valve of the coolant temperature regulator. This ensures that coolant flows around the engine under cold operating conditions. The water temperature regulator begins to open when the engine jacket water has reached the correct minimum operating temperature. As the jacket water coolant temperature rises above the minimum operating temperature the water temperature regulator opens further allowing more coolant through the radiator to dissipate excess heat.

The progressive opening of the water temperature regulator operates the progressive closing of the bypass passage between the cylinder block and head. This ensures maximum coolant flow to the radiator in order to achieve maximum heat dissipation.

Note: Perkins discourages the use of all air flow restriction devices such as radiator shutters. Restriction of the air flow can result in the following: high exhaust temperatures, power loss, excessive fan usage, and reduction in fuel economy.

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A cab heater is beneficial in very cold weather. The feed from the engine and the return lines from the cab should be insulated in order to reduce heat loss to the outside air.

Insulating the Air Inlet and Engine Compartment

When temperatures below −18 °C (−0 °F) will be frequently encountered, an air cleaner inlet that is located in the engine compartment may be specified. An air cleaner that is located in the engine compartment may also minimize the entry of snow into the air cleaner. Also, heat that is rejected by the engine helps to warm the intake air.

Additional heat can be retained around the engine by insulating the engine compartment.

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Fuel and the Effect from Cold Weather

Note: Only use grades of fuel that are recommended by Perkins. Refer to this Operation and Maintenance Manual, "Fluid Recommendations".

The following fuels can be used in this series of engine.

- Group 1
- Group 2
- Group 3
- Special Fuels

Perkins prefer only Group 1 and Group 2 fuels for use in this series of engines.

Group 1 fuels are the preferred Group of Fuels for general use by Perkins. Group 1 fuels maximize engine life and engine performance. Group 1 fuels are usually less available than Group 2 fuels. Frequently, Group 1 fuels are not available in colder climates during the winter.

Note: Group 2 fuels must have a maximum wear scar of 650 micrometers (HFRR to ISO 12156-1).

Group 2 fuels are considered acceptable for issues of warranty. This group of fuels may reduce the life of the engine, the engine's maximum power, and the engine's fuel efficiency.

When Group 2 diesel fuels are used the following components provide a means of minimizing problems in cold weather:

- Glow plugs (if equipped)
- Engine coolant heaters, which may be an OEM option
- Fuel heaters, which may be an OEM option
- Fuel line insulation, which may be an OEM option

There are three major differences between Group 1 fuels and Group 2 fuels. Group 1 fuels have the following different characteristics to Group 2 fuels.

- A lower cloud point
- A lower pour point
- A higher energy per unit volume of fuel

Note: Group 3 fuels reduce the life of the engine. The use of Group 3 fuels is not covered by the Perkins warranty.

Group 3 fuels include Low Temperature Fuels and Aviation Kerosene Fuels.

Special fuels include Biofuel.

The cloud point is a temperature that allows wax crystals to form in the fuel. These crystals can cause the fuel filters to plug.

The pour point is the temperature when diesel fuel will thicken. The diesel fuel becomes more resistant to flow through fuel lines, fuel filters,and fuel pumps.

Be aware of these facts when diesel fuel is purchased. Consider the average ambient air temperature for the engine's application. Engines that are fueled in one climate may not operate well if the engines are moved to another climate. Problems can result due to changes in temperature.

Before troubleshooting for low power or for poor performance in the winter, check the fuel for waxing.

Low temperature fuels may be available for engine operation at temperatures below 0 °C (32 °F). These fuels limit the formation of wax in the fuel at low temperatures.

For more information on cold weather operation, refer to the Operation and Maintenance Manual, "Cold Weather Operation and Fuel Related Components in Cold Weather".

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Fuel Related Components in Cold Weather

Fuel Tanks

Condensation can form in partially filled fuel tanks. Top off the fuel tanks after you operate the engine.

Fuel tanks should contain some provision for draining water and sediment from the bottom of the tanks. Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe.

Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

Drain the water and sediment from any fuel storage tank at the following intervals: weekly, oil changes, and refueling of the fuel tank. This will help prevent water and/or sediment from being pumped from the fuel storage tank and into the engine fuel tank.

Fuel Filters

It is possible that a primary fuel filter is installed between the fuel tank and the engine fuel inlet. After you change the fuel filter, always prime the fuel system in order to remove air bubbles from the fuel system. Refer to the Operation and Maintenance Manual in the Maintenance Section for more information on priming the fuel system.

The micron rating and the location of a primary fuel filter is important in cold weather operation. The primary fuel filter and the fuel supply line are the most common components that are affected by cold fuel.

Fuel Heaters

Note: The OEM may equip the application with fuel heaters. If this is the case, disconnect an electric type of fuel heater in warm weather in order to prevent overheating of the fuel. If the type of fuel heater is a heat exchanger, the OEM should have included a bypass for warm weather. Ensure that the bypass is operational during warm weather in order to prevent overheating of the fuel.

For more information about fuel heaters (if equipped), refer to the OEM information.

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Maintenance Section

Refill Capacities

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Refill Capacities

Lubrication System

The refill capacities for the engine crankcase reflect the approximate capacity of the crankcase or sump plus standard oil filters. Auxiliary oil filter systems will require additional oil. Refer to the OEM specifications for the capacity of the auxiliary oil filter. Refer to the Operation and Maintenance Manual, "Maintenance Section" for more information on Lubricant Specifications.

1104 Engine

Table 5

1104 Engine		
Compartment or System	**Liters**	**Quarts**
Standard Oil Sump for the Engine Crankcase (1)	6.5	7

(1) These values are the approximate capacities for the crankcase oil sump which include the standard factory installed oil filters. Engines with auxiliary oil filters will require additional oil. Refer to the OEM specifications for the capacity of the auxiliary oil filter.

1103 Engine

Table 6

1103 Engine		
Compartment or System	**Liters**	**Quarts**
Standard Oil Sump for the Engine Crankcase (1)	6.5	7

(1) These values are the approximate capacities for the crankcase oil sump which include the standard factory installed oil filters. Engines with auxiliary oil filters will require additional oil. Refer to the OEM specifications for the capacity of the auxiliary oil filter.

Cooling System

To maintain the cooling system, the Total Cooling System capacity must be known. The approximate capacity for the engine cooling system is listed below. External System capacities will vary among applications. Refer to the OEM specifications for the External System capacity. This capacity information will be needed in order to determine the amount of coolant/antifreeze that is required for the Total Cooling System.

1104 Engine

Table 7

1104 Naturally Aspirated Engine		
Compartment or System	**Liters**	**Quarts**
Engine Only	10.4	11
External cooling system capacity (OEM recommendation) (1)		
Total Cooling System (2)		

(1) The external cooling system includes a radiator or an expansion tank with the following components: heat exchanger, aftercooler, and piping. Refer to the OEM specifications. Enter the value for the external system capacity in this row.

(2) The Total Cooling System includes the capacity for the engine cooling system plus the capacity for the external cooling system. Enter the total in this row.

Table 8

1104 Turbocharged Engine		
Compartment or System	**Liters**	**Quarts**
Engine Only	11.4	12
External cooling System capacity (OEM recommendation) (1)		
Total Cooling System (2)		

(1) The external cooling system includes a radiator or an expansion tank with the following components: heat exchanger, aftercooler, and piping. Refer to the OEM specifications. Enter the value for the external cooling system capacity in this row.

(2) The Total Cooling System includes the capacity for the engine cooling system plus the capacity for the external cooling system. Enter the total in this row.

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1103 Engine

Table 9

1103 Naturally Aspirated Engine without an oil cooler		
Compartment or System	**Liters**	**Quarts**
Engine Only	4.21	4
External cooling system capacity (OEM recommendation) (1)		
Total Cooling System (2)		

(1) The external cooling system includes a radiator or an expansion tank with the following components: heat exchanger, aftercooler, and piping. Refer to the OEM specifications. Enter the value for the external system capacity in this row.
(2) The Total Cooling System includes the capacity for the engine cooling system plus the capacity for the external cooling system. Enter the total in this row.

Table 10

1103 Naturally Aspirated Engines and Turbocharged Engines with an oil cooler		
Compartment or System	**Liters**	**Quarts**
Engine Only	4.43	4.02
External cooling system capacity (OEM recommendation) (1)		
Total Cooling System (2)		

(1) The external cooling system includes a radiator or an expansion tank with the following components: heat exchanger, aftercooler, and piping. Refer to the OEM specifications. Enter the value for the external system capacity in this row.
(2) The Total Cooling System includes the capacity for the engine cooling system plus the capacity for the external cooling system. Enter the total in this row.

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Fluid Recommendations

General Lubricant Information

Because of government regulations regarding the certification of exhaust emissions from the engine, the lubricant recommendations must be followed.

Engine Manufacturers Association (EMA) Oils

The "Engine Manufacturers Association Recommended Guideline on Diesel Engine Oil" is recognized by Perkins. For detailed information about this guideline, see the latest edition of EMA publication, "EMA DHD -1".

API Oils

The Engine Oil Licensing and Certification System by the American Petroleum Institute (API) is recognized by Perkins. For detailed information about this system, see the latest edition of the "API publication No. 1509". Engine oils that bear the API symbol are authorized by API.

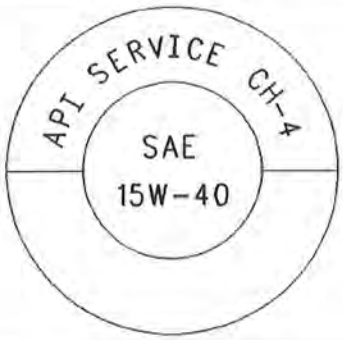


Illustration 24 g00546535
Typical API symbol

Diesel engine oils CC, CD, CD-2, and CE have not been API authorized classifications since 1 January 1996. Table 11 summarizes the status of the classifications.

Table 11

API Classifications	
Current	**Obsolete**
CF-4, CG-4, CH-4	CE
CF	CC, CD
CF-2(1)	CD-2(1)

(1) The classifications CD-2 and American Petroleum Institute CF-2 are for two-cycle diesel engines. Perkins does not sell engines that utilize CD-2 and API CF-2 oils.

Terminology

Certain abbreviations follow the nomenclature of "SAE J754". Some classifications follow "SAE J183" abbreviations, and some classifications follow the "EMA Recommended Guideline on Diesel Engine Oil". In addition to Perkins definitions, there are other definitions that will be of assistance in purchasing lubricants. Recommended oil viscosities can be found in this publication, "Fluid Recommendations/Engine Oil" topic (Maintenance Section).

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Engine Oil

Commercial Oils

The performance of commercial diesel engine oils is based on American Petroleum Institute (API) classifications. These API classifications are developed in order to provide commercial lubricants for a broad range of diesel engines that operate at various conditions.

Only use commercial oils that meet the following classifications:

- EMA DHD-1 multigrade oil (preferred oil)
- API CH-4 multigrade oil (preferred oil)
- ACEAE3

In order to make the correct choice of a commercial oil, refer to the following explanations:

EMA DHD-1 – The Engine Manufacturers Association (EMA) has developed lubricant recommendations as an alternative to the API oil classification system. DHD-1 is a Recommended Guideline that defines a level of oil performance for these types of diesel engines: high speed, four stroke cycle, heavy-duty, and light duty. DHD-1 oils may be used in Perkins engines when the following oils are recommended: API CH-4, API CG-4, and API CF-4. DHD-1 oils are intended to provide superior performance in comparison to API CG-4 and API CF-4.

DHD-1 oils will meet the needs of high performance Perkins diesel engines that are operating in many applications. The tests and the test limits that are used to define DHD-1 are similar to the new API CH-4 classification. Therefore, these oils will also meet the requirements for diesel engines that require low emissions. DHD-1 oils are designed to control the harmful effects of soot with improved wear resistance and improved resistance to plugging of the oil filter. These oils will also provide superior piston deposit control for engines with either two-piece steel pistons or aluminum pistons.

All DHD-1 oils must complete a full test program with the base stock and with the viscosity grade of the finished commercial oil. The use of "API Base Oil Interchange Guidelines" are not appropriate for DHD-1 oils. This feature reduces the variation in performance that can occur when base stocks are changed in commercial oil formulations.

DHD-1 oils are recommended for use in extended oil change interval programs that optimize the life of the oil. These oil change interval programs are based on oil analysis. DHD-1 oils are recommended for conditions that demand a premium oil. Your Perkins dealer or your Perkins distributor has the specific guidelines for optimizing oil change intervals.

API CH-4 – API CH-4 oils were developed in order to meet the requirements of the new high performance diesel engines. Also, the oil was designed to meet the requirements of the low emissions diesel engines. API CH-4 oils are also acceptable for use in older diesel engines and in diesel engines that use high sulfur diesel fuel. API CH-4 oils may be used in Perkins engines that use API CG-4 and API CF-4 oils. API CH-4 oils will generally exceed the performance of API CG-4 oils in the following criteria: deposits on pistons, control of oil consumption, wear of piston rings, valve train wear, viscosity control, and corrosion.

Three new engine tests were developed for the API CH-4 oil. The first test specifically evaluates deposits on pistons for engines with the two-piece steel piston. This test (piston deposit) also measures the control of oil consumption. A second test is conducted with moderate oil soot. The second test measures the following criteria: wear of piston rings, wear of cylinder liners, and resistance to corrosion. A third new test measures the following characteristics with high levels of soot in the oil: wear of the valve train, resistance of the oil in plugging the oil filter, and control of sludge.

In addition to the new tests, API CH-4 oils have tougher limits for viscosity control in applications that generate high soot. The oils also have improved oxidation resistance. API CH-4 oils must pass an additional test (piston deposit) for engines that use aluminum pistons (single piece). Oil performance is also established for engines that operate in areas with high sulfur diesel fuel.

All of these improvements allow the API CH-4 oil to achieve optimum oil change intervals. API CH-4 oils are recommended for use in extended oil change intervals. API CH-4 oils are recommended for conditions that demand a premium oil. Your Perkins dealer or your Perkins distributor has specific guidelines for optimizing oil change intervals.

Some commercial oils that meet the API classifications may require reduced oil change intervals. To determine the oil change interval, closely monitor the condition of the oil and perform a wear metal analysis.

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NOTICE
Failure to follow these oil recommendations can cause shortened engine service life due to deposits and/or excessive wear.

Total Base Number (TBN) and Fuel Sulfur Levels for Direct Injection (DI) Diesel Engines

The Total Base Number (TBN) for an oil depends on the fuel sulfur level. For direct injection engines that use distillate fuel, the minimum TBN of the new oil must be 10 times the fuel sulfur level. The TBN is defined by "ASTM D2896". The minimum TBN of the oil is 5 regardless of fuel sulfur level. Illustration 25 demonstrates the TBN.

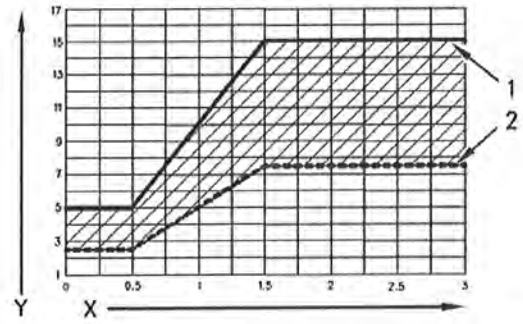


Illustration 25 g00799818

(Y) TBN by "ASTM D2896"
(X) Percentage of fuel sulfur by weight
(1) TBN of new oil
(2) Change the oil when the TBN deteriorates to 50 percent of the original TBN.

Use the following guidelines for fuel sulfur levels that exceed 1.5 percent:

- Choose an oil with the highest TBN that meets one of these classifications: EMA DHD-1 and API CH-4.
- Reduce the oil change interval. Base the oil change interval on the oil analysis. Ensure that the oil analysis includes the condition of the oil and a wear metal analysis.

Excessive piston deposits can be produced by an oil with a high TBN. These deposits can lead to a loss of control of the oil consumption and to the polishing of the cylinder bore.

NOTICE
Operating Direct Injection (DI) diesel engines with fuel sulphur levels over 0.5 percent will require shortened oil change intervals in order to help maintain adequate wear protection.

Table 12

Percentage of Sulfur in the fuel	Oil change interval
Lower than 0.5	Normal
0.5 to 1.0	0.75 of normal
Greater than 1.0	0.50 of normal

Lubricant Viscosity Recommendations for Direct Injection (DI) Diesel Engines

The correct SAE viscosity grade of oil is determined by the minimum ambient temperature during cold engine start-up, and the maximum ambient temperature during engine operation.

Refer to Table 13 (minimum temperature) in order to determine the required oil viscosity for starting a cold engine.

Refer to Table 13 (maximum temperature) in order to select the oil viscosity for engine operation at the highest ambient temperature that is anticipated.

Generally, use the highest oil viscosity that is available to meet the requirement for the temperature at start-up.

Table 13

Engine Oil Viscosity		
EMA LRG-1 API CH-4 Viscosity Grade	Ambient Temperature	
	Minimum	Maximum
SAE 0W20	−40 °C (−40 °F)	10 °C (50 °F)
SAE 0W30	−40 °C (−40 °F)	30 °C (86 °F)
SAE 0W40	−40 °C (−40 °F)	40 °C (104 °F)
SAE 5W30	−30 °C (−22 °F)	30 °C (86 °F)
SAE 5W40	−30 °C (−22 °F)	40 °C (104 °F)
SAE 10W30	−20 °C (−4 °F)	40 °C (104 °F)
SAE 15W40	−10 °C (14 °F)	50 °C (122 °F)

Synthetic Base Stock Oil

Synthetic base oils are acceptable for use in these engines if these oils meet the performance requirements that are specified for the engine.

Synthetic base oils generally perform better than conventional oils in the following two areas:

- Synthetic base oils have improved flow at low temperatures especially in arctic conditions.
- Synthetic base oils have improved oxidation stability especially at high operating temperatures.

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Some synthetic base oils have performance characteristics that enhance the service life of the oil. Perkins does not recommend the automatic extending of the oil change intervals for any type of oil.

Re-refined base stock oil

Re-refined base stock oil are acceptable for use in Perkins engines if these oils meet the performance requirements that are specified by Perkins.Re-refined base stock oil can be used exclusively in finished oil or in a combination with new base stock oil . The US military specifications and the specifications of other heavy equipment manufacturers also allow the use of re-refined base stock oil that meet the same criteria.

The process that is used to make re-refined base stock oil should adequately remove all wear metals that are in the used oil and all the additives that are in the used oil. The process that is used to make re-refined base stock oil generally involves the process of vacuum distillation and hydrotreating the used oil. Filtering is adequate for the production of high quality, re-refined base stock oil.

Lubricants for Cold Weather

When an engine is started and an engine is operated in ambient temperatures below −20 °C (−4 °F), use multigrade oils that are capable of flowing in low temperatures.

These oils have lubricant viscosity grades of SAE 0W or SAE 5W.

When an engine is started and operated in ambient temperatures below −30 °C (−22 °F), use a synthetic base stock multigrade oil with an 0W viscosity grade or with a 5W viscosity grade. Use an oil with a pour point that is lower than −50 °C (−58 °F).

The number of acceptable lubricants is limited in cold weather conditions. Perkins recommends the following lubricants for use in cold weather conditions:

First Choice – Use oil with an EMA DHD-1 Recommended Guideline. Use a CH-4 oil that has an API license. The oil should be either SAE 0W20, SAE 0W30, SAE 0W40, SAE 5W30, or SAE 5W40 lubricant viscosity grade.

Second Choice – Use an oil that has a CH-4 additive package. Although the oil has not been tested for the requirements of the API license, the oil must be either SAE 0W20, SAE 0W30, SAE 0W40, SAE 5W30, or SAE 5W40.

NOTICE
Shortened engine service life could result if second choice oils are used.

Aftermarket Oil Additives

Perkins does not recommend the use of aftermarket additives in oil. It is not necessary to use aftermarket additives in order to achieve the engine's maximum service life or rated performance. Fully formulated, finished oils consist of base oils and of commercial additive packages. These additive packages are blended into the base oils at precise percentages in order to help provide finished oils with performance characteristics that meet industry standards.

There are no industry standard tests that evaluate the performance or the compatibility of aftermarket additives in finished oil. Aftermarket additives may not be compatible with the finished oil's additive package, which could lower the performance of the finished oil. The aftermarket additive could fail to mix with the finished oil. This could produce sludge in the crankcase. Perkins discourages the use of aftermarket additives in finished oils.

To achieve the best performance from a Perkins engine, conform to the following guidelines:

- Select the correct oil, or a commercial oil that meets the "EMA Recommended Guideline on Diesel Engine Oil" or the recommended API classification.
- See the appropriate "Lubricant Viscosities" table in order to find the correct oil viscosity grade for your engine.
- At the specified interval, service the engine. Use new oil and install a new oil filter.
- Perform maintenance at the intervals that are specified in the Operation and Maintenance Manual, "Maintenance Interval Schedule".

S·O·S Oil analysis

Some engines may be equipped with an oil sampling valve. If S·O·S oil analysis is required the oil sampling valve is used to obtain samples of the engine oil. The S·O·S oil analysis will complement the preventive maintenance program.

The S·O·S oil analysis is a diagnostic tool that is used to determine oil performance and component wear rates. Contamination can be identified and measured through the use of the S·O·S oil analysis. The S·O·S oil analysis includes the following tests:

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- The Wear Rate Analysis monitors the wear of the engine's metals. The amount of wear metal and type of wear metal that is in the oil is analyzed. The increase in the rate of engine wear metal in the oil is as important as the quantity of engine wear metal in the oil.
- Tests are conducted in order to detect contamination of the oil by water, glycol or fuel.
- The Oil Condition Analysis determines the loss of the oil's lubricating properties. An infrared analysis is used to compare the properties of new oil to the properties of the used oil sample. This analysis allows technicians to determine the amount of deterioration of the oil during use. This analysis also allows technicians to verify the performance of the oil according to the specification during the entire oil change interval.

Fuel Specifications

Fuel Recommendations

To get the correct power and performance from the engine, use a fuel of the correct quality. The recommended fuel specification for Perkins engines is shown below:

- Cetane number_____45 minimum
- Viscosity_____2,0 to 4.5 cSt at 40 °C (104 °F)
- Density_____0.835 to 0.855 Kg/liter
- Sulfur_____0.2% of mass, maximum
- Distillation_____85% at 350 °C (662 °F)
- Lubricity_____460 micrometers maximum wear scar on "ISO 12156 - 1"

Cetane number

This indicates the properties of ignition of the fuel. Fuel with a low cetane number can be the root cause of problems during cold start. This will affect combustion.

Viscosity

This is the resistance to flow of a fluid. If this resistance is outside the limits, the engine and the engine starting performance in particular can be affected.

Sulfur

High sulfur content of the fuel is not normally found in Europe, North America or Australasia. This can cause engine wear. When only high sulfur fuels are available, it will be necessary that high alkaline lubricating oil is used in the engine or that the lubricating oil change interval is reduced.

Distillation

This is an indication of the mixture of different hydrocarbons in the fuel. A high ratio of light weight hydrocarbons can affect the characteristics of combustion.

Lubricity

This is the capability of the fuel to prevent pump wear.

Diesel engines have the ability to burn a wide variety of fuels. These fuels are divided into four general groups:

- Group 1 (preferred fuels)
- Group 2 (permissible fuels)
- Group 3 (aviation kerosene fuels)
- Other fuels

Group 1 (preferred fuels): Specification

"DERV to EN590"

Note: Only use Arctic fuels when the temperature is below 0 °C (32 °F). Do not use Arctic fuels when the ambient temperature is above 0 °C (32 °F). To ensure that the time period between cranking the engine and first fire is kept to a minimum, only use fuel of the correct viscosity and at the correct temperature.

Gas oil to "BS2869 Class A2"

"ASTM D975 - 91 Class 2D" This can only be used if the fuel has the correct specification of lubricity.

"JIS K2204 (1992) Grades 1,2,3 and Special Grade 3" This can only be used if the fuel has the correct specification of lubricity.

Note: If low sulfur or low sulfur aromatic fuels are used, then fuel additives can be used to increase lubricity.

Group 2 (permissible fuels): Specification

These fuel specifications are considered acceptable for issues of warranty. However,these fuels may reduce the life of the engine, the engine's maximum power and the engine's fuel efficiency.

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"ASTM D975 - 91 Class 1D"

"JP7, Mil T38219"

"NATO F63"

NOTICE
These fuels should have a wear scar value of 650 micrometers maximum *HFRR to ISO 12156 - 1.*

Group 3 (aviation kerosene fuels): Specification

These fuels need additives to achieve lubricity of 650 micrometers wear scar and the reliability of the fuel injection pump will be reduced. The fuel injection pump is not covered by a warranty, even when the additives are included.

"JP5 MIL T5624 (Avcat FSII, NATO F44"

"JP8 T83133 (Avtur FSII, NATO F34"

"Jet A"

"Jet A1, NATO F35, XF63"

Low temperature fuels

Special fuels for use in cold weather may be available for engine operation at temperatures below 0 °C (32 °F). These fuels limit the formation of wax in the fuel oil at low temperatures. If wax forms in the fuel oil, this could stop the flow of fuel oil through the filter.

Note: These fuels that lack lubricity may cause the following problems:

- Low engine power
- Difficult starting in hot conditions or in cold conditions
- White smoke
- Deterioration of emissions and misfire at certain operating conditions

Biofuel: Specification

Biofuel: A 5% mix of RME to EN14214 in conventional fuel is permitted.

NOTICE
Water emulsion fuels: These fuels are not permitted

Refer to the following fuel specifications for North America.

The preferred fuels provide maximum engine service life and performance. The preferred fuels are distillate fuels. These fuels are commonly called diesel fuel or gas oil.

The permissible fuels are crude oils or blended fuels. Use of these fuels can result in higher maintenance costs and in reduced engine service life.

Diesel fuels that meet the specifications in Table 14 will help to provide maximum engine service life and performance. In North America, diesel fuel that is identified as No. 2-D in "ASTM D975" generally meets the specifications. Table 14 is for diesel fuels that are distilled from crude oil. Diesel fuels from other sources could exhibit detrimental properties that are not defined or controlled by this specification.

Table 14

Perkins Specifications for Distillate Diesel Fuel		
Specifications	**Requirements**	**ASTM Test**
Aromatics	35% maximum	"D1319"
Ash	0.02% maximum (weight)	"D482"
Carbon Residue on 10% Bottoms	0.35% maximum (weight)	"D524"
Cetane Number	40 minimum (DI engines)	"D613"
Cloud Point	The cloud point must not exceed the lowest expected ambient temperature.	-

(continued)

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(Table 14, contd)

Copper Strip Corrosion	No. 3 maximum	"D130"
Distillation	10% at 282 °C (540 °F) maximum	"D86"
	90% at 360 °C (680 °F) maximum	
Flash Point	legal limit	"D93"
API Gravity	30 minimum	"D287"
	45 maximum	
Pour Point	6 °C (10 °F) minimum below ambient temperature	"D97"
Sulfur (1)	0.2% maximum	"D3605" or "D1552"
Kinematic Viscosity (2)	2.0 cSt minimum and 4.5 cSt maximum at 40 °C (104 °F)	"D445"
Water and Sediment	0.1% maximum	"D1796"
Water	0.1% maximum	"D1744"
Sediment	0.05% maximum (weight)	"D473"
Gum and Resins (3)	10 mg per 100 mL maximum	"D381"
Lubricity (4)	0.38 mm (0.015 inch) maximum at 25 °C (77 °F)	"D6079"

(1) Perkins fuel systems and engine components can operate on high sulfur fuels. Fuel sulfur levels affect exhaust emissions. High sulfur fuels also increase the potential for corrosion of internal components. Fuel sulfur levels above 0.5 percent may significantly shorten the oil change interval. For additional information, see this publication, "Fluid Recommendations/Engine Oil" topic (Maintenance Section).

(2) The values of the fuel viscosity are the values as the fuel is delivered to the fuel injection pumps. If a fuel with a low viscosity is used, cooling of the fuel may be required to maintain a 1.4 cSt viscosity at the fuel injection pump. Fuels with a high viscosity might require fuel heaters in order to bring down the viscosity to a 20 cSt viscosity.

(3) Follow the test conditions and procedures for gasoline (motor).

(4) The lubricity of a fuel is a concern with low sulfur fuel. To determine the lubricity of the fuel, use either the "ASTM D6078 Scuffing Load Wear Test (SBOCLE)" or the "ASTM D6079 High Frequency Reciprocating Rig (HFRR)" test. If the lubricity of a fuel does not meet the minimum requirements, consult your fuel supplier. Do not treat the fuel without consulting the fuel supplier. Some additives are not compatible. These additives can cause problems in the fuel system.

NOTICE
Operating with fuels that do not meet the Perkins recommendations can cause the following effects: Starting difficulty, poor combustion, deposits in the fuel injectors, reduced service life of the fuel system, deposits in the combustion chamber, and reduced service life of the engine.

NOTICE
Heavy Fuel Oil (HFO), Residual fuel, or Blended fuel must NOT be used in Perkins diesel engines. Severe component wear and component failures will result if HFO type fuels are used in engines that are configured to use distillate fuel.

In extreme cold ambient conditions, you may use the distillate fuels that are specified in Table 15. However, the fuel that is selected must meet the requirements that are specified in Table 14. These fuels are intended to be used in operating temperatures that are down to −54 °C (−65 °F).

Table 15

Distillate Fuels (1)	
Specification	**Grade**
"MIL-T-5624R"	JP-5
"ASTM D1655"	Jet-A-1
"MIL-T-83133D"	JP-8

(1) The fuels that are listed in this Table may not meet the requirements that are specified in the "Perkins Specifications for Distillate Diesel Fuel" Table. Consult the supplier for the recommended additives in order to maintain the correct fuel lubricity.

These fuels are lighter than the No. 2 grades of fuel. The cetane number of the fuels in Table 15 must be at least 40. If the viscosity is below 1.4 cSt at 38 °C (100 °F), use the fuel only in temperatures below 0 °C (32 °F). Do not use any fuels with a viscosity of less than 1.2 cSt at 38 °C (100 °F). Fuel cooling may be required in order to maintain the minimum viscosity of 1.4 cSt at the fuel injection pump.

There are many other diesel fuel specifications that are published by governments and by technological societies. Usually, those specifications do not review all the requirements that are addressed in this specification. To ensure optimum engine performance, a complete fuel analysis should be obtained before engine operation. The fuel analysis should include all of the properties that are listed in Table 14.

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Cooling System Specifications

General Coolant Information

NOTICE
Never add coolant to an overheated engine. Engine damage could result. Allow the engine to cool first.

NOTICE
If the engine is to be stored in, or shipped to an area with below freezing temperatures, the cooling system must be either protected to the lowest outside temperature or drained completely to prevent damage.

NOTICE
Frequently check the specific gravity of the coolant for proper freeze protection or for anti-boil protection.

Clean the cooling system for the following reasons:

- Contamination of the cooling system
- Overheating of the engine
- Foaming of the coolant

NOTICE
Never operate an engine without water temperature regulators in the cooling system. Water temperature regulators help to maintain the engine coolant at the proper operating temperature. Cooling system problems can develop without water temperature regulators.

Many engine failures are related to the cooling system. The following problems are related to cooling system failures: Overheating, leakage of the water pump, and plugged radiators or heat exchangers.

These failures can be avoided with correct cooling system maintenance. Cooling system maintenance is as important as maintenance of the fuel system and the lubrication system. Quality of the coolant is as important as the quality of the fuel and the lubricating oil.

Coolant is normally composed of three elements: Water, additives, and glycol.

Water

Water is used in the cooling system in order to transfer heat.

Distilled water or deionized water is recommended for use in engine cooling systems.

DO NOT use the following types of water in cooling systems: Hard water, softened water that has been conditioned with salt, and sea water.

If distilled water or deionized water is not available, use water with the properties that are listed in Table 16.

Table 16

Perkins Minimum Acceptable Water Requirements	
Property	**Maximum Limit**
Chloride (Cl)	40 mg/L
Sulfate (SO_4)	100 mg/L
Total Hardness	170 mg/L
Total Solids	340 mg/L
Acidity	pH of 5.5 to 9.0

For a water analysis, consult one of the following sources:

- Local water utility company
- Agricultural agent
- Independent laboratory

Additives

Additives help to protect the metal surfaces of the cooling system. A lack of coolant additives or insufficient amounts of additives enable the following conditions to occur:

- Corrosion
- Formation of mineral deposits
- Rust
- Scale
- Foaming of the coolant

Many additives are depleted during engine operation. These additives must be replaced periodically.

Additives must be added at the correct concentration. Overconcentration of additives can cause the inhibitors to drop out-of-solution. The deposits can enable the following problems to occur:

- Formation of gel compounds
- Reduction of heat transfer
- Leakage of the water pump seal
- Plugging of radiators, coolers, and small passages

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Glycol

Glycol in the coolant helps to provide protection against the following conditions:

- Boiling
- Freezing
- Cavitation of the water pump

For optimum performance, Perkins recommends a 1:1 mixture of a water/glycol solution.

Note: Use a mixture that will provide protection against the lowest ambient temperature.

Note: 100 percent pure glycol will freeze at a temperature of −23 °C (−9 °F).

Most conventional coolant/antifreezes use ethylene glycol. Propylene glycol may also be used. In a 1:1 mixture with water, ethylene and propylene glycol provide similar protection against freezing and boiling. See Tables 17 and 18.

Table 17

Ethylene Glycol		
Concentration	**Freeze Protection**	**Boil Protection**
50 Percent	−36 °C (−33 °F)	106 °C (223 °F)
60 Percent	−51 °C (−60 °F)	111 °C (232 °F)

NOTICE
Do not use propylene glycol in concentrations that exceed 50 percent glycol because of propylene glycol's reduced heat transfer capability. Use ethylene glycol in conditions that require additional protection against boiling or freezing.

Table 18

Propylene Glycol		
Concentration	**Freeze Protection**	**Anti-Boil Protection**
50 Percent	−29 °C (−20 °F)	106 °C (223 °F)

To check the concentration of glycol in the coolant, measure the specific gravity of the coolant.

Coolant Recommendations

The following two coolants are used in Perkins diesel engines:

Preferred – Perkins Extended Life Coolant (ELC)

Acceptable – A commercial heavy-duty coolant/antifreeze that meets "ASTM D4985" specifications

NOTICE
Do not use a commercial coolant/antifreeze that only meets the ASTM D3306 specification. This type of coolant/antifreeze is made for light automotive applications.

Perkins recommends a 1:1 mixture of water and glycol. This mixture of water and glycol will provide optimum heavy-duty performance as a coolant/antifreeze. This ratio may be increased to 1:2 water to glycol if extra freezing protection is required.

Note: A commercial heavy-duty coolant/antifreeze that meets "ASTM D4985" specifications MAY require a treatment with an SCA at the initial fill. Read the label or the instructions that are provided by the OEM of the product.

In stationary engine applications and marine engine applications that do not require anti-boil protection or freeze protection, a mixture of SCA and water is acceptable. Perkins recommends a six percent to eight percent concentration of SCA in those cooling systems. Distilled water or deionized water is preferred. Water which has the recommended properties may be used.

Engines that are operating in an ambient temperature above 43 °C (109.4 °F) must use SCA and water. Engines that operate in an ambient temperature above 43 °C (109.4 °F) and below 0 °C (32 °F) due to seasonal variations consult your Perkins dealer or your Perkins distributor for the correct level of protection.

Table 19

Coolant Service Life	
Coolant Type	**Service Life**
Perkins ELC	12,000 Service Hours or Six Years
Commercial Heavy-Duty Coolant/Antifreeze that meets "ASTM D4985"	3000 Service Hours or Two Years
Perkins POWERPART SCA	3000 Service Hours or Two Years
Commercial SCA and Water	3000 Service Hours or Two Years

Extended Life Coolant (ELC)

Perkins provides Extended Life Coolant (ELC) for use in the following applications:

- Heavy-duty spark ignited gas engines

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- Heavy-duty diesel engines
- Automotive applications

The anti-corrosion package for ELC is different from the anti-corrosion package for other coolants. ELC is an ethylene glycol base coolant. However, ELC contains organic corrosion inhibitors and antifoam agents with low amounts of nitrite. Perkins ELC has been formulated with the correct amount of these additives in order to provide superior corrosion protection for all metals in engine cooling systems.

ELC extends the service life of the coolant to 12000 service hours or six years. ELC does not require a frequent addition of a Supplemental Coolant Additive (SCA). An Extender is the only additional maintenance that is needed at 6000 service hours or one half of the ELC service life.

ELC is available in a 1:1 premixed cooling solution with distilled water. The Premixed ELC provides freeze protection to −36 °C (−33 °F). The Premixed ELC is recommended for the initial fill of the cooling system. The Premixed ELC is also recommended for topping off the cooling system.

ELC Concentrate is also available. ELC Concentrate can be used to lower the freezing point to −51 °C (−60 °F) for arctic conditions.

Containers of several sizes are available. Consult your Perkins dealer or your Perkins distributor for the part numbers.

ELC Cooling System Maintenance

Correct additions to the Extended Life Coolant

NOTICE
Use only Perkins products for pre-mixed or concentrated coolants.

Use only Perkins Extender with Extended Life Coolant.

Mixing Extended Life Coolant with other products reduces the Extended Life Coolant service life. Failure to follow the recommendations can reduce cooling system components life unless appropriate corrective action is performed.

In order to maintain the correct balance between the antifreeze and the additives, you must maintain the recommended concentration of Extended Life Coolant (ELC). Lowering the proportion of antifreeze lowers the proportion of additive. This will lower the ability of the coolant to protect the system from pitting, from cavitation, from erosion, and from deposits.

NOTICE
Do not use a conventional coolant to top-off a cooling system that is filled with Extended Life Coolant (ELC).

Do not use standard supplemental coolant additive (SCA). Only use ELC Extender in cooling systems that are filled with ELC.

Perkins ELC Extender

ELC Extender is added to the cooling system halfway through the ELC service life. Treat the cooling system with ELC Extender at 6000 hours or three years. Use Table 20 in order to determine the correct amount of ELC Extender that is required.

Containers of several sizes are available. Consult your Perkins dealer or your Perkins distributor for the part numbers.

Use the formula in Table 20 to determine the correct amount of ELC Extender for your cooling system. Refer to Operation and Maintenance Manual, "Refill Capacities" in order to determine the capacity of the cooling system.

Table 20

Formula For Adding ELC Extender To ELC
V × 0.02 = X
V is the total capacity of the cooling system.
X is the amount of ELC Extender that is required.

Table 21 is an example for using the formula that is in Table 20.

Table 21

Example Of The Equation For Adding ELC Extender To ELC		
Total Volume of the Cooling System (V)	**Multiplication Factor**	**Amount of ELC Extender that is Required (X)**
9 L (2.4 US gal)	× 0.02	0.18 L (0.05 US gal) or (6 fl oz)

NOTICE
When using Perkins ELC, do not use standard SCA's or SCA filters.

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ELC Cooling System Cleaning

Note: If the cooling system is already using ELC, cleaning agents are not required to be used at the specified coolant change interval. Cleaning agents are only required if the system has been contaminated by the addition of some other type of coolant or by cooling system damage.

Clean water is the only cleaning agent that is required when ELC is drained from the cooling system.

After the cooling system is drained and after the cooling system is refilled, operate the engine while the cooling system filler cap is removed. Operate the engine until the coolant level reaches the normal operating temperature and until the coolant level stabilizes. As needed, add the coolant mixture in order to fill the system to the specified level.

Changing to Perkins ELC

To change from heavy-duty coolant/antifreeze to the Perkins ELC, perform the following steps:

NOTICE
Care must be taken to ensure that all fluids are contained during performance of inspection, maintenance, testing, adjusting and the repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

1. Drain the coolant into a suitable container.
2. Dispose of the coolant according to local regulations.
3. Flush the system with clean water in order to remove any debris.
4. Use Perkins cleaner to clean the system. Follow the instruction on the label.
5. Drain the cleaner into a suitable container. Flush the cooling system with clean water.
6. Fill the cooling system with clean water and operate the engine until the engine is warmed to 49° to 66°C (120° to 150°F).

NOTICE
Incorrect or incomplete flushing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all the signs of the cleaning agent are gone.

7. Drain the cooling system into a suitable container and flush the cooling system with clean water.

Note: The cooling system cleaner must be thoroughly flushed from the cooling system. Cooling system cleaner that is left in the system will contaminate the coolant. The cleaner may also corrode the cooling system.

8. Repeat Steps 6 and 7 until the system is completely clean.
9. Fill the cooling system with the Perkins Premixed ELC.

ELC Cooling System Contamination

NOTICE
Mixing ELC with other products reduces the effectiveness of the ELC and shortens the ELC service life. Use only Perkins Products for premixed or concentrate coolants. Use only Perkins ELC extender with Perkins ELC. Failure to follow these recommendations can result in shortened cooling system component life.

ELC cooling systems can withstand contamination to a maximum of ten percent of conventional heavy-duty coolant/antifreeze or SCA. If the contamination exceeds ten percent of the total system capacity, perform ONE of the following procedures:

- Drain the cooling system into a suitable container. Dispose of the coolant according to local regulations. Flush the system with clean water. Fill the system with the Perkins ELC.
- Drain a portion of the cooling system into a suitable container according to local regulations. Then, fill the cooling system with premixed ELC. This should lower the contamination to less than 10 percent.
- Maintain the system as a conventional Heavy-Duty Coolant. Treat the system with an SCA. Change the coolant at the interval that is recommended for the conventional Heavy-Duty Coolant.

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Commercial Heavy-Duty Coolant/ Antifreeze and SCA

NOTICE
Commercial Heavy-Duty Coolant which contains Amine as part of the corrision protection system must not be used.

NOTICE
Never operate an engine without water temperature regulators in the cooling system. Water temperature regulators help to maintain the engine coolant at the correct operating temperature. Cooling system problems can develop without water temperature regulators.

Check the coolant/antifreeze (glycol concentration) in order to ensure adequate protection against boiling or freezing. Perkins recommends the use of a refractometer for checking the glycol concentration.

Perkins engine cooling systems should be tested at 500 hour intervals for the concentration of Supplemental Coolant Additive (SCA).

Additions of SCA are based on the results of the test. An SCA that is liquid may be needed at 500 hour intervals.

Refer to Table 22 for part numbers and for quantities of SCA.

Table 22

Perkins Liquid SCA	
Part Number	**Quantity**
21825735	

Adding the SCA to Heavy-Duty Coolant at the Initial Fill

Commercial heavy-duty coolant/antifreeze that meets "ASTM D4985" specifications MAY require an addition of SCA at the initial fill. Read the label or the instructions that are provided by the OEM of the product.

Use the equation that is in Table 23 to determine the amount of Perkins SCA that is required when the cooling system is initially filled.

Table 23

Equation For Adding The SCA To The Heavy-Duty Coolant At The Initial Fill
V × 0.045 = X
V is the total volume of the cooling system.
X is the amount of SCA that is required.

Table 24 is an example for using the equation that is in Table 23.

Table 24

Example Of The Equation For Adding The SCA To The Heavy-Duty Coolant At The Initial Fill		
Total Volume of the Cooling System (V)	**Multiplication Factor**	**Amount of SCA that is Required (X)**
15 L (4 US gal)	× 0.045	0.7 L (24 oz)

Adding The SCA to The Heavy-Duty Coolant For Maintenance

Heavy-duty coolant/antifreeze of all types REQUIRE periodic additions of an SCA.

Test the coolant/antifreeze periodically for the concentration of SCA. For the interval, refer to the Operation and Maintenance Manual, "Maintenance Interval Schedule" (Maintenance Section). Test the concentration of SCA.

Additions of SCA are based on the results of the test. The size of the cooling system determines the amount of SCA that is needed.

Use the equation that is in Table 25 to determine the amount of Perkins SCA that is required, if necessary:

Table 25

Equation For Adding The SCA To The Heavy-Duty Coolant For Maintenance
V × 0.014 = X
V is the total volume of the cooling system.
X is the amount of SCA that is required.

Table 26 is an example for using the equation that is in Table 25.

Table 26

Example Of The Equation For Adding The SCA To The Heavy-Duty Coolant For Maintenance		
Total Volume of the Cooling System (V)	**Multiplication Factor**	**Amount of SCA that is Required (X)**
15 L (4 US gal)	× 0.014	0.2 L (7 oz)

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Cleaning the System of Heavy-Duty Coolant/Antifreeze

Perkins cooling system cleaners are designed to clean the cooling system of harmful scale and corrosion. Perkins cooling system cleaners dissolve mineral scale, corrosion products, light oil contamination and sludge.

- Clean the cooling system after used coolant is drained or before the cooling system is filled with new coolant.
- Clean the cooling system whenever the coolant is contaminated or whenever the coolant is foaming.

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Maintenance Interval Schedule

When Required

Battery - Replace 54
Battery or Battery Cable - Disconnect 55
Engine - Clean 60
Engine Air Cleaner Element (Dual Element) - Clean/Replace 61
Engine Air Cleaner Element (Single Element) - Inspect/Replace 63
Engine Oil Sample - Obtain 64
Fuel Injector - Test/Change 68
Fuel System - Prime 69
Severe Service Application - Check 75

Daily

Alternator and Fan Belts - Inspect/Adjust/ Replace 53
Cooling System Coolant Level - Check 59
Driven Equipment - Check 60
Engine Air Cleaner Service Indicator - Inspect 63
Engine Oil Level - Check 64
Fuel System Primary Filter/Water Separator - Drain 70
Walk-Around Inspection 77

Every 50 Service Hours or Weekly

Fuel Tank Water and Sediment - Drain 73

Every 500 Service Hours or 1 Year

Battery Electrolyte Level - Check 54
Engine Air Cleaner Element (Dual Element) - Clean/Replace 61
Engine Air Cleaner Element (Single Element) - Inspect/Replace 63
Engine Ground - Inspect/Clean 64
Engine Oil and Filter - Change 65
Fuel System Primary Filter (Water Separator) Element - Replace 70
Fuel System Secondary Filter - Replace 71
Hoses and Clamps - Inspect/Replace 74
Radiator - Clean 75

Every 1000 Service Hours

Engine Valve Lash - Inspect/Adjust 67

Every 2000 Service Hours

Aftercooler Core - Inspect 52
Alternator - Inspect 53
Engine Mounts - Inspect 64
Starting Motor - Inspect 76
Turbocharger - Inspect 76
Water Pump - Inspect 78

Every 2 Years

Cooling System Coolant - Change 58

Every 3000 Service Hours

Fuel Injector - Test/Change 68

Every 3000 Service Hours or 2 Years

Cooling System Coolant (Commercial Heavy-Duty) - Change 55

Every 4000 Service Hours

Aftercooler Core - Clean/Test 52

Every 6000 Service Hours or 3 Years

Cooling System Coolant Extender (ELC) - Add 59

Every 12 000 Service Hours or 6 Years

Cooling System Coolant (ELC) - Change 57

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Aftercooler Core - Clean/Test

1. Remove the core. Refer to the OEM information for the correct procedure.

2. Turn the aftercooler core upside-down in order to remove debris.

⚠ WARNING

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

3. Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction of the fan's air flow. Hold the nozzle approximately 6 mm (.25 inch) away from the fins. Slowly move the air nozzle in a direction that is parallel with the tubes. This will remove debris that is between the tubes.

4. Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

NOTICE
Do not use a high concentration of caustic cleaner to clean the core. A high concentration of caustic cleaner can attack the internal metals of the core and cause leakage. Only use the recommended concentration of cleaner.

5. Back flush the core with a suitable cleaner.

6. Steam clean the core in order to remove any residue. Flush the fins of the aftercooler core. Remove any other trapped debris.

7. Wash the core with hot, soapy water. Rinse the core thoroughly with clean water.

⚠ WARNING

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

8. Dry the core with compressed air. Direct the air in the reverse direction of the normal flow.

9. Inspect the core in order to ensure cleanliness. Pressure test the core. If necessary, repair the core.

10. Install the core. Refer to the OEM information for the correct procedure.

11. After cleaning, start the engine and accelerate the engine to high idle rpm. This will help in the removal of debris and drying of the core. Stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

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Aftercooler Core - Inspect

Note: Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the aftercooler for these items: damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the aftercooler, if necessary.

For air-to-air aftercoolers, use the same methods that are used for cleaning radiators.

⚠ WARNING

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

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After cleaning, start the engine and accelerate the engine to high idle rpm. This will help in the removal of debris and drying of the core. Stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a "comb".

Note: If parts of the aftercooler system are repaired or replaced, a leak test is highly recommended.

Inspect these items for good condition: Welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

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Alternator - Inspect

Perkins recommends a scheduled inspection of the alternator. Inspect the alternator for loose connections and correct battery charging. Check the ammeter (if equipped) during engine operation in order to ensure correct battery performance and/or correct performance of the electrical system. Make repairs, as required.

Check the alternator and the battery charger for correct operation. If the batteries are correctly charged, the ammeter reading should be very near zero. All batteries should be kept charged. The batteries should be kept warm because temperature affects the cranking power. If the battery is too cold, the battery will not crank the engine. When the engine is not run for long periods of time or if the engine is run for short periods, the batteries may not fully charge. A battery with a low charge will freeze more easily than a battery with a full charge.

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Alternator and Fan Belts - Inspect/Adjust/Replace

Inspection

To maximize the engine performance, inspect the belts for wear and for cracking. Replace belts that are worn or damaged.

For applications that require multiple drive belts, replace the belts in matched sets. Replacing only one belt of a matched set will cause the new belt to carry more load because the older belt is stretched. The additional load on the new belt could cause the new belt to break.

If the belts are too loose, vibration causes unnecessary wear on the belts and pulleys. Loose belts may slip enough to cause overheating.

To accurately check the belt tension, a suitable gauge should be used.

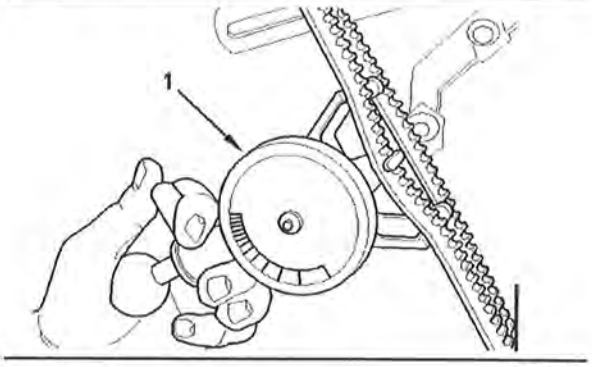


Illustration 26 g01003936

Typical example

(1) Burroughs Gauge

Fit the gauge (1) at the center of the longest free length and check the tension. The correct tension is 535 N (120 lb). If the tension of the belt is below 250 N (56 lb) adjust the belt to 535 N (120 lb).

If twin belts are installed, check and adjust the tension on both belts.

Adjustment

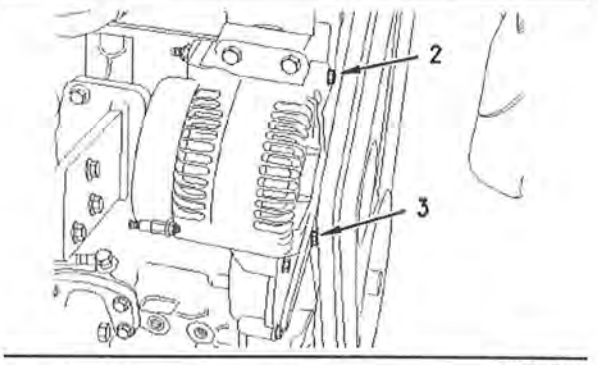


Illustration 27 g01003939

1. Loosen The alternator pivot bolt (2) and the bolt (3).

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2. Move the alternator in order to increase or decrease the belt tension. Tighten the alternator pivot bolt and the link bolt to 22 N·m (16 lb ft).(1).

Replacement

Refer to the Disassembly and Assembly Manual for the installation procedure and the removal procedure for the belt.

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Battery - Replace

⚠ WARNING

Batteries give off combustible gases which can explode. A spark can cause the combustible gases to ignite. This can result in severe personal injury or death.

Ensure proper ventilation for batteries that are in an enclosure. Follow the proper procedures in order to help prevent electrical arcs and/or sparks near batteries. Do not smoke when batteries are serviced.

⚠ WARNING

The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.

Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.

1. Switch the engine to the OFF position. Remove all electrical loads.
2. Turn off any battery chargers. Disconnect any battery chargers.
3. The NEGATIVE "-" cable connects the NEGATIVE "-" battery terminal to the NEGATIVE "-" terminal on the starting motor. Disconnect the cable from the NEGATIVE "-" battery terminal.
4. The POSITIVE "+" cable connects the POSITIVE "+" battery terminal to the POSITIVE "+" terminal on the starting motor. Disconnect the cable from the POSITIVE "+" battery terminal.

Note: Always recycle a battery. Never discard a battery. Dispose of used batteries to an appropriate recycling facility.

5. Remove the used battery.
6. Install the new battery.

Note: Before the cables are connected, ensure that the engine start switch is OFF.

7. Connect the cable from the starting motor to the POSITIVE "+" battery terminal.
8. Connect the NEGATIVE "-" cable to the NEGATIVE "-" battery terminal.

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Battery Electrolyte Level - Check

When the engine is not run for long periods of time or when the engine is run for short periods, the batteries may not fully recharge. Ensure a full charge in order to help prevent the battery from freezing. If batteries are correctly charged, the ammeter reading should be very near zero, when the engine is in operation.

⚠ WARNING

All lead-acid batteries contain sulfuric acid which can burn the skin and clothing. Always wear a face shield and protective clothing when working on or near batteries.

1. Remove the filler caps. Maintain the electrolyte level to the "FULL" mark on the battery.

   If the addition of water is necessary, use distilled water. If distilled water is not available use clean water that is low in minerals. Do not use artificially softened water.
2. Check the condition of the electrolyte with a suitable battery tester.
3. Install the caps.
4. Keep the batteries clean.

   Clean the battery case with one of the following cleaning solutions:

   - Use a solution of 0.1 kg (0.2 lb) baking soda and 1 L (1 qt) of clean water.
   - Use a solution of ammonium hydroxide.

   Thoroughly rinse the battery case with clean water.

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Battery or Battery Cable - Disconnect

⚠ WARNING

The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.

Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.

1. Turn the start switch to the OFF position. Turn the ignition switch (if equipped) to the OFF position and remove the key and all electrical loads.
2. Disconnect the negative battery terminal. Ensure that the cable cannot contact the terminal. When four 12 volt batteries are involved, two negative connection must be disconnected.
3. Remove the positive connection.
4. Clean all disconnected connection and battery terminals.
5. Use a fine grade of sandpaper to clean the terminals and the cable clamps. Clean the items until the surfaces are bright or shiny. DO NOT remove material excessively. Excessive removal of material can cause the clamps to not fit correctly. Coat the clamps and the terminals with a suitable silicone lubricant or petroleum jelly.
6. Tape the cable connections in order to help prevent accidental starting.
7. Proceed with necessary system repairs.
8. In order to connect the battery, connect the positive connection before the negative connector.

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Cooling System Coolant (Commercial Heavy-Duty) - Change

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to Local regulations and mandates.

NOTICE
Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

Note: When the cooling system is cleaned, only clean water is needed.

Note: Inspect the water pump and the water temperature regulator after the cooling system has been drained. This is a good opportunity to replace the water pump, the water temperature regulator and the hoses, if necessary.

Drain

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

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1. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.

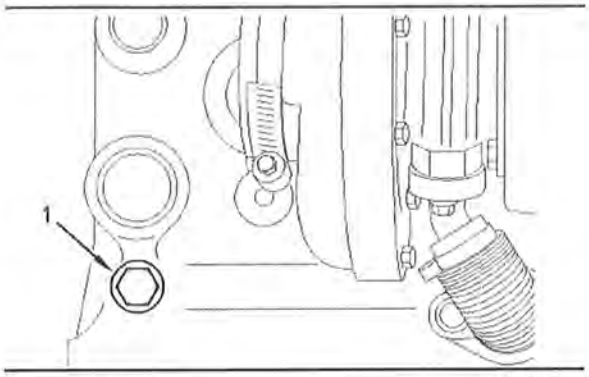


Illustration 28 g01003928

2. Open the drain cock or remove the drain plug (1) on the engine. Open the drain cock or remove the drain plug on the radiator.

   Allow the coolant to drain.

NOTICE
Dispose of used engine coolant or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Perkins to reclaim the coolant.

For information regarding the disposal and the recycling of used coolant, consult your Perkins dealer or your Perkins distributor.

Flush

1. Flush the cooling system with clean water in order to remove any debris.

2. Close the drain cock or install the drain plug in the engine. Close the drain cock or install the drain plug on the radiator.

NOTICE
Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

3. Fill the cooling system with clean water. Install the cooling system filler cap.

4. Start and run the engine at low idle until the temperature reaches 49 to 66 °C (120 to 150 °F).

5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain cock or remove the drain plug on the engine. Open the drain cock or remove the drain plug on the radiator. Allow the water to drain. Flush the cooling system with clean water.

Fill

1. Close the drain cock or install the drain plug on the engine. Close the drain cock or install the drain plug on the radiator.

NOTICE
Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

2. Fill the cooling system with Commercial Heavy-Duty Coolant. Add Supplemental Coolant Additive to the coolant. For the correct amount, refer to the Operation and Maintenance Manual, "Fluid Recommendations" topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.

3. Start and run the engine at low idle. Increase the engine rpm to high idle. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.

4. Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level in the expansion bottle (if equipped) at the correct level.

5. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, use a suitable pressurizing pump in order to pressure test the cooling system filler cap. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.

6. Start the engine. Inspect the cooling system for leaks and for correct operating temperature.

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i02203595

Cooling System Coolant (ELC) - Change

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to Local regulations and mandates.

NOTICE
Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

Note: When the cooling system is cleaned, only clean water is needed when the ELC is drained and replaced.

Note: Inspect the water pump and the water temperature regulator after the cooling system has been drained. This is a good opportunity to replace the water pump, the water temperature regulator and the hoses, if necessary.

Drain

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.

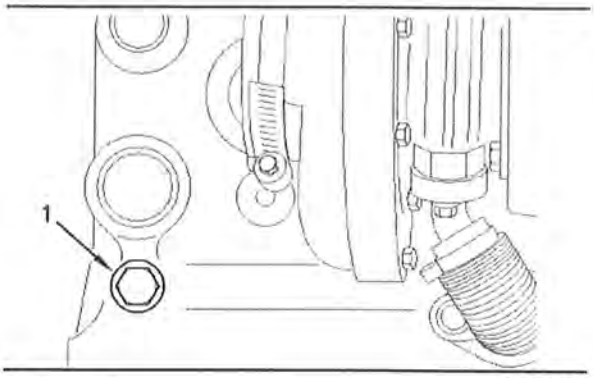


Illustration 29 g01003928
Typical example

2. Open the drain cock or remove the drain plug (1) on the engine. Open the drain cock or remove the drain plug on the radiator.

   Allow the coolant to drain.

NOTICE
Dispose of used engine coolant or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Perkins to reclaim the coolant.

For information regarding the disposal and the recycling of used coolant, consult your Perkins dealer or your Perkins distributor.

Flush

1. Flush the cooling system with clean water in order to remove any debris.
2. Close the drain cock or install the drain plug in the engine. Close the drain cock or install the drain plug on the radiator.

NOTICE
Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

3. Fill the cooling system with clean water. Install the cooling system filler cap.
4. Start and run the engine at low idle until the temperature reaches 49 to 66 °C (120 to 150 °F).

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5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain cock or remove the drain plug on the engine. Open the drain cock or remove the drain plug on the radiator. Allow the water to drain. Flush the cooling system with clean water.

Fill

1. Close the drain cock or install the drain plug on the engine. Close the drain cock or install the drain plug on the radiator.

NOTICE
Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

2. Fill the cooling system with Extended Life Coolant (ELC). Refer to the Operation and Maintenance Manual, "Fluid Recommendations" topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.

3. Start and run the engine at low idle. Increase the engine rpm to high idle. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.

4. Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level in the expansion bottle (if equipped) at the correct level.

5. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, use a suitable pressurizing pump in order to pressure test the cooling system filler cap. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.

6. Start the engine. Inspect the cooling system for leaks and for correct operating temperature.

i01929799

Cooling System Coolant - Change

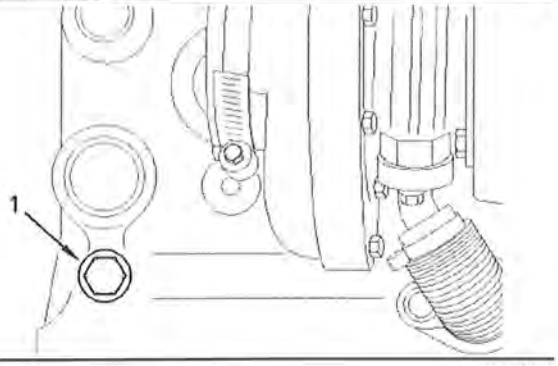


Illustration 30 g01003928
Drain plug

NOTICE
Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.

Note: The radiator may not have been provided by Perkins. The following is a general procedure for changing the coolant. Refer to the OEM information for the correct procedure.

1. Ensure that the vehicle is on level ground.

2. Remove the filler cap of the cooling system.

3. Remove the drain plug (1) from the side of the cylinder block in order to drain the engine. Ensure that the drain hole is not restricted.

4. Open the radiator drain tap or remove the drain plug at the bottom of the radiator in order to drain the radiator. If the radiator does not have a radiator drain tap or a drain plug, disconnect the hose at the bottom of the radiator.

5. Flush the coolant system with clean water.

6. Install the drain plugs and close the radiator drain tap. Install the radiator hose if the radiator hose was previously removed.

7. Fill the system with an approved antifreeze mixture. The maximum flow rate is 1 L (0.2200 Imp gal) per minute in order to fill the system. Install the filler cap.

8. Run the engine and check for coolant leaks.

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i02335364

Cooling System Coolant Extender (ELC) - Add

The Perkins Extended Life Coolant (ELC) does not need the frequent addition of Supplemental Coolant Additives (SCA) that are associated with conventional coolants. The Extender only needs to be added once.

Check the cooling system only when the engine is stopped and cool.

1. Loosen the cooling system filler cap slowly in order to relieve pressure. Remove the cooling system filler cap.
2. It may be necessary to drain enough coolant from the cooling system in order to add the Extender.
3. Add Extender according to the requirements for your engine's cooling system capacity. Refer to this Operation and Maintenance Manual, "Refill Capacities" in the Maintenance Section for the capacity of the cooling system for your engine. Refer to this Operation and Maintenance Manual, "Fluid Recommendations" information for the Perkins ELC Extender.
4. Clean the cooling system filler cap and inspect the gasket. If the gasket is damaged, discard the old filler cap and install a new filler cap. If the gasket is not damaged, use a suitable pressurizing pump in order to pressure test the filler cap. The correct pressure is stamped on the face of the filler cap. If the filler cap does not retain the correct pressure, install a new filler cap.

i02335378

Cooling System Coolant Level - Check

Engines With a Coolant Recovery Tank

Note: The cooling system may not have been provided by Perkins. The procedure that follows is for typical cooling systems. Refer to the OEM information for the correct procedures.

Check the coolant level when the engine is stopped and cool.

1. Observe the coolant level in the coolant recovery tank. Maintain the coolant level to "COLD FULL" mark on the coolant recovery tank.

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

2. Loosen filler cap slowly in order to relieve any pressure. Remove the filler cap.
3. Pour the correct coolant mixture into the tank. Refer to the Operation and Maintenance Manual, "Refill Capacities and Recommendations" for information on the correct mixture and type of coolant. Refer to the Operation and Maintenance Manual, "Refill Capacities and Recommendations" for the cooling system capacity. Do not fill the coolant recovery tank above "COLD FULL" mark.

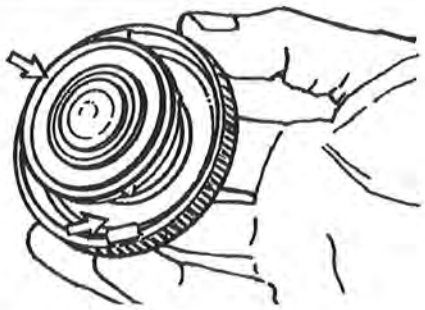


Illustration 31 g00103639

4. Clean filler cap and the receptacle. Reinstall the filler cap and inspect the cooling system for leaks.

Note: The coolant will expand as the coolant heats up during normal engine operation. The additional volume will be forced into the coolant recovery tank during engine operation. When the engine is stopped and cool, the coolant will return to the engine.

Engines Without a Coolant Recovery Tank

Check the coolant level when the engine is stopped and cool.

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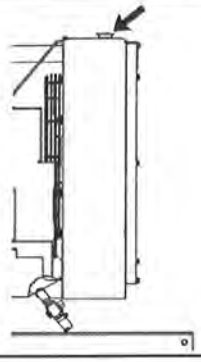


Illustration 32 g00285520
Cooling system filler cap

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Remove the cooling system filler cap slowly in order to relieve pressure.
2. Maintain the coolant level within 13 mm (0.5 inch) of the bottom of the filler pipe. If the engine is equipped with a sight glass, maintain the coolant level to the correct level in the sight glass.
3. Clean the cooling system filler cap and inspect the gasket. If the gasket is damaged, discard the old filler cap and install a new filler cap. If the gasket is not damaged, use a suitable pressurizing pump in order to pressure test the filler cap. The correct pressure is stamped on the face of the filler cap. If the filler cap does not retain the correct pressure, install a new filler cap.
4. Inspect the cooling system for leaks.

i00174798

Driven Equipment - Check

Refer to the OEM specifications for more information on the following maintenance recommendations for the driven equipment:

- Inspection
- Adjustment
- Lubrication
- Other maintenance recommendations

Perform any maintenance for the driven equipment which is recommended by the OEM.

i01930350

Engine - Clean

⚠ WARNING

Personal injury or death can result from high voltage.

Moisture can create paths of electrical conductivity.

Make sure that the electrical system is OFF. Lock out the starting controls and tag the controls "DO NOT OPERATE".

NOTICE
Accumulated grease and oil on an engine is a fire hazard. Keep the engine clean. Remove debris and fluid spills whenever a significant quantity accumulates on the engine.

NOTICE
Failure to protect some engine components from washing may make your engine warranty invalid. Allow the engine to cool for one hour before washing the engine.

Periodic cleaning of the engine is recommended. Steam cleaning the engine will remove accumulated oil and grease. A clean engine provides the following benefits:

- Easy detection of fluid leaks
- Maximum heat transfer characteristics
- Ease of maintenance

Note: Caution must be used in order to prevent electrical components from being damaged by excessive water when the engine is cleaned. Pressure washers and steam cleaners should not be directed at any electrical connectors or the junction of cables into the rear of the connectors. Avoid electrical components such as the alternator and the starter. Protect the fuel injection pump from fluids in order to wash the engine.

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i01915869

Engine Air Cleaner Element (Dual Element) - Clean/Replace

NOTICE
Never run the engine without an air cleaner element installed. Never run the engine with a damaged air cleaner element. Do not use air cleaner elements with damaged pleats, gaskets or seals. Dirt entering the engine causes premature wear and damage to engine components. Air cleaner elements help to prevent air-borne debris from entering the air inlet.

NOTICE
Never service the air cleaner element with the engine running since this will allow dirt to enter the engine.

Servicing the Air Cleaner Elements

Note: The air filter system may not have been provided by Perkins. The procedure that follows is for a typical air filter system. Refer to the OEM information for the correct procedure.

If the air cleaner element becomes plugged, the air can split the material of the air cleaner element. Unfiltered air will drastically accelerate internal engine wear. Refer to the OEM information for the correct air cleaner elements for your application.

- Check the precleaner (if equipped) and the dust bowl daily for accumulation of dirt and debris. Remove any dirt and debris, as needed.
- Operating conditions (dust, dirt and debris) may require more frequent service of the air cleaner element.
- The air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

Replace the dirty air cleaner elements with clean air cleaner elements. Before installation, the air cleaner elements should be thoroughly checked for tears and/or holes in the filter material. Inspect the gasket or the seal of the air cleaner element for damage. Maintain a supply of suitable air cleaner elements for replacement purposes.

Dual Element Air Cleaners

The dual element air cleaner contains a primary air cleaner element and a secondary air cleaner element. The primary air cleaner element can be used up to six times if the element is properly cleaned and properly inspected. The primary air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

The secondary air cleaner element is not serviceable or washable. Refer to the OEM information for instructions in order to replace the secondary air cleaner element. When the engine is operating in environments that are dusty or dirty, air cleaner elements may require more frequent replacement.

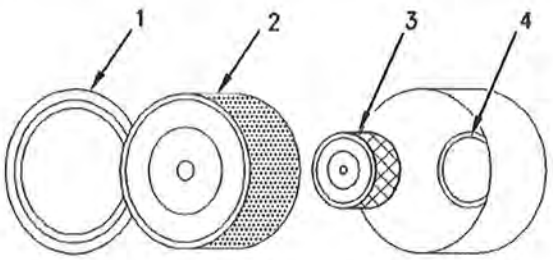


Illustration 33 g00736431

(1) Cover
(2) Primary air cleaner element
(3) Secondary air cleaner element
(4) Air inlet

1. Remove the cover. Remove the primary air cleaner element.
2. The secondary air cleaner element should be removed and discarded for every three cleanings of the primary air cleaner element.

Note: Refer to "Cleaning the Primary Air Cleaner Elements".

3. Cover the air inlet with tape in order to keep dirt out.
4. Clean the inside of the air cleaner cover and body with a clean, dry cloth.
5. Remove the tape for the air inlet. Install the secondary air cleaner element. Install a primary air cleaner element that is new or cleaned.
6. Install the air cleaner cover.
7. Reset the air cleaner service indicator.

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Cleaning the Primary Air Cleaner Elements

NOTICE
Observe the following guidelines if you attempt to clean the filter element:

Do not tap or strike the filter element in order to remove dust.

Do not wash the filter element.

Use low pressure compressed air in order to remove the dust from the filter element. Air pressure must not exceed 207 kPa (30 psi). Direct the air flow up the pleats and down the pleats from the inside of the filter element. Take extreme care in order to avoid damage to the pleats.

Do not use air filters with damaged pleats, gaskets, or seals. Dirt entering the engine will cause damage to engine components.

Refer to the OEM information in order to determine the number of times that the primary filter element can be cleaned. When the primary air cleaner element is cleaned, check for rips or tears in the filter material. The primary air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

NOTICE
Do not clean the air cleaner elements by bumping or tapping. This could damage the seals. Do not use elements with damaged pleats, gaskets or seals. Damaged elements will allow dirt to pass through. Engine damage could result.

Visually inspect the primary air cleaner elements before cleaning. Inspect the air cleaner elements for damage to the seal, the gaskets, and the outer cover. Discard any damaged air cleaner elements.

There are two common methods that are used to clean primary air cleaner elements:

- Pressurized air
- Vacuum cleaning

Pressurized Air

Pressurized air can be used to clean primary air cleaner elements that have not been cleaned more than two times. Pressurized air will not remove deposits of carbon and oil. Use filtered, dry air with a maximum pressure of 207 kPa (30 psi).

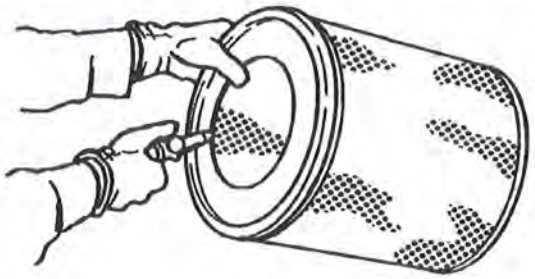


Illustration 34 g00281692

Note: When the primary air cleaner elements are cleaned, always begin with the clean side (inside) in order to force dirt particles toward the dirty side (outside).

Aim the hose so that the air flows inside the element along the length of the filter in order to help prevent damage to the paper pleats. Do not aim the stream of air directly at the primary air cleaner element. Dirt could be forced further into the pleats.

Note: Refer to "Inspecting the Primary Air Cleaner Elements".

Vacuum Cleaning

Vacuum cleaning is a good method for cleaning primary air cleaner elements which require daily cleaning because of a dry, dusty environment. Cleaning with pressurized air is recommended prior to vacuum cleaning. Vacuum cleaning will not remove deposits of carbon and oil.

Note: Refer to "Inspecting the Primary Air Cleaner Elements".

Inspecting the Primary Air Cleaner Elements



Illustration 35 g00281693

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Inspect the clean, dry primary air cleaner element. Use a 60 watt blue light in a dark room or in a similar facility. Place the blue light in the primary air cleaner element. Rotate the primary air cleaner element. Inspect the primary air cleaner element for tears and/or holes. Inspect the primary air cleaner element for light that may show through the filter material. If it is necessary in order to confirm the result, compare the primary air cleaner element to a new primary air cleaner element that has the same part number.

Do not use a primary air cleaner element that has any tears and/or holes in the filter material. Do not use a primary air cleaner element with damaged pleats, gaskets or seals. Discard damaged primary air cleaner elements.

i02152042

Engine Air Cleaner Element (Single Element) - Inspect/Replace

Refer to Operation and Maintenance Manual, "Engine Air Cleaner Service Indicator-Inspect".

NOTICE
Never run the engine without an air cleaner element installed. Never run the engine with a damaged air cleaner element. Do not use air cleaner elements with damaged pleats, gaskets or seals. Dirt entering the engine causes premature wear and damage to engine components. Air cleaner elements help to prevent air-borne debris from entering the air inlet.

NOTICE
Never service the air cleaner element with the engine running since this will allow dirt to enter the engine.

A wide variety of air cleaners may be installed for use with this engine. Consult the OEM information for the correct procedure to replace the air cleaner.

i01909507

Engine Air Cleaner Service Indicator - Inspect

Some engines may be equipped with a different service indicator.

Some engines are equipped with a differential gauge for inlet air pressure. The differential gauge for inlet air pressure displays the difference in the pressure that is measured before the air cleaner element and the pressure that is measured after the air cleaner element. As the air cleaner element becomes dirty, the pressure differential rises. If your engine is equipped with a different type of service indicator, follow the OEM recommendations in order to service the air cleaner service indicator.

The service indicator may be mounted on the air cleaner element or in a remote location.



Illustration 36 g00103777
Typical service indicator

Observe the service indicator. The air cleaner element should be cleaned or the air cleaner element should be replaced when one of the following conditions occur:

- The yellow diaphragm enters the red zone.
- The red piston locks in the visible position.

Test the Service Indicator

Service indicators are important instruments.

- Check for ease of resetting. The service indicator should reset in less than three pushes.
- Check the movement of the yellow core when the engine is accelerated to the engine rated speed. The yellow core should latch approximately at the greatest vacuum that is attained.

If the service indicator does not reset easily, or if the yellow core does not latch at the greatest vacuum, the service indicator should be replaced. If the new service indicator will not reset, the hole for the service indicator may be restricted.

The service indicator may need to be replaced frequently in environments that are severely dusty.

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i01941505

Engine Ground - Inspect/Clean

Inspect the wiring harness for good connections.

Perkins use the starter motor in order to ground the engine. Check the connection on the starter motor at every oil change. Ground wires and straps should be combined at engine grounds. All grounds should be tight and free of corrosion.

- Clean the grounding stud on the starter motor and the terminals with a clean cloth.
- If the connections are corroded, clean the connections with a solution of baking soda and water.
- Keep the grounding stud and the strap clean and coated with suitable grease or petroleum jelly.

i02323089

Engine Mounts - Inspect

Note: The engine mounts may not have been supplied by Perkins. Refer to the OEM information for further information on the engine mounts and the correct bolt torque.

Inspect the engine mounts for deterioration and for correct bolt torque. Engine vibration can be caused by the following conditions:

- Incorrect mounting of the engine
- Deterioration of the engine mounts
- Loose engine mounts

Any engine mount that shows deterioration should be replaced. Refer to the OEM information for the recommended torques.

i02335785

Engine Oil Level - Check

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

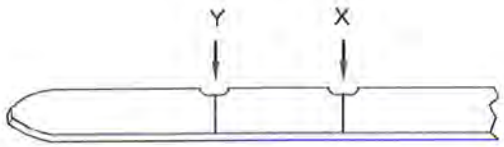


Illustration 37 g01165836

(Y) "Min" mark. (X) "Max" mark.

NOTICE
Perform this maintenance with the engine stopped.

Note: Ensure that the engine is either level or that the engine is in the normal operating position in order to obtain a true level indication.

Note: After the engine has been switched OFF, wait for ten minutes in order to allow the engine oil to drain to the oil pan before checking the oil level.

1. Maintain the oil level between the "ADD" mark (Y) and the "FULL" mark (X) on the engine oil dipstick. Do not fill the crankcase above the "FULL" mark (X).

NOTICE
Operating your engine when the oil level is above the "FULL" mark could cause your crankshaft to dip into the oil. The air bubbles created from the crankshaft dipping into the oil reduces the oil's lubricating characteristics and could result in the loss of power.

2. Remove the oil filler cap and add oil, if necessary. Clean the oil filler cap. Install the oil filler cap.

i02202699

Engine Oil Sample - Obtain

The condition of the engine lubricating oil may be checked at regular intervals as part of a preventive maintenance program. Perkins include an oil sampling valve as an option. The oil sampling valve (if equipped) is included in order to regularly sample the engine lubricating oil. The oil sampling valve is positioned on the oil filter head or the oil sampling valve is positioned on the cylinder block.

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Perkins recommends using a sampling valve in order to obtain oil samples. The quality and the consistency of the samples are better when a sampling valve is used. The location of the sampling valve allows oil that is flowing under pressure to be obtained during normal engine operation.

Obtain the Sample and the Analysis

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

In order to help obtain the most accurate analysis, record the following information before an oil sample is taken:

- The date of the sample
- Engine model
- Engine number
- Service hours on the engine
- The number of hours that have accumulated since the last oil change
- The amount of oil that has been added since the last oil change

Ensure that the container for the sample is clean and dry. Also ensure that the container for the sample is clearly labelled.

To ensure that the sample is representative of the oil in the crankcase, obtain a warm, well mixed oil sample.

To avoid contamination of the oil samples, the tools and the supplies that are used for obtaining oil samples must be clean.

The sample can be checked for the following: the quality of the oil, the existence of any coolant in the oil, the existence of any ferrous metal particles in the oil, and the existence of any nonferrous metal particles in the oil.

i01929323

Engine Oil and Filter - Change

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

Do not drain the oil when the engine is cold. As the oil cools, suspended waste particles settle on the bottom of the oil pan. The waste particles are not removed with the draining cold oil. Drain the crankcase with the engine stopped. Drain the crankcase with the oil warm. This draining method allows the waste particles that are suspended in the oil to be drained properly.

Failure to follow this recommended procedure will cause the waste particles to be recirculated through the engine lubrication system with the new oil.

Drain the Engine Oil

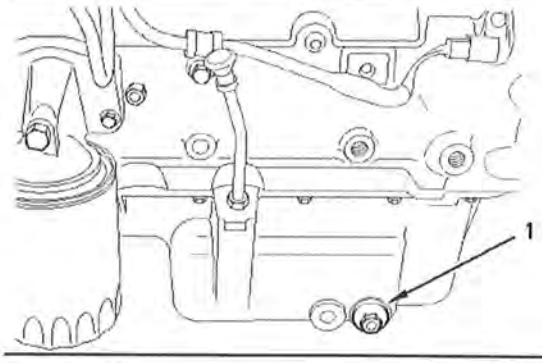


Illustration 38 g01003623

Oil drain plug

After the engine has been run at the normal operating temperature, stop the engine. Use one of the following methods to drain the engine crankcase oil:

- If the engine is equipped with a drain valve, turn the drain valve knob counterclockwise in order to drain the oil. After the oil has drained, turn the drain valve knob clockwise in order to close the drain valve.
- If the engine is not equipped with a drain valve, remove the oil drain plug (1) in order to allow the oil to drain. If the engine is equipped with a shallow sump, remove the bottom oil drain plugs from both ends of the oil pan.

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After the oil has drained, the oil drain plugs should be cleaned and installed. If necessary, renew the O ring seal on the drain plug.

Some types of oil pans have oil drain plugs that are on both sides of the oil pan, because of the shape of the pan. This type of oil pan requires the engine oil to be drained from both plugs.

Replace the Spin-on Oil Filter

NOTICE
Perkins oil filters are manufactured to Perkins specifications. Use of an oil filter that is not recommended by Perkins could result in severe damage to the engine bearings, crankshaft, etc., as a result of the larger waste particles from unfiltered oil entering the engine lubricating system. Only use oil filters recommended by Perkins.

1. Remove the oil filter with a suitable tool.

Note: The following actions can be carried out as part of the preventive maintenance program.

2. Cut the oil filter open with a suitable tool. Break apart the pleats and inspect the oil filter for metal debris. An excessive amount of metal debris in the oil filter may indicate early wear or a pending failure.

   Use a magnet to differentiate between the ferrous metals and the nonferrous metals that are found in the oil filter element. Ferrous metals may indicate wear on the steel and cast iron parts of the engine.

   Nonferrous metals may indicate wear on the aluminum parts, brass parts or bronze parts of the engine. Parts that may be affected include the following items: main bearings, rod bearings, turbocharger bearings, and cylinder heads.

   Due to normal wear and friction, it is not uncommon to find small amounts of debris in the oil filter.

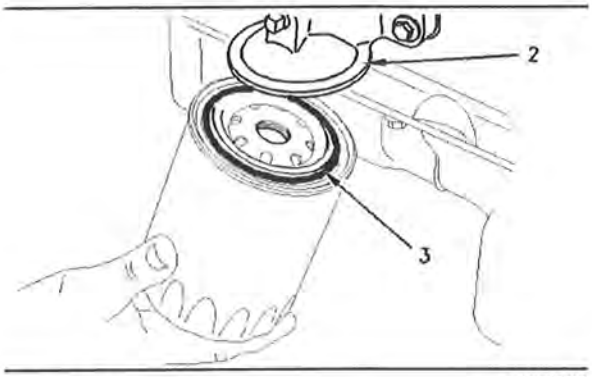


Illustration 39 g01003628

(2) Filter head
(3) O ring seal

3. Clean the sealing surface of the oil filter head (2). Ensure that the union (not shown) in the oil filter head is secure.

4. Apply clean engine oil to the O ring seal (3) on the oil filter.

NOTICE
Do not fill the oil filters with oil before installing them. This oil would not be filtered and could be contaminated. Contaminated oil can cause accelerated wear to engine components.

5. Install the oil filter. Tighten the oil filter by hand according to the instructions that are shown on the oil filter. Do not overtighten the oil filter.

Replace the Element for the Oil Filter

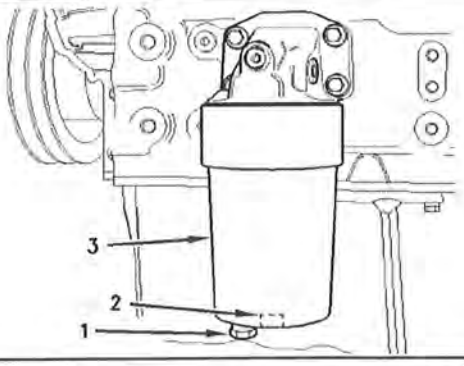


Illustration 40 g01003662

(1) Drain plug
(2) Square hole
(3) Filter bowl

1. Place a suitable container under the oil filter. Remove the drain plug (1) and the seal, from the oil filter.

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2. Locate a suitable wrench into the square hole (2) in order to remove the filter bowl (3).

3. Remove the filter bowl (3) and remove the element from the filter bowl. Clean the filter bowl.

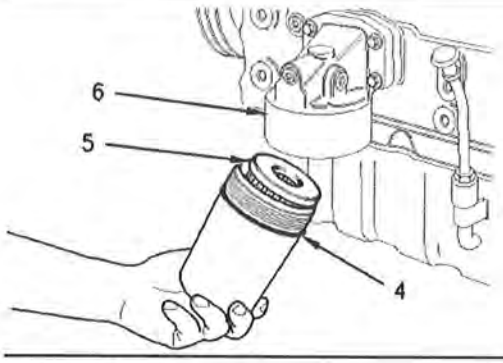


Illustration 41 g01003675

(4) O ring seal
(5) Element
(6) Filter head

4. Install a new O ring (4) onto the filter bowl and lubricate the O ring with clean engine oil. Install the filter element (5) into the filter bowl.

5. Install the filter bowl into the oil filter head (6). Tighten the filter bowl to the following torque 25 N·m (18 lb ft).

6. Install a new seal onto the drain plug (1) and install the drain plug into the oil filter. Tighten the drain plug to the following torque 12 N·m (8 lb ft).

Note: Some engines may have a horizontally mounted oil filter. This oil filter has a drain plug that is located in the oil filter head.

Fill the Engine Crankcase

1. Remove the oil filler cap. Refer to the Operation and Maintenance Manual for more information on lubricant specifications. Fill the crankcase with the proper amount of oil. Refer to the Operation and Maintenance Manual for more information on refill capacities.

NOTICE
If equipped with an auxiliary oil filter system or a remote oil filter system, follow the OEM or filter manufacturer's recommendations. Under filling or overfilling the crankcase with oil can cause engine damage.

NOTICE
To prevent crankshaft bearing damage, crank the engine with the fuel OFF. This will fill the oil filters before starting the engine. Do not crank the engine for more than 30 seconds.

2. Start the engine and run the engine at "LOW IDLE" for two minutes. Perform this procedure in order to ensure that the lubrication system has oil and that the oil filters are filled. Inspect the oil filter for oil leaks.

3. Stop the engine and allow the oil to drain back to the sump for a minimum of ten minutes.

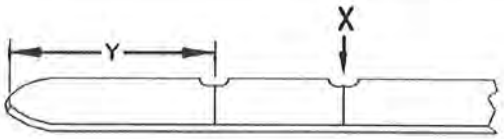


Illustration 42 g00998024

(Y) "ADD" mark. (X) "FULL" mark.

4. Remove the oil level gauge in order to check the oil level. Maintain the oil level between the "ADD" and "FULL" marks on the engine oil dipstick.

i02171102

Engine Valve Lash - Inspect/Adjust

This maintenance is recommended by Perkins as part of a lubrication and preventive maintenance schedule in order to help provide maximum engine life.

NOTICE
Only qualified service personel should perform this maintenance. Refer to the Service Manual or your authorized Perkins dealer or your Perkins distributor for the complete valve lash adjustment procedure.

Operation of Perkins engines with incorrect valve lash can reduce engine efficiency, and also reduce engine component life.

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⚠ WARNING

Ensure that the engine can not be started while this maintenance is being performed. To help prevent possible injury, do not use the starting motor to turn the flywheel.

Hot engine components can cause burns. Allow additional time for the engine to cool before measuring/adjusting valve lash clearance.

Ensure that the engine is stopped before measuring the valve lash. The engine valve lash can be inspected and adjusted when the temperature of the engine is hot or cold.

Refer to Systems Operation/Testing and Adjusting, "Engine Valve Lash - Inspect/Adjust" for more information.

i02198352

Fuel Injector - Test/Change

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

NOTICE
Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.

NOTICE
If a fuel injector is suspected of operating outside of normal parameters it should be removed by a qualified technician. The suspect fuel injector should be taken to an authorised agent for inspection.

The fuel injector (1) in illustration 43 has no fuel return. The fuel injector (2) has a fuel return.

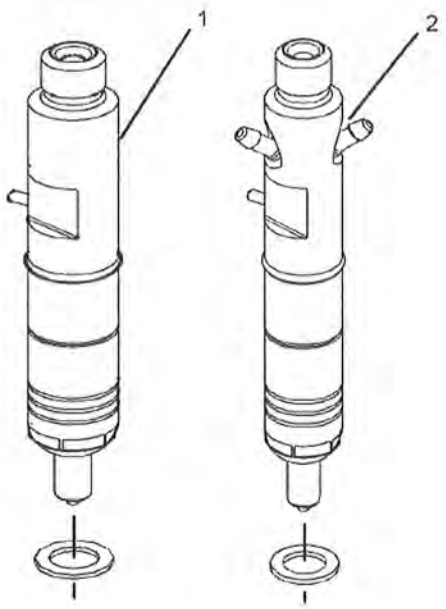


Illustration 43 g01110422
Typical fuel Injectors

The fuel injector (1) will need to be removed and the injector will need to be checked for performance.

The fuel injectors should not be cleaned as cleaning with incorrect tools can damage the nozzle. The fuel injectors should be renewed only if a fault with the fuel injectors occurs. Some of the problems that may indicate that new fuel injectors are needed are listed below:

- The engine will not start or the engine is difficult to start.
- Not enough power
- The engine misfires or the engine runs erratically.
- High fuel consumption
- Black exhaust smoke
- The engine knocks or there is vibration in the engine.
- Excessive engine temperature

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Removal and Installation of the Fuel Injectors

⚠ WARNING

Work carefully around an engine that is running. Engine parts that are hot, or parts that are moving, can cause personal injury.

⚠ WARNING

Make sure that you wear eye protection at all times during testing. When fuel injection nozzles are tested, test fluids travel through the orifices of the nozzle tip with high pressure. Under this amount of pressure, the test fluid can pierce the skin and cause serious injury to the operator. Always keep the tip of the fuel injection nozzle pointed away from the operator and into the fuel collector and extension.

NOTICE
If your skin comes into contact with high pressure fuel, obtain medical assistence immediately.

Operate the engine at a fast idle speed in order to identify the faulty fuel injector. Individually loosen and tighten the union nut for the high pressure pipe to each fuel injector. Do not loosen the union nut more than half a turn. There will be little effect on the engine speed when the union nut to the faulty fuel injection nozzle is loosened. Refer to the Disassembly and Assembly Manual for more information. Consult your authorized Perkins dealer or your Perkins distributor for assistance.

i02890360

Fuel System - Prime

If air enters the fuel system, the air must be purged from the fuel system before the engine can be started. Air can enter the fuel system when the following events occur:

- The fuel tank is empty or the fuel tank has been partially drained.
- The low pressure fuel lines are disconnected.
- A leak exists in the low pressure fuel system.
- The fuel filter is replaced.
- A new injection pump is installed.

Use the following procedure in order to remove air from the fuel system:

1. Ensure that all low pressure fuel connections and high pressure fuel lines are installed correctly.
2. Turn the ignition key to the RUN position. Leave the ignition key in the RUN position for three minutes. If a manual purging screw is installed, the purging screw should be slackened during priming the fuel system.

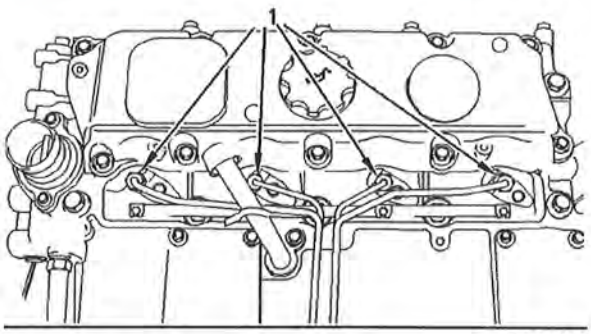


Illustration 44 g01003929
Typical example

3. Crank the engine with the throttle lever in the CLOSED position until the engine starts.

Note: If necessary, loosen the union nuts (1) on the fuel injection lines at the connection with the fuel injector until fuel is evident. Stop cranking the engine. Tighten the union nuts (1) to a torque of 30 N·m (22 lb ft).

4. Start the engine and run the engine at idle for one minute.

NOTICE
Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

5. Cycle the throttle lever from the low idle position to the high idle position three times. The cycle time for the throttle lever is one second to six seconds for one complete cycle.

Note: In order to purge air from the fuel injection pump on Perkins engines with a fixed throttle, the engine should be run at full load for thirty seconds. The load should then be decreased until the engine is at high idle. This should be repeated three times. This will assist in removing trapped air from the fuel injection pump.

6. Check for leaks in the fuel system.

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i02206563

Fuel System Primary Filter (Water Separator) Element - Replace

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

NOTICE
Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.

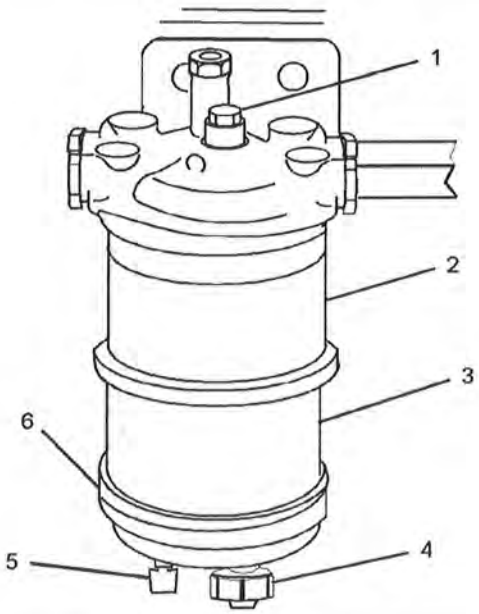


Illustration 45 g01118416

(1) Screw
(2) Element
(3) Glass bowl
(4) Sensor connection
(5) Drain
(6) Bottom cover

1. Turn the fuel supply valve (if equipped) to the OFF position.
2. Place a suitable container under the water separator. Clean the outside of the water separator.
3. Open the drain (5). Allow the fluid to drain into the container.
4. Tighten the drain (5) by hand pressure only.
5. Hold the element (2) and remove the screw (1). Remove the element and the glass bowl (3) from the base. Discard the old element.
6. Clean the glass bowl (4). Clean the bottom cover (6).
7. Install the new O ring seal. Install the bottom cover onto the new element. Install the assembly onto the base.
8. Install the screw (1) and tighten the screw to a torque of 8 N·m (6 lb ft).
9. Remove the container and dispose of the fuel safely.
10. Open the fuel supply valve.
11. Prime the fuel system. Refer to the Operation and Maintenance Manual, "Fuel System - Prime" for more information.

i02211066

Fuel System Primary Filter/Water Separator - Drain

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

NOTICE
The water separator is not a filter. The water separator separates water from the fuel. The engine should never be allowed to run with the water separator more than half full. Engine damage may result.

NOTICE
The water separator is under suction during normal engine operation. Ensure that the drain valve is tightened securely to help prevent air from entering the fuel system.

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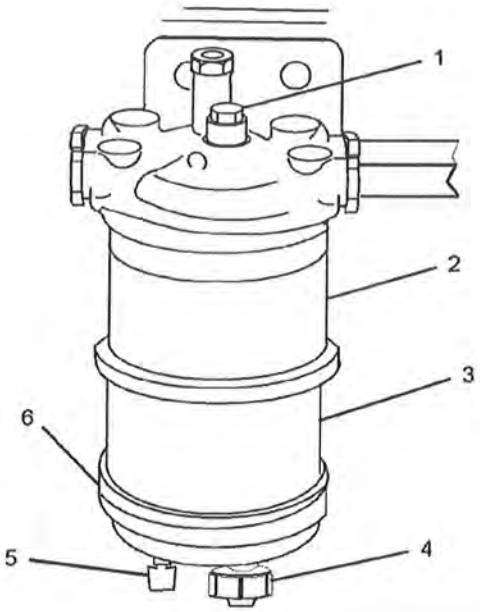


Illustration 46 g01118416

(1) Screw
(2) Element
(3) Glass bowl
(4) Sensor connection
(5) Drain
(6) Bottom cover

1. Place a suitable container below the water separator.
2. Open the drain (5). Allow the fluid to drain into the container.
3. When clean fuel drains from the water separator close the drain (5). Tighten the drain by hand pressure only. Dispose of the drained fluid correctly.

i02469473

Fuel System Secondary Filter - Replace

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

NOTICE
Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.

Element filter

Turn the valves for the fuel lines (if equipped) to the OFF position before performing this maintenance. Place a tray under the fuel filter in order to catch any fuel that might spill. Clean up any spilled fuel immediately.

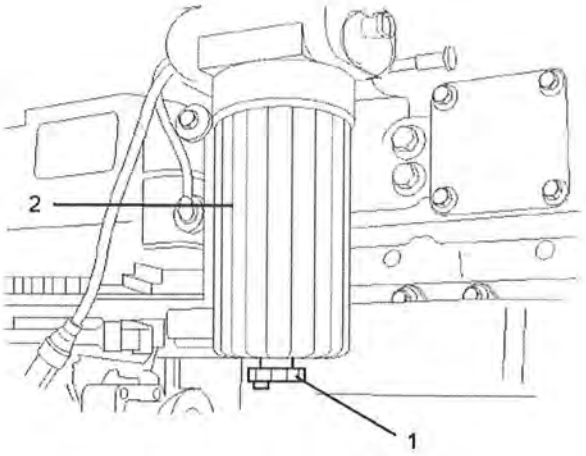


Illustration 47 g01010637

(1) Drain
(2) Filter bowl

1. Close the valves for the fuel lines (if equipped).
2. Clean the outside of the fuel filter assembly. Open the fuel drain (1) and drain the fuel into a suitable container.

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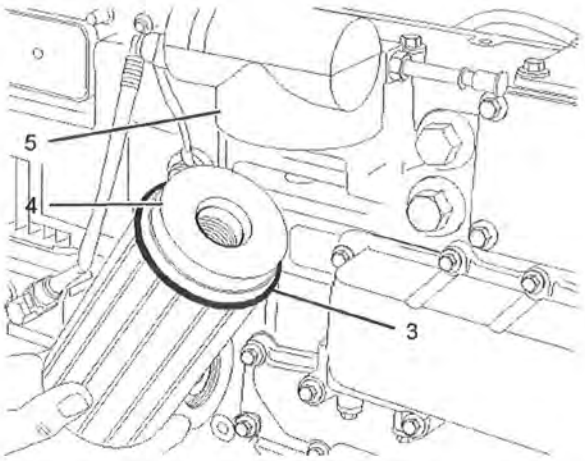


Illustration 48 g01010595

(3) O ring seal
(4) Element
(5) Filter head

3. Remove the filter bowl (2) from the filter head (5). Press on the element (4). Rotate the element counterclockwise in order to release the element for the filter bowl and remove the element from the bowl. Discard the used element.

4. Remove the O ring (3) from the filter bowl and clean the filter bowl. Check that the threads of the filter bowl are not damaged.

5. Install a new O ring seal (3) to the filter bowl (2).

6. Locate a new filter element (4) into the filter bowl. Press on the element and rotate the element clockwise in order to lock the element into the filter bowl.

7. Install the filter bowl (4) into the top of the filter head (5).

8. Tighten the filter bowl by hand until the filter bowl contacts the filter head. Rotate the filter bowl through 90 degrees.

Note: Do not use a tool to tighten the filter bowl.

9. Open the valves for the fuel lines (if equipped).

Spin-on filter

Turn the valves for the fuel lines (if equipped) to the OFF position before performing this maintenance. Place a tray under the fuel filter in order to catch any fuel that might spill. Clean up any spilled fuel immediately.

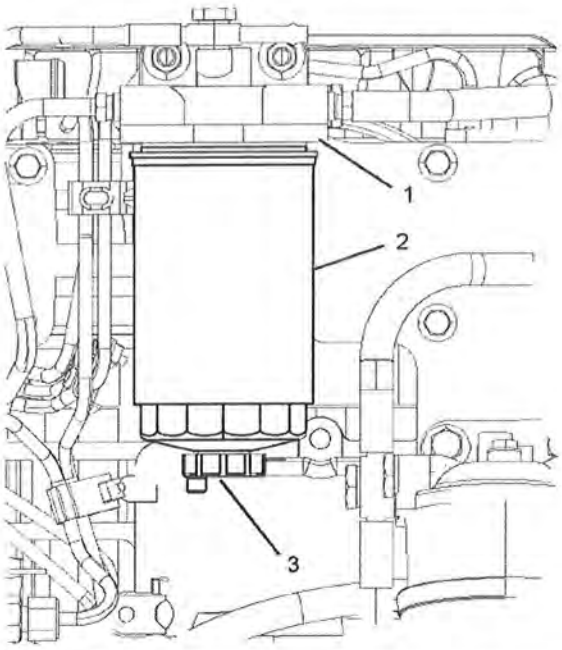


Illustration 49 g01121396

(1) Filter Head
(2) Spin-on filter
(3) Drain

1. Clean the outside of the fuel filter assembly. Open the fuel drain (3) and drain the fuel into a suitable container.

2. Use a suitable tool in order to remove the spin-on filter (2) from the filter head (1).

3. Ensure that the fuel drain (3) on the new spin-on filter is closed.

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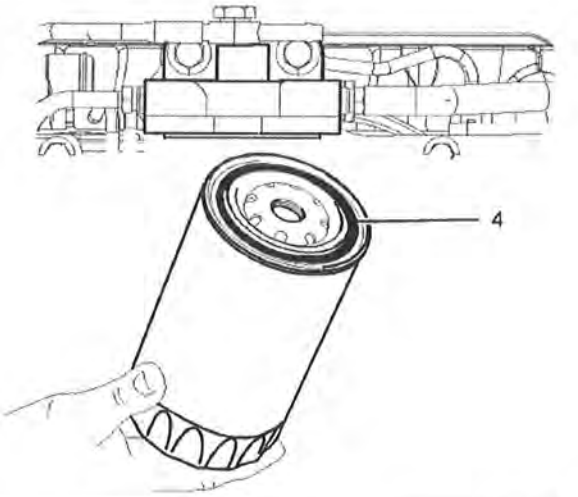


Illustration 50 g01121723

4. Lubricate the sealing ring (4) with clean fuel oil.
5. Install the spin-on filter (2) into the top of the filter head (1).
6. Tighten the spin-on filter by hand until the sealing ring contacts the filter head. Rotate the spin-on filter through 90 degrees.
7. Prime the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime".

i02335436

Fuel Tank Water and Sediment - Drain

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

Fuel Tank

Fuel quality is critical to the performance and to the service life of the engine. Water in the fuel can cause excessive wear to the fuel system.

Water can be introduced into the fuel tank when the fuel tank is being filled.

Condensation occurs during the heating and cooling of fuel. The condensation occurs as the fuel passes through the fuel system and the fuel returns to the fuel tank. This causes water to accumulate in fuel tanks. Draining the fuel tank regularly and obtaining fuel from reliable sources can help to eliminate water in the fuel.

Drain the Water and the Sediment

Fuel tanks should contain some provision for draining water and draining sediment from the bottom of the fuel tanks.

Open the drain valve on the bottom of the fuel tank in order to drain the water and the sediment. Close the drain valve.

Check the fuel daily. Allow five minutes after the fuel tank has been filled before draining water and sediment from the fuel tank.

Fill the fuel tank after operating the engine in order to drive out moist air. This will help prevent condensation. Do not fill the tank to the top. The fuel expands as the fuel gets warm. The tank may overflow.

Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe. Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

Fuel Storage Tanks

Drain the water and the sediment from the fuel storage tank at the following intervals:

- Weekly
- Service intervals
- Refill of the tank

This will help prevent water or sediment from being pumped from the storage tank into the engine fuel tank.

If a bulk storage tank has been refilled or moved recently, allow adequate time for the sediment to settle before filling the engine fuel tank. Internal baffles in the bulk storage tank will also help trap sediment. Filtering fuel that is pumped from the storage tank helps to ensure the quality of the fuel. When possible, water separators should be used.

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i02813964

Hoses and Clamps - Inspect/Replace

Inspect all hoses for leaks that are caused by the following conditions:

- Cracking
- Softness
- Loose clamps

Replace hoses that are cracked or soft. Tighten any loose clamps.

NOTICE
Do not bend or strike high pressure lines. Do not install bent or damaged lines, tubes or hoses. Repair any loose or damaged fuel and oil lines, tubes and hoses. Leaks can cause fires. Inspect all lines, tubes and hoses carefully. Tighten all connections to the recommended torque. Do not clip any other item to the high pressure lines.

Check for the following conditions:

- End fittings that are damaged or leaking
- Outer covering that is chafed or cut
- Exposed wire that is used for reinforcement
- Outer covering that is ballooning locally
- Flexible part of the hose that is kinked or crushed
- Armoring that is embedded in the outer covering

A constant torque hose clamp can be used in place of any standard hose clamp. Ensure that the constant torque hose clamp is the same size as the standard clamp.

Due to extreme temperature changes, the hose will harden. Hardening of the hoses will cause hose clamps to loosen. This can result in leaks. A constant torque hose clamp will help to prevent loose hose clamps.

Each installation application can be different. The differences depend on the following factors:

- Type of hose
- Type of fitting material
- Anticipated expansion and contraction of the hose
- Anticipated expansion and contraction of the fittings

Replace the Hoses and the Clamps

Refer to the OEM information for further information on removing and replacing fuel hoses (if equipped).

The coolant system and the hoses for the coolant system are not usually supplied by Perkins. The following text describes a typical method of replacing coolant hoses. Refer to the OEM information for further information on the coolant system and the hoses for the coolant system.

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Stop the engine. Allow the engine to cool.
2. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.

Note: Drain the coolant into a suitable, clean container. The coolant can be reused.

3. Drain the coolant from the cooling system to a level that is below the hose that is being replaced.
4. Remove the hose clamps.
5. Disconnect the old hose.
6. Replace the old hose with a new hose.
7. Install the hose clamps with a torque wrench.

Note: For the correct coolant, see this Operation and Maintenance Manual, "Fluid Recommendations".

8. Refill the cooling system. Refer to the OEM information for further information on refilling the cooling system.
9. Clean the cooling system filler cap. Inspect the cooling system filler cap's seals. Replace the cooling system filler cap if the seals are damaged. Install the cooling system filler cap.
10. Start the engine. Inspect the cooling system for leaks.

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Radiator - Clean

The radiator is not usually supplied by Perkins. The following text describes a typical cleaning procedure for the radiator. Refer to the OEM information for further information on cleaning the radiator.

Note: Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the radiator for these items: Damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the radiator, if necessary.

⚠ WARNING

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction to the fan's air flow. Hold the nozzle approximately 6 mm (0.25 inch) away from the radiator fins. Slowly move the air nozzle in a direction that is parallel with the radiator tube assembly. This will remove debris that is between the tubes.

Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

Use a degreaser and steam for removal of oil and grease. Clean both sides of the core. Wash the core with detergent and hot water. Thoroughly rinse the core with clean water.

If the radiator is blocked internally, refer to the OEM Manual for information regarding flushing the cooling system.

After cleaning the radiator, start the engine. Allow the engine to operate at low idle speed for three to five minutes. Accelerate the engine to high idle. This will help in the removal of debris and the drying of the core. Slowly reduce the engine speed to low idle and then stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a "comb". Inspect these items for good condition: Welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

i02335775

Severe Service Application - Check

Severe service is the application of an engine that exceeds the current published standards for that engine. Perkins maintains standards for the following engine parameters:

- Performance such as power range, speed range, and fuel consumption
- Fuel quality
- Operational Altitude
- Maintenance intervals
- Oil selection and maintenance
- Coolant type and maintenance
- Environmental qualities
- Installation
- The temperature of the fluid in the engine

Refer to the standards for the engine or consult your Perkins dealer or your Perkins distributor in order to determine if the engine is operating within the defined parameters.

Severe service operation can accelerate component wear. Engines that operate under severe conditions may need more frequent maintenance intervals in order to ensure maximum reliability and retention of full service life.

Due to individual applications, it is not possible to identify all of the factors which can contribute to severe service operation. Consult your Perkins dealer or your Perkins distributor for the unique maintenance that is necessary for the engine.

The operating environment, incorrect operating procedures and incorrect maintenance procedures can be factors which contribute to a severe service application.

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Environmental Factors

Ambient temperatures – The engine may be exposed to extended operation in extremely cold environments or hot environments. Valve components can be damaged by carbon buildup if the engine is frequently started and stopped in very cold temperatures. Extremely hot intake air reduces engine performance.

Quality of the air – The engine may be exposed to extended operation in an environment that is dirty or dusty, unless the equipment is cleaned regularly. Mud, dirt and dust can encase components. Maintenance can be very difficult. The buildup can contain corrosive chemicals.

Buildup – Compounds, elements, corrosive chemicals and salt can damage some components.

Altitude – Problems can arise when the engine is operated at altitudes that are higher than the intended settings for that application. Necessary adjustments should be made.

Incorrect Operating Procedures

- Extended operation at low idle
- Frequent hot shutdowns
- Operating at excessive loads
- Operating at excessive speeds
- Operating outside the intended application

Incorrect Maintenance Procedures

- Extending the maintenance intervals
- Failure to use recommended fuel, lubricants and coolant/antifreeze

i02177969

Starting Motor - Inspect

Perkins recommends a scheduled inspection of the starting motor. If the starting motor fails, the engine may not start in an emergency situation.

Check the starting motor for correct operation. Check the electrical connections and clean the electrical connections. Refer to the Systems Operation, Testing and Adjusting Manual, "Electric Starting System - Test" for more information on the checking procedure and for specifications or consult your Perkins dealer or your Perkins distributor for assistance.

i02184788

Turbocharger - Inspect (If Equipped)

A regular visual inspection of the turbocharger is recommended. Any fumes from the crankcase are filtered through the air inlet system. Therefore, by-products from oil and from combustion can collect in the turbocharger compressor housing. Over time, this buildup can contribute to loss of engine power, increased black smoke and overall loss of engine efficiency.

If the turbocharger fails during engine operation, damage to the turbocharger compressor wheel and/or to the engine may occur. Damage to the turbocharger compressor wheel can cause additional damage to the pistons, the valves, and the cylinder head.

NOTICE
Turbocharger bearing failures can cause large quantities of oil to enter the air intake and exhaust systems. Loss of engine lubricant can result in serious engine damage.

Minor leakage of oil into a turbocharger under extended low idle operation should not cause problems as long as a turbocharger bearing failure has not occured.

When a turbocharger bearing failure is accompanied by a significant engine performance loss (exhaust smoke or engine rpm up at no load), do not continue engine operation until the turbocharger is renewed.

A visual inspection of the turbocharger can minimize unscheduled downtime. A visual inspection of the turbocharger can also reduce the chance for potential damage to other engine parts.

Removal and Installation

Note: The turbochargers that are supplied are nonserviceable.

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For options regarding the removal, installation, and replacement, consult your Perkins dealer or your Perkins distributor. Refer to the Disassembly and Assembly Manual, "Turbocharger - Remove and Turbocharger - Install" for further information.

Inspecting

NOTICE
The compressor housing for the turbocharger must not be removed from the turbocharger for cleaning.

The actuator linkage is connected to the compressor housing. If the actuator linkage is moved or disturbed the engine may not comply with emmissions legislation.

1. Remove the pipe from the turbocharger exhaust outlet and remove the air intake pipe to the turbocharger. Visually inspect the piping for the presence of oil. Clean the interior of the pipes in order to prevent dirt from entering during reassembly.
2. Check for the presence of oil. If oil is leaking from the back side of the compressor wheel, there is a possibility of a failed turbocharger oil seal.

   The presence of oil may be the result of extended engine operation at low idle. The presence of oil may also be the result of a restriction of the line for the intake air (clogged air filters), which causes the turbocharger to slobber.
3. Inspect the bore of the housing of the turbine outlet for corrosion.
4. Fasten the air intake pipe and the exhaust outlet pipe to the turbocharger housing.

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Walk-Around Inspection

Inspect the Engine for Leaks and for Loose Connections

A walk-around inspection should only take a few minutes. When the time is taken to perform these checks, costly repairs and accidents can be avoided.

For maximum engine service life, make a thorough inspection of the engine compartment before starting the engine. Look for items such as oil leaks or coolant leaks, loose bolts, worn belts, loose connections and trash buildup. Make repairs, as needed:

- The guards must be in the correct place. Repair damaged guards or replace missing guards.
- Wipe all caps and plugs before the engine is serviced in order to reduce the chance of system contamination.

NOTICE
For any type of leak (coolant, lube, or fuel) clean up the fluid. If leaking is observed, find the source and correct the leak. If leaking is suspected, check the fluid levels more often than recommended until the leak is found or fixed, or until the suspicion of a leak is proved to be unwarranted.

NOTICE
Accumulated grease and/or oil on an engine is a fire hazard. Remove the accumulated grease and oil. Refer to this Operation and Maintenance Manual, "Engine - Clean" for more information.

- Ensure that the cooling system hoses are correctly clamped and that the cooling system hoses are tight. Check for leaks. Check the condition of all pipes.
- Inspect the water pump for coolant leaks.

Note: The water pump seal is lubricated by the coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and the parts contract.

Excessive coolant leakage may indicate the need to replace the water pump seal. For the removal of the water pump and the installation of water pump and/or seal, refer to the Disassembly and Assembly Manual, "Water Pump - Remove and Install" for more information or consult your Perkins dealer or your Perkins distributor.

- Inspect the lubrication system for leaks at the front crankshaft seal, the rear crankshaft seal, the oil pan, the oil filters and the rocker cover.
- Inspect the fuel system for leaks. Look for loose fuel line clamps and/or tie-wraps.
- Inspect the piping for the air intake system and the elbows for cracks and for loose clamps. Ensure that hoses and tubes are not contacting other hoses, tubes, wiring harnesses, etc.
- Inspect the alternator belts and any accessory drive belts for cracks, breaks or other damage.

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Belts for multiple groove pulleys must be replaced as matched sets. If only one belt is replaced, the belt will carry more load than the belts that are not replaced. The older belts are stretched. The additional load on the new belt could cause the belt to break.

- Drain the water and the sediment from the fuel tank on a daily basis in order to ensure that only clean fuel enters the fuel system.
- Inspect the wiring and the wiring harnesses for loose connections and for worn wires or frayed wires.
- Inspect the ground strap for a good connection and for good condition.
- Disconnect any battery chargers that are not protected against the current drain of the starting motor. Check the condition and the electrolyte level of the batteries, unless the engine is equipped with a maintenance free battery.
- Check the condition of the gauges. Replace any gauges that are cracked. Replace any gauge that can not be calibrated.

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Water Pump - Inspect

A failed water pump may cause severe engine overheating problems that could result in the following conditions:

- Cracks in the cylinder head
- A piston seizure
- Other potential damage to the engine

Note: The water pump seal is lubricated by the coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and parts contract.

Visually inspect the water pump for leaks. Renew the water pump seal or the water pump if there is an excessive leakage of coolant. Refer to the Disassembly and Assembly Manual, "Water Pump - Remove and Install" for the disassembly and assembly procedure.

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Warranty Section

Warranty Information

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Emissions Warranty Information

This engine may be certified to comply with exhaust emission standards and gaseous emission standards that are prescribed by the law at the time of manufacture, and this engine may be covered by an Emissions Warranty. Consult your authorized Perkins dealer or your authorized Perkins distributor in order to determine if your engine is emissions certified and if your engine is subject to an Emissions Warranty.

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Index

A

After Starting Engine 30
After Stopping Engine 32
Aftercooler Core - Clean/Test 52
Aftercooler Core - Inspect 52
Alternator - Inspect 53
Alternator and Fan Belts - Inspect/Adjust/Replace 53
  Adjustment 53
  Inspection 53
  Replacement 54

B

Battery - Replace 54
Battery Electrolyte Level - Check 54
Battery or Battery Cable - Disconnect 55
Before Starting Engine 10, 28
Burn Prevention 7
  Batteries 8
  Coolant 8
  Oils 8

C

Cold Weather Operation 33
  Hints for Cold Weather Operation 33
  Idling the Engine 34
  Recommendations for Coolant Warm Up 34
  Recommendations for the Coolant 33
  Viscosity of the Engine Lubrication Oil 33
Cold Weather Starting 29
Cooling System Coolant - Change 58
Cooling System Coolant (Commercial Heavy-Duty) - Change 55
  Drain 55
  Fill 56
  Flush 56
Cooling System Coolant (ELC) - Change 57
  Drain 57
  Fill 58
  Flush 57
Cooling System Coolant Extender (ELC) - Add 59
Cooling System Coolant Level - Check 59
  Engines With a Coolant Recovery Tank 59
  Engines Without a Coolant Recovery Tank 59
Crushing Prevention and Cutting Prevention 10

D

Driven Equipment - Check 60

E

Electrical System 11
  Grounding Practices 12
Emergency Stopping 32
Emissions Certification Film 20
  Label for compliant engines 20
  Label for engines that comply with MSHA emissions 22
  Label for engines that do not comply with emissions 22
Emissions Warranty Information 79
Engine - Clean 60
Engine Air Cleaner Element (Dual Element) - Clean/Replace 61
  Cleaning the Primary Air Cleaner Elements 62
  Servicing the Air Cleaner Elements 61
Engine Air Cleaner Element (Single Element) - Inspect/Replace 63
Engine Air Cleaner Service Indicator - Inspect 63
  Test the Service Indicator 63
Engine Description 16
  Engine Cooling and Lubrication 18
  Engine Service Life 18
  Engine Specifications 16
Engine Ground - Inspect/Clean 64
Engine Identification 19
Engine Lifting 24
Engine Mounts - Inspect 64
Engine Oil and Filter - Change 65
  Drain the Engine Oil 65
  Fill the Engine Crankcase 67
  Replace the Element for the Oil Filter 66
  Replace the Spin-on Oil Filter 66
Engine Oil Level - Check 64
Engine Oil Sample - Obtain 64
  Obtain the Sample and the Analysis 65
Engine Operation 31
Engine Starting 11, 28
Engine Stopping 11, 32
Engine Storage 24
  Cooling System 25
  Exhaust System 25
  General Items 26
  Induction System 25
  Lubrication System 24
Engine Valve Lash - Inspect/Adjust 67
Engine Warm-up 31

F

Fire Prevention and Explosion Prevention 8
  Fire Extinguisher 9
  Lines, Tubes and Hoses 9

This document is printed from SPI². Not for Resale.

Fluid Recommendations 38
Cooling System Specifications 45
ELC Cooling System Maintenance 47
Engine Oil 39
Fuel Specifications 42
General Lubricant Information 38
Foreword 4
California Proposition 65 Warning 4
Literature Information 4
Maintenance 4
Maintenance Intervals 4
Operation 4
Overhaul 4
Safety 4
Fuel and the Effect from Cold Weather 35
Fuel Conservation Practices 31
Fuel Injector - Test/Change 68
Removal and Installation of the Fuel Injectors ... 69
Fuel Related Components in Cold Weather 36
Fuel Filters 36
Fuel Heaters 36
Fuel Tanks 36
Fuel System - Prime 69
Fuel System Primary Filter (Water Separator) Element - Replace 70
Fuel System Primary Filter/Water Separator - Drain 70
Fuel System Secondary Filter - Replace 71
Element filter 71
Spin-on filter 72
Fuel Tank Water and Sediment - Drain 73
Drain the Water and the Sediment 73
Fuel Storage Tanks 73
Fuel Tank 73

G

Gauges and Indicators 27
General Hazard Information 6
Containing Fluid Spillage 7
Fluid Penetration 7
Pressure Air and Water 7

H

Hoses and Clamps - Inspect/Replace 74
Replace the Hoses and the Clamps 74

I

Important Safety Information 2

L

Lifting and Storage 24

M

Maintenance Interval Schedule 51
Maintenance Section 37
Model View Illustrations 13
1103 Engine Model Views 15
1104 Engine Model Views 13
Model Views 13
Mounting and Dismounting 10

O

Operation Section 24

P

Product Identification Information 19
Product Information Section 13

R

Radiator - Clean 75
Reference Numbers 19
Record for Reference 19
Refill Capacities 37
Cooling System 37
Lubrication System 37

S

Safety Messages 5
(1) Universal Warning 5
(2) Ether 5
Safety Section 5
Serial Number Plate 19
Severe Service Application - Check 75
Environmental Factors 76
Incorrect Maintenance Procedures 76
Incorrect Operating Procedures 76
Starting Motor - Inspect 76
Starting the Engine 29
Starting with Jump Start Cables 30
Stopping the Engine 32

T

Table of Contents 3
Turbocharger - Inspect (If Equipped) 76
Inspecting 77
Removal and Installation 76

This document is printed from SPI². Not for Resale.

W

Walk-Around Inspection 77
Inspect the Engine for Leaks and for Loose Connections 77
Warranty Information 79
Warranty Section 79
Water Pump - Inspect 78

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Product and Dealer Information

Note: For product identification plate locations, see the section "Product Identification Information" in the Operation and Maintenance Manual.

Delivery Date: _____

Product Information

Model: _____

Product Identification Number: _____

Engine Serial Number: _____

Transmission Serial Number: _____

Generator Serial Number: _____

Attachment Serial Numbers: _____

Attachment Information: _____

Customer Equipment Number: _____

Dealer Equipment Number: _____

Dealer Information

Name: _____ Branch: _____

Address: _____

_____

_____

	Dealer Contact	Phone Number	Hours
Sales:	_____	_____	_____
Parts:	_____	_____	_____
Service:	_____	_____	_____

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COMPLEX SOLUTIONS MADE SIMPLE.

DSE®

DSECONTROL®

DSE7000 Series Control Module

057-074

Author : Anthony Manton

Deep Sea Electronics Plc
Highfield House
Hunmanby
North Yorkshire
YO14 0PH
ENGLAND

Sales Tel: +44 (0) 1723 890099
Sales Fax: +44 (0) 1723 893303

E-mail: sales@deepseaplc.com
Website: www.deepseaplc.com

DSE Model 7000 series Control and Instrumentation System Operators Manual

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Amendments since last publication

Amd. No.	Comments

Clarification of notation used within this publication.

NOTE:	Highlights an essential element of a procedure to ensure correctness.
CAUTION!	Indicates a procedure or practice, which, if not strictly observed, could result in damage or destruction of equipment.
WARNING!	Indicates a procedure or practice, which could result in injury to personnel or loss of life if not followed correctly.

TABLE OF CONTENTS

Section **Page**

1 BIBLIOGRAPHY 6

2 INTRODUCTION 6

3 SPECIFICATIONS 7

3.1 PART NUMBERING 7

3.1.1 MODEL NAMING 7

3.1.2 SHORT NAMES 7

3.1 POWER SUPPLY REQUIREMENTS 8

3.2 TERMINAL SPECIFICATION 8

3.3 GENERATOR AND MAINS VOLTAGE / FREQUENCY SENSING 9

3.4 GENERATOR CURRENT SENSING 9

3.5 INPUTS 9

3.5.1 DIGITAL INPUTS 9

3.5.2 ANALOGUE INPUTS 10

3.5.3 CHARGE FAIL INPUT 11

3.5.4 MAGNETIC PICKUP 11

3.6 OUTPUTS 11

3.6.1 OUTPUTS A & B 11

3.6.2 OUTPUTS C & D 11

3.6.3 OUTPUTS E,F,G & H 11

3.7 COMMUNICATION PORTS 12

3.8 DSENET® 12

3.9 ACCUMULATED INSTRUMENTATION 12

3.10 DIMENSIONS AND MOUNTING 13

3.10.1 FIXING CLIPS 14

3.10.2 CABLE TIE FIXING POINTS 15

3.10.3 SILICON SEALING GASKET 15

3.11 APPLICABLE STANDARDS 16

4 INSTALLATION 17

4.1 USER CONNECTIONS 17

4.2 TERMINAL DESCRIPTION 18

4.2.1 DC SUPPLY, FUEL AND START OUTPUTS 18

4.2.2 ANALOGUE SENSOR 18

4.2.3 MAGNETIC PICKUP, CAN AND EXPANSION 19

4.2.4 LOAD SWITCHING AND GENERATOR VOLTAGE SENSING 20

4.2.5 MAINS VOLTAGE SENSING 20

4.2.6 GENERATOR CURRENT TRANSFORMERS 21

4.2.7 CONFIGURABLE DIGITAL INPUTS 22

4.2.8 PC CONFIGURATION INTERFACE CONNECTOR 22

4.2.9 RS485 CONNECTOR 23

4.2.10 RS232 CONNECTOR 23

4.3 TYPICAL WIRING DIAGRAMS 24

4.3.1 7210 AUTOSTART CONTROLLER 24

4.3.2 7220 AMF CONTROLLER 25

4.3.3 7310 AUTOSTART CONTROLLER 26

4.3.4 7320 AMF CONTROLLER 27

4.4 ALTERNATIVE TOPOLOGIES 28

4.4.1 3 PHASE, 4 WIRE WITHOUT EARTH FAULT PROTECTION 28

4.4.2 SINGLE PHASE WITH RESTRICTED EARTH FAULT MEASURING 29

4.4.3 SINGLE PHASE WITHOUT EARTH FAULT MEASURING 30

4.4.4 2 PHASE (L1 & L2) 3 WIRE WITH RESTRICTED EARTH FAULT MEASURING ... 31

4.4.5 2 PHASE (L1 & L2) 3 WIRE WITHOUT EARTH FAULT MEASURING 32
4.4.6 2 PHASE (L1 & L3) 3 WIRE WITH RESTRICTED EARTH FAULT MEASURING ... 33
4.4.7 2 PHASE (L1 & L3) 3 WIRE WITHOUT EARTH FAULT MEASURING 34
4.4.8 3 PHASE 4 WIRE WITH UNRESTRICTED EARTH FAULT MEASURING 35
4.5 CT LOCATION 36

5 DESCRIPTION OF CONTROLS 37
5.1 DSE7210 / DSE7310 AUTOSTART CONTROL MODULE 37
5.2 DSE7220 / DSE7320 AMF CONTROL MODULE 39
5.3 QUICKSTART GUIDE 41
5.3.1 STARTING THE ENGINE 41
5.3.2 STOPPING THE ENGINE 41
5.4 VIEWING THE INSTRUMENTS 42
5.4.1 INSTRUMENT PAGE CONTENT 43
5.4.2 CAN ERROR MESSAGES 44
5.5 VIEWING THE EVENT LOG 45
5.6 USER CONFIGURABLE INDICATORS 45
5.7 CONTROLS 46

6 OPERATION 48
6.1 AUTOMATIC MODE OF OPERATION 49
6.1.1 WAITING IN AUTO MODE 49
6.1.2 STARTING SEQUENCE 49
6.1.3 ENGINE RUNNING 50
6.1.4 STOPPING SEQUENCE 50
6.2 MANUAL OPERATION 51
6.2.1 WAITING IN MANUAL MODE 51
6.2.2 STARTING SEQUENCE 51
6.2.3 ENGINE RUNNING 52
6.2.4 STOPPING SEQUENCE 52
6.3 TEST MODE OF OPERATION 53
6.3.1 WAITING IN TEST MODE 53
6.3.2 STARTING SEQUENCE 53
6.3.3 ENGINE RUNNING 54

7 PROTECTIONS 55
7.1 WARNINGS 56
7.2 ANALOGUE PRE-ALARMS 57
7.3 HIGH CURRENT WARNING ALARM 57
7.4 SHUTDOWNS 58
7.5 HIGH CURRENT SHUTDOWN ALARM 59
7.6 ELECTRICAL TRIPS 59

8 FRONT PANEL CONFIGURATION 60
8.1 ACCESSING THE MAIN FRONT PANEL CONFIGURATION EDITOR 60
8.1.1 EDITING A PARAMETER 61
8.1.2 ADJUSTABLE PARAMETERS 62
8.2 ACCESSING THE 'RUNNING' CONFIGURATION EDITOR 63
8.2.1 EDITING A PARAMETER 63
8.2.2 ADJUSTABLE PARAMETERS (RUNNING EDITOR) 63

9 COMMISSIONING 64
9.1.1 PRE-COMMISSIONING 64

10 FAULT FINDING 65

11 FACTORY DEFAULT CONFIGURATION 67

12 MAINTENANCE, SPARES, REPAIR AND SERVICING 71
12.1 PURCHASING ADDITIONAL CONNECTOR PLUGS FROM DSE 71
12.1.1 DSE7200 SERIES 71
12.1.2 DSE7300 SERIES 72
12.2 PURCHASING ADDITIONAL FIXING CLIPS FROM DSE 72
12.3 PURCHASING ADDITIONAL SEALING GASKET FROM DSE 72

12.4 EXPANSION MODULES....73

13 WARRANTY....74

14 DISPOSAL....74

14.1 WEEE (WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT)....74

14.2 ROHS (RESTRICTION OF HAZARDOUS SUBSTANCES)....74

15 APPENDIX....75

15.1 IDMT TRIPPING CURVES (TYPICAL)....75

15.2 SENSOR WIRING RECOMMENDATIONS....76

15.2.1 EARTH RETURN SENSORS....76

15.2.2 INSULATED RETURN SENSORS....76

15.3 CAN INTERFACE....76

15.4 COMMUNICATIONS OPTION CONNECTIONS....77

15.4.1 DESCRIPTION....77

15.4.2 PC TO CONTROLLER (DIRECT) CONNECTION....77

15.5 ENCLOSURE CLASSIFICATIONS....78

1 BIBLIOGRAPHY

This document refers to and is referred to by the following DSE publications which can be obtained from the DSE website www.deepseaplc.com

DSE PART	DESCRIPTION
053-026	7210 installation instructions
053-027	7220 installation instructions
053-028	7310 installation instructions
053-029	7320 installation instructions
057-004	Electronic Engines and DSE wiring manual
057-077	DSE7000 Series configuration software manual
057-082	DSE2130 input expansion manual
057-083	DSE2157 output expansion manual
057-084	DSE2548 annunciator expansion manual

2 INTRODUCTION

This document details the installation and operation requirements of the DSE7000 Series modules, part of the DSEControl® range of products.
The manual forms part of the product and should be kept for the entire life of the product. If the product is passed or supplied to another party, ensure that this document is passed to them for reference purposes.
This is not a *controlled document.* You will not be automatically informed of updates. Any future updates of this document will be included on the DSE website at www.deepseaplc.com

The **DSE 7000 series** is designed to provide differing levels of functionality across a common platform. This allows the generator OEM greater flexibility in the choice of controller to use for a specific application.

The **DSE 7000 series** module has been designed to allow the operator to start and stop the generator, and if required, transfer the load to the generator either manually (via fascia mounted push-buttons) or automatically. Additionally, the DSE7320 automatically starts and stops the generator set depending upon the status of the mains (utility) supply.
The user also has the facility to view the system operating parameters via the LCD display.

The **DSE 7000** module monitors the engine, indicating the operational status and fault conditions, automatically shutting down the engine and giving a true first up fault condition of an engine failure by a COMMON AUDIBLE ALARM. The LCD display indicates the fault.

The powerful ARM microprocessor contained within the module allows for incorporation of a range of complex features:

- *Text based LCD display (supporting multiple languages).*
- ***True RMS** Voltage, Current and Power monitoring.*
- *Engine parameter monitoring.*
- *Fully configurable inputs for use as alarms or a range of different functions.*
- *Engine ECU interface to **electronic engines**.*

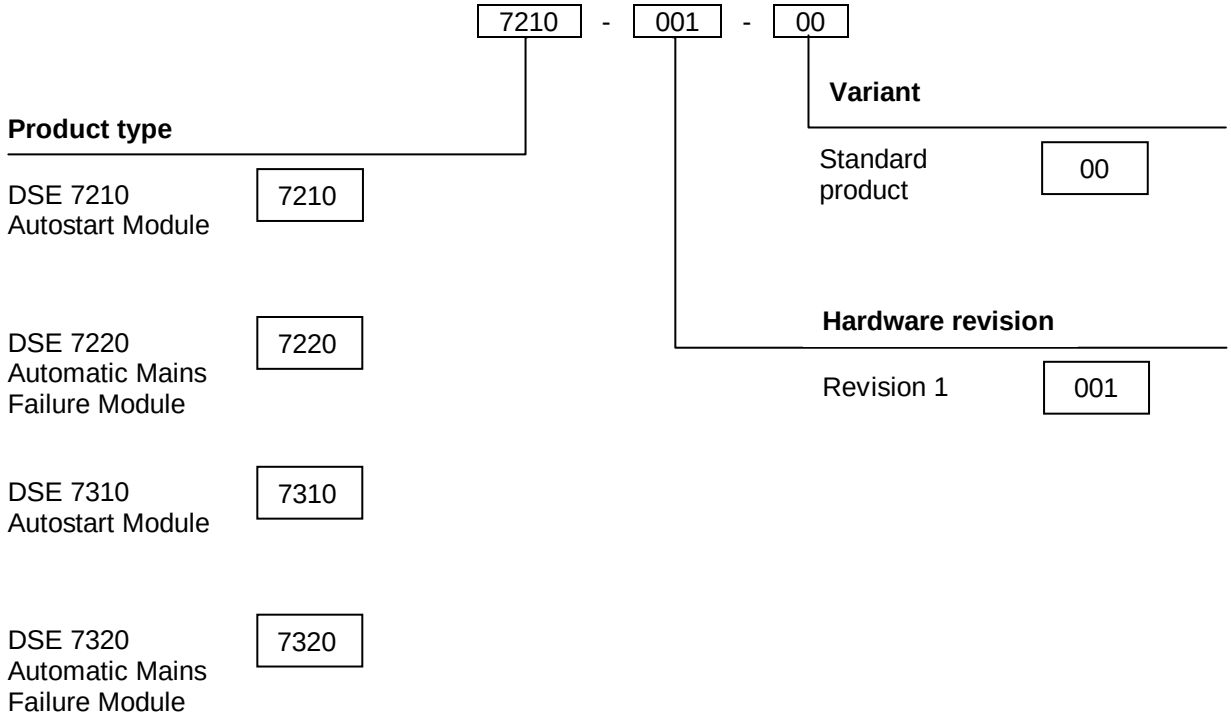
Using a PC and the 7000 series configuration software allows alteration of selected operational sequences, timers and alarm trips.

Additionally, the module's integral fascia configuration editor allows adjustment of a subset of this information.

A robust plastic case designed for front panel mounting houses the module. Connections are via locking plug and sockets.

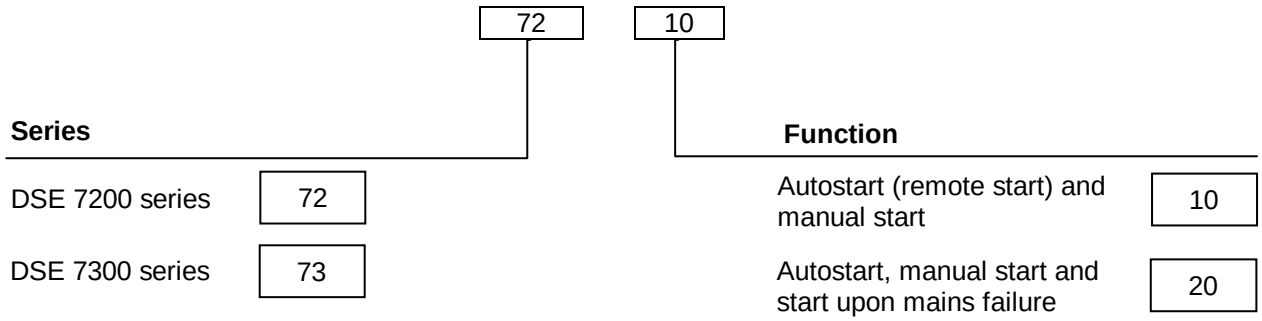
3 SPECIFICATIONS

3.1 PART NUMBERING



At the time of this document production, there are no variants of this product and there have been no revisions of the module hardware.

3.1.1 MODEL NAMING



3.1.2 SHORT NAMES

Short name	Description
DSE7000	All modules in the DSE7000 Series
DSE7x10	All Autostart modules in the DSE7000 Series
DSE7x20	All AMF modules in the DSE7000 Series
DSE72x0	All modules in the DSE7200 series
DSE73x0	All modules in the DSE7300 series

3.1 POWER SUPPLY REQUIREMENTS

Minimum supply voltage	8V continuous	
Cranking dropouts	Able to survive 0V for 50mS providing the supply was at least 10V before the dropout and recovers to 5V afterwards.	
Maximum supply voltage	35V continuous (60V protection)	
Reverse polarity protection	-35V continuous	
Maximum operating current	DSE7200 / DSE7300	160mA at 24V 340mA at 12V
Maximum standby current	DSE7200 / DSE7300	80mA at 24V 160mA at 12V

Plant supply instrumentation display

Range	0V-70V DC (note Maximum continuous operating voltage of 35V DC)
Resolution	0.1V
Accuracy	1% full scale

3.2 TERMINAL SPECIFICATION

Connection type	Screw terminal, rising clamp, no internal spring
Min cable size	0.5mm² (AWG 24)
Max cable size	2.5mm² (AWG 10)

3.3 GENERATOR AND MAINS VOLTAGE / FREQUENCY SENSING

Measurement type	True RMS conversion
Sample Rate	5KHz or better
Harmonics	Up to 10th or better
Input Impedance	300K Ω ph-N
Phase to Neutral	15V to 333V AC (max)
Phase to Phase	25V to 576V AC (max)
Common mode offset from Earth	100V AC (max)
Resolution	1V AC phase to neutral 2V AC phase to phase
Accuracy	±1% of full scale phase to neutral ±2% of full scale phase to phase
Minimum frequency	3.5Hz
Maximum frequency	75.0Hz
Frequency resolution	0.1Hz
Frequency accuracy	±0.2Hz

3.4 GENERATOR CURRENT SENSING

Measurement type	True RMS conversion
Sample Rate	5KHz or better
Harmonics	Up to 10th or better
Nominal CT secondary rating	1A or 5A
Maximum continuous current	5A
Overload Measurement	3 x Nominal Range setting
Absolute maximum overload	50A for 1 second
Burden	0.5VA (0.02Ω current shunts)
common mode offset	±2V peak plant ground to CT common terminal
Resolution	0.5% of 5A
Accuracy	±1% of Nominal (1A or 5A) (excluding CT error)

3.5 INPUTS

3.5.1 DIGITAL INPUTS

Number	DSE72x0	6
	DSE73x0	8
Arrangement	Contact between terminal and ground	
Low level threshold	2.1V minimum	
High level threshold	6.6V maximum	
Maximum input voltage	+50V DC with respect to plant supply negative	
Minimum input voltage	-24V DC with respect to plant supply negative	
Contact wetting current	7mA typical	
Open circuit voltage	12V typical	

3.5.2 ANALOGUE INPUTS

Oil Pressure

Measurement type	Resistance measurement by measuring voltage across sensor with a fixed current applied
Arrangement	Differential resistance measurement input
Measurement current	15mA
Full scale	240Ω
Over range / fail	270Ω
Resolution	1-2 PSI / 0.1 Bar
Accuracy	+/-2% of full scale resistance excluding transducer error
Max common mode voltage	±2V
Display range	0-200 PSI / 13.7 bar subject to limits of the sensor

Coolant Temperature

Measurement type	Resistance measurement by measuring voltage across sensor with a fixed current applied
Arrangement	Differential resistance measurement input
Measurement current	10mA
Full scale	480Ω
Over range / fail	540Ω
Resolution	1°C, 2℉
Accuracy	+/-2% of full scale resistance excluding transducer error
Max common mode voltage	±2V
Display range	0°C -140°C, 32℉ - 284℉ Depending on sensor

Fuel Level

Measurement type	Resistance measurement by measuring voltage across sensor with a fixed current applied
Arrangement	Differential resistance measurement input
Measurement current	10mA
Full scale	480Ω
Over range / fail	540Ω
Resolution	1%
Accuracy	+/-2% of full scale resistance excluding transducer error
Max common mode voltage	±2V
Display range	0-250%

Flexible Sensor

NOTE : Flexible sensor is not available on DSE7200 series controllers

Measurement type	Resistance measurement by measuring voltage across sensor with a fixed current applied
Arrangement	Differential resistance measurement input
Measurement current	10mA
Full scale	480Ω
Over range / fail	540Ω
Resolution	1%
Accuracy	+/-2% of full scale resistance excluding transducer error
Max common mode voltage	±2V
Display range	0-250%

3.5.3 CHARGE FAIL INPUT

Minimum voltage	0V
Maximum voltage	35V (plant supply)
Resolution	0.2V
Accuracy	± 1% of max measured voltage
Excitation	Active circuit constant power output
Output Power	2.5W Nominal @12V and 24V
Current at 12V	210mA
Current at 24V	10mA

3.5.4 MAGNETIC PICKUP

Type	Differential input
Minimum voltage	0.5V RMS
Max common mode voltage	±2V
Maximum voltage	Clamped to ±70V by transient suppressers, dissipation not to exceed 1W.
Maximum frequency	10,000Hz
Resolution	6.25 RPM
Accuracy	±25 RPM
Flywheel teeth	10 to 500

3.6 OUTPUTS

3.6.1 OUTPUTS A & B

Type	Normally used for Fuel / Start outputs. Fully configurable for other purposes if the module is configured to control an electronic engine. Supplied from Emergency Stop terminal 3.
Rating	15A @ 35V

3.6.2 OUTPUTS C & D

Type	Voltage free relays, fully configurable, normally used for generator / mains load switch control.
Rating	8A @ 250 V AC

3.6.3 OUTPUTS E,F,G & H

Type	Fully configurable, supplied from DC supply terminal 2.
Rating	3A @ 35V

3.7 COMMUNICATION PORTS

USB Port	USB2.0 Device for connection to PC running DSE configuration suite only
Serial Communication (not available on DSE7200 series)	RS232 and RS485 are fitted but do NOT provide independent operation
RS232 Port (not available on DSE7200 series)	Non – Isolated port Max Baud rate 115K baud subject to S/W TX, RX, RTS, CTS, DSR, DTR, DCD Male 9 way D type connector
RS485 Serial (not available on DSE7200 series)	Isolated Data connection 2 wire + common Half Duplex Data direction control for Transmit (by s/w protocol) Max Baud Rate 19200 External termination required (120R) Max common mode offset 70V (on board protection transorb)
CAN Port	Engine CAN Port Standard implementation of 'Slow mode', up to 250K bits/s Non Isolated. Internal Termination provided (120Ω)

3.8 DSENET®

DSENet® is the interconnection cable between the host controller and the expansion module(s) and must not be connect to any device other than DSE equipment designed for connection to the DSENet®

NOTE : DSENet® is not available on DSE7200 series controllers.

Cable type	Two core screened twisted pair
Cable characteristic impedance	120Ω
Recommended cable	Belden 9841 Belden 9271
Maximum cable length	1000m (1km) when using Belden 9841 or direct equivalent. 500m (0.5km) when using Belden 9271 or direct equivalent.
DSENet® topology	Bus with no stubs (spurs)
DSENet® termination	120Ω. Fitted internally to host controller. Must be fitted externally to the 'last' expansion module by the customer .
Maximum expansion modules	Refer to host controller documentation

NOTE : As a termination resistor is internally fitted to the host controller, the host controller must be the 'first' unit on the DSENet®. A termination resistor MUST be fitted to the 'last' unit on the DSENet®. For connection details, you are referred to the section entitled 'typical wiring diagram' elsewhere in this document.

3.9 ACCUMULATED INSTRUMENTATION

NOTE : When an accumulated instrumentation value exceeds the maximum number as listed below, it will reset and begin counting from zero again.

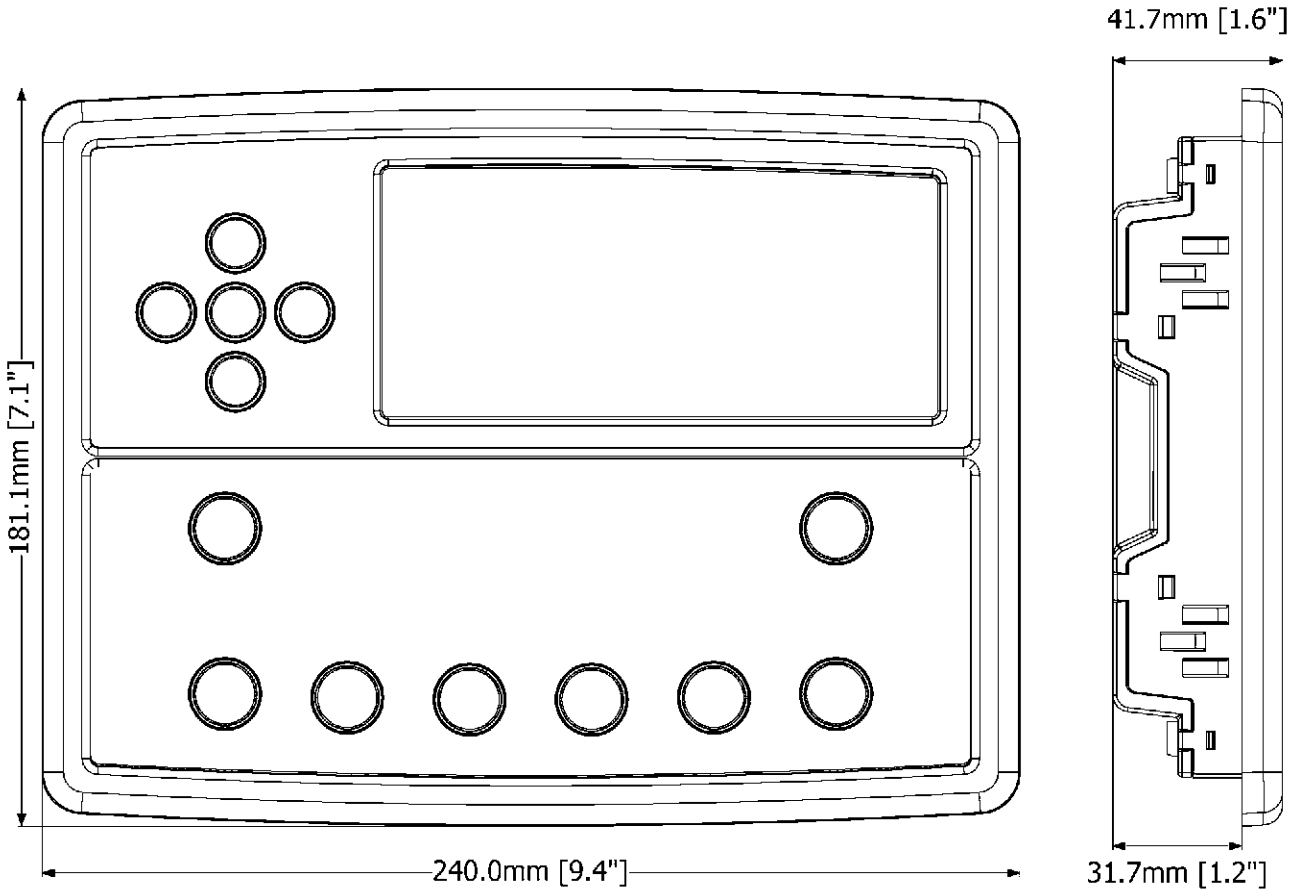
Engine hours run	Maximum 99999 hrs 59 minutes (approximately 11yrs 4months)
Number of starts	1,000,000 (1 million)

3.10 DIMENSIONS AND MOUNTING

DIMENSIONS
240.0mm x 181.1mm x 41.7mm (9.4" x 7.1" x 1.6")

PANEL CUTOUT
220mm x 160mm (8.7" x 6.3")

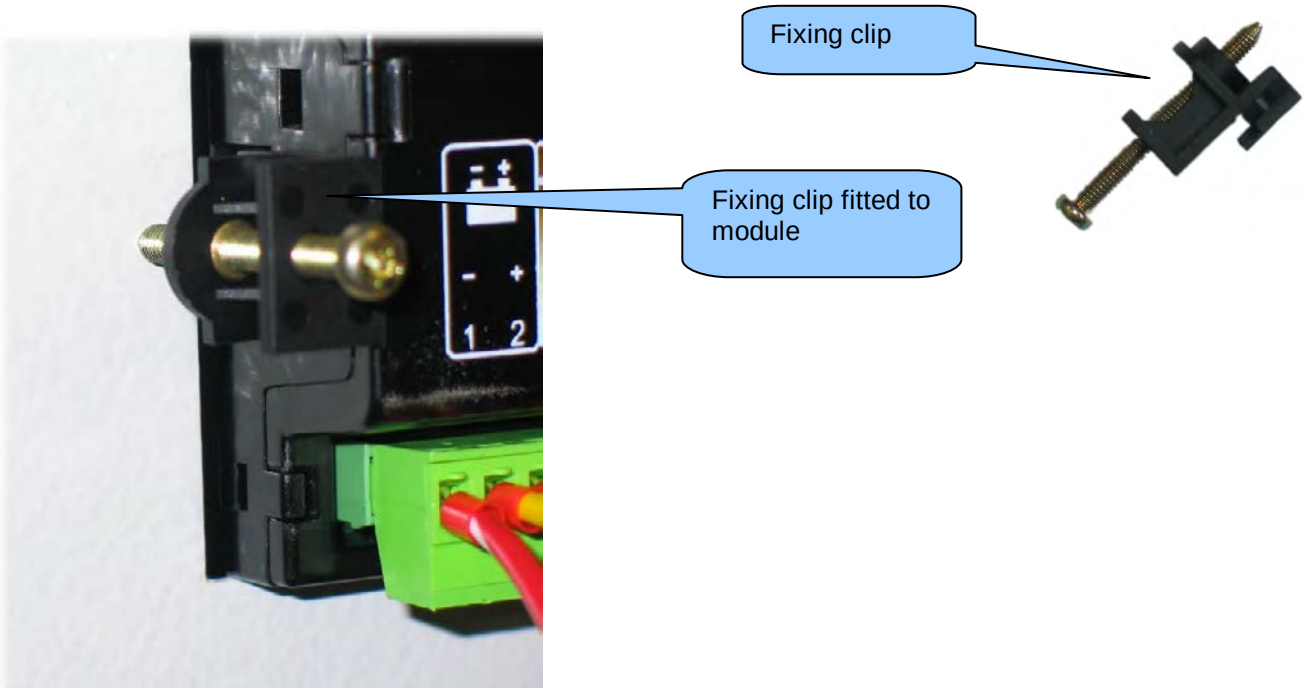
WEIGHT
0.7kg (1.4lb)



3.10.1 FIXING CLIPS

The module is held into the panel fascia using the supplied fixing clips.

- Withdraw the fixing clip screw (turn anticlockwise) until only the pointed end is protruding from the clip.
- Insert the three 'prongs' of the fixing clip into the slots in the side of the 7000 series module case.
- Pull the fixing clip backwards (towards the back of the module) ensuring all three prongs of the clip are inside their allotted slots.
- Turn the fixing clip screws clockwise until they make contact with the panel fascia.
- Turn the screws a little more to secure the module into the panel fascia. Care should be taken not to over tighten the fixing clip screws.



NOTE:- In conditions of excessive vibration, mount the module on suitable anti-vibration mountings.

3.10.2 CABLE TIE FIXING POINTS

Integral cable tie fixing points are included on the rear of the module's case to aid wiring. This additionally provides strain relief to the cable loom by removing the weight of the loom from the screw connectors, thus reducing the chance of future connection failures.
Care should be taken not to overtighten the cable tie (for instance with cable tie tools) to prevent the risk of damage to the module case.



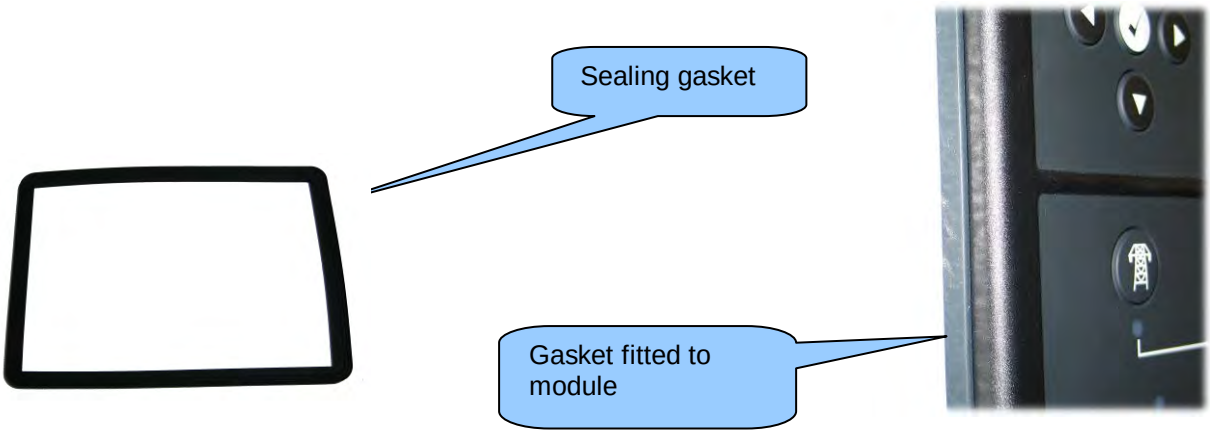
Cable tie fixing point



With cable and tie in place

3.10.3 SILICON SEALING GASKET

The supplied silicon gasket provides improved sealing between the 7000 series module and the panel fascia. The gasket is fitted to the module before installation into the panel fascia.
Take care to ensure the gasket is correctly fitted to the module to maintain the integrity of the seal.



3.11 APPLICABLE STANDARDS

BS 4884-1	This document conforms to BS4884-1 1992 Specification for presentation of essential information.
BS 4884-2	This document conforms to BS4884-2 1993 Guide to content
BS 4884-3	This document conforms to BS4884-3 1993 Guide to presentation
BS EN 60068-2-1 (Minimum temperature)	-30°C (-22°F)
BS EN 60068-2-2 (Maximum temperature)	+70°C (158°F)
BS EN 60950	Safety of information technology equipment, including electrical business equipment
BS EN 61000-6-2	EMC Generic Immunity Standard (Industrial)
BS EN 61000-6-4	EMC Generic Emission Standard (Industrial)
BS EN 60529 (Degrees of protection provided by enclosures)	IP65 (front of module when installed into the control panel with the supplied sealing gasket) IP42 (front of module when installed into the control panel WITHOUT being sealed to the panel)
UL508 **NEMA rating** (Approximate)	12 (Front of module when installed into the control panel with the supplied sealing gasket). 2 (Front of module when installed into the control panel WITHOUT being sealed to the panel)
IEEE C37.2 (Standard Electrical Power System Device Function Numbers and Contact Designations)	Under the scope of IEEE 37.2, *function numbers can also be used to represent functions in microprocessor devices and software programs*. The 7000 series controller is device number 11L-7000 (Multifunction device protecting Line (generator) – 7000 series module). As the module is configurable by the generator OEM, the functions covered by the module will vary. Under the module's factory configuration, the device numbers included within the module are : 2 – Time delay starting or closing relay 6 – Starting circuit breaker 27AC – AC undervoltage relay 27DC – DC undervoltage relay 30 – annunciator relay 42 – Running circuit breaker 50 – instantaneous overcurrent relay 51 – ac time overcurrent relay 52 – ac circuit breaker 53DC – exciter or dc generator relay 54 – turning gear engaging device 59AC – AC overvoltage relay 59DC – DC overvoltage relay 62 – time delay stopping or opening relay 63 – pressure switch 74– alarm relay 81 – frequency relay 86 – lockout relay

In line with our policy of continual development, Deep Sea Electronics, reserve the right to change specification without notice.

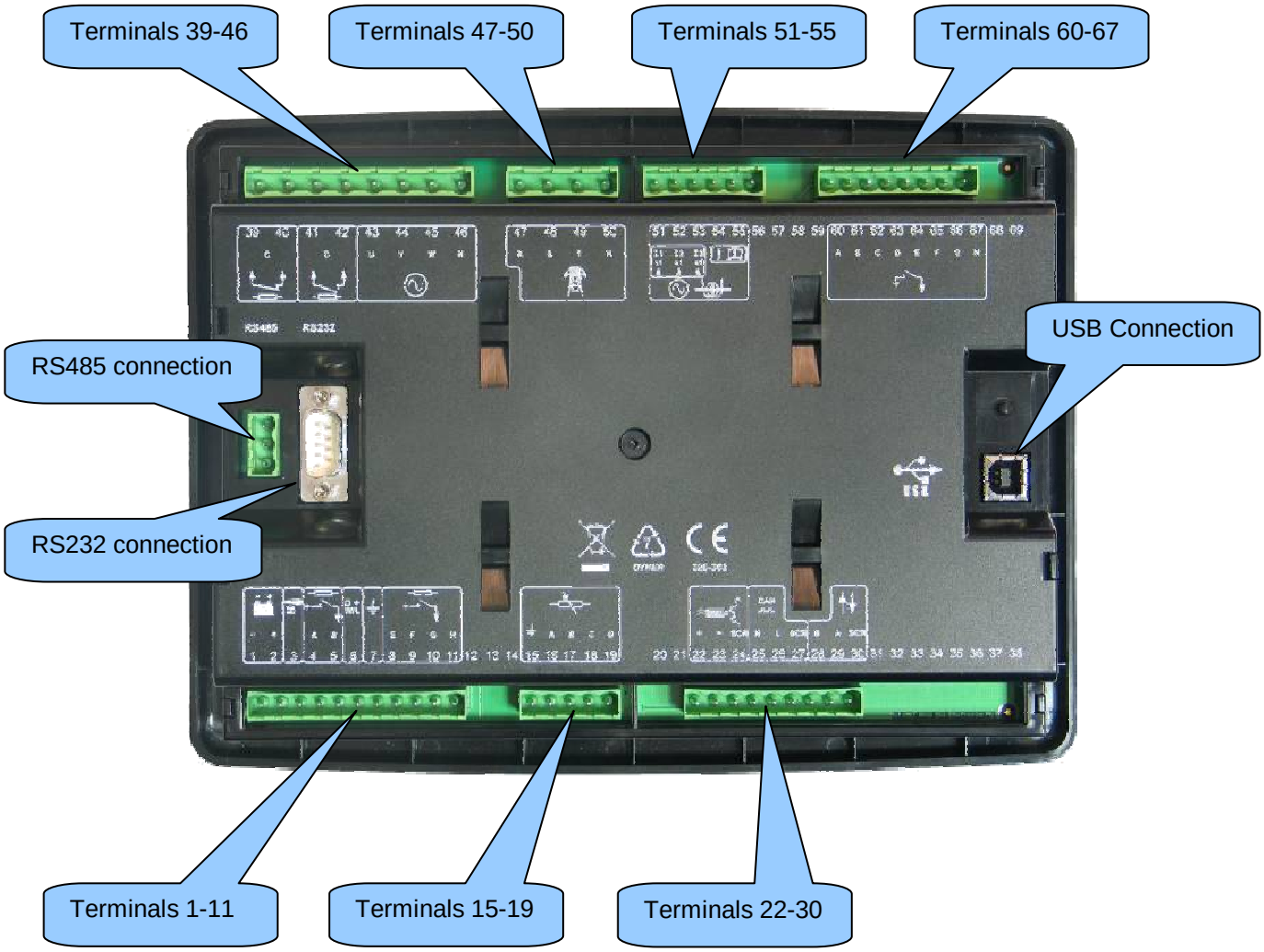
4 INSTALLATION

The DSE7000 Series module is designed to be mounted on the panel fascia. For dimension and mounting details, see the section entitled *Specification, Dimension and mounting* elsewhere in this document.

4.1 USER CONNECTIONS

To aid user connection, icons are used on the rear of the module to help identify terminal functions. An example of this is shown below.

NOTE : Availability of some terminals depends upon module version. Full details are given in the section entitled *Terminal Description* elsewhere in this manual.



4.2 TERMINAL DESCRIPTION

4.2.1 DC SUPPLY, FUEL AND START OUTPUTS

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	1	DC Plant Supply Input (Negative)	2.5mm² AWG 13	
	2	DC Plant Supply Input (Positive)	2.5 mm² AWG 13	(Recommended Maximum Fuse 15A anti-surge) Supplies the module (2A anti-surge requirement) and Output relays E,F,G & H
	3	Emergency Stop Input	2.5mm² AWG 13	Plant Supply Positive. Also supplies outputs 1 & 2. (Recommended Maximum Fuse 20A)
	4	Output relay A (FUEL)	2.5mm² AWG 13	Plant Supply Positive from terminal 3. 15 Amp rated. Fixed as FUEL relay if electronic engine is not configured.
	5	Output relay B (START)	2.5mm² AWG 13	Plant Supply Positive from terminal 3. 15 Amp rated. Fixed as START relay if electronic engine is not configured.
D + W/L	6	Charge fail / excite	2.5mm² AWG 13	Do not connect to ground (battery negative). If charge alternator is not fitted, leave this terminal disconnected.
	7	Functional Earth	2.5mm² AWG 13	Connect to a good clean earth point.
	8	Output relay E	1.0mm² AWG 18	Plant Supply Positive from terminal 2. 3 Amp rated.
	9	Output relay F	1.0mm² AWG 18	Plant Supply Positive from terminal 2. 3 Amp rated.
	10	Output relay G	1.0mm² AWG 18	Plant Supply Positive. from terminal 2. 3 Amp rated.
	11	Output relay H	1.0mm² AWG 18	Plant Supply Positive from terminal 2. 3 Amp rated.

NOTE:- Terminals 12 to 14 are not fitted to the DSE7200/DSE7300 series controller.

NOTE:- When the module is configured for operation with an electronic engine, FUEL and START output requirements may be different. Refer to *Electronic Engines and DSE Wiring* for further information. Part No. 057-004.

4.2.2 ANALOGUE SENSOR

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	15	Sensor Common Return	0.5mm² AWG 20	Return feed for sensors*
	16	Oil Pressure Input	0.5mm² AWG 20	Connect to Oil pressure sensor
	17	Coolant Temperature Input	0.5mm² AWG 20	Connect to Coolant Temperature sensor
	18	Fuel Level input	0.5mm² AWG 20	Connect to Fuel Level sensor
	19	Flexible sensor (not available on 7200 series controller)	0.5mm² AWG 20	Connect to additional sensor (user configurable)

NOTE:- Terminals 20 and 21 are not fitted to the 7200/7300 series controller.

NOTE*:- If using single terminal sensors refer to the Appendix section entitled "Sensor wiring recommendations" elsewhere in this manual.

4.2.3 MAGNETIC PICKUP, CAN AND EXPANSION

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	22	Magnetic pickup Positive	0.5mm² AWG 20	Connect to Magnetic Pickup device
	23	Magnetic pickup Negative	0.5mm² AWG 20	Connect to Magnetic Pickup device
	24	Magnetic pickup screen	Shield	Connect to ground at one end only
CAN	25	CAN port H	0.5mm² AWG 20	Use only 120Ω CAN approved cable
	26	CAN port L	0.5mm² AWG 20	Use only 120Ω CAN approved cable
	27	CAN port Common	0.5mm² AWG 20	Use only 120Ω CAN approved cable
	28	+	0.5mm² AWG 20	Use only 120Ω RS485 approved cable
	29	-	0.5mm² AWG 20	Use only 120Ω RS485 approved cable
	30	SCR	0.5mm² AWG 20	Use only 120Ω RS485 approved cable

NOTE:- Terminals 31 to 38 are not fitted to the 7200 / 7300 controller

NOTE:- Screened cable must be used for connecting the Magnetic Pickup, ensuring that the screen is earthed at one end ONLY.

NOTE:- Screened 120Ω impedance cable specified for use with CAN must be used for the CAN link and the Multiset comms link.
DSE stock and supply Belden cable 9841 which is a high quality 120Ω impedance cable suitable for CAN use (DSE part number 016-030)

NOTE:- When the module is configured for CAN operation, terminals 22, 23 & 24 should be left unconnected. Engine speed is transmitted to the 7000 series controller on the CAN link.
Refer to *Electronic Engines and DSE Wiring* for further information. Part No. 057-004.

4.2.4 LOAD SWITCHING AND GENERATOR VOLTAGE SENSING

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	39	Output relay C	1.0mm AWG 18	Normally configured to control mains contactor coil (Recommend 10A fuse)
	40	Output relay C	1.0mm AWG 18	Normally configured to control mains contactor coil
	41	Output relay D	1.0mm AWG 18	Normally configured to control generator contactor coil (Recommend 10A fuse)
	42	Output relay D	1.0mm AWG 18	Normally configured to control generator contactor coil
	43	Generator L1 (U) voltage monitoring	1.0mm² AWG 18	Connect to generator L1 (U) output (AC) (Recommend 2A fuse)
	44	Generator L2 (V) voltage monitoring input	1.0mm² AWG 18	Connect to generator L2 (V) output (AC) (Recommend 2A fuse)
	45	Generator L3 (W) voltage monitoring input	1.0mm² AWG 18	Connect to generator L3 (W) output (AC) (Recommend 2A fuse)
	46	Generator Neutral (N) input	1.0mm² AWG 18	Connect to generator Neutral terminal (AC)

NOTE:- The above table describes connections to a three phase, four wire alternator. For alternative wiring topologies, please see the ALTERNATIVE AC TOPOLOGIES section of this manual.

4.2.5 MAINS VOLTAGE SENSING

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	47	Mains L1 (R) voltage monitoring	1.0mm AWG 18	Connect to Mains L1 (R) incoming supply (AC) (Recommend 2A fuse)
	48	Mains L2 (S) voltage monitoring	1.0mm AWG 18	Connect to Mains L1 (S) incoming supply (AC) (Recommend 2A fuse)
	49	Mains L3 (T) voltage monitoring	1.0mm AWG 18	Connect to Mains L1 (T) incoming supply (AC) (Recommend 2A fuse)
	50	Mains Neutral (N) input	1.0mm AWG 18	Connect to Mains N incoming supply (AC)

NOTE:- Terminals 47-50 are not fitted to the 7210 / 7310 controller.

4.2.6 GENERATOR CURRENT TRANSFORMERS

WARNING!:- Do not disconnect this plug when the CTs are carrying current. Disconnection will open circuit the secondary of the C.T.'s and dangerous voltages may then develop. Always ensure the CTs are not carrying current and the CTs are short circuit connected before making or breaking connections to the module.

NOTE:- The 7000 series module has a burden of 0.5VA on the CT. Ensure the CT is rated for the burden of the 7000 series controller, the cable length being used and any other equipment sharing the CT. If in doubt, consult your CT supplier.

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	51	CT Secondary for Gen L1	2.5mm² AWG 13	Connect to s1 secondary of L1 monitoring CT
	52	CT Secondary for Gen L2	2.5mm² AWG 13	Connect to s1 secondary of L2 monitoring CT
	53	CT Secondary for Gen L3	2.5mm² AWG 13	Connect to s1 secondary of L3 monitoring CT

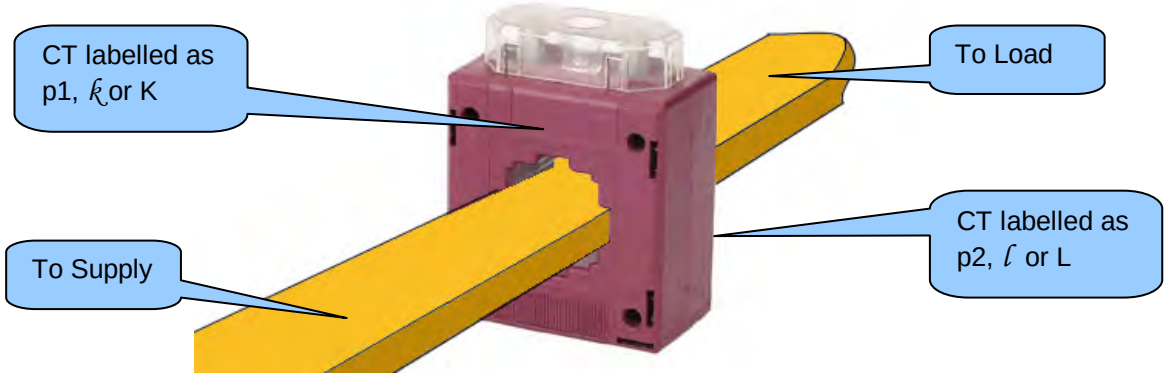
Connection to terminals 54 & 55

The function of terminals 54 and 55 change position depending upon wiring topology as follows :

Type	Topology	Pin No	Description	CABLE SIZE
7200 series	All	54	DO NOT CONNECT	
		55	Common for CTs connected to L1,L2,L3	2.5mm² AWG 13
7300 series	No earth fault measuring	54	DO NOT CONNECT	
		55	Common for CTs connected to L1,L2,L3	2.5mm² AWG 13
	Restricted earth fault measuring	54	Common for CTs connected to L1,L2,L3,N	2.5mm² AWG 13
		55	Connect to CT on the neutral conductor	2.5mm² AWG 13
	Un-restricted earth fault measuring (Earth fault CT is fitted in the neutral to earth link)	54	DO NOT CONNECT	
		55	Common for CTs connected to L1,L2,L3	2.5mm² AWG 13

NOTE:- Terminals 56 to 59 are not fitted to the 7200 / 7300 series controller.

NOTE:- Take care to ensure correct polarity of the CT primary as shown below. If in doubt, check with the CT supplier.



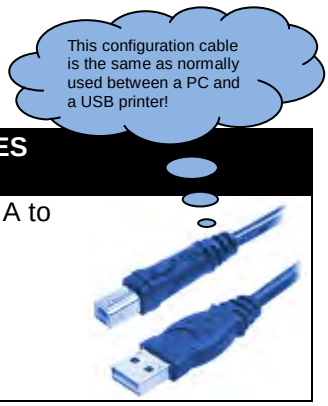
4.2.7 CONFIGURABLE DIGITAL INPUTS

	PIN No	DESCRIPTION	CABLE SIZE	NOTES
	60	Configurable digital input A	0.5mm² AWG 20	Switch to negative
	61	Configurable digital input B	0.5mm² AWG 20	Switch to negative
	62	Configurable digital input C	0.5mm² AWG 20	Switch to negative
	63	Configurable digital input D	0.5mm² AWG 20	Switch to negative
	64	Configurable digital input E	0.5mm² AWG 20	Switch to negative
	65	Configurable digital input F	0.5mm² AWG 20	Switch to negative
	66	Configurable digital input G (not available on 7200 series)	0.5mm² AWG 20	Switch to negative
	67	Configurable digital input H (not available on 7200 series)	0.5mm² AWG 20	Switch to negative

NOTE:- Terminals 66 to 69 are not fitted to the 7200 series controller.

NOTE:- Terminals 68 and 69 are not fitted to the 7300 series controller.

4.2.8 PC CONFIGURATION INTERFACE CONNECTOR



	DESCRIPTION	CABLE SIZE	NOTES
USB	Socket for connection to PC with 7xxx series PC software.	0.5mm² AWG 20	This is a standard USB type A to type B connector.

NOTE:- The USB connection cable between the PC and the 7000 series module must not be extended beyond 5m (5yds). For distances over 5m, it is possible to use a third party USB extender. Typically, they extend USB up to 50m (yds). The supply and support of this type of equipment is outside the scope of Deep Sea Electronics PLC.

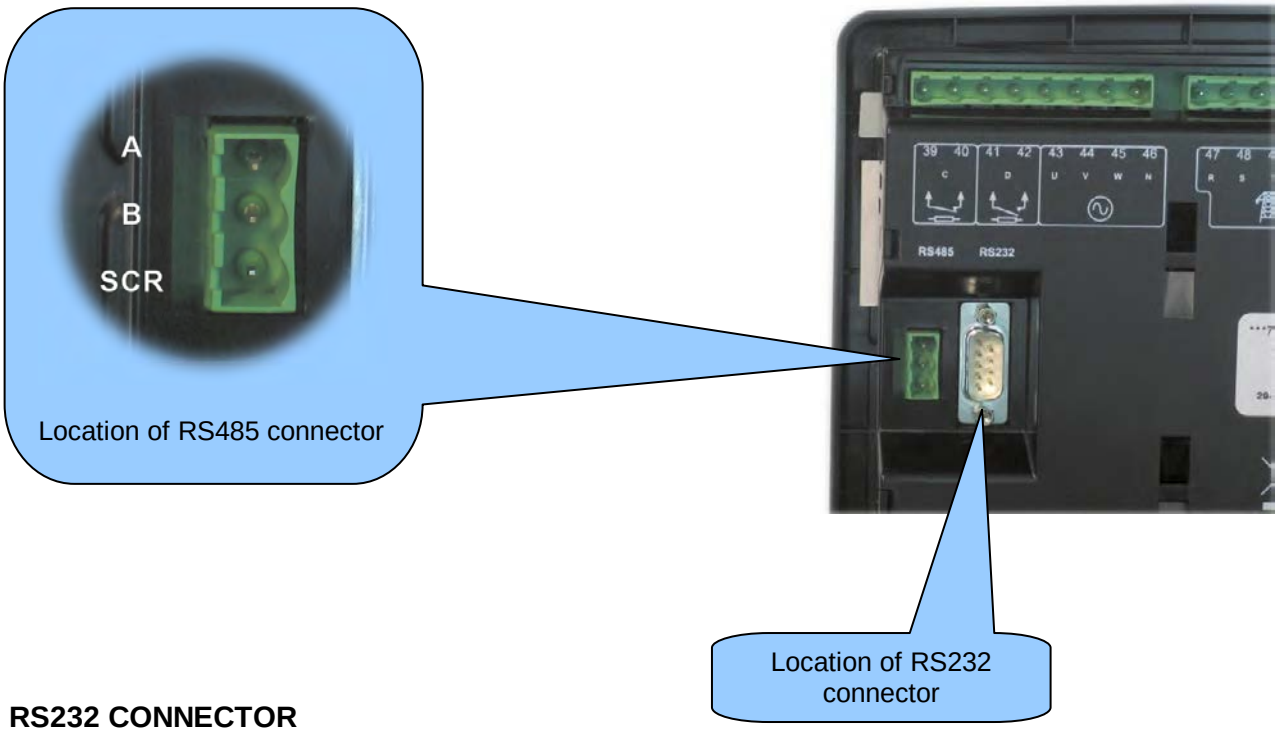
CAUTION!: Care must be taken not to overload the PCs USB system by connecting more than the recommended number of USB devices to the PC. For further information, consult your PC supplier.

CAUTION!: This socket must not be used for any other purpose.

4.2.9 RS485 CONNECTOR

NOTE:- RS485 connector is not fitted to the 7200 series controller.

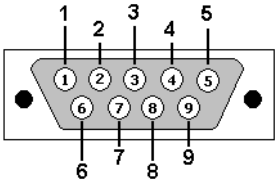
PIN No	NOTES
A	Two core screened twisted pair cable. 120Ω impedance suitable for RS485 use. Recommended cable type - Belden 9841 Max distance 1000m (1km) when using Belden 9841 or direct equivalent.
B	
SCR	



4.2.10 RS232 CONNECTOR

NOTE:- RS232 connector is not fitted to the 7200 series controller.

PIN No	NOTES
1	Received Line Signal Detector (Data Carrier Detect)
2	Received Data
3	Transmit Data
4	Data Terminal Ready
5	Signal Ground
6	Data Set Ready
7	Request To Send
8	Clear To Send
9	Ring Indicator

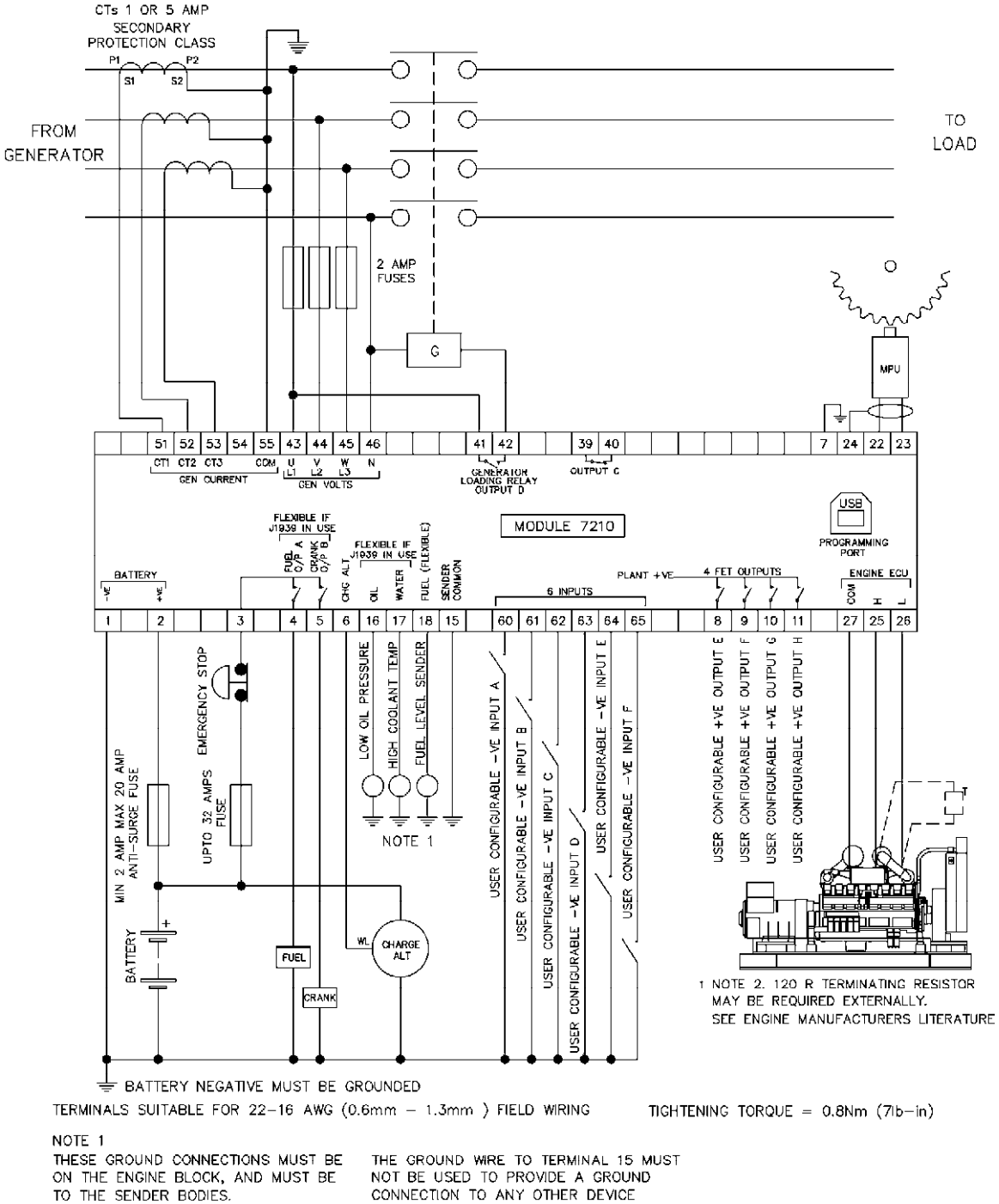


View looking into the male connector on the 7000 series module

4.3 TYPICAL WIRING DIAGRAMS

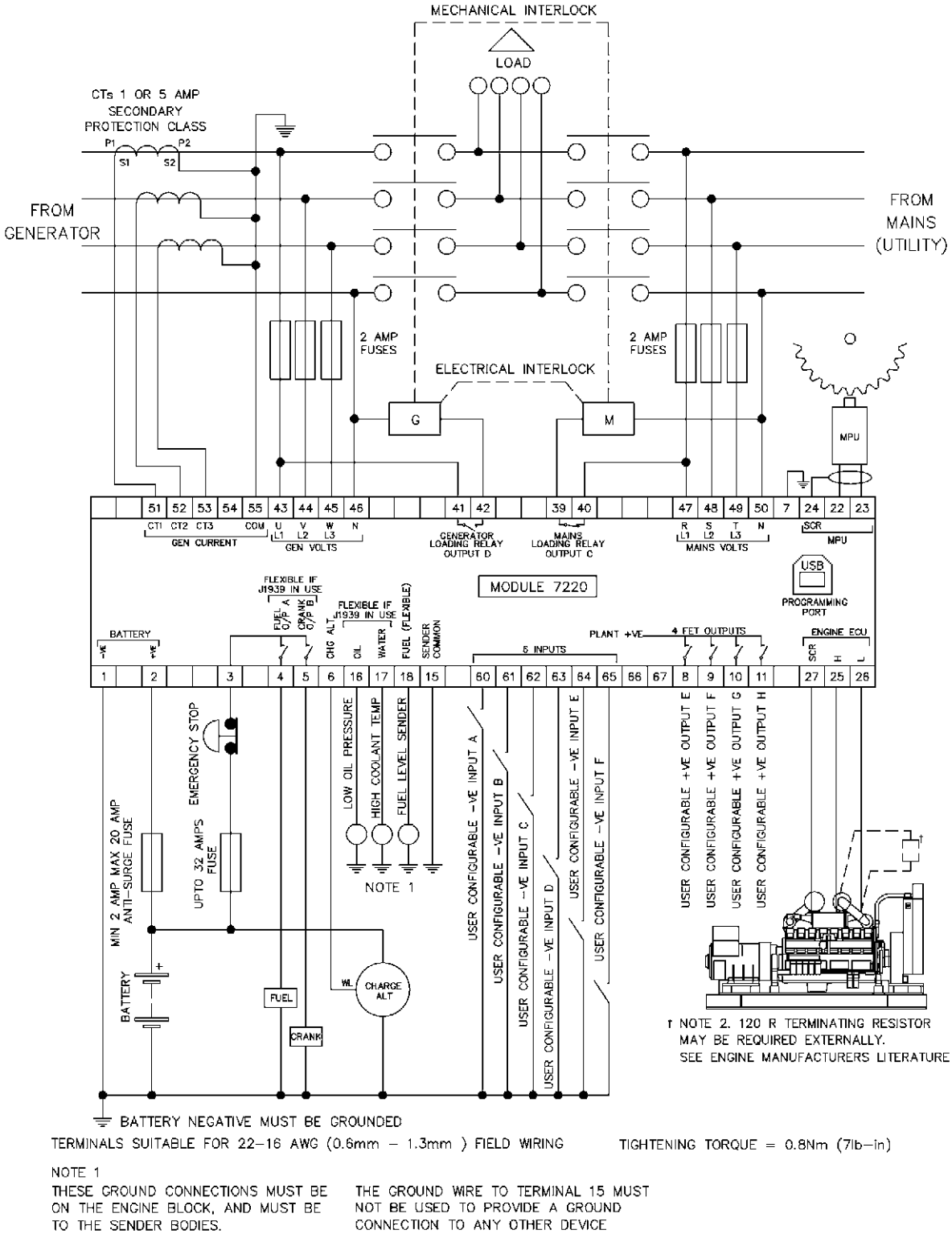
4.3.1 7210 AUTOSTART CONTROLLER

3 phase, 4 wire



4.3.2 7220 AMF CONTROLLER

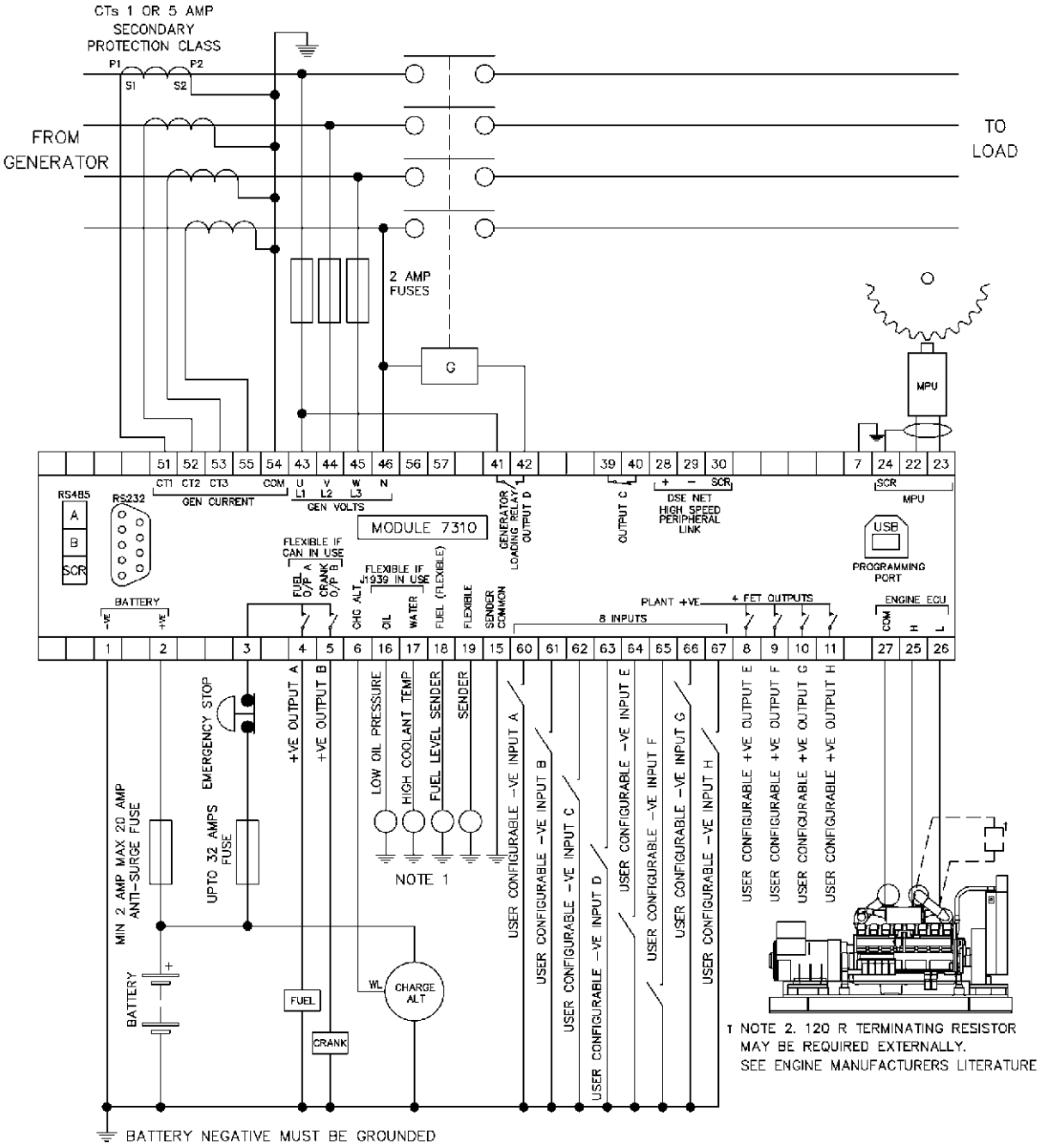
3 phase, 4 wire



4.3.3 7310 AUTOSTART CONTROLLER

3 phase, 4 wire with restricted earth fault protection

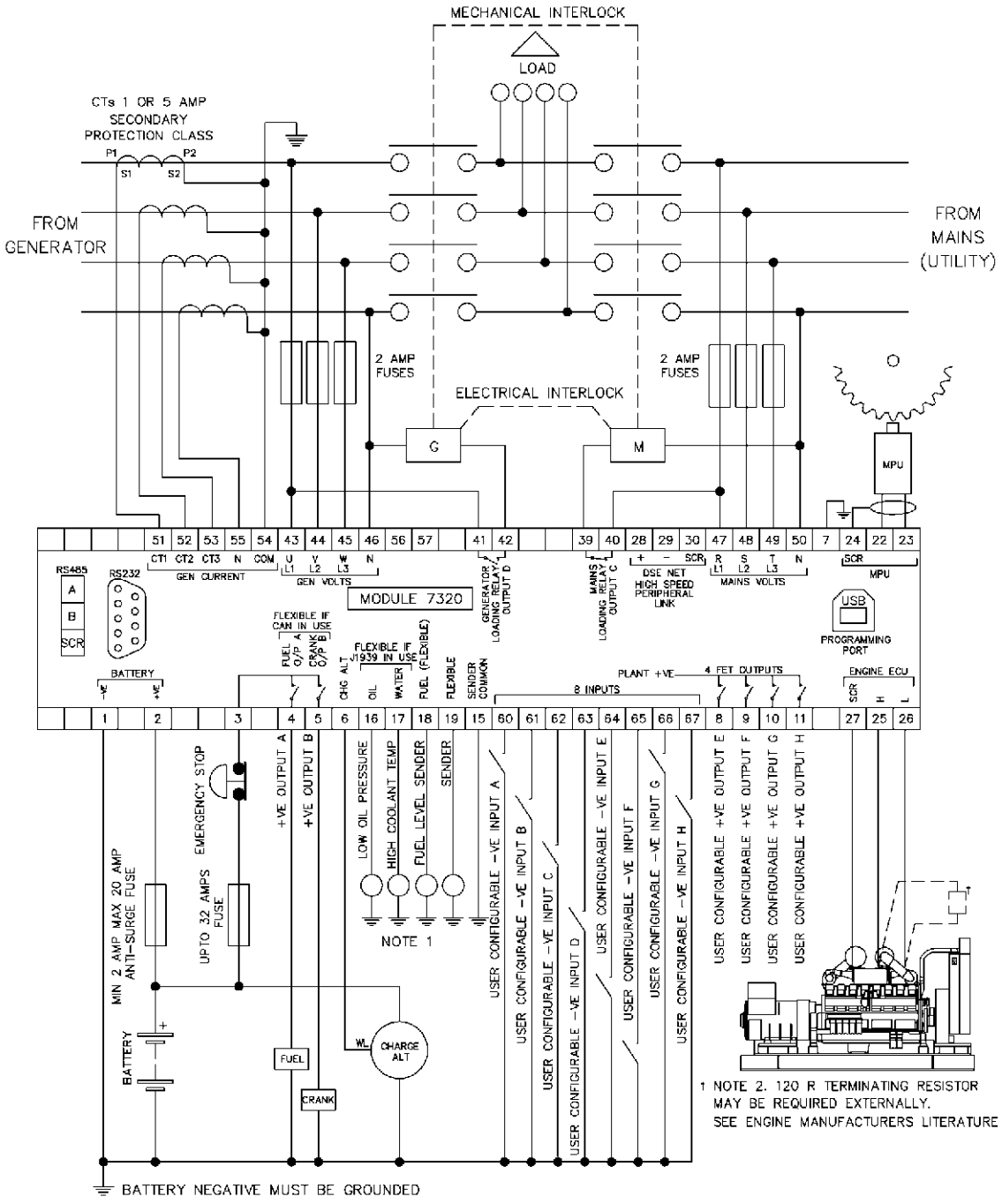
NOTE:- Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT)



4.3.4 7320 AMF CONTROLLER

3 phase, 4 wire with restricted earth fault protection

NOTE:- Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT)



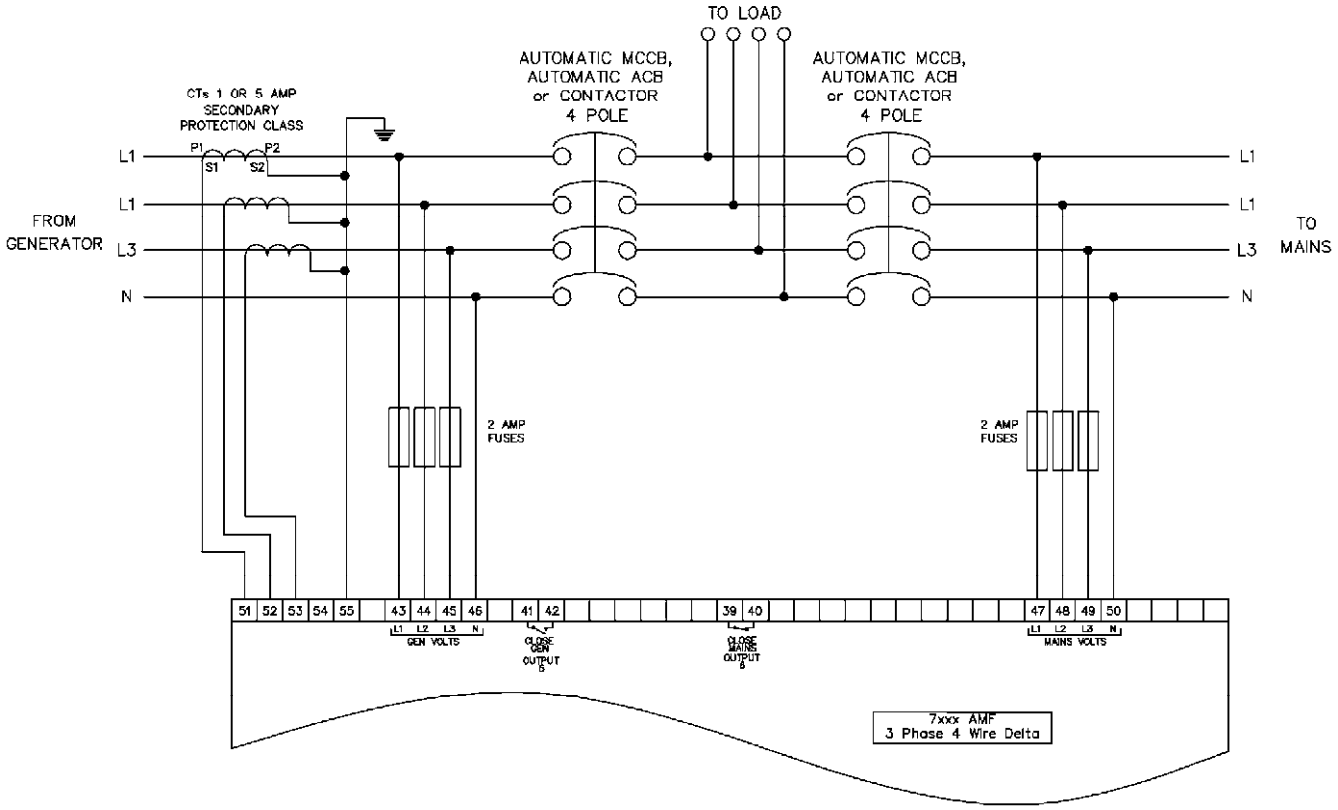
4.4 ALTERNATIVE TOPOLOGIES

The 7000 controller is factory configured to connect to a 3 phase, 4 wire Star connected alternator. This section details connections for alternative AC topologies. Ensure to configure the 7000 series controller to suit the required topology.

NOTE:- Further details of module configuration are contained within the DSE7000 Series configuration software manual (DSE part number 057-077)

4.4.1 3 PHASE, 4 WIRE WITHOUT EARTH FAULT PROTECTION

NOTE:- Mains sensing (Terminals 47-50) is not fitted to DSE7210/ DSE7310 autostart controllers.

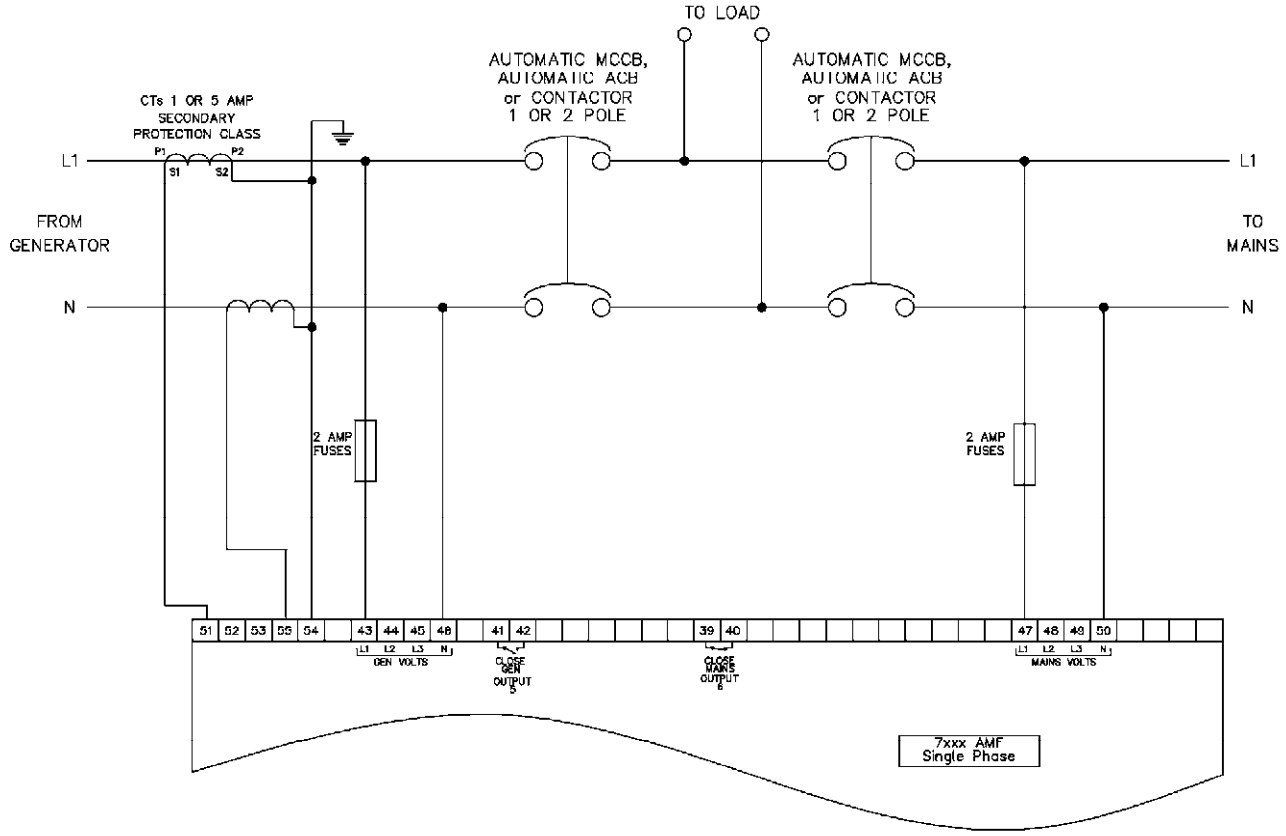


4.4.2 SINGLE PHASE WITH RESTRICTED EARTH FAULT MEASURING

NOTE:- Earth fault measuring not available on 7200 series controllers.

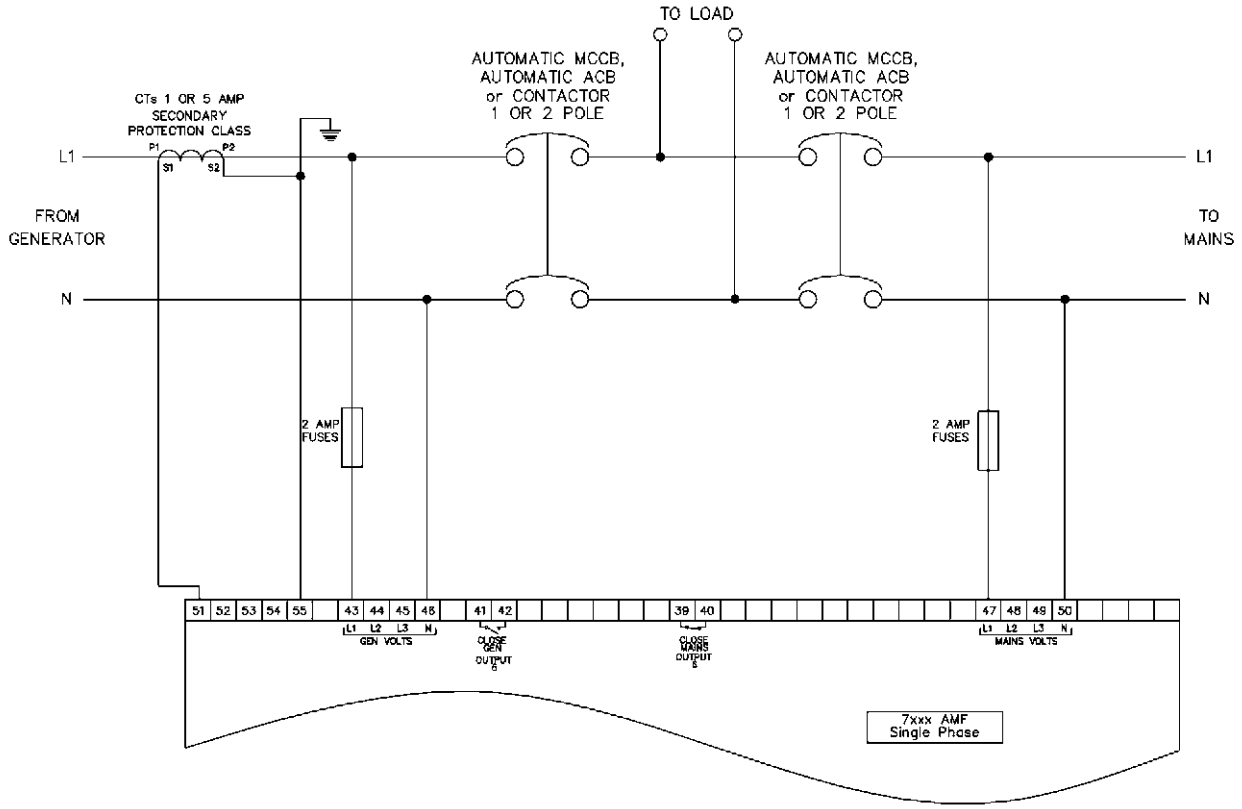
NOTE:- Mains sensing (Terminals 47-50) is not fitted to DSE7210/ DSE7310 autostart controllers.

NOTE:- Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT)



4.4.3 SINGLE PHASE WITHOUT EARTH FAULT MEASURING

NOTE:- Mains sensing (Terminals 47-50) is not fitted to DSE7210/ DSE7310 autostart controllers.

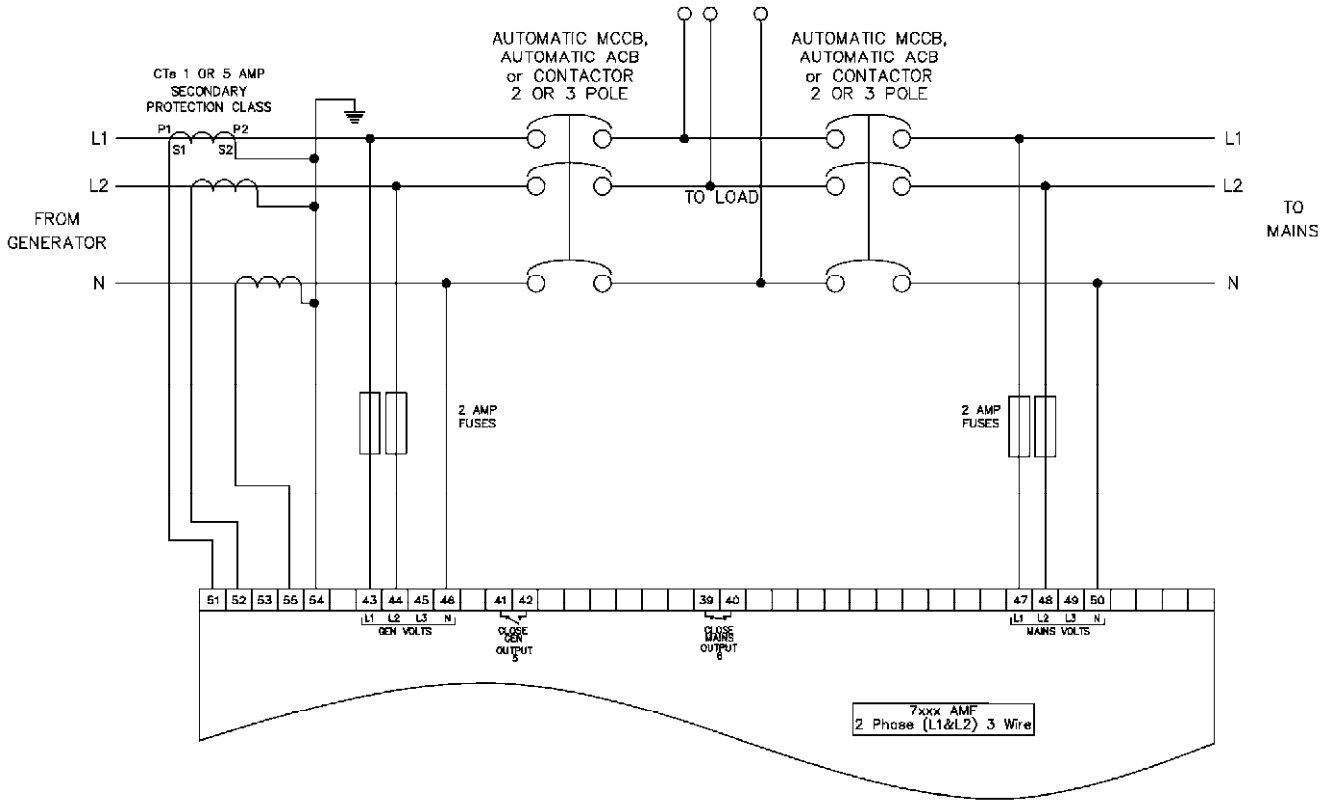


4.4.4 2 PHASE (L1 & L2) 3 WIRE WITH RESTRICTED EARTH FAULT MEASURING

NOTE:- Earth fault measuring not available on 7200 series controllers.

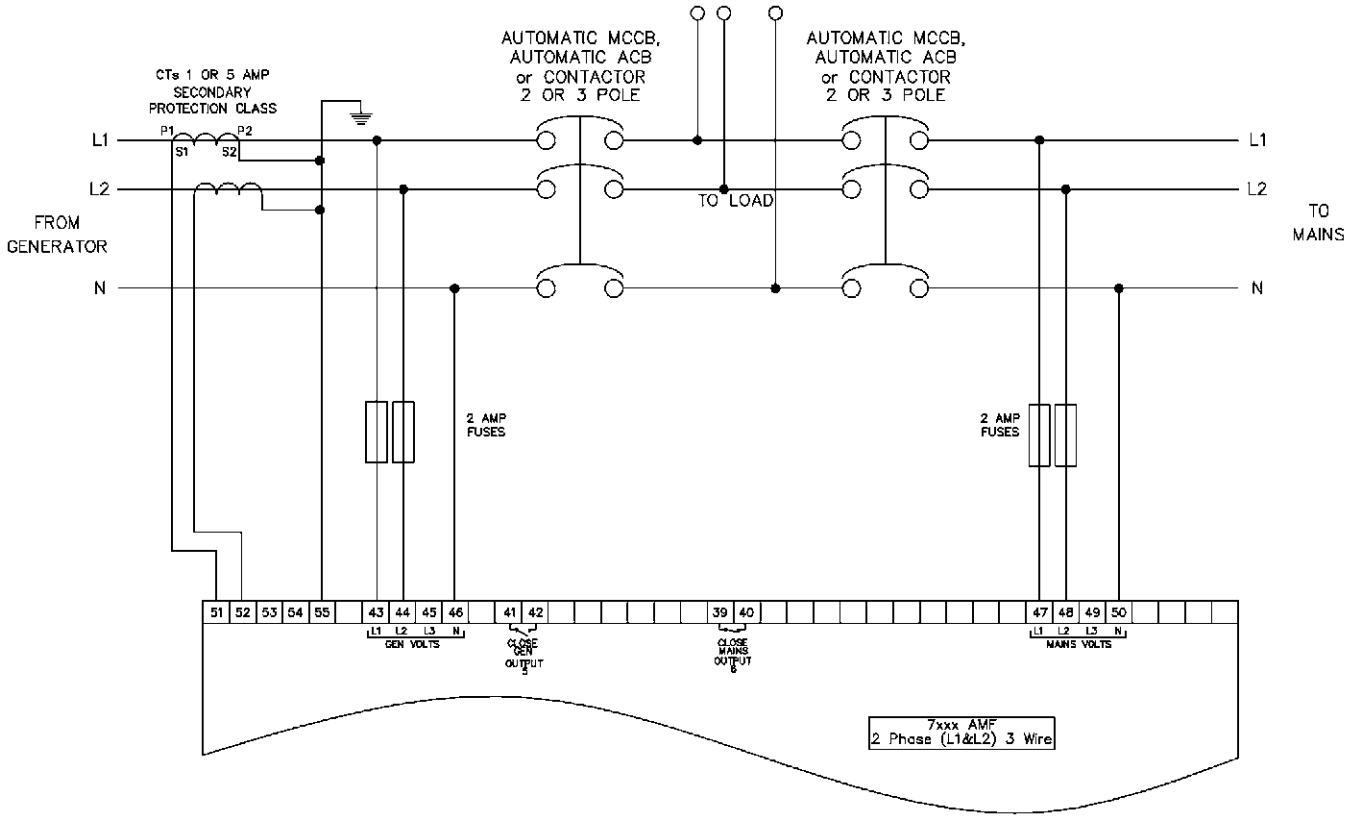
NOTE:- Mains sensing (Terminals 47-50) is not fitted to DSE7210/ DSE7310 autostart controllers.

NOTE:- Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT)



4.4.5 2 PHASE (L1 & L2) 3 WIRE WITHOUT EARTH FAULT MEASURING

NOTE:- Mains sensing (Terminals 47-50) is not fitted to DSE7210/ DSE7310 autostart controllers.

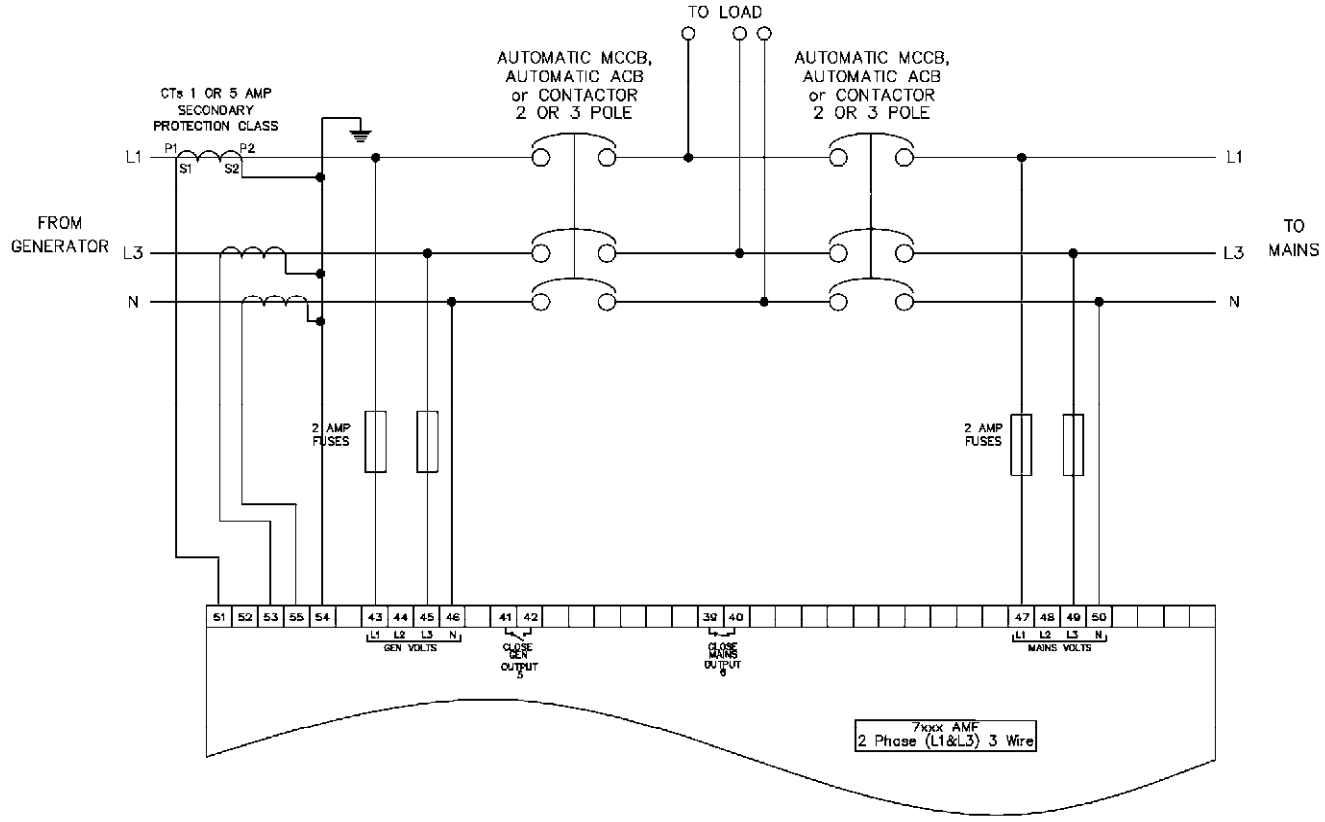


4.4.6 2 PHASE (L1 & L3) 3 WIRE WITH RESTRICTED EARTH FAULT MEASURING

NOTE:- Earth fault measuring not available on 7200 series controllers.

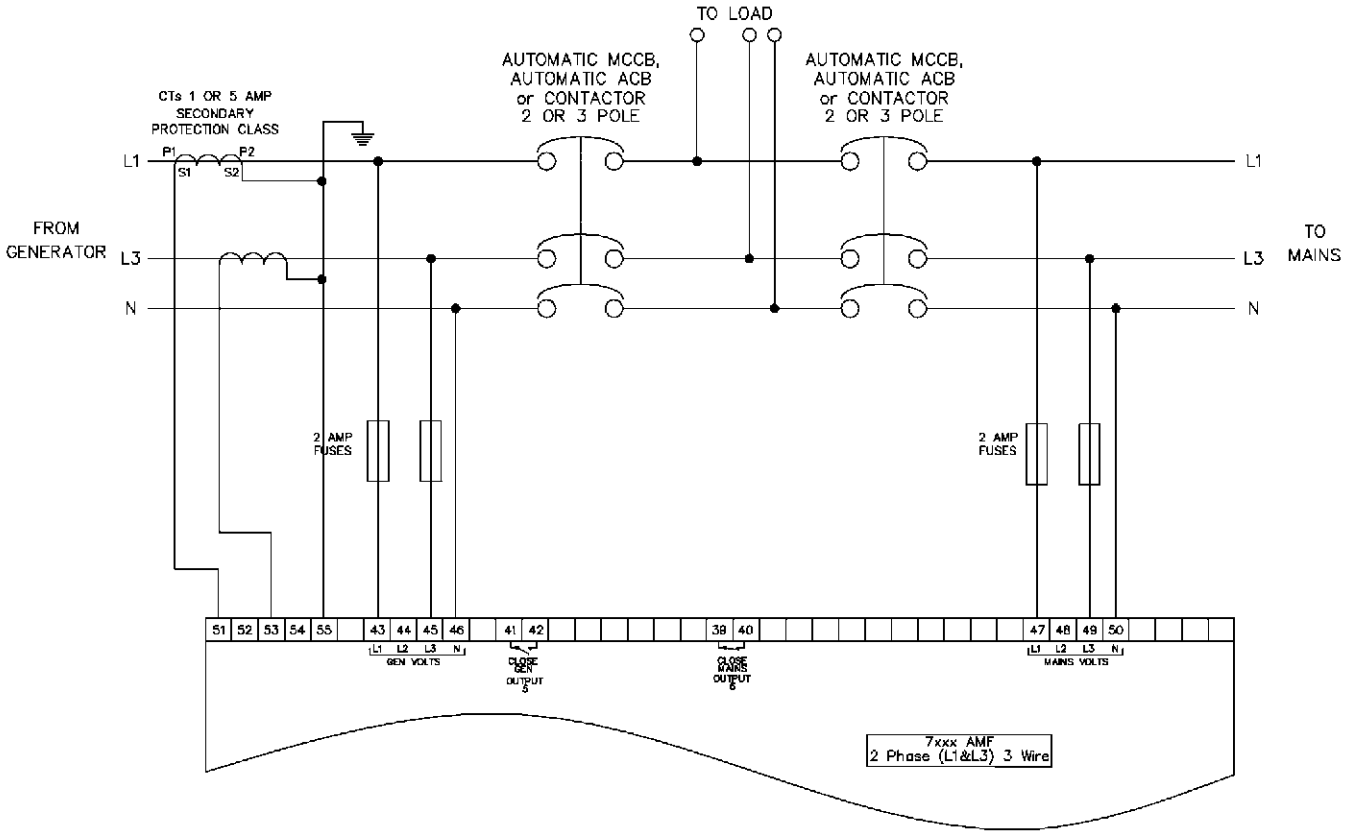
NOTE:- Mains sensing (Terminals 47-50) is not fitted to DSE7210/ DSE7310 autostart controllers.

NOTE:- Earthing the neutral conductor 'before' the neutral CT allows the module to read earth faults 'after' the CT only (Restricted to load / downstream of the CT)
Earthing the neutral conductor 'after' the neutral CT allows the module to read earth faults 'before' the CT only (Restricted to generator / upstream of the CT)



4.4.7 2 PHASE (L1 & L3) 3 WIRE WITHOUT EARTH FAULT MEASURING

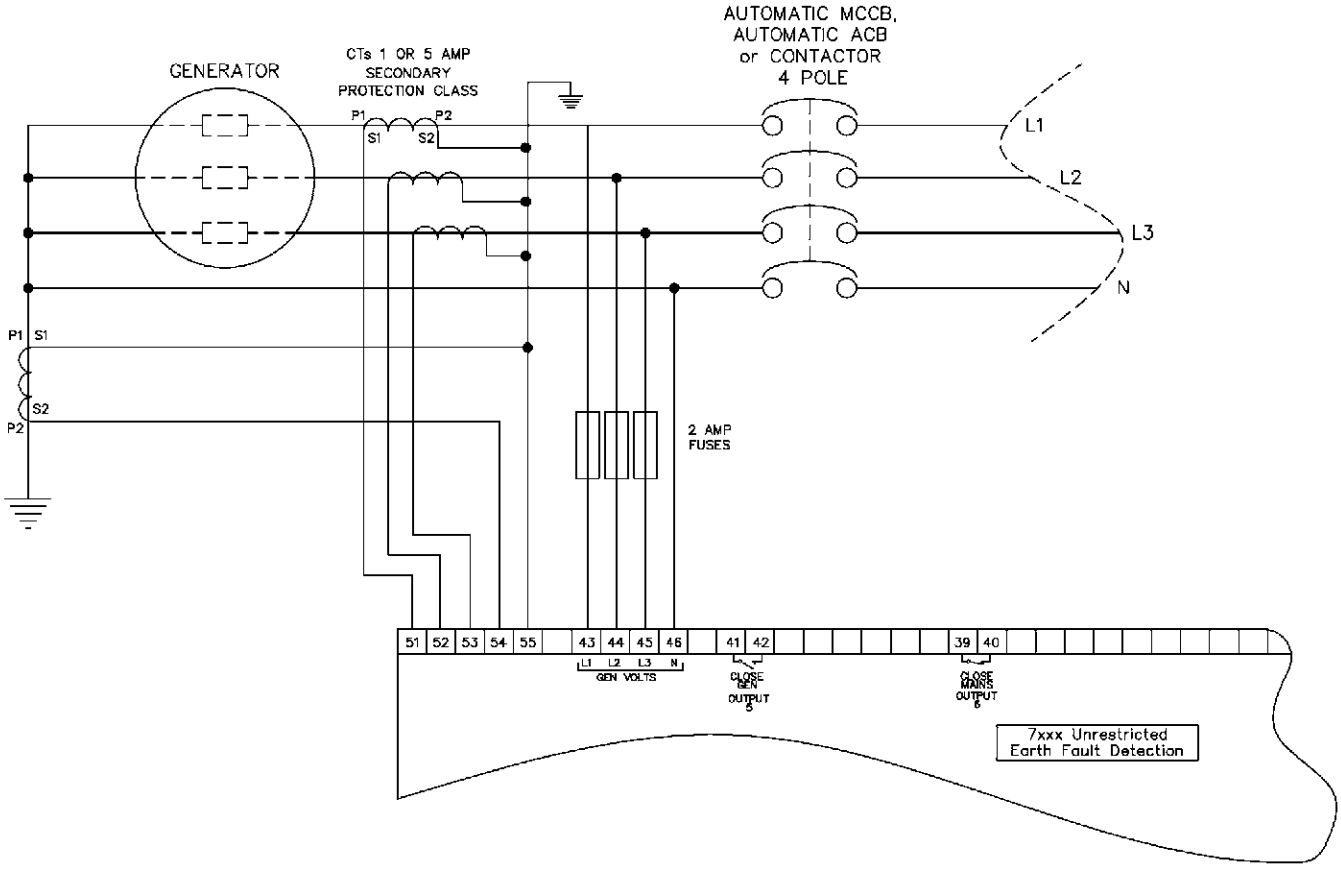
NOTE:- Mains sensing (Terminals 47-50) is not fitted to DSE7210/ DSE7310 autostart controllers.



4.4.8 3 PHASE 4 WIRE WITH UNRESTRICTED EARTH FAULT MEASURING

NOTE:- Earth fault measuring not available on 7200 series controllers.

NOTE:- Mains sensing (Terminals 47-50) is not fitted to DSE7210/ DSE7310 autostart controllers.

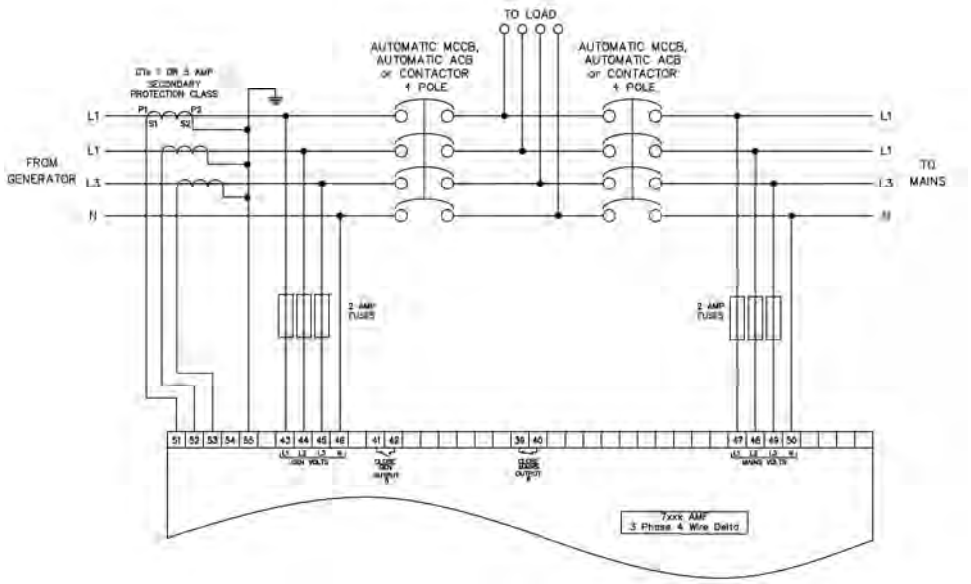


4.5 CT LOCATION

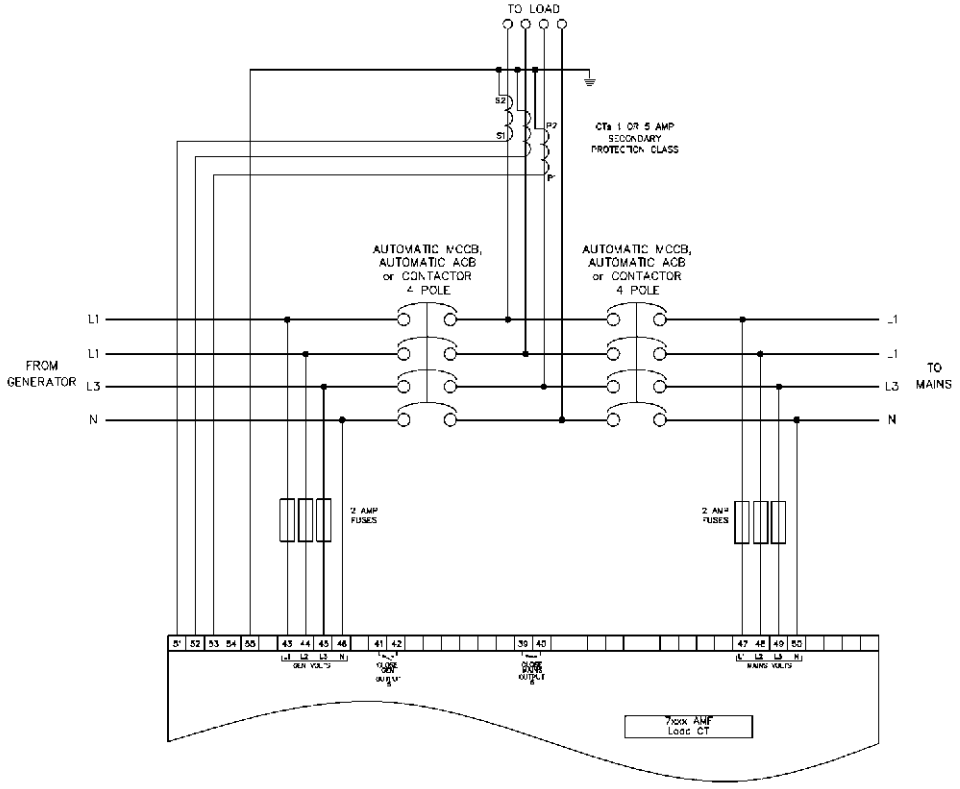
NOTE:- CT Location is not applicable to the DSE7210 / DSE7310 autostart controllers.

There are two possible locations for the current transformers in the system:

1) **Generator** : The CTs are used to measure and display generator current only. The typical wiring diagrams in the preceding section all show the CT measuring the generator load. For clarity, an example is shown below.



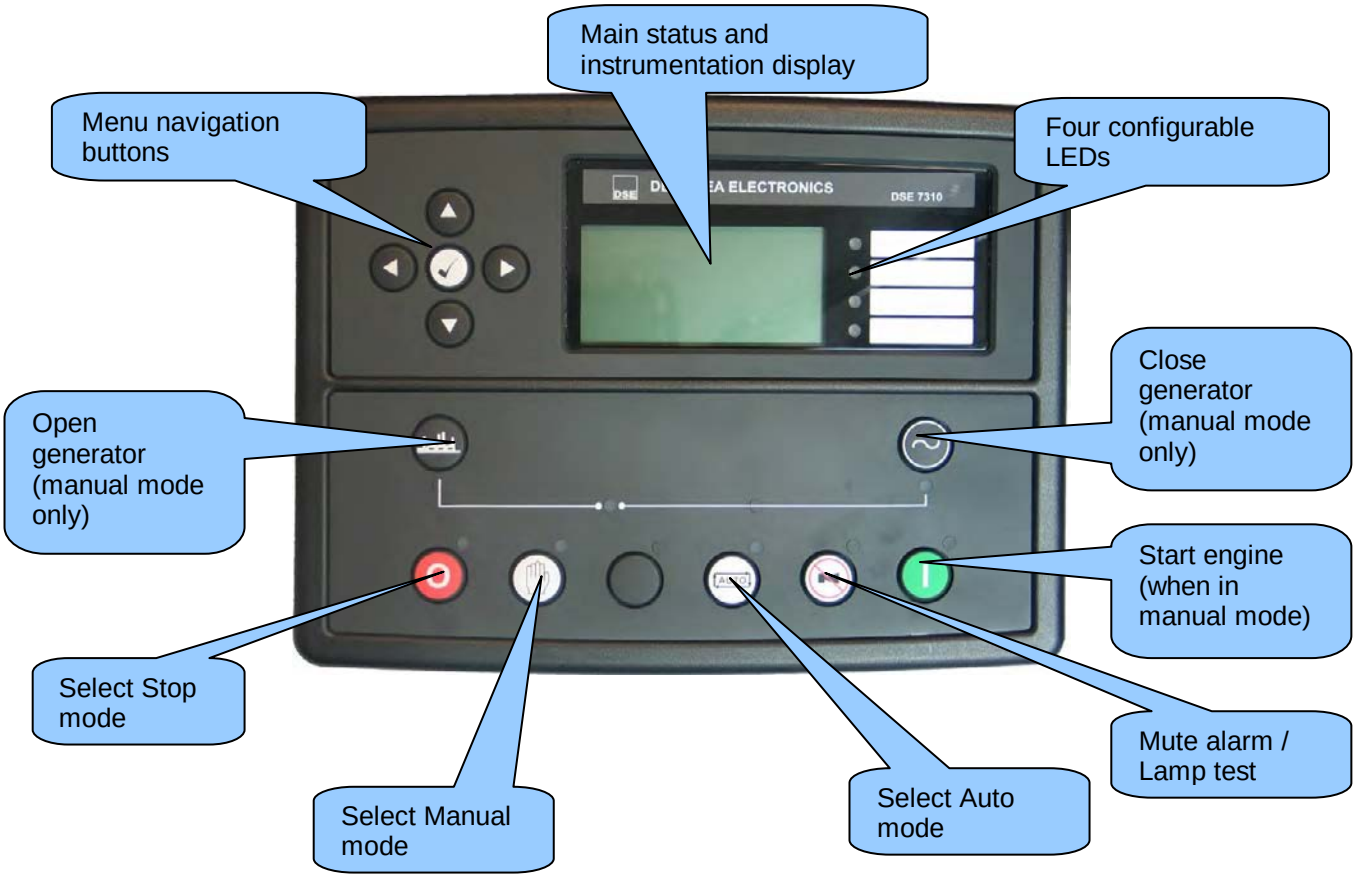
2) **Load** : The CTs are used to measure and display generator current when the generator is on load and mains current when the mains is on load. The module display automatically changes to display the current in the relevant instrumentation page. This example shows the CTs in the 'load' for a three phase delta system but the same philosophy is applicable to the other topologies.

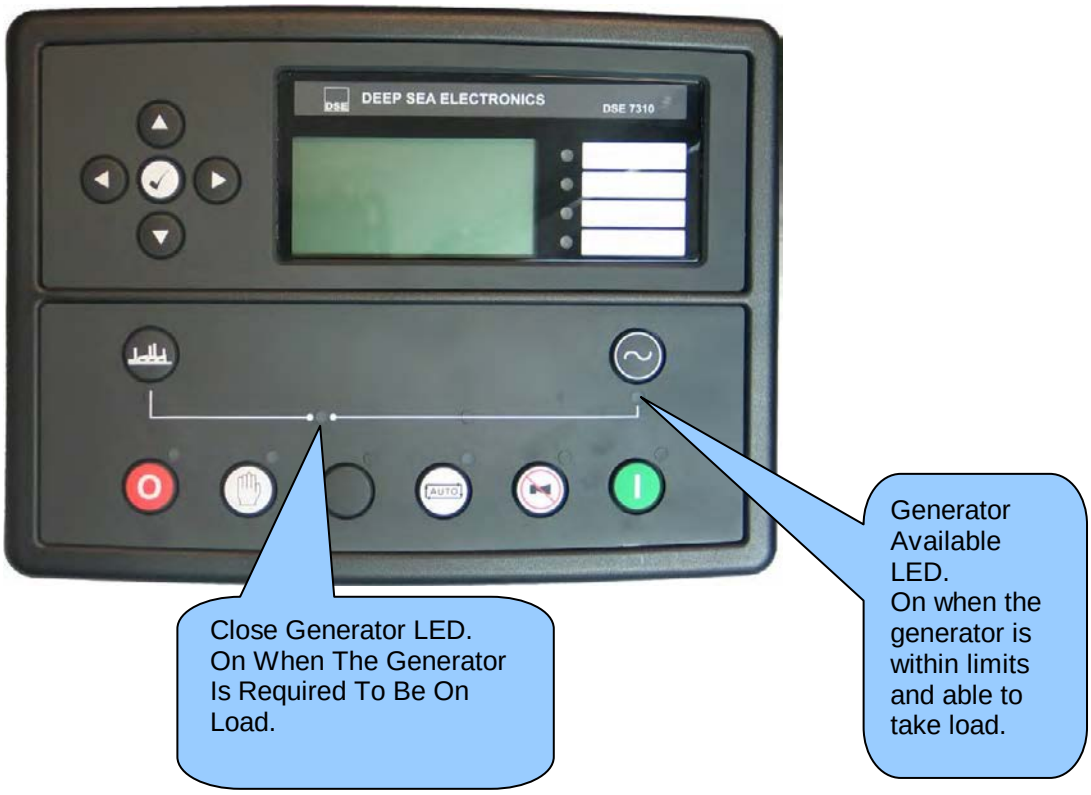


5 DESCRIPTION OF CONTROLS

The following section details the function and meaning of the various controls on the module.

5.1 DSE7210 / DSE7310 AUTOSTART CONTROL MODULE

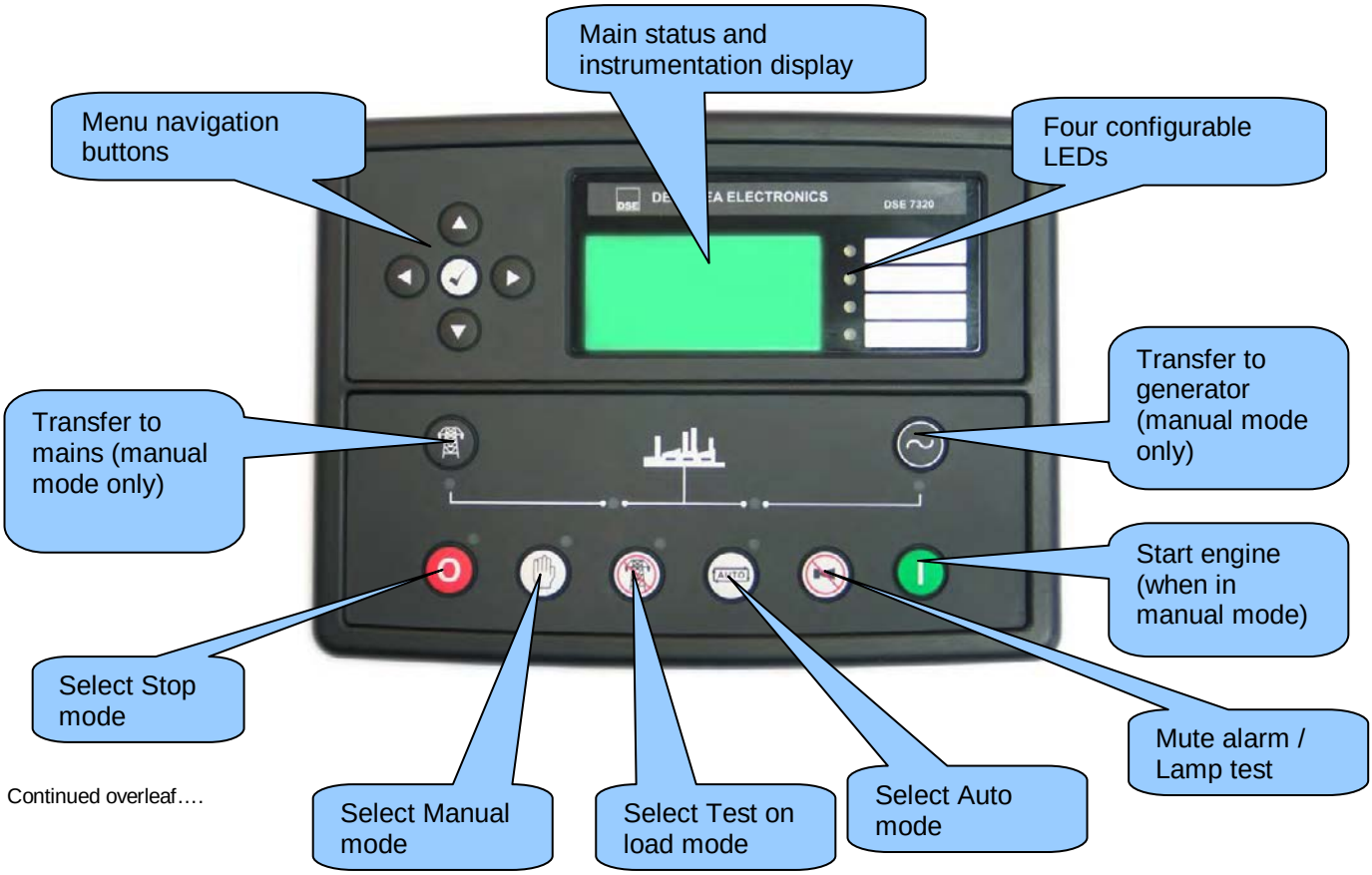




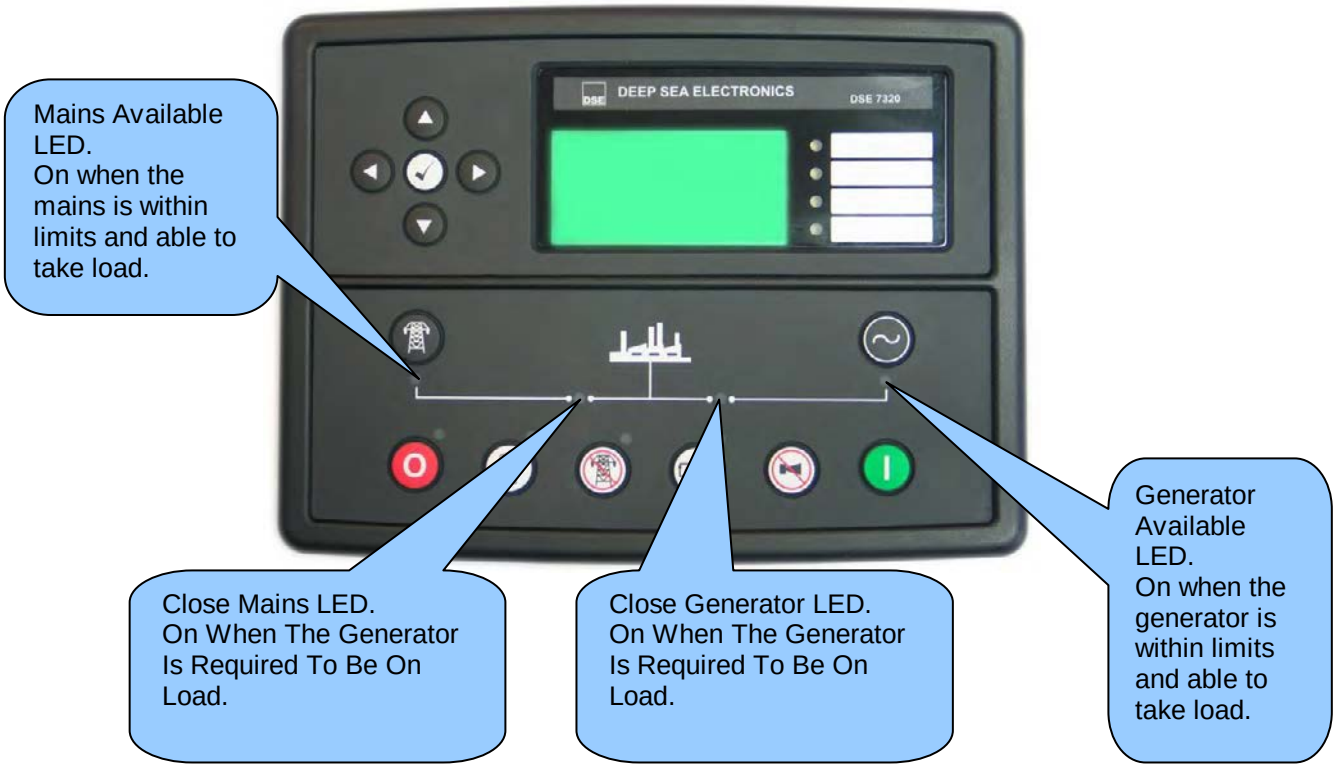
NOTE:- "Generator on load" LED has two modes of operation depending upon the configuration of the controllers digital inputs.

1) **Digital input configured for "Generator closed auxiliary" – The LED illuminates when the generator closed auxiliary input is active – The LED shows the state of the auxiliary contact.**
2) **There is NO input configured for "Generator closed auxiliary" (factory default setting) – The LED illuminates when the 7x20 gives the loading signal to the generator – The LED shows the state of the 7x20's loading request.**

5.2 DSE7220 / DSE7320 AMF CONTROL MODULE



Continued overleaf….



NOTE:- "Generator on load" LED has two modes of operation depending upon the configuration of the controllers digital inputs.

3) **Digital input configured for "Generator closed auxiliary" – The LED illuminates when the generator closed auxiliary input is active – The LED shows the state of the auxiliary contact.**
4) **There is NO input configured for "Generator closed auxiliary" (factory default setting) – The LED illuminates when the 7x20 gives the loading signal to the generator – The LED shows the state of the 7x20's loading request.**

NOTE:- "Mains on load" LED has two modes of operation depending upon the configuration of the controllers digital inputs.

5) **Digital input configured for "Mains closed auxiliary" – The LED illuminates when the mains closed auxiliary input is active – The LED shows the state of the auxiliary contact.**
6) **There is NO input configured for "Mains closed auxiliary" (factory default setting) – The LED illuminates when the 7x20 gives the loading signal to the mains – The LED shows the state of the 7x20's loading request.**

5.3 QUICKSTART GUIDE

This section provides a quick start guide to the module's operation.

5.3.1 STARTING THE ENGINE



NOTE:- For further details, see the section entitled 'OPERATION' elsewhere in this manual.

5.3.2 STOPPING THE ENGINE



NOTE:- For further details, see the section entitled 'OPERATION' elsewhere in this manual.

5.4 VIEWING THE INSTRUMENTS

It is possible to scroll to display the different pages of information by repeatedly operating the next page button.

Once selected the page will remain on the LCD display until the user selects a different page or after an extended period of inactivity, the module will revert to the status display.

If no buttons are pressed upon entering an instrumentation page, the instruments will be displayed automatically subject to the setting of the *Scroll Delay*.

Alternatively, to scroll manually through all instruments on the currently selected page, press the scroll or buttons. The 'autoscroll' is disabled.

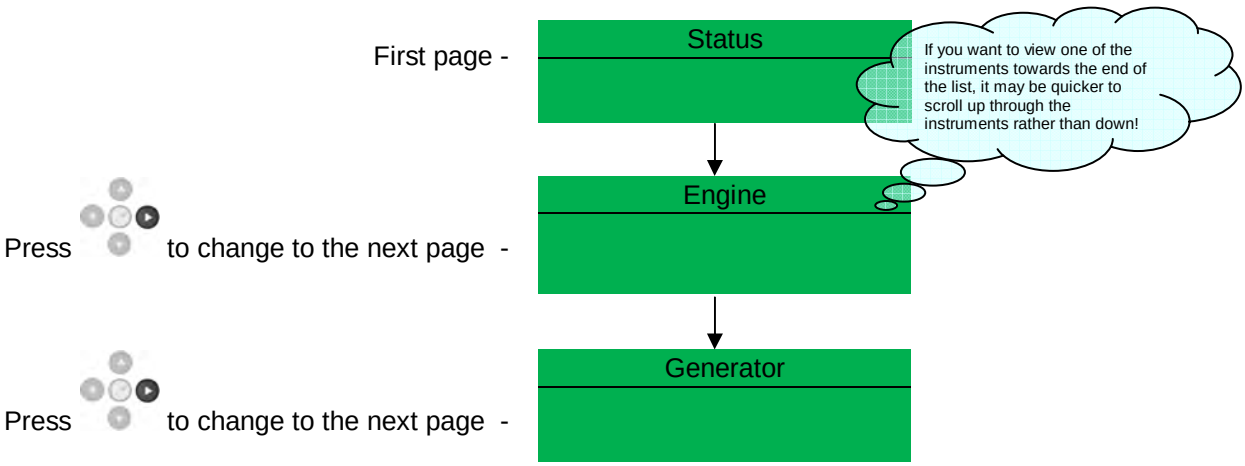
To re-enable 'autoscroll' press the or buttons to scroll to the 'title' of the instrumentation page (ie Engine).

When scrolling manually, the display will automatically return to the Status page if no buttons are pressed for the duration of the configurable *LCD Page Timer*.

If an alarm becomes active while viewing the status page, the display shows the Alarms page to draw the operator's attention to the alarm condition.

Page order:-

Status, Engine, Generator, Mains, Alarms, ECU DTCs (electronic engines only), Event log, Scheduler (if enabled), About.



5.4.1 INSTRUMENT PAGE CONTENT

Engine

- Engine Speed
- Oil Pressure
- Coolant Temperature
- Engine Battery Volts
- Run Time
- Oil Temperature*
- Coolant Pressure*
- Inlet Temperature*
- Exhaust Temperature*
- Fuel Temperature*
- Turbo Pressure
- Fuel Pressure*
- Fuel Consumption*
- Fuel Used*
- Fuel Level*
- Auxiliary Sensors (If fitted and configured)
- Engine Maintenance Due (If configured)
- Engine ECU Link*

*When connected to suitably configured and compatible engine ECU. For details of supported engines see 'Electronic Engines and DSE wiring' (DSE Part number 057-004)

Generator

- Generator Voltage (ph-N)
- Generator Voltage (ph-ph)
- Generator Frequency
- Generator Current
- Generator Earth Current
- Generator Load (kW)
- Generator Load (kVA)
- Generator Power Factor
- Generator Load (kVAr)
- Generator Load (kWh, kVAh, kVArh)
- Generator Phase Sequence

Mains (DSE7220/DSE7320 only)

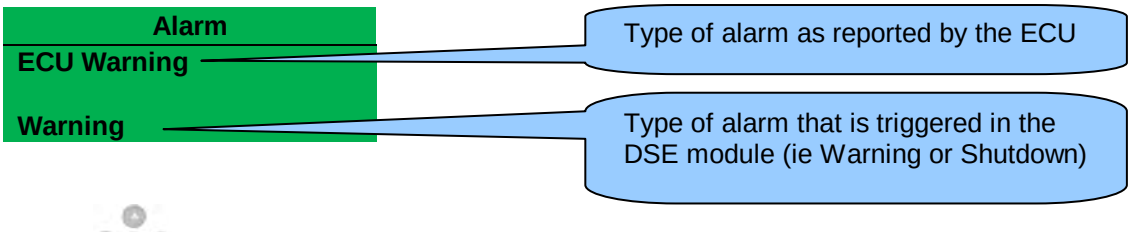
- Mains Voltage (ph-N)
- Mains Voltage (ph-ph)
- Mains Frequency

About

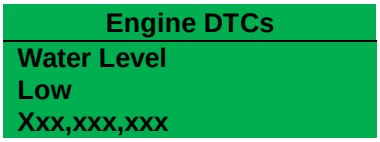
- Module Type
- Application Version
- USB ID – unique identifier for PC USB connection
- Analogue Measurements Version
- Firmware Update Bootloader Version

5.4.2 CAN ERROR MESSAGES

When connected to a suitable CAN engine the 7000 series controller displays alarm status messages from the ECU.



Press  to access the list of current active Engine DTCs (Diagnostic Trouble Codes).

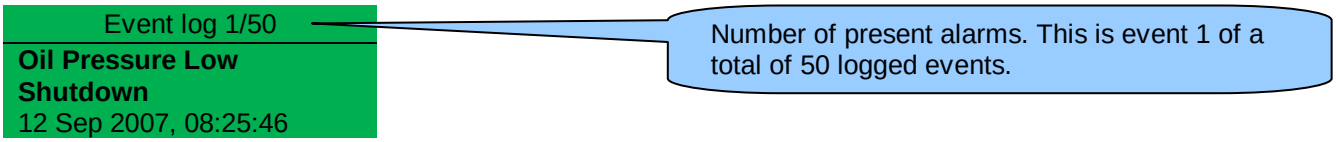


The code interpreted by the module shows on the display as a text message. Additionally, the manufactures code is shown.

NOTE:- For details on these code meanings, refer to the ECU instructions provided by the engine manufacturer, or contact the engine manufacturer for further assistance.

NOTE:- For further details on connection to electronic engines please refer to *Electronic engines and DSE wiring.* Part No. 057-004

5.5 VIEWING THE EVENT LOG



The 7000 series modules maintains a log of the last 50 shutdown alarms (7200 series logs 30 shutdown alarms) to enable the operator or engineer to view the past alarms history.
The event log only includes shutdown and electrical trip alarms logged; **The event log does not contain Warning alarms.**

If *All warnings are latched* is configured, the event log will capture warning alarms. For more details consult the 7xxx series configuration software manual.

Once the log is full, any subsequent shutdown alarms will overwrite the oldest entry in the log.
Hence, the log will always contain the most recent shutdown alarms.
The module logs the alarm, along with the date and time of the event in the format shown in this example.

To view the event log, repeatedly press the next page button  until the LCD screen displays the Event log.

Press down  to view the next most recent shutdown alarm:

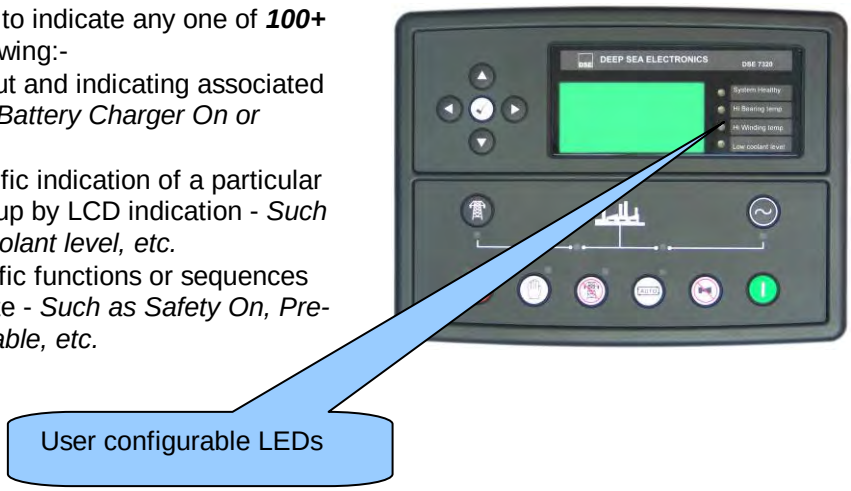
Continuing to press down  cycles through the past alarms after which the display shows the most recent alarm and the cycle begins again.

To exit the event log and return to viewing the instruments, press the next page  button.

5.6 USER CONFIGURABLE INDICATORS

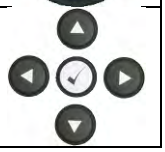
These LEDs can be configured by the user to indicate any one of ***100+ different functions*** based around the following:-

- **Indications** - Monitoring of a digital input and indicating associated functioning user's equipment - *Such as Battery Charger On or Louver's Open, etc*.
- **WARNINGS a**nd **SHUTDOWNS** - Specific indication of a particular warning or shutdown condition, backed up by LCD indication - *Such as Low Oil Pressure Shutdown, Low Coolant level, etc.*
- **Status Indications** - Indication of specific functions or sequences derived from the modules operating state - *Such as Safety On, Pre-heating, Panel Locked, Generator Available, etc.*



5.7 CONTROLS

Stop / Reset This button places the module into its **Stop/Reset** mode. This will clear any alarm conditions for which the triggering criteria have been removed. If the engine is running and the module is in Stop mode, the module will automatically instruct the changeover device to unload the generator *('**Close Generator**' becomes inactive (if used))*. The fuel supply de-energises and the engine comes to a standstill. Should a **remote start signal** be present while operating in this mode, a remote start will not occur.	
Manual This mode allows manual control of the generator functions. Once in **Manual mode** the module will respond to the start button, start the engine, and run off load. If the engine is running off-load in the **Manual mode** and a **remote start signal** becomes present, the module will automatically instruct the changeover device to place the generator on load *('**Close Generator**' becomes active (if used))*. Upon removal of the **remote start signal**, the generator remains on load until either selection of the **'STOP/RESET'** or **'AUTO'** modes. *For further details, please see the more detailed description of 'Manual operation' elsewhere in this manual.*	
Auto This button places the module into its **'Automatic'** mode. This mode allows the module to control the function of the generator automatically. The module will monitor the *remote start* input and mains supply status and once a start request is made, the set will be automatically started and placed on load. Upon removal of the starting signal, the module will automatically transfer the load from the generator and shut the set down observing the *stop delay* timer and *cooling* timer as necessary. The module will then await the next start event. *For further details, please see the more detailed description of 'Auto operation' elsewhere in this manual.*	
Test (DSE7220/DSE7320 only) This button places the module into its **'Test'** mode. This allows an on load test of the generator. Once in **Test mode** the module will respond to the start button, start the engine, and run on load. *For further details, please see the more detailed description of 'Test operation' elsewhere in this manual.*	
Start This button is only active in STOP/RESET or MANUAL mode. Pressing this button in manual or test mode will start the engine and run off load (manual) or on load (test). Pressing this button in STOP/RESET mode will turn on the CAN engine ECU (when correctly configured and fitted to a compatible engine ECU)	
Mute / Lamp Test This button silences the audible alarm if it is sounding and illuminates all of the LEDs as a lamp test feature/ When correctly configured and fitted to a compatible engine ECU, pressing this button in STOP/RESET mode after pressing the START button (to power the ECU) will cancel any "passive" alarms on the engine ECU.	

Transfer to generator Allows the operator to transfer the load to the generator (when in Manual mode only)	
Open generator (DSE7210/DSE7310 only) Allows the operator to open the generator (when in Manual mode only)	
Transfer to mains (DSE7220/DSE7320 only) Allows the operator to transfer the load to the mains (when in Manual mode only)	
Menu navigation Used for navigating the instrumentation, event log and configuration screens. For further details, please see the more detailed description of these items elsewhere in this manual.	

6 OPERATION

The following description details the sequences followed by a module containing the standard '*factory configuration*'.

Remember that if you have purchased a completed generator set or control panel from your supplier, the module's configuration will probably have been changed by them to suit their particular requirements.

Always refer to your configuration source for the exact sequences and timers observed by any particular module in the field.



6.1 AUTOMATIC MODE OF OPERATION

NOTE:- If a digital input configured to *panel lock* is active, changing module modes will not be possible. Viewing the instruments and event logs is NOT affected by panel lock.

Activate auto mode be pressing the AUTO pushbutton. An LED indicator beside the button confirms this action.

Auto mode will allow the generator to operate fully automatically, starting and stopping as required with no user intervention.

6.1.1 WAITING IN AUTO MODE

If a starting request is made, the starting sequence will begin.
Starting requests can be from the following sources :

- Mains supply out of limits (DSE7220/7320 only)
- Activation of an auxiliary input that has been configured to *remote start*
- Activation of the inbuilt exercise scheduler.

6.1.2 STARTING SEQUENCE

To allow for 'false' start requests such as mains brownouts, the *start delay* timer begins.

Should all start requests be removed during the *start delay* timer, the unit will return to a stand-by state.

If a start request is still present at the end of the *start delay* timer, the fuel relay is energised and the engine will be cranked.

NOTE:- If the unit has been configured for CAN, compatible ECU's will receive the start command via CAN.

If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the *crank rest* duration after which the next start attempt is made. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and the display shows ***Fail to Start.***

When the engine fires, the starter motor is disengaged. Speed detection is factory configured to be derived from the main alternator output frequency but can additionally be measured from a Magnetic Pickup mounted on the flywheel (Selected by PC using the 7000 series configuration software).

Additionally, rising oil pressure can be used to disconnect the starter motor (but cannot detect underspeed or overspeed).

NOTE:- If the unit has been configured for CAN, speed sensing is via CAN.

After the starter motor has disengaged, the *Safety On* timer activates, allowing Oil Pressure, High Engine Temperature, Under-speed, Charge Fail and any delayed Auxiliary fault inputs to stabilise without triggering the fault.

6.1.3 ENGINE RUNNING

Once the engine is running, the *Warm Up* timer, if selected, begins, allowing the engine to stabilise before accepting the load.

DSE7210/DSE7310 - The generator will be placed on load.
DSE7220/DSE7320 - Load will be transferred from the mains supply to the generator

NOTE:-The load transfer signal remains inactive until the Oil Pressure has risen. This prevents excessive wear on the engine.

If all start requests are removed, the *stopping sequence* will begin.

6.1.4 STOPPING SEQUENCE

The *return delay* timer operates to ensure that the starting request has been permanently removed and isn't just a short term removal. Should another start request be made during the cooling down period, the set will return on load.

If there are no starting requests at the end of the *return delay* timer, the load is transferred back from the generator to the mains supply and the *cooling* timer is initiated.

The *cooling* timer allows the set to run off load and cool sufficiently before being stopped. This is particularly important where turbo chargers are fitted to the engine.

After the *cooling* timer has expired, the set is stopped.

6.2 MANUAL OPERATION

NOTE:- If a digital input configured to *panel lock* is active, changing module modes will not be possible. Viewing the instruments and event logs is NOT affected by panel lock.

Activate Manual mode be pressing the pushbutton. An LED indicator beside the button confirms this action.

Manual mode allows the operator to start and stop the set manually, and if required change the state of the load switching devices.

6.2.1 WAITING IN MANUAL MODE

When in manual mode, the set will not start automatically.

To begin the starting sequence, press the button.

6.2.2 STARTING SEQUENCE

NOTE:- There is no *start delay* in this mode of operation.

The fuel relay is energised and the engine is cranked.

NOTE:- If the unit has been configured for CAN, compatible ECU's will receive the start command via CAN.

If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the *crank rest* duration after which the next start attempt is made. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and the display shows ***Fail to Start.***

When the engine fires, the starter motor is disengaged. Speed detection is factory configured to be derived from the main alternator output frequency but can additionally be measured from a Magnetic Pickup mounted on the flywheel (Selected by PC using the 7000 series configuration software).

Additionally, rising oil pressure can be used disconnect the starter motor (but cannot detect underspeed or overspeed).

NOTE:- If the unit has been configured for CAN, speed sensing is via CAN.

After the starter motor has disengaged, the *Safety On* timer activates, allowing Oil Pressure, High Engine Temperature, Under-speed, Charge Fail and any delayed Auxiliary fault inputs to stabilise without triggering the fault.

6.2.3 ENGINE RUNNING

In manual mode, the load is not transferred to the generator unless a 'loading request' is made.
A loading request can come from a number of sources.

- Pressing the *transfer to generator* button
- Mains supply out of limits (DSE7220/DSE7320 only)
- Activation of an auxiliary input that has been configured to *remote start on load*
- Activation of the inbuilt exercise scheduler if configured for 'on load' runs.

NOTE:-The load transfer signal remains inactive until the Oil Pressure has risen. This prevents excessive wear on the engine.

Once the load has been transferred to the generator, it will not be automatically transferred back to the mains supply. To manually transfer the load back to the mains either:

- Press the *transfer to mains* button (DSE7220/DSE7320 only)
- Press the *Open Generator* button (DSE7210/DSE7310 only)
- Press the *auto mode* button to return to automatic mode.

6.2.4 STOPPING SEQUENCE

In manual mode the set will continue to run until either :

- The *stop button* is pressed – The set will immediately stop
- The *auto button* is pressed. The set will observe all auto mode start requests and stopping timers before beginning the *Auto mode stopping sequence*.

6.3 TEST MODE OF OPERATION

NOTE:- Test Mode is only applicable to DSE7220/DSE7320 controllers.

NOTE:- If a digital input configured to *panel lock* is active, changing module modes will not be possible. Viewing the instruments and event logs is NOT affected by panel lock.

Activate test mode be pressing the pushbutton. An LED indicator beside the button confirms this action.

Test mode will start the set and transfer the load to the generator to provide a ***Test on load*** function.

6.3.1 WAITING IN TEST MODE

When in test mode, the set will not start automatically.

To begin the starting sequence, press the button.

6.3.2 STARTING SEQUENCE

The set begins to crank.

NOTE:- If the unit has been configured for CAN, compatible ECU's will receive the start command via CAN.

If the engine fails to fire during this cranking attempt then the starter motor is disengaged for the *crank rest* duration after which the next start attempt is made. Should this sequence continue beyond the set number of attempts, the start sequence will be terminated and the display shows ***Fail to Start.***

When the engine fires, the starter motor is disengaged. Speed detection is factory configured to be derived from the main alternator output frequency but can additionally be measured from a Magnetic Pickup mounted on the flywheel (Selected by PC using the 7000 series configuration software).

Additionally, rising oil pressure can be used disconnect the starter motor (but cannot detect underspeed or overspeed).

NOTE:- If the unit has been configured for CAN, speed sensing is via CAN.

After the starter motor has disengaged, the *Safety On* timer activates, allowing Oil Pressure, High Engine Temperature, Under-speed, Charge Fail and any delayed Auxiliary fault inputs to stabilise without triggering the fault.

6.3.3 ENGINE RUNNING

Once the engine is running, the *Warm Up* timer, if selected, begins, allowing the engine to stabilise before accepting the load.

Load will be automatically transferred from the mains supply to the generator.

NOTE:-The load transfer signal remains inactive until the Oil Pressure has risen. This prevents excessive wear on the engine.

In test mode, the set will continue to run *on load* until either:

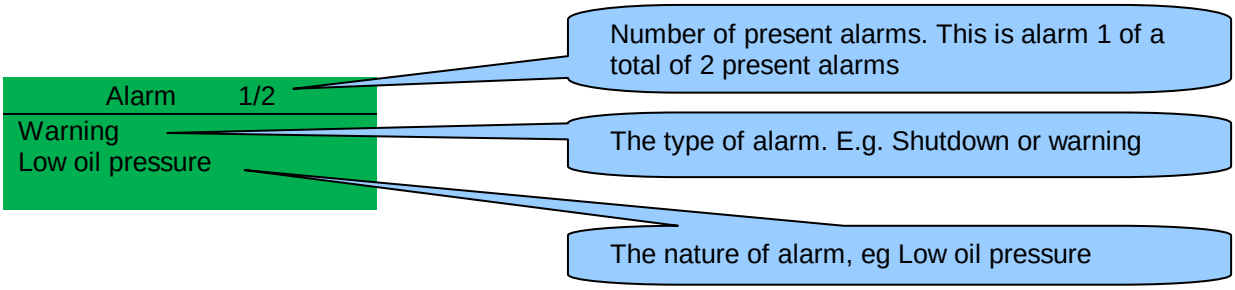
- The *stop button* is pressed – The set will immediately stop
- The *auto button* is pressed. The set will observe all auto mode start requests and stopping timers before beginning the *Auto mode stopping sequence*.

7 PROTECTIONS

When an alarm is present, the Audible Alarm will sound and the Common alarm LED if configured will illuminate.

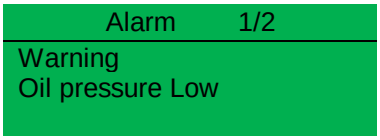
The audible alarm can be silenced by pressing the *Mute button* 

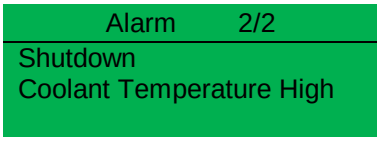
The LCD display will jump from the 'Information page' to display the Alarm Page



The LCD will display multiple alarms E.g. "High Engine Temperature shutdown", "Emergency Stop" and "Low Coolant Warning". These will automatically scroll round in the order that they occurred;

In the event of a warning alarm, the LCD will display the appropriate text. If a shutdown then occurs, the module will again display the appropriate text.
Example:-

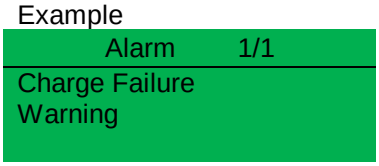




7.1 WARNINGS

Warnings are non-critical alarm conditions and do not affect the operation of the generator system, they serve to draw the operators attention to an undesirable condition.

Example



In the event of an alarm the LCD will jump to the alarms page, and scroll through all active warnings and shutdowns.

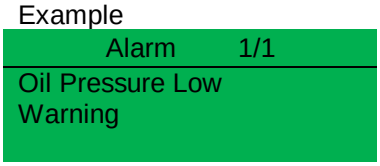
By default, warning alarms are self-resetting when the fault condition is removed. However enabling 'all warnings are latched' will cause warning alarms to latch until reset manually. This is enabled using the 7000 series configuration suite in conjunction with a compatible PC.

Display	Reason
CHARGE FAILURE	The auxiliary charge alternator voltage is low as measured from the W/L terminal.
BATTERY UNDER VOLTAGE	The DC supply has fallen below the low volts setting level for the duration of the low battery volts timer
BATTERY OVER VOLTAGE	The DC supply has risen above the high volts setting level for the duration of the high battery volts timer
FAIL TO STOP	The module has detected a condition that indicates that the engine is running when it has been instructed to stop. **NOTE:- 'Fail to Stop' could indicate a faulty oil pressure sensor - If engine is at rest check oil sensor wiring and configuration.**
AUXILIARY INPUTS	Auxiliary inputs can be user configured and will display the message as written by the user.
LOW FUEL LEVEL	The level detected by the fuel level sensor is below the low fuel level setting.
CAN ECU ERROR	The engine ECU has detected a warning alarm and has informed the DSE module of this situation. The exact error is also indicated on the module's display.

7.2 ANALOGUE PRE-ALARMS

The following alarms are termed 'pre-alarms' as they pre-warn the operator of a potentially more serious alarm condition. For instance, if the engine temperature rises past the pre alarm level, a warning condition will occur to notify the operator. If the temperature falls below this level, then the alarm ceases, and the set will continue to run as normal. However if the temperature continues to rise until the coolant temperature trip point is reached, the warning is escalated and a high coolant temperature shutdown is initiated.

Example



By default, analogue pre alarms are self-resetting when the fault condition is removed. However enabling 'all warnings are latched' will cause warning alarms to latch until reset manually. This is enabled using the 7000 series configuration suite in conjunction with a compatible PC.

Display	Reason
LOW OIL PRESSURE	The module detects that the engine oil pressure has fallen below the low oil pressure pre-alarm setting level after the *Safety On* timer has expired.
ENGINE HIGH TEMPERATURE	The module detects that the engine coolant temperature has exceeded the high engine temperature pre-alarm setting level after the *Safety On* timer has expired.
ENGINE LOW TEMPERATURE	The module detects that the engine coolant temperature has fallen below the high engine temperature pre-alarm setting level.
OVERSPEED	The engine speed has risen above the overspeed pre alarm setting
UNDERSPEED	The engine speed has fallen below the underspeed pre alarm setting
GENERATOR OVER FREQUENCY	The generator output frequency has risen above the pre-set pre-alarm setting.
GENERATOR UNDER FREQUENCY	The generator output frequency has fallen below the pre-set pre-alarm setting after the *Safety On* timer has expired.
GENERATOR OVER VOLTAGE	The generator output voltage has risen above the pre-set pre-alarm setting.
GENERATOR UNDER VOLTAGE	The generator output voltage has fallen below the pre-set pre-alarm setting after the *Safety On* timer has expired.
ECU WARNING	The engine ECU has detected a warning alarm and has informed the DSE module of this situation. The exact error is also indicated on the module's display.

If the module is configured for **CAN** and receives an "error" message from the engine control unit, 'Can ECU Warning" is shown on the module's display and a warning alarm is generated.

7.3 HIGH CURRENT WARNING ALARM

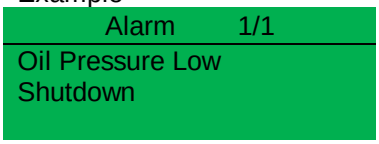
GENERATOR HIGH CURRENT, if the module detects a generator output current in excess of the pre-set trip a warning alarm initiates. The module shows Alarm Warning High Current. If this high current condition continues for an excess period, then the alarm escalates to a shutdown condition. For further details of the high current alarm, please see High Current Shutdown Alarm.

By default, High Current Warning Alarm is self-resetting when the overcurrent condition is removed. However enabling 'all warnings are latched' will cause the alarm to latch until reset manually. This is enabled using the 7000 series configuration suite in conjunction with a compatible PC.

7.4 SHUTDOWNS

Shutdowns are latching alarms and stop the Generator. Clear the alarm and remove the fault then press Stop/Reset to reset the module.

Example



NOTE:- The alarm condition must be rectified before a reset will take place. If the alarm condition remains, it will not be possible to reset the unit (The exception to this is the Low Oil Pressure alarm and similar 'delayed alarms', as the oil pressure will be low with the engine at rest).

Display	Reason
FAIL TO START	The engine has not fired after the preset number of start attempts
EMERGENCY STOP	The emergency stop button has been depressed. This a failsafe (normally closed to battery positive) input and will immediately stop the set should the signal be removed. Removal of the battery positive supply from the emergency stop input will also remove DC supply from the Fuel and Start outputs of the controller. **NOTE:- The Emergency Stop Positive signal must be present otherwise the unit will shutdown.**
LOW OIL PRESSURE	The engine oil pressure has fallen below the low oil pressure trip setting level after the *Safety On* timer has expired.
ENGINE HIGH TEMPERATURE	The engine coolant temperature has exceeded the high engine temperature trip setting level after the *Safety On* timer has expired.
OVERSPEED	The engine speed has exceeded the pre-set trip **NOTE:-During the start-up sequence, the overspeed trip logic can be configured to allow an extra trip level margin. This is used to prevent nuisance tripping on start-up - Refer to the 7000 series configuration software manual under heading 'Overspeed Overshoot' for details.**
UNDERSPEED	The engine speed has fallen below the pre-set trip after the ***Safety On*** timer has expired.
GENERATOR OVER FREQUENCY	The generator output frequency has risen above the preset level
GENERATOR UNDER FREQUENCY	The generator output frequency has fallen below the preset level
GENERATOR OVER VOLTAGE	The generator output voltage has risen above the preset level
GENERATOR UNDER VOLTAGE	The generator output voltage has fallen below the preset level
OIL PRESSURE SENSOR OPEN CIRCUIT	The oil pressure sensor is detected as not being present (open circuit)
AUXILIARY INPUTS	An active auxiliary input configured as a shutdown will cause the engine to shut down. The display shows the text as configured by the user.
LOSS OF SPEED SIGNAL	The speed signal from the magnetic pickup is not being received by the DSE controller.
ECU DATA FAIL	The module is configured for CAN operation and does not detect data on the engine Can datalink, the engine shuts down.
ECU SHUTDOWN	The engine ECU has detected a shutdown alarm and has informed the DSE module of this situation. The exact error is also indicated on the module's display.

7.5 HIGH CURRENT SHUTDOWN ALARM

GENERATOR HIGH CURRENT, if the module detects a generator output current in excess of the adjustable trip a warning alarm occurs. This warning will continue for a period depending upon the level of overload placed on the generator, and the configuration setting for Generator High Current in the 7000 series configuration software.

For instance, the factory default settings for Generator High Current allow for a loading of the generator to 110% for one hour. That is to say if the generator load level exceeds the trip point by 10%, a warning alarm will occur while the overload condition exists. If the load level does not drop to normal levels within one hour, the set stops, with the 7000 series module displaying either a shutdown or electrical trip alarm depending upon module configuration.

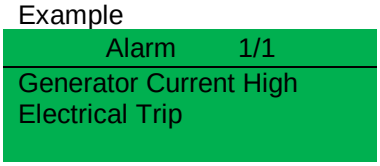
High current shutdown is a latching alarm and stops the Generator. Remove the fault then press Stop/Reset to reset the module.

NOTE:- Higher overload levels will result in a faster acting shutdown condition. For instance with the factory default configuration, an overload level twice that of the trip level (typically 200%) will result in a Generator High Current shutdown condition after 36 seconds.
For details of the relationship between the overload and the shutdown time, please see the Appendix section of this manual.

7.6 ELECTRICAL TRIPS

Electrical trips are latching and stop the Generator but in a controlled manner. On initiation of the electrical trip condition the module will de-energise the **'Close Generator'** Output to remove the load from the generator. Once this has occurred the module will start the Cooling timer and allow the engine to cool off-load before shutting down the engine. The alarm must be accepted and cleared, and the fault removed to reset the module.

Example



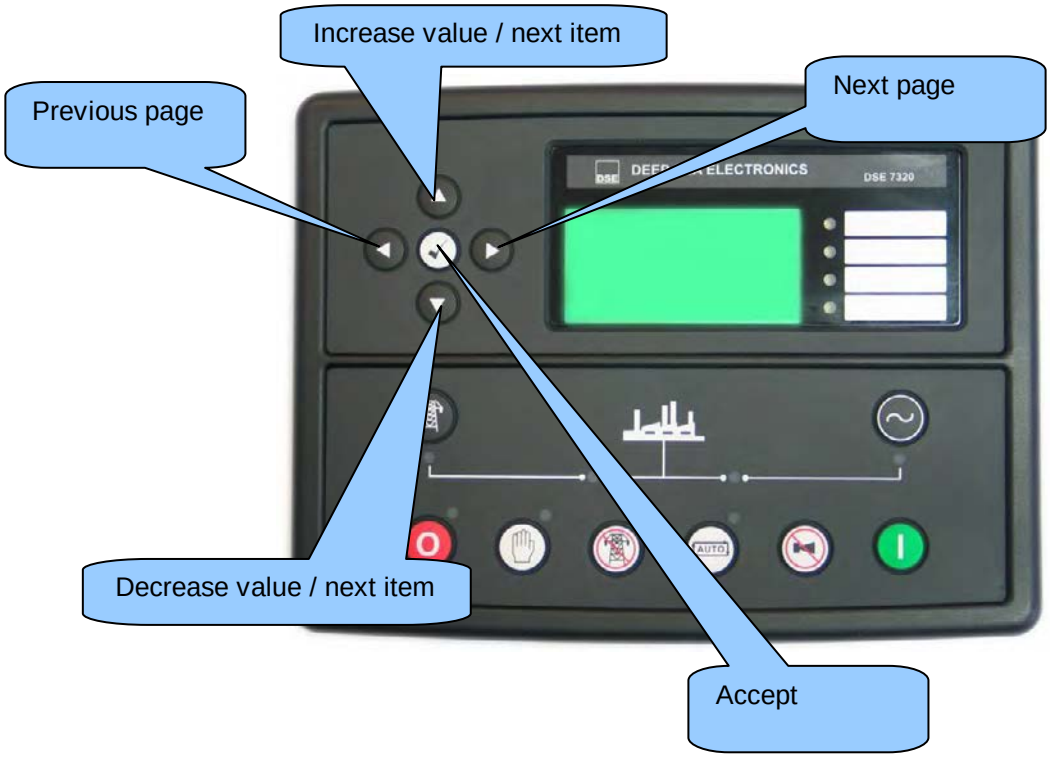
Electrical trips are latching alarms and stop the Generator. Remove the fault then press Stop/Reset to reset the module.

Display	Reason
GENERATOR OVER CURRENT	If a generator output in excess of the high current alarm point, a warning alarm occurs. If this high current condition continues for an excess period, then the alarm escalates to either a shutdown or electrical trip condition (depending upon module configuration). For further details of the high current alarm, please see High Current Shutdown Alarm.
AUXILIARY INPUTS	If an auxiliary input configured as an electrical trip is active, the appropriate message will be displayed as configured by the user.

8 FRONT PANEL CONFIGURATION

This configuration mode allows the operator limited customising of the way the module operates.

Use the module's navigation buttons to traverse the menu and make value changes to the parameters:



8.1 ACCESSING THE MAIN FRONT PANEL CONFIGURATION EDITOR

Ensure the engine is at rest and the module is in STOP mode by pressing the Stop/Reset button.

Press the Stop/Reset and Info buttons simultaneously.
If a module security PIN has been set, the PIN number request is then shown :



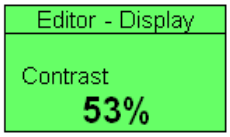
Press , the first '#' changes to '0'. Press (up) or (down) to adjust it to the correct value.

Press (right) when the first digit is correctly entered. The digit you have just entered will now show '#' for security.

Repeat this process for the other digits of the PIN number. You can press (left) if you need to move back to adjust one of the previous digits.

When is pressed after editing the final PIN digit, the PIN is checked for validity. If the number is not correct, you must re-enter the PIN.

If the PIN has been successfully entered (or the module PIN has not been enabled), the editor is displayed :



8.1.1 EDITING A PARAMETER

Enter the editor as described above.

Press the  (left) or  (right) buttons to cycle to the section you wish to view/change.

Press the  (up) or  (down) buttons to select the parameter you wish to view/change within the currently selected section.

To edit the parameter, press ✓ to enter edit mode. The parameter begins to flash to indicate that you are editing the value.

Press the  (up) or  (down) buttons to change the parameter to the required value.

Press ✓ to save the value. The parameter ceases flashing to indicate that it has been saved.

To exit the editor at any time, press and hold the ✓ button.

⚠NOTE: - When the editor is visible, it is automatically exited after 5 minutes of inactivity to ensure security.

⚠NOTE: - The PIN number is automatically reset when the editor is exited (manually or automatically) to ensure security.

⚠ NOTE: - More comprehensive module configuration is possible using the 7xxx series PC configuration software. Please contact us for further details.

8.1.2 ADJUSTABLE PARAMETERS

Front Panel Configuration Editor

Section	Parameter as shown on display	Factory Settings
DISPLAY	Contrast	53%
	Language	English
	LCD Page Timer	5m
	Auto Scroll Delay	2s
	Current Date and time	hh:mm
ENGINE	Oil Pressure Low Shutdown	1.03bar
	Oil Pressure Low Pre Alarm	1.17bar
	Coolant Temperature Low Warning	70ºC
	Coolant Temperature High Pre Alarm	90ºC
	Coolant Temperature High Shutdown	95ºC
	Start Delay Timer	5s
	Pre Heat Timer	0s
	Crank Duration Timer	10s
	Crank Rest Timer	10s
	Safety On Delay	10s
	Smoke Limiting	0s
	Smoke Limiting Off	0s
	Warm Up Timer	0s
	Cool Down Timer	1m
	Engine Under Speed Shutdown	Inactive
	Engine Under Speed Shutdown	1260RPM
	Engine Under Speed Warning	Inactive
	Engine Under Speed Warning	1350RPM
	Engine Over Speed Warning	Inactive
	Engine Over Speed Warning	1650RPM
	Engine Over Speed Shutdown	1710RPM
	Engine Speed Overshoot Delay	2s
	Engine Speed Overshoot	0s
	Fail To Stop Delay	30s
	Battery Under Voltage Warning	Active
	Battery Under voltage Warning Delay	1m
	Battery Under Voltage	10V
	Charge Alternator Failure Warning	Active
	Battery Over Voltage Warning Delay	1m
	Battery Over Voltage Warning	30V
	Charge Alternator Failure Warning	Active
	Charge Alternator Failure Warning	6V
	Droop control	Disable (Compatible engine ECUs only)
	Droop control	4% (Compatible engine ECUs only)
GENERATOR	Generator Under Voltage Shutdown	184V
	Generator Under Voltage Pre Alarm	196V
	Generator Over Voltage Pre Alarm	265V
	Generator Over Voltage Shutdown	276V
	Generator Under Frequency Shutdown	40Hz
	Generator Under Frequency Pre Alarm	42Hz
	Generator Over Frequency Pre Alarm	55Hz
	Generator Over Frequency Shutdown	57Hz
	Full Load Rating	500A
	Delayed Over Current	Active
	Delayed Over Current	100%
	AC System	3 Phase, 4 Wire
	CT Primary	600A
	CT Secondary	5A
	Generator Transient Delay	0s
MAINS **Mains settings only applicable to DSE7220 and DSE7320 controllers.**	Mains Under Voltage Trip	184V
	Mains Over Voltage Trip	276V
	Mains Under Frequency Trip	45Hz
	Mains Over Frequency Trip	55Hz
	Mains Transient Delay	2s
	Return Delay	30s
	Mains Transfer Time	0.7s
TIMERS	Auto Scroll Delay	2s
	LCD Page Timer	5m
	Start Delay Timer	5s
	Pre Heat Timer	0s
	Crank Duration Timer	10s
	Crank Rest Timer	10s
	Safety On Delay	10s
	Smoke Limiting	0s
	Smoke Limiting Off	0s
	Warm Up Timer	0s
	Cool Down Timer	1m
	Speed Overshoot Delay	2s
	Fail To Stop Delay	30s
	Battery voltage Low Warning Delay	1m
	Battery Voltage High Warning Delay	1m
	Generator Transient Delay	0s
DSE7220 / DSE7320 only	Mains Transient Delay	2s
	Return Delay	30s
DSE7220 / DSE7320 only	Mains Transfer Time	0.7s

8.2 ACCESSING THE 'RUNNING' CONFIGURATION EDITOR

The 'running' editor can be entered while the engine is running. All protections remain active if the engine is running while the running editor is entered.

Press and hold the ✓ button to enter the running editor.

8.2.1 EDITING A PARAMETER

Enter the editor as described above.

Press the  (left) or  (right) buttons to cycle to the section you wish to view/change.

Press the  (up) or  (down) buttons to select the parameter you wish to view/change within the currently selected section.

To edit the parameter, press ✓ to enter edit mode. The parameter begins to flash to indicate that you are editing the value.

Press the  (up) or  (down) buttons to change the parameter to the required value.

Press ✓ to save the value. The parameter ceases flashing to indicate that it has been saved.

To exit the editor at any time, press and hold the ✓ button.

8.2.2 ADJUSTABLE PARAMETERS (RUNNING EDITOR)

Running Editor (Factory default settings are shown in bold italicised text)

Sectio	Parameter as shown on display	Factory Setting
DISPLAY	Contrast	50%
	Language	English

9 COMMISSIONING

9.1.1 PRE-COMMISSIONING

Before the system is started, it is recommended that the following checks are made:-

10.1. The unit is adequately cooled and all the wiring to the module is of a standard and rating compatible with the system. Check all mechanical parts are fitted correctly and that all electrical connections (including earths) are sound.

10.2. The unit **DC** supply is fused and connected to the battery and that it is of the correct polarity.

10.3. The Emergency Stop input is wired to an external normally closed switch connected to **DC** positive.

NOTE:- If Emergency Stop feature is not required, link this input to the DC Positive. The module will not operate unless either the Emergency Stop is fitted correctly OR terminal 3 is connected to DC positive.

10.4. To check the start cycle operation, take appropriate measures to prevent the engine from starting (disable the operation of the fuel solenoid). After a visual inspection to ensure it is safe to proceed, connect the battery supply. Select **"MANUAL"** and then press **"START"** the unit start sequence will commence.

10.5. The starter will engage and operate for the pre-set crank period. After the starter motor has attempted to start the engine for the pre-set number of attempts, the LCD will display 'Failed *to start*. Select the **STOP/RESET** position to reset the unit.

10.6. Restore the engine to operational status (reconnect the fuel solenoid). Select **"MANUAL"** and then press **"START"**. This time the engine should start and the starter motor should disengage automatically. If not then check that the engine is fully operational (fuel available, etc.) and that the fuel solenoid is operating. The engine should now run up to operating speed. If not, and an alarm is present, check the alarm condition for validity, then check input wiring. The engine should continue to run for an indefinite period. It will be possible at this time to view the engine and alternator parameters - refer to the 'Description of Controls' section of this manual.

10.7. Select **"AUTO"** on the front panel, the engine will run for the pre-set cooling down period, then stop. The generator should stay in the standby mode. If not check that there is not a signal present on the **Remote start** input.

10.8. Initiate an automatic start by supplying the remote start signal (if configured). The start sequence will commence and the engine will run up to operational speed. Once the generator is available a load transfer will take place (if configured), the Generator will accept the load. If not, check the wiring to the Generator Contactor Coil *(if used)*. Check the Warming timer has timed out.

10.9. Remove the remote start signal. The return sequence will begin. After the pre-set time, the generator is unloaded. The generator will then run for the pre-set cooling down period, then shutdown into its standby mode.

10.10. Set the modules internal clock/calendar to ensure correct operation of the scheduler and event logging functions. For details of this procedure see section entitled *Front Panel Configuration – Editing the date and time.*

10.11. If, despite repeated checking of the connections between the **7000** series controller and the customer's system, satisfactory operation cannot be achieved, then the customer is requested to contact the factory for further advice on:-

INTERNATIONAL TEL: +44 (0) 1723 890099
INTERNATIONAL FAX: +44 (0) 1723 893303
E-mail: Support@Deepseaplc.com
Website : www.deepseaplc.com

10 FAULT FINDING

SYMPTOM	POSSIBLE REMEDY
Unit is inoperative Read/Write configuration does not operate	Check the battery and wiring to the unit. Check the DC supply. Check the DC fuse.
Unit shuts down	Check DC supply voltage is not above 35 Volts or below 9 Volts Check the operating temperature is not above 70°C. Check the DC fuse.
Unit locks out on Emergency Stop	If no Emergency Stop Switch is fitted, ensure that a DC positive signal is connected to the Emergency Stop input. Check emergency stop switch is functioning correctly. Check Wiring is not open circuit.
Intermittent Magnetic Pick-up sensor fault	Ensure that Magnetic pick-up screen only connects to earth at one end, if connected at both ends, this enables the screen to act as an aerial and will pick up random voltages. Check pickup is correct distance from the flywheel teeth.
Low oil Pressure fault operates after engine has fired	Check engine oil pressure. Check oil pressure switch/sensor and wiring. Check configured polarity (if applicable) is correct (i.e. Normally Open or Normally Closed) or that sensor is compatible with the 73x0 Module and is correctly configured.
High engine temperature fault operates after engine has fired.	Check engine temperature. Check switch/sensor and wiring. Check configured polarity (if applicable) is correct (i.e. Normally Open or Normally Closed) or that sensor is compatible with the 7000 series module.
Shutdown fault operates	Check relevant switch and wiring of fault indicated on LCD display. Check configuration of input.
Warning fault operates	Check relevant switch and wiring of fault indicated on LCD display. Check configuration of input.
Fail to Start is activated after pre-set number of attempts to start	Check wiring of fuel solenoid. Check fuel. Check battery supply. Check battery supply is present on the Fuel output of the module. Check the speed-sensing signal is present on the 7000 series module's inputs. Refer to engine manual.
Continuous starting of generator when in **AUTO**	Check that there is no signal present on the "Remote Start" input. Check configured polarity is correct. Check the mains supply is available and within configured limits (DSE7220/DSE7320 only)
Generator fails to start on receipt of Remote Start signal.	Check Start Delay timer has timed out. Check signal is on "Remote Start" input. Confirm correct configuration of input is configured to be used as "Remote Start". Check that the oil pressure switch or sensor is indicating low oil pressure to the controller. Depending upon configuration, then set will not start if oil pressure is not low.
Pre-heat inoperative	Check wiring to engine heater plugs. Check battery supply. Check battery supply is present on the Pre-heat output of module. Check pre-heat configuration is correct.
Starter motor inoperative	Check wiring to starter solenoid. Check battery supply. Check battery supply is present on the Starter output of module. Ensure that the Emergency Stop input is at Positive. Ensure oil pressure switch or sensor is indicating the "low oil pressure" state to the 7300 series controller.
Engine runs but generator will not take load	Check Warm up timer has timed out. Ensure generator load inhibit signal is not present on the module inputs. Check connections to the switching device. Note that the set will not take load in manual mode unless there is an active remote start on load signal.

SYMPTOM	POSSIBLE REMEDY
Incorrect reading on Engine gauges Fail to stop alarm when engine is at rest	Check engine is operating correctly. Check sensor and wiring paying particular attention to the wiring to terminal 47 (refer to appendix). Check that sensor is compatible with the 7000 series module and that the module configuration is suited to the sensor.
Module appears to 'revert' to an earlier configuration	When editing a configuration using the PC software it is vital that the configuration is first 'read' from the controller before editing it. This edited configuration must then be "written" back to the controller for the changes to take effect. When editing a configuration using the fascia editor, be sure to press the Accept button to save the change before moving to another item or exiting the fascia editor
Set will not take load	Ensure the generator available LED is lit Check that the output configuration is correct to drive the load switch device and that all connections are correct. Remember that the set will not take load in manual mode unless a remote start on load input is present or the close generator button is pressed.
Inaccurate generator measurements on controller display	Check that the CT primary, CT secondary and VT ratio settings are correct for the application. Check that the CTs are wired correctly with regards to the direction of current flow (p1,p2 and s1,s2) and additionally ensure that CTs are connected to the correct phase (errors will occur if CT1 is connected to phase 2). Remember to consider the power factor. Ie (kW = kVA x powerfactor) The 7000 series controller is true RMS measuring so gives more accurate display when compared with an 'average' meter such as an analogue panel meter or some lower specified digital multimeters. Accuracy of the controller is better than 1% of full scale. Ie Gen volts full scale is 333V ph-n so accuracy is ±3.33V (1% of 333V).

NOTE:- The above fault finding is provided as a guide check-list only. As the module can be configured to provide a wide range of different features, always refer to the source of your module configuration if in doubt.

11 FACTORY DEFAULT CONFIGURATION

Module

Description
1
2

LED Indicators	Insert Card Text
1 Digital Input A	Lit
2 Common Warning	Lit
3 Common Shutdown	Lit
4 Common Electrical Trip	Lit

ECU (ECM) Options	
Engine Type	Conventional Engine
Enhanced J1939	No

Miscellaneous Options	
Enable fast loading feature	No
Audible alarm prior to starting	No
All warnings are latched	No

Inputs

Oil Pressure

Input Type
VDO 10 Bar

Low Oil Pressure Alarms	
Shutdown	Enabled
Trip	1.03bar, 14.94 Psi, 103 kPa
Pre-alarm	Enabled
Trip	1.17bar, 16.97 Psi, 117 kPa
Return	1.24bar, 17.98 Psi, 124 kPa

Engine Temperature

Input type
VDO 120 °C

High Coolant Temperature Alarms	
Shutdown	
	95 °C, 203 °F
Pre-alarm	Yes
Trip	90 °C, 194 °F
Return	88 °C, 190 °F

Low Coolant Temperature Alarms	
Pre-alarm	No
Return	75 °C, 167 °F
Trip	70 °C, 158 °F

Fuel Level

Input Type
Not used

Low Fuel Level Alarm	
Enable	No
Action	Warning
Warning	10 %

Fuel Pump Control	
Enable	No
On	25 %
Off	75 %

NOTE:- Flexible sensor not available on DSE7200 series controllers.

Flexible Sender

Sender Description	
Sender Type	None
Sender Name	Flexible Sender

Input Type
VDO 10 Bar

Sender Alarms	
Alarm Arming	Always
Low Shutdown Enable	No
Low Shutdown	1.03Bar, 14.94 PSI, 103 KPa
Low Pre-alarm Enable	No
Low Pre-alarm Trip	1.17Bar, 16.97 PSI, 117 KPa
Low Pre-alarm Return	1.24Bar, 17.98 PSI, 124 KPa
Low Alarm String	Flexible Sender Low
High Pre-alarm Enable	No
High Pre-alarm Return	1.40Bar, 20.30 PSI, 140 KPa
High Pre-alarm Trip	1.50Bar, 21.75 PSI, 150 KPa
High Shutdown Enable	No
High Shutdown	1.60Bar, 23.21 PSI, 160 KPa
High Alarm String	Flexible Sender High

Digital Inputs

Digital Inputs A - C

Digital Input A	
Function	Remote Start on Load
Polarity	Close to Activate
Action	None
Arming	Always
LCD Display	
Activation Delay	0s

Digital Input B	
Function	Lamp Test
Polarity	Close to Activate
Action	None
Arming	Always
LCD Display	
Activation Delay	0s

Digital Input C	
Function	User Configured
Polarity	Close to Activate
Action	Warning
Arming	From Safety On
LCD Display	
Activation Delay	0s

Digital Inputs D - F

Digital Input D	
Function	User Configured
Polarity	Close to Activate
Action	Shutdown
Arming	Always
LCD Display	
Activation Delay	0s

Digital Input E	
Function	User Configured
Polarity	Close to Activate
Action	Shutdown
Arming	From Safety On
LCD Display	
Activation Delay	0s

Digital Input F	
Function	User Configured
Polarity	Close to Activate
Action	Electrical Trip
Arming	Always
LCD Display	
Activation Delay	0s

Digital Inputs G - H

Digital Input G	
Function	User Configured
Polarity	Close to Activate
Action	Warning
Arming	From Safety On
LCD Display	
Activation Delay	0s

Digital Input H	
Function	User Configured
Polarity	Close to Activate
Action	Electrical Trip
Arming	From Safety On
LCD Display	
Activation Delay	0s

Digital Outputs

Relay Outputs (Supplied from Emergency Stop Input)		
	Source	Polarity
Output A	Fuel Relay	Energise
Output B	Start Relay	Energise

Relay Outputs (Volts Free)		
	Source	Polarity
Output C (N/C)	Close Mains Output	De-Energise
Output D	Close Gen Output	Energise

Relay Outputs (DC Supply Out)		
	Source	Polarity
Output E	Digital Input A	Energise
Output F	Common Warning	Energise
Output G	Common Shutdown	Energise
Output H	Common Electrical Trip	Energise

NOTE:- The following timers are not available on DSE7210 / DSE7310 controllers:

- Mains Transient Delay
- Transfer time

Timers

Start Timers

Start Timers	
Mains Transient Delay	2s
Start Delay	5s
Pre-heat	0s
Cranking Time	10s
Crank Rest Time	10s
Smoke Limit	0s
Smoke Limit Off	0s
Safety On Delay	10s
Warming Up Time	0s

Load/Stopping Timers

Load Timers	
Transfer Time	0.7s
Breaker Close Pulse	0.5s
Breaker Trip Pulse	0.5s

Stopping Timers	
Return Delay	30s
Cooling Time	1m
ETS Solenoid Hold	0s
Fail to Stop Delay	30s
Generator Transient Delay	0.0s

Module Timers

Interface Timers
LCD Page Timer 5m

Generator

Generator Options

Generator Options		
Alternator Fitted	Yes	
	Poles	4
AC System	3 Phase, 4 Wire	
VT fitted	No	
	Primary	111
	Secondary	110

Generator Contactor Alarm	
Enable Fail to Close Warning	No
Generator Fail to Close Delay	1.0s

Generator Voltage Alarms

Under Voltage Alarms			
Shutdown	Yes		
	Trip	184v PhN	80.0 %
Pre-alarm	Yes		
	Trip	196v PhN	85.2 %
Loading Voltage			
		207v PhN	90.0 %

Nominal Voltage
230v PhN

Over Voltage Alarms			
Pre-alarm	Yes		
	Return	254v PhN	110.4 %
	Trip	265v PhN	115.2 %
Shutdown			
	Trip	277v PhN	120.4 %

Generator Frequency Alarms

Under Frequency Alarms			
Shutdown	Yes		
	Trip	40.0 Hz	80.0 %
Pre-alarm	Yes		
	Trip	42.0 Hz	84.0 %
Loading Frequency			
		45.0 Hz	90.0 %

Nominal Frequency
50.0 Hz

Over Frequency Alarms			
Pre-alarm	Yes		
	Return	54.0 Hz	108.0 %
	Trip	55.0 Hz	110.0 %
Shutdown	Yes		
	Trip	57.0 Hz	114.0 %

Generator Current

Generator Current Options	
CT Primary (L1,L2,L3)	600 A
CT Secondary	5 Amp
CT Location	Gen
Full Load Rating	500 A

Overcurrent Alarm			
Immediate Warning	Yes		
IDMT Alarm	Yes		
	Trip	100 %	500 A
Time Multiplier	36		
Action	Electrical Trip		

Droop
Enable No
4.0 %

NOTE:- Mains settings are not available on DSE7210 / DSE7310 controllers.

Mains

Mains Options

Mains Options	
Mains Failure Detection	Yes
Immediate Mains Dropout	No
AC System	3 Phase, 4 Wire
VT fitted	No
	Primary 111
	Secondary 110

Mains Alarms

Voltage Alarms		
Undervolts	Yes	
	Trip	184v PhN
	Return	207v PhN
Overvolts	Yes	
	Return	253v PhN
	Trip	276v PhN

Frequency Alarms		
Under Freq.	Yes	
	Trip	45.0 Hz
	Return	48.0 Hz
Over Freq.	Yes	
	Return	52.0 Hz
	Trip	55.0 Hz

Engine

Engine Options

ECU (ECM) Options	
Engine Type	Conventional Engine
Enhanced Instrumentation	No

Sensing Options	
Magnetic Pickup Fitted	No
Flywheel Teeth	190

Startup Options	
Start Attempts	3
Loss of Sensing Signal	Shutdown

Overspeed Options	
Overspeed Overshoot	0 %
Overshoot Delay	2s

Gas Engine Options	
Choke Timer	2s
Gas On Delay	2s
Ignition Off Delay	2s

Crank Disconnect

Options	
Crank disconnect on oil pressure	No
Check oil pressure prior to starting	Yes

Crank Disconnect	
Generator Frequency	21.0 Hz
Magnetic Pickup	600 RPM
Oil Pressure	2.00bar, 29.01 Psi, 200 kPa

Speed Alarms

Under Speed		
Shutdown	No	
	Trip	1200 RPM
Pre-alarm	No	
	Trip	1260 RPM
	Return	1350 RPM

Over Speed		
Pre-alarm	No	
	Return	1620 RPM
	Trip	1650 RPM
Shutdown		
	Trip	1710 RPM

Plant Battery

Voltage Alarms		
Undervolts	Yes	
	Warning	10.0 V DC
	Return	10.5 V DC
	Delay	1m
Overvolts	Yes	
	Return	29.5 V DC
	Warning	30.0 V DC
	Delay	1m

Charge Alternator Alarm	
Enable	Yes
Trip	6.0 V DC

Scheduler

Exercise Scheduler

Enabled No
Scheduled runs are ON-LINE No
Schedule Period Weekly

Week	Day	Start Time	Duration	Week	Day	Start Time	Duration
	Monday	00:00	00:00		Monday	00:00	00:00
	Monday	00:00	00:00		Monday	00:00	00:00
	Monday	00:00	00:00		Monday	00:00	00:00
	Monday	00:00	00:00		Monday	00:00	00:00
	Monday	00:00	00:00		Monday	00:00	00:00
	Monday	00:00	00:00		Monday	00:00	00:00
	Monday	00:00	00:00		Monday	00:00	00:00
	Monday	00:00	00:00		Monday	00:00	00:00

NOTE:- Communications settings are not available on DSE7200 series controllers.

Communications

Basic

Module Identification

Site identity
Genset identity

Serial Port Configuration

Port Usage Not connected
Alarm number

Connection Settings

Master inactivity timeout 5s
Connect delay 60s
Retries 4
Retry delay 5s
Repeat cycle delay 10s

RS485

Baud Rate 19200
Slave ID 10

Advanced

Initialisation strings

Init (not auto answer) E0S7=60S0=0&S0&C1&D3
Init (auto answer) E0S7=60S0=2&S0&C1&D3
Hangup H0

SMS

Enable messaging No
Message centre number
Recipient numbers

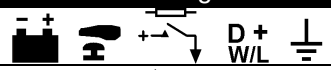
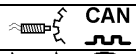
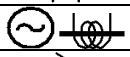
12 MAINTENANCE, SPARES, REPAIR AND SERVICING

The DSE7000 Series controller is designed to be *Fit and Forget*. As such, there are no user serviceable parts within the controller.
In the case of malfunction, you should contact your original equipment supplier (OEM).

12.1 PURCHASING ADDITIONAL CONNECTOR PLUGS FROM DSE

12.1.1 DSE7200 SERIES

If you require additional plugs from DSE, please contact our Sales department using the part numbers below.

7000 series terminal designation	Plug description	Part No.
1-11 	11 way 5.08mm	007-451
15-18 	4 way 5.08mm (DSE7200 series only)	007-100
22-30 	9 way 5.08mm	007-167
39-46 	8 way 7.62mm	007-454
47-50 	4 way 7.62mm (Not fitted to DSE7210)	007-171
51-56 	6 way 5.08mm	007-446
60-65 	6 way 5.08mm (DSE7200 series only)	007-379
60-67 	8 way 5.08mm (DSE7300 series only)	007-164
	PC Configuration interface lead (USB type A – type B)	016-125

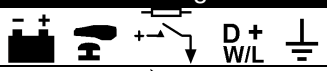
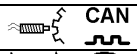
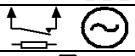
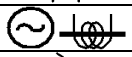
NOTE:- Terminal 19 is not fitted to DSE72000 series controllers.

NOTE:- Mains sensing (Terminals 47-50) is not fitted on DSE7210 autostart controller.

NOTE:- RS485 connector is not fitted to the 7200 series controller.

12.1.2 DSE7300 SERIES

If you require additional plugs from DSE, please contact our Sales department using the part numbers below.

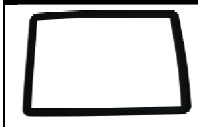
7000 series terminal designation	Plug description	Part No.
1-11 	11 way 5.08mm	007-451
15-19 	5 way 5.08mm	007-445
22-30 	9 way 5.08mm	007-167
39-46 	8 way 7.62mm	007-454
47-50 	4 way 7.62mm (Not fitted to DSE7310)	007-171
51-56 	6 way 5.08mm	007-446
60-67 	8 way 5.08mm (DSE7300 series only)	007-164
RS485	3 way 5.08mm	007-174
	PC Configuration interface lead (USB type A – type B)	016-125

NOTE:- Mains sensing (Terminals 47-50) is not fitted on DSE7310 autostart controller.

12.2 PURCHASING ADDITIONAL FIXING CLIPS FROM DSE

Item	Description	Part No.
	7000 series fixing clips (packet of 4)	020-294

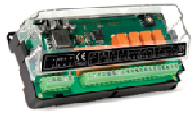
12.3 PURCHASING ADDITIONAL SEALING GASKET FROM DSE

Item	Description	Part No.
	7000 series silicon sealing gasket	020-507

12.4 EXPANSION MODULES

NOTE:- Expansion modules are not compatible with the DSE7200 series controllers.

NOTE:- A maximum of twenty (20) expansion modules can be connected to the DSENet.

Item	Description	DSE Part numbers	
		Sales literature	Operator manual
	Model DSE2130 expansion input module provides additional analogue and digital inputs for use with the 7320 controller. Up to 4 DSE2130s can be fitted to the 73x0 module at one time.	055-060	057-082
	Model DSE2157 expansion relay module provides eight additional voltage free relays for use with the 73x0 controller Up to 10 DSE2157s can be fitted to the 73x0 module at one time.	055-061	057-083
	Model DSE2548 expansion LED module provides additional LED indications for use with the 73x0 controller. Up to 10 DSE2548s can be fitted to the 73x0 module at one time.	055-062	057-084

13 WARRANTY

DSE provides limited warranty to the equipment purchaser at the point of sale. For full details of any applicable warranty, you are referred to your original equipment supplier (OEM).

14 DISPOSAL

14.1 WEEE (WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT)

Directive 2002/96/EC
If you use electrical and electronic equipment you must store, collect, treat, recycle and dispose of WEEE separately from your other waste.



14.2 ROHS (RESTRICTION OF HAZARDOUS SUBSTANCES)

Directive 2002/95/EC:2006
To remove specified hazardous substances (Lead, Mercury, Hexavalent Chromium, Cadmium, PBB & PBDE´s)

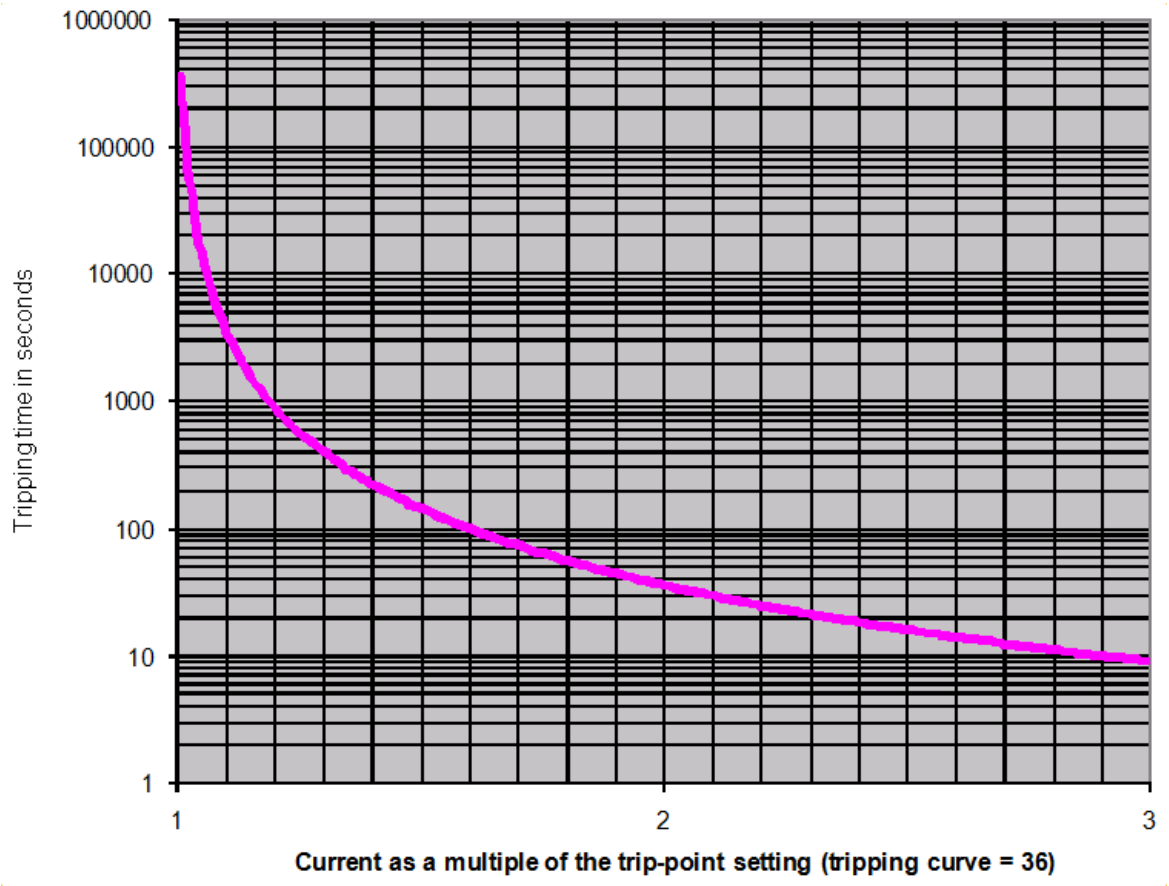
Exemption Note: Category 9. (Monitoring & Control Instruments) as defined in Annex 1B of the WEEE directive will be exempt from the RoHS legislation. This was confirmed in the August 2005 UK´s Department of Trade and Industry RoHS REGULATIONS Guide (Para 11).

Despite this exemption DSE has been carefully removing all non RoHS compliant components from our supply chain and products.
When this is completed a Lead Free & RoHS compatible manufacturing process will be phased into DSE production.

This is a process that is almost complete and is being phased through different product groups.

15 APPENDIX

15.1 IDMT TRIPPING CURVES (TYPICAL)



NOTE:- The factory default settings of *tripping curve 36* and *trip level of 100%* of full load allows for the set to run at 110% of full load for one hour.

15.2 SENSOR WIRING RECOMMENDATIONS

15.2.1 EARTH RETURN SENSORS

Connection Name	Terminal Number
Sensor common	15
Oil pressure Sensor	16
Coolant temperature sensor	17
Fuel level sensor	18
Flexible Sensor (Not fitted to 7200 series)	19

NOTE:- . It is important that terminal 15 (sensor common) is soundly connected to an earth point on the ENGINE BLOCK, not within the control panel, and must be a sound electrical connection to the sensor bodies.

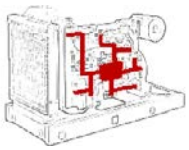
NOTE:- . If you use PTFE insulating tape on the sensor thread when using earth return sensors, ensure you do not insulate the entire thread, as this will prevent the sensor body from being earthed via the engine block.

15.2.2 INSULATED RETURN SENSORS

Connection Name	Terminal Number
Sensor common	15
Oil pressure Sensor	16
Coolant temperature sensor	17
Fuel level sensor	18
Flexible Sensor (Not fitted to 7200 series)	19

NOTE:- . It is important that terminal 15 (sensor common) is soundly connected to an earth point on the ENGINE BLOCK, not within the control panel.

15.3 CAN INTERFACE



Modules are fitted with the CAN interface as standard and are capable of receiving engine data from engine CAN controllers compliant with the CAN standard.
CAN enabled engine controllers monitor the engines operating parameters such as engine speed, oil pressure, engine temperature (among others) in order to closely monitor and control the engine. The industry standard communications interface (CAN) transports data gathered by the engine controller interface (CAN). This allows generator controllers such as the DSE 73x0 range to access these engine parameters with no physical connection to the sensor device.

NOTE:- For further details for connections to CAN enabled engines and the functions available with each engine type, refer to the manual *Electronic Engines and DSE Wiring.* Part No. 057-004

15.4 COMMUNICATIONS OPTION CONNECTIONS

15.4.1 DESCRIPTION

The 7000 series configuration software allows the controller to communicate with a PC. The computer connects to the module as shown below. The operator is then able to control the module, starting or stopping the generator, selecting operating modes, etc.
The various operating parameters (such as output volts, oil pressure, etc.) of the remote generator can be viewed.

15.4.2 PC TO CONTROLLER (DIRECT) CONNECTION

To connect a 7000 series module to a PC the following items are required: -

- 7000 series module



- 7000 series configuration software (Supplied on configuration suite software CD).



- USB cable Type A to Type B.





NOTE:- The DC supply must be connected to the module for configuration by PC.

NOTE:- Refer to 7xxx software Manual for further details on configuring, monitoring and control.

15.5 ENCLOSURE CLASSIFICATIONS

IP CLASSIFICATIONS

7000 series specification under BS EN 60529 Degrees of protection provided by enclosures

IP65 (Front of module when module is installed into the control panel with the optional sealing gasket).
IP42 (front of module when module is installed into the control panel WITHOUT being sealed to the panel)

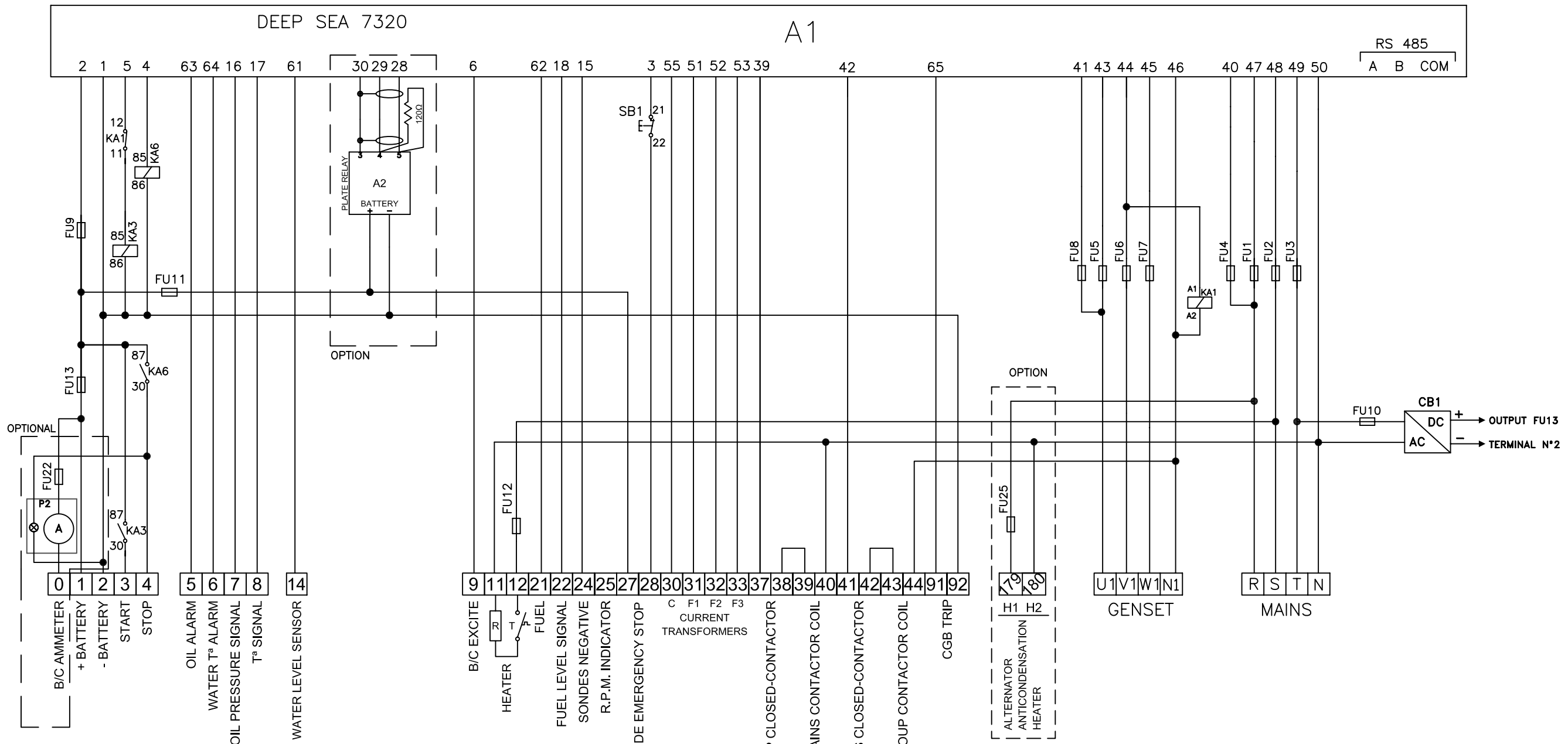
First Digit Protection against contact and ingress of solid objects		Second Digit Protection against ingress of water	
0	No protection	0	No protection
1	Protected against ingress solid objects with a diameter of more than 50 mm. No protection against deliberate access, e.g. with a hand, but large surfaces of the body are prevented from approach.	1	Protection against dripping water falling vertically. No harmful effect must be produced (vertically falling drops).
2	Protected against penetration by solid objects with a diameter of more than 12 mm. Fingers or similar objects prevented from approach.	2	Protection against dripping water falling vertically. There must be no harmful effect when the equipment (enclosure) is tilted at an angle up to 15° from it s normal position (drops falling at an angle).
3	Protected against ingress of solid objects with a diameter of more than 2.5 mm. Tools, wires etc. with a thickness of more than 2.5 mm are prevented from approach.	3	Protection against water falling at any angle up to 60° from the vertical. There must be no harmful effect (spray water).
4	Protected against ingress of solid objects with a diameter of more than 1 mm. Tools, wires etc. with a thickness of more than 1 mm are prevented from approach.	4	Protection against water splashed against the equipment (enclosure) from any direction. There must be no harmful effect (splashing water).
5	Protected against harmful dust deposits. Ingress of dust is not totally prevented but the dust must not enter in sufficient quantity to interface with satisfactory operation of the equipment. Complete protection against contact.	5	Protection against water projected from a nozzle against the equipment (enclosure) from any direction. There must be no harmful effect (water jet).
6	Protection against ingress of dust (dust tight). Complete protection against contact.	6	Protection against heavy seas or powerful water jets. Water must not enter the equipment (enclosure) in harmful quantities (splashing over).

NEMA CLASSIFICATIONS

7000 series NEMA Rating (Approximate)
12 (Front of module when module is installed into the control panel with the optional sealing gasket).
2 (front of module when module is installed into the control panel WITHOUT being sealed to the panel)

NOTE: - There is no direct equivalence between IP / NEMA ratings. IP figures shown are approximate only.

1 **IP30**	Provides a degree of protection against contact with the enclosure equipment and against a limited amount of falling dirt.
2 **IP31**	Provides a degree of protection against limited amounts of falling water and dirt.
3 **IP64**	Provides a degree of protection against windblown dust, rain and sleet; undamaged by the formation of ice on the enclosure.
3R **IP32**	Provides a degree of protection against rain and sleet:; undamaged by the formation of ice on the enclosure.
4 (X) **IP66**	Provides a degree of protection against splashing water, windblown dust and rain, hose directed water; undamaged by the formation of ice on the enclosure. (Resist corrosion).
12/12K **IP65**	Provides a degree of protection against dust, falling dirt and dripping non corrosive liquids.
13 **IP65**	Provides a degree of protection against dust and spraying of water, oil and non corrosive coolants.



A1	CONTROL MODULE
A2	EXPANSION MODULE
KA1	RELAY 230V 1C
KA3	RELAY 12V 1C
KA6	RELAY 12V 1C
SB1	EMERGENCY STOP
CB1	BATTERY CHARGER
P2	BATTERY CHARGER AMMETER
FU1	FUSE 6A
FU2	FUSE 6A
FU3	FUSE 6A

FU4	FUSE 6A
FU5	FUSE 6A
FU6	FUSE 6A
FU7	FUSE 6A
FU8	FUSE 6A
FU9	FUSE 6A
FU10	FUSE 6A
FU11	FUSE 6A
FU12	FUSE 6A
FU13	FUSE 32A
FU22	FUSE 32A
FU25	FUSE 6A

DATE	DRAW	MODIFICATION	VERSION
24.11.09	H.SANCHEZ	REMOVED CIRCUIT BREAKER	V.03
16.09.08	F.GARCIA	ADDED TO OPTION ANTICONDENSATION RESISTANCE	V.02

GESAN

DATE:	04.06.08	SIGNATURE:	SIGNATURE:	ESCALA:
DRAW:	F.GARCIA			
ID.S. NORMS	J.LORENTE			

WIRING DIAGRAM TO WATERCOOLED GENSET 400/230V 50Hz WITHOUT CONTACTORS,TABLE IN GROUP

MODEL: DPA 25 - 150 E
DVA 165E, DZA 100-165E

CODE:

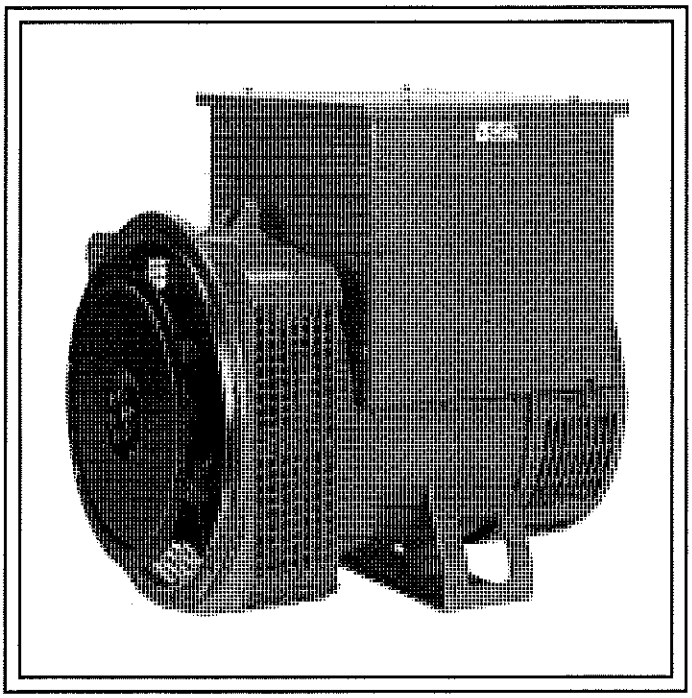
PLANE Nº: 3758

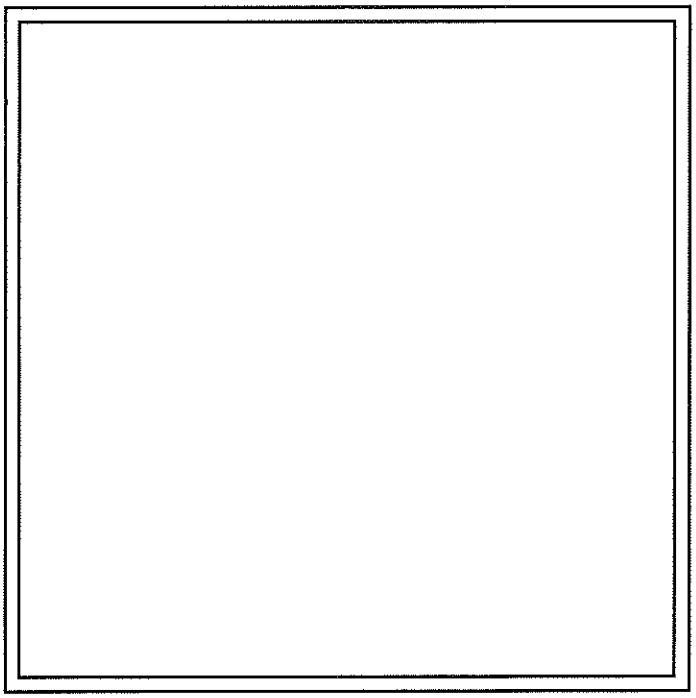
VERSION: V.03

WB196 Seib Street Water Booster - JPR - Operation and Maintenance Manual
Page 912 of 1068
Active: 18/04/2016
Q-Pulse ID: JMS 594

LEROY SOMER®

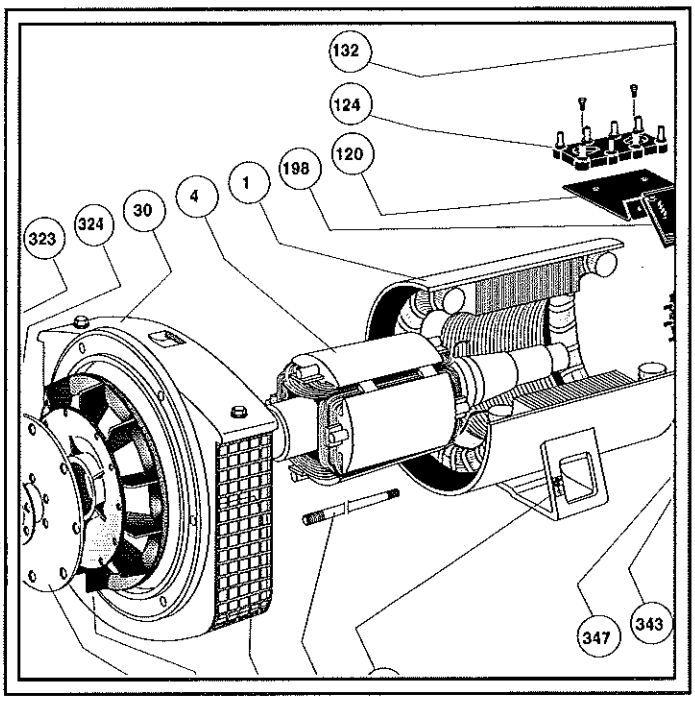
3433 es - 06.2007 / e





CE

Estas instrucciones deben transmitirse al usuario final



LSA 42.2 - 2 & 4 POLOS

ALTERNADORES

Instalación y mantenimiento

LEROY-SOMER	INSTALACIÓN Y MANTENIMIENTO	3433 es - 06.2007 / e

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES

Estas instrucciones se aplican al alternador que Usted acaba de adquirir.

Última creación de una nueva generación, esta gama se beneficia de la experiencia del primer fabricante mundial que utiliza una avanzada tecnología y efectúa rigurosos controles de calidad.

Deseamos destacar la importancia de estas instrucciones de mantenimiento. Si se respetan ciertos aspectos importantes durante la instalación, uso y mantenimiento del alternador, podrá disfrutar de muchos años de funcionamiento sin problemas.

LAS MEDIDAS DE SEGURIDAD

Antes de poner en marcha su máquina, debe leer este manual de instalación y mantenimiento en su totalidad.

Todas las operaciones e intervenciones que se deben llevar a cabo para utilizar esta máquina estarán a cargo de personal cualificado.

Nuestro servicio de asistencia técnica está a su disposición para ofrecerle toda la información que necesite.

Las distintas intervenciones descritas a continuación se presentan con recomendaciones o símbolos con el fin de informar al usuario sobre los riesgos de accidentes. Es imprescindible que Usted comprenda y respete las distintas recomendaciones de seguridad aquí presentadas.

ATENCION

Recomendación de seguridad relativa a una intervención que pueda dañar o destruir la máquina o el material del entorno.



Recomendación de seguridad contra los riesgos genéricos que afecten al personal.

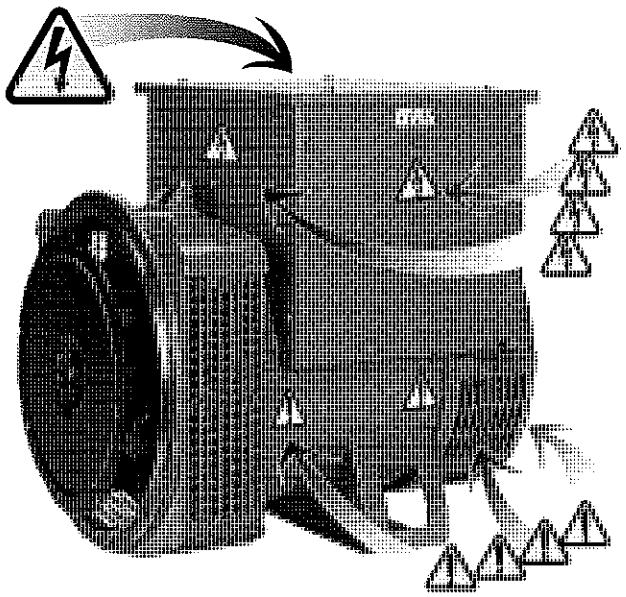


Recomendación de seguridad contra un riesgo eléctrico que afecte al personal.

Nota: LEROY-SOMER se reserva el derecho de cambiar las características de sus productos en todo momento para incorporar los últimos adelantos tecnológicos. La información que contiene este documento puede ser modificada sin previo aviso.

LAS RECOMENDACIONES DE SEGURIDAD

Una hoja de autoadhesivos con las diversas recomendaciones de seguridad acompaña estas instrucciones de mantenimiento. Su colocación se llevará a cabo según el diagrama y una vez que la máquina esté completamente instalada.



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LEROY-SOMER	INSTALACIÓN Y MANTENIMIENTO	3433 es - 06.2007 / e

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
SUMARIO

1 - RECEPCION

1.1 - Normas y medidas de seguridad 4
1.2 - Inspección 4
1.3 - Identificación 4
1.4 - Almacenaje 4

2 - CARACTERISTICAS TECNICAS

2.1 - Características eléctricas 5
2.2 - Características mecánicas 5

3 - INSTALACION – PUESTA EN MARCHA

3.1 - Montaje 6
3.2 - Inspección antes de la puesta en marcha 6
3.3 - Esquemas de conexión de las bornas 7
3.4 - Puesta en marcha 9
3.5 - Ajuste 9

4 - MANTENIMIENTO

4.1 - Medidas de seguridad 10
4.2 - Mantenimiento habitual 10
4.3 - Detección de averías 10
4.4 - Fallos mecánicos 11
4.5 - Fallos eléctricos 11
4.6 - Desmontaje, montaje 13
4.7 - Tabla de características 15

5 - PIEZAS DE REPUESTO

5.1 - Piezas de primer mantenimiento 16
5.2 - Denominación de los rodamientos 16
5.3 - Servicios de asistencia técnica 16
5.4 - Despiece, nomenclatura 17

LEROY-SOMER	INSTALACIÓN Y MANTENIMIENTO	3433 es - 06.2007 / e

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
RECEPCION

1 - RECEPCION

1.1 - Normas y medidas de seguridad

Nuestros alternadores son conformes con la mayoría de las normas internacionales y son compatibles con:
- las recomendaciones de la
Comisión Electrotécnica Internacional
CEI 34-1 (EN 60034) ;
- las recomendaciones de
la International Standard Organisation ISO 8528;
- la directiva 89/336/CEE de la Comunidad Europea sobre la Compatibilidad Electromagnética (CEM).
- las directivas de la Comunidad Europea
73/23/EEC y 93/68/EEC (Directiva Baja Tensión).
Llevan la marca CE de acuerdo con la (Directiva Baja Tensión) como componente de una máquina. A demanda se puede proporcionar una declaración de incorporación.
Antes de cualquier utilización de su generador, lea detenidamente este manual de instalación y mantenimiento suministrado junto con la máquina. Todas las operaciones efectuadas en el altemador han de ser realizadas por personal cualificado para la puesta en marcha, el mantenimiento y la reparación de los elementos eléctricos y mecánicos. Es preciso guardar este manual de mantenimiento durante toda la vida de la máquina y debe ser entregado con ella a cada cambio de propiedad.
Las distintas intervenciones descritas a continuación se presentan con recomendaciones o símbolos con el fin de informar al usuario sobre los riesgos de accidentes. Es imprescindible que Usted comprenda y respete las recomendaciones de seguridad aquí presentadas.

1.2 - Control

Al recibir su alternador, compruebe que no haya sufrido ningún daño durante el transporte. Si hubiera señales evidentes de golpes, manifieste sus reservas al transportista (pueden intervenir los seguros de transporte) y después de un control visual, haga girar la máquina a mano para detectar cualquier eventual anomalía.

1.3 - Identificación

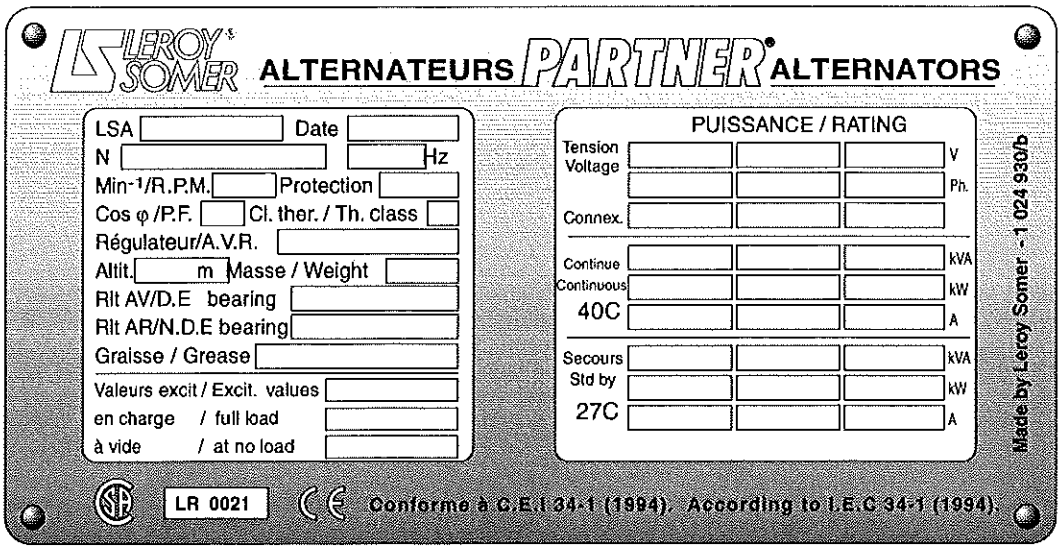
El alternador está identificado por una placa de características pegada sobre su carcasa.
Comprobar de que la placa de características de la máquina se corresponda con su pedido.
La denominación de la máquina se realiza según diferentes criterios (ver a continuación).
Ejemplo de la descripción del tipo: **LSA 42.2 S4 J6/4 -**
- LSA : denominación de la gama PARTNER
  M : Marino / C : Cogeneración / T : Telecomunicaciones.
- 42.2 : tipo de máquina
- S4 : modelo
- J : Sistema de excitación
  (C:AREP / J:SHUNT / E:COMPOUND)
- 6/4 : número bobinado / número de polos.

1.3.1 - Placa de características

A fin de poder identificar de manera exacta y rápida su máquina, Usted puede transcribir sus características a la placa de características abajo incluída.

1.4 - Almacenaje

En espera de la puesta en marcha, es preciso guardar las máquinas al abrigo de la humedad: en efecto, con una humedad superior al 90 %, el aislamiento de la máquina puede disminuir muy rápidamente hasta llegar a ser prácticamente nulo alrededor del 100 %; comprobar el estado de la protección antióxido de las partes no pintadas.
Para un almacenaje muy prolongado, se puede poner la máquina dentro de un contenedor sellado (por ejemplo plástico termosoldable) con bolsitas deshidratantes en el interior, al abrigo de fuertes variaciones de temperatura para evitar cualquier fenómeno de condensación durante el almacenaje.
En caso de vibraciones en el entorno, es preciso reducir el efecto de dichas vibraciones colocando el alternador sobre un soporte amortiguador (placa de caucho u otro) y girar el rotor de una fracción de vuelta cada 15 días para evitar que las pistas de los rodamientos queden marcadas.

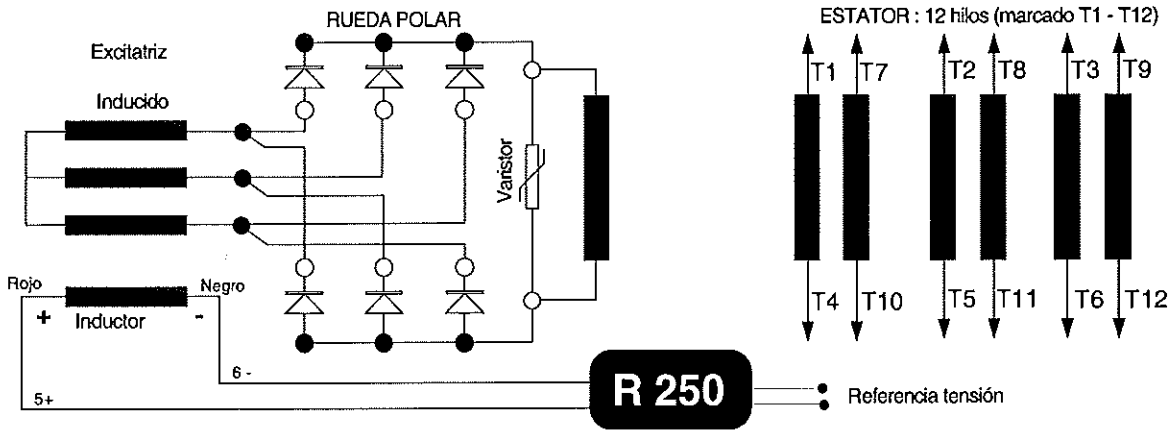


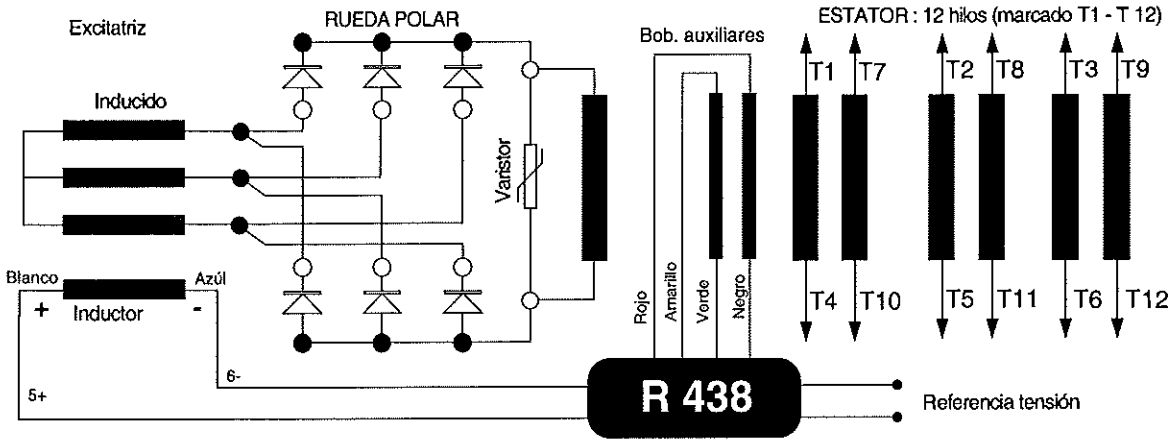
LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
CARACTERISTICAS TECNICAS

2 - CARACTERISTICAS TECNICAS

2.1 - Características eléctricas

El alternador PARTNER LSA 42.2 es una máquina autoexcitada, sin escobillas, de inductor giratorio, con bobinado de "Paso 2/3", 12 hilos, con aislamiento clase H y sistema de excitación disponible en la versión "SHUNT" o en la versión "AREP" (ver 2.3, 2.4). El grado antiparasitaje es conforme a la norma EN 55011, grupo 1, clase B.





2.1.1 - Opciones

- Sondas de detección de la temperatura del estátor.
- Resistencias de caldeo.

2.2 - Características mecánicas

- Carcasa de acero
- Bridas de fundición
- Rodamientos de bolas estancos
- Formas de construcción

IM 1201 (MD 35) :
monopalier de disco con patas y bridas/discos SAE.
IM 1001 (B 34) :
bipalier con brida SAE y extremo de eje cilíndrico normalizado.

- Máquina abierta, autoventilada
- Grado de protección: IP 23

2.2.1 - Opciones

- Protecciones contra los entornos agresivos
- Filtro en la entrada del aire, filtro en la salida del aire.

Los alternadores equipados con filtros en la entrada del aire son sometidos a una desclasificación de potencia del 5 %.
A fin de evitar un recalentamiento excesivo causado por la obturación de los filtros, se aconseja equipar el bobinado del estátor con dispositivos de detección térmica (CTP ó PT100).

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
INSTALACION

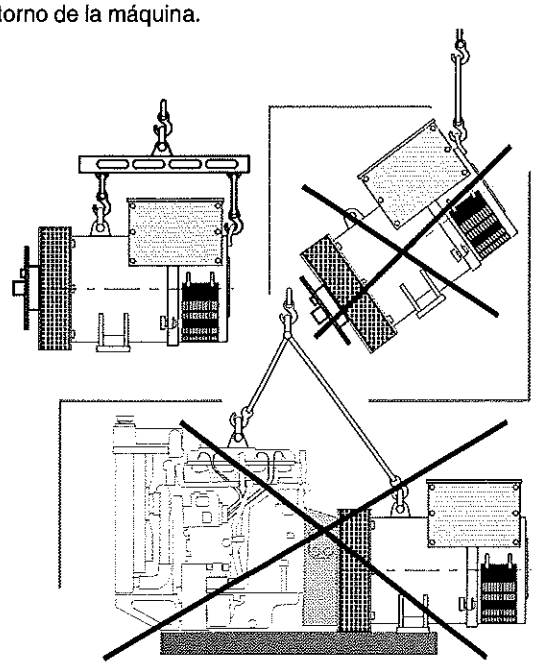
3 - INSTALACION

3.1 - Montaje

Todas las operaciones de elevación y desplazamiento han de ser efectuadas con equipos adecuados.
Durante las manipulaciones la máquina ha de estar siempre horizontal.

3.1.1 - Desplazamiento

Los cáncamos de elevación han sido ampliamente dimensionados y permiten únicamente la manipulación del alternador. No se deben utilizar para levantar el grupo completo. Prever un sistema de elevación que respete el entorno de la máquina.



3.1.2 - Acoplamiento

3.1.2.1 - Alternador monopalier
Antes de acoplar las dos máquinas, verificar la compatibilidad mediante:
- un análisis de torsión de la línea de eje del grupo,
- un control de las medidas del volante y del cárter de volante, de la brida, de los discos y de la distancia de las caras de apoyo del alternador.

ATENCION

Durante el acoplamiento se obtiene la alineación de los agujeros de los discos y del volante haciendo girar la polea primaria del motor térmico. No utilizar el ventilador para hacer girar el rotor del alternador.
Apretar los tornillos de los discos con el par recomendado (ver §4.6.2.) y comprobar que quede un juego lateral del cigüeñal.

3.1.2.2 - Alternador bipalier
- Acoplamiento semielástico
Se recomienda alinear cuidadosamente las máquinas, comprobando que las diferencias de concentricidad y de paralelismo de los 2 medios manguitos no excedan de 0,1 mm.

ATENCION

Este alternador ha sido equilibrado con 1/2 chaveta.

3.1.3 - Ubicación

El sitio donde se va a colocar el alternador ha de ser tal que la temperatura ambiente no pueda sobrepasar los 40°C para las potencias standard (para temperaturas > 40°C, aplicar un coeficiente de desclasificación). El aire fresco exento de humedad y polvo ha de llegar libremente a las rejillas de entrada del aire, situadas en el lado opuesto al acoplamiento. Es esencial impedir el reciclaje del aire caliente que sale de la máquina o del motor térmico, así como de los gases de escape.

3.2 - Controles antes de la primera puesta en marcha

3.2.1 - Verificaciones eléctricas

Se prohibe terminantemente poner en marcha un alternador, nuevo o no, si el aislamiento es inferior a 1 Megaohmio para el estátor y a 100 000 Ohmios para el resto de los bobinados.
Para recuperar los valores mínimos antedichos hay varios métodos.
a) Deshidratar la máquina durante 24 horas en una estufa a una temperatura de unos 110 °C (sin el regulador).
b) Soplar aire caliente en la entrada del aire asegurando la rotación de la máquina con el inductor desconectado.
c) Funcionamiento en cortocircuito (desconectar el regulador).
- poner en cortocircuito las tres bornas de salida (potencia) mediante conexiones capaces de soportar la intensidad nominal (a ser posible no exceder 6 A/mm^2).
- instalar una pinza amperimétrica para controlar la intensidad que pasa por las conexiones del cortocircuito;
- conectar en las bornas de los inductores de la excitación, respetando las polaridades, una batería de 48 V, en serie con un reóstato de aproximadamente 10 ohmios (50 W);
- abrir al máximo todas las aperturas del alternador;
- poner en rotación el alternador a su velocidad nominal y ajustar su excitación mediante el reóstato de manera tal que se consiga la intensidad nominal en las conexiones del cortocircuito.
Nota: A fin de evitar estos problemas después de una parada prolongada, se recomienda utilizar resistencias de caldeo y una rotación de mantenimiento periódico. Las resistencias de caldeo son verdaderamente eficaces sólo si funcionan permanentemente mientras la máquina está parada.

LEROY-SOMER	INSTALACIÓN Y MANTENIMIENTO	3433 es - 06.2007 / e

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
INSTALACION

3.2.2 - Verificaciones mecánicas

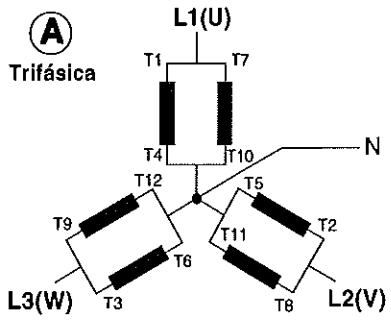
Antes del primer arranque comprobar que:
- los pernos de fijación de las patas estén bien bloqueados,
- el aire de enfriamiento sea aspirado libremente,
- las rejillas y el cárter protector estén en su sitio,
- el sentido de giro standard es el sentido horario visto lado eje (giro de las fases 1-2-3). Para un sentido de giro antihorario, intercambiar 2 y 3,
- la conexión corresponda a la tensión de red de la instalación (ver § 3.3)

3.3 - Esquemas conexión de las bornas

La modificación de las conexiones se realiza cambiando de bornas los cables. El código del bobinado viene indicado en la placa de características.

Todas las operaciones en las bornas del alternador durante las reconexiones o las verificaciones han de ser efectuadas con la máquina parada.

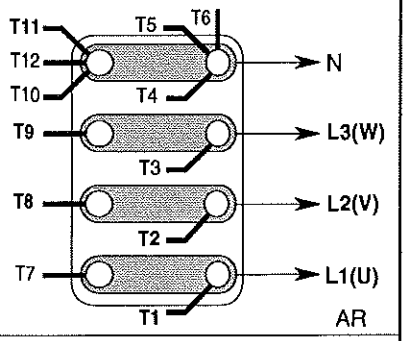
Código conexiones A — Trifásica



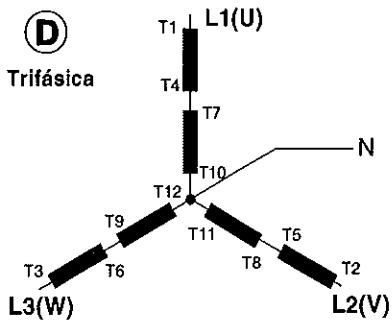
Bobinado	50 Hz	60 Hz
6	190 - 208	190 - 240
7	220 - 230	-
8	-	190 - 208

Detección de tensión R 250 :
0 => (T8) / 110 V => (T11)
Detección de tensión R 438 :
0 => (T3) / 220 V => (T2)

Conexión de fábrica

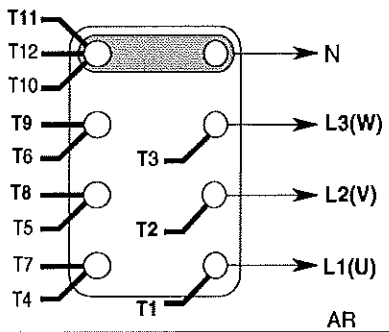


Código conexiones D — Trifásica

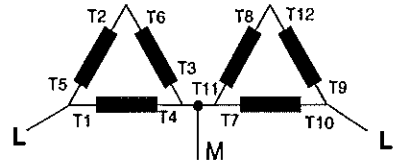


Bobinado	50 Hz	60 Hz
6	380 - 415	380 - 480
7	440 - 460	-
8	-	380 - 416

Detección de tensión R 250 :
0 => (T8) / 110 V => (T11)
Detección de tensión R 438 :
0 => (T3) / 380 V => (T2)



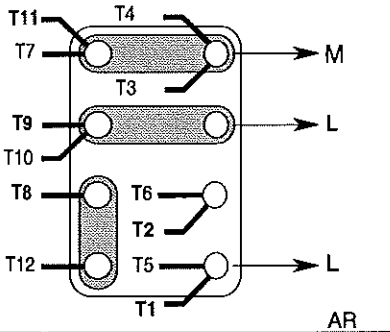
Código conexiones FF — Monofásica



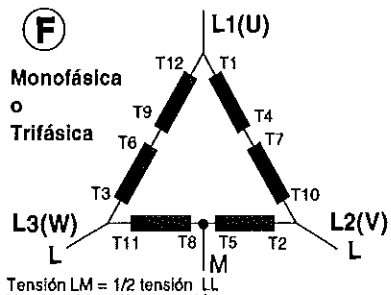
Tensión LM = 1/2 tensión LL
Voltage LM = 1/2 voltage LL

Bobinado	50 Hz	60 Hz
6	220 - 240	220 - 240
7	250 - 260	-
8	200	220 - 240

Detección de tensión R 250 :
0 => (T1) / 110 V => (T4)
Detección de tensión R 438 :
0 => (T10) / 220 V => (T1)



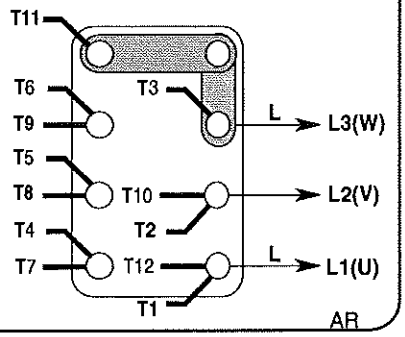
Código conexiones F — Monofásica o Trifásica



Tensión LM = 1/2 tensión LL
Voltage LM = 1/2 voltage LL

Bobinado	50 Hz	60 Hz
6	220 - 240	220 - 240
7	250 - 260	-
8	200	220 - 240

Detección de tensión R 250 :
0 => (T8) / 110 V => (T11)
Detección de tensión R 438 :
0 => (T3) / 220 V => (T2)

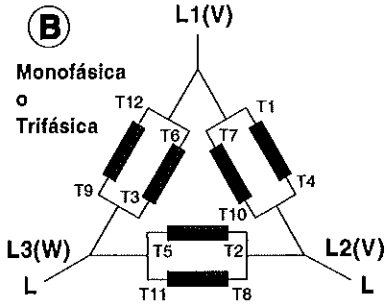


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LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
INSTALACION

Código conexiones

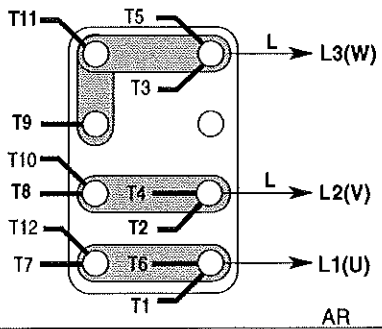
B Monofásica o Trifásica



Tensión L.L		
Bobinado	50 Hz	60 Hz
6	110 - 120	120
7	120 - 130	-
8	-	110 - 120

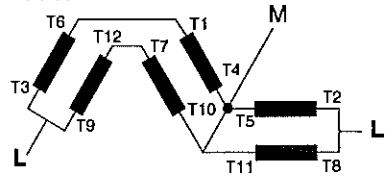
Detección de tensión R 250 :
0 => (T8) / 110 V => (T11)
Detección de tensión R 438 :
0 => (T3) / 110 V => (T2)

Conexión de fábrica



G Connexion déconseillée

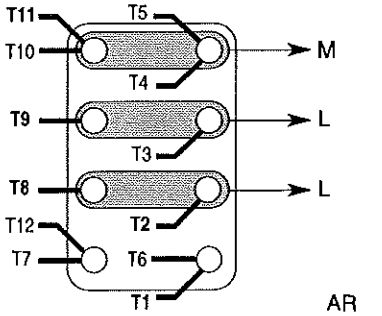
1 PH



Tensión LM = 1/2 tensión LL

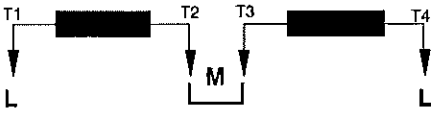
Bobinado	50 Hz	60 Hz
6	220 - 240	220 - 240
7	250 - 260	-
8	200	220 - 240

Detección de tensión R 250 :
0 => (T8) / 110 V => (T11)
Detección de tensión R 438 :
0 => (T3) / 220 V => (T2)



MONOFASICO 4 HILOS - BOBINADO ESPECIFICO tipo M o M1

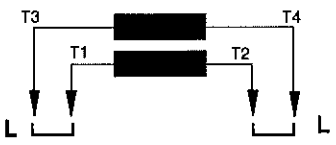
CONEXION SERIE



Tensión 50/60 Hz			Salida		
L - L	L - M	Conectar	L	L	M
220 230 240	110 115 120	T2 - T3	T1	T4	T2 - T3

R 250 detección de tensión : 0 => (T1) / 110 V => (T2)

CONEXION PARALELO

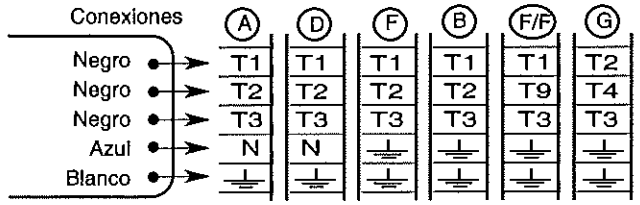


Tensión 50/60 Hz			Salida		
L - L	L - M	Conectar	L	L	M
110 115 120	- - -	T1 - T3 T2 - T4	T1-T3	T2 - T4	-

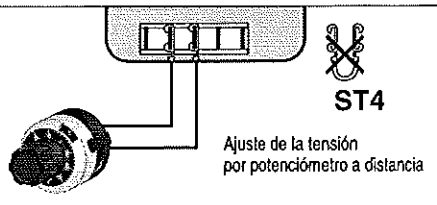
R 250 detección de tensión : 0 => (T1) / 110 V => (T2)

3.3.1 - Esquema de conexión de las opciones

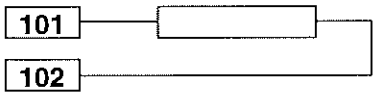
Kit antiparasitaje R 791 T (standard para marcado CE)



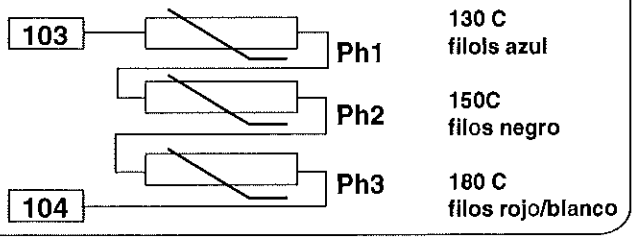
Potenciómetro tensión



Resistencia de caldeo



Sondas estátor CTP



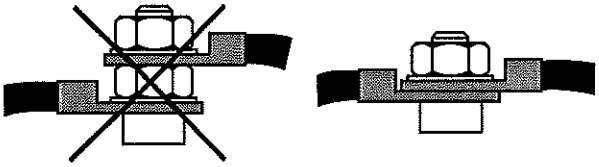
LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
INSTALACION

3.3.2 - Verificaciones de las conexiones



Es preciso realizar las instalaciones eléctricas conforme a la legislación vigente en el país de utilización.

Comprobar que:
- el dispositivo de corte diferencial, conforme a la legislación sobre la protección de las personas, vigente en el país de utilización, haya sido bien instalado en la salida de potencia del alternador, lo más cerca posible de él. (En este caso, desconectar el hilo azul del módulo contra interferencias R 791 que enlaza el neutro).
- las eventuales protecciones no estén disparadas,
- en el caso de un regulador externo, las conexiones entre el alternador y el armario estén bien realizadas según el esquema de conexionado,
- no haya cortocircuito entre fases o entre fase y neutro en las bornas de salida del alternador y el armario de control del grupo electrógeno (parte del circuito no protegida por los disyuntores o relés del armario).
- las conexiones de las máquinas se realizan terminal con terminal y conforme al esquema de conexión de las bornas.



3.4 - Puesta en marcha



El arranque y el uso de la máquina no son posibles si la instalación no cumple las reglas y normas establecidas en este manual.
La máquina es ensayada y ajustada en la fábrica. Al arrancar por primera vez en vacío, es preciso comprobar que la velocidad de accionamiento sea correcta y estable (ver la placa de características). Cuando se aplica la carga, la máquina ha de recuperar su velocidad nominal y su tensión; sin embargo, si el funcionamiento fuese irregular, se puede intervenir sobre el ajuste de la máquina (seguir el procedimiento de ajuste § 3.5). Si el funcionamiento sigue siendo defectuoso, entonces es preciso averiguar la causa de la avería (ver § 4.4).

3.5 - Ajustes



Los ajustes durante las pruebas han de ser efectuados por personal cualificado. Es obligatorio respetar la velocidad de accionamiento especificada en la placa de características para acometer un procedimiento de ajuste. Tras la puesta a punto hay que montar de nuevo en su sitio los paneles de acceso y las tapas.
Los únicos ajustes posibles de la máquina se realizan mediante el regulador.

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
MANTENIMIENTO

4 - MANTENIMIENTO

4.1 - Medidas de seguridad



Es preciso ajustarse terminantemente a las operaciones de mantenimiento o de reparación a fin de evitar riesgos de accidentes y mantener la máquina en su estado original.



Todas estas operaciones efectuadas en el alternador han de ser realizadas por personal capacitado para la puesta en marcha, el mantenimiento y la reparación de los elementos eléctricos y mecánicos.
Antes de efectuar cualquier operación en la máquina, comprobar que ésta no se pueda poner en marcha con un sistema manual o automático y que se hayan entendido los principios de funcionamiento del sistema.

4.2 - Mantenimiento ordinario

4.2.1 - Control tras la puesta en marcha

Al cabo de unas 20 horas de operación, comprobar el apriete de todos los tornillos de fijación de la máquina, su estado general y las diferentes conexiones eléctricas de la instalación.

4.2.2 - Circuito de ventilación

Se recomienda prestar atención a que no se reduzca la circulación de aire debido a una obstrucción parcial de las rejillas de aspiración y salida: lodos, fibras, hollín, etc.

4.2.3 - Rodamientos

Los rodamientos están engrasados de por vida: duración aproximada de la grasa (según utilización) = 20 000 horas o 3 años. Vigilar el aumento de temperatura de los rodamientos, que no debe superar los 90 °C. Si se supera este valor es preciso parar la máquina y proceder a una comprobación.

4.2.4 - Mantenimiento eléctrico

Producto de limpieza para los devanados

ATENCION

No utilizar: tricloretileno, percloretileno, tricloretano ni cualquier producto alcalino.

Se pueden utilizar productos desengrasantes y volátiles puros bien definidos como por ejemplo:
- Gasolina (sin aditivos); inflamable
- Tolueno (poco tóxico); inflamable
- Benceno (o bencina, tóxico); inflamable
- Ciclohexano (no tóxico); inflamable

Limpieza de estátor, rotor, excitatriz y puente de diodos

Los aislantes y el sistema de impregnación no son atacados por los disolventes (ver la lista anterior de los productos autorizados).
Se debe evitar que el producto de limpieza fluya hacia las ranuras. Aplicar el producto con un pincel repasando a menudo una esponja para evitar acumulaciones en la carcasa. Secar el devanado con un trapo seco. Dejar evaporar los restos antes de cerrar la máquina.

4.2.5 - Mantenimiento mecánico

ATENCION

Se prohibe utilizar agua o un aparato de limpieza a alta presión para limpiar la máquina.
Todo desperfecto debido a esta utilización quedará excluído de nuestra garantía.
Para desengrasar la máquina se utilizará un pincel y un producto desengrasante. Comprobar su compatibilidad con la pintura.
Para quitar el polvo utilizar aire comprimido.
Si después de la fabricación de la máquina han sido añadidos unos filtros y la máquina no tiene protecciones térmicas, el personal de mantenimiento debe proceder periódica y sistemáticamente a limpiar los filtros del aire, tan a menudo como sea necesario (cada día para los entornos muy polvorientos)...
Para lavar se utiliza agua en caso de polvos secos y con un baño con jabón o detergente si se trata de polvos grasos. También se puede utilizar gasolina o cloroetano.
Después de limpiar el alternador es imprescindible comprobar el aislamiento de los bobinados (ver § 3.2. § 4.8.).

4.3 - Detección de averías

Si a la puesta en marcha el funcionamiento del alternador es anómalo, es preciso averiguar el origen de la avería.
Para ello cabe comprobar que:
- las protecciones estén bien activadas,
- las conexiones y los enlaces sean conformes a los esquemas de los manuales adjuntos a la máquina,
- la velocidad del grupo sea correcta (ver § 1.3.).

Repetir todas las operaciones establecidas en el capítulo 3.

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
MANTENIMIENTO

4.4- Averías mecánicas

Defecto		Acción
Rodamiento	Calentamiento excesivo del o de los palieres (temperatura > 80 °C en los casquetes de los rodamientos con o sin ruido anómalo)	- Si el rodamiento se ha vuelto azul o si la grasa está carbonizada, cambiar el rodamiento. - Rodamiento mal encajado. - Mala alineación de los palieres (bridas mal encajadas).
Temperatura anómala	Calentamiento excesivo de la carcasa del alternador (más de 40° C por encima de la temperatura ambiente)	- Entrada-salida del aire parcialmente obstruida o recirculación del aire caliente del alternador o del motor térmico - Funcionamiento alternador a tensión demasiado alta (> al 105% de Un c/carga) - Funcionamiento del alternador en sobrecarga
Vibraciones	Vibraciones excesivas	- Alineación incorrecta (acoplamiento) - Amortiguación defectuosa o juego en el acoplamiento - Rotor desequilibrado
	Vibraciones excesivas y zumbido procedentes de la máquina	- Marcha monofásica del alternador (carga monofásica o contactor estropeado o fallo de la instalación) - Cortocircuito del estátor.
Ruidos anómalos	Choque violento, eventualmente seguido de zumbido y vibraciones	- Cortocircuito en la instalación - Falsa conexión (conexión en paralelo no en fase) Posibles consecuencias - Ruptura o deterioro del acoplamiento - Ruptura o torsión del extremo de eje. - Desplazamiento y puesta en cortocircuito del bobinado de la rueda polar. - Ruptura o desbloqueo del ventilador - Destrucción de los diodos giratorios del regulador

4.5 - Averías eléctricas

Defecto	Acción	Medidas	Control/Origen
Falta de tensión en vacío al arranque	Conectar, entre E– y E+ una pila nueva de 4 a 12 voltios respetando las polaridades durante 2 a 3 segundos	El alternador se ceba y su tensión queda normal cuando se quita la pila	- Falta de remanente
		El alternador se ceba pero su tensión no aumenta hasta el valor nominal tras quitar la pila	- Comprobar conexión referencia tensión del regulador - Defecto de diodos - Cortocircuito del inducido
		El alternador se ceba pero su tensión desaparece cuando se quita la pila	- Defecto del regulador - Inductores cortados - Rueda polar cortada. Comprobar la resistencia
Tensión demasiado baja	Comprobar la velocidad de accionamiento	Velocidad buena	Comprobar la conexión del regulador (eventualmente regulador estropeado) - Inductores en cortocircuito - Diodos giratorios abiertos - Rueda polar en cortocircuito – Comprobar resistencia
		Velocidad demasiado baja	Aumentar la velocidad de accionamiento (No tocar el potenciómetro tensión (P2) del regulador antes de recobrar la velocidad correcta).
Tensión demasiado alta	Ajuste del potenciómetro de tensión del regulador	Ajuste inoperante	Defecto del regulador
Oscilaciones de la tensión	Ajuste del potenciómetro de estabilidad del regulador	Si no se tiene efecto: probar los modos normal rápido (ST2)	- Comprobar velocidad: posibles irregularidades cíclicas - Bornas mal apretadas - Defecto del regulador - Velocidad baja con carga (o LAM demasiado alto)
Tensión correcta en vacío y demasiado baja con carga (*)	Poner en vacío y comprobar la tensión entre E+ y E- en el regulador	Tensión entre E+ y E- SHUNT < 6V - AREP < 10V	- Comprobar velocidad (o LAM demasiado alto)
		Tensión entre E+ y E- SHUNT > 10V - AREP > 15V	- Diodos giratorios estropeados - Cortocircuito en la rueda polar. Comprobar resistencia - Inducido de la excitatriz estropeado.
(*) Atención: En utilización monofásica, comprobar que los hilos de detección procedentes del regulador estén bien conectados en las bornas de utilización.			
Desaparición tensión durante el funciona-miento (**)	Comprobar el regulador, el varistor, los diodos giratorios y cambiar el elemento estropeado	La tensión no vuelve al valor nominal.	- Inductor excitatriz cortado - Inducido excitatriz estropeado - Regulador defectuoso - Rueda polar cortada o en cortocircuito
(**) Atención: Acción posible de la protección interna (sobrecarga, corte, cortocircuito).			

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
MANTENIMIENTO

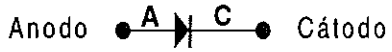
4.5.1 - Verificación del bobinado

Se puede comprobar el aislamiento del bobinado efectuando una prueba dieléctrica. En tal caso es obligatorio desconectar todas las conexiones del regulador.

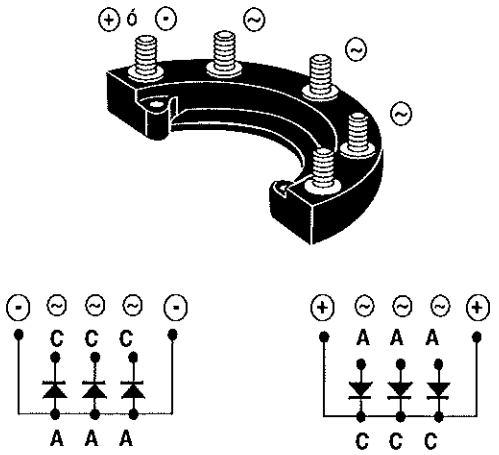
ATENCION

Los daños causados al regulador en estas condiciones no están cubiertos por nuestra garantía.

4.5.2 - Verificación del puente de diodos



Un diodo en buen estado permite la circulación de intensidad en un solo sentido desde el ánodo al cátodo.



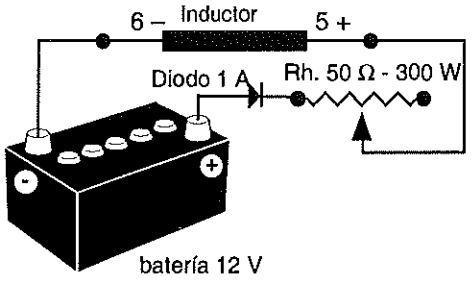
4.5.3 - Verificación de los bobinados y de los diodos giratorios por excitación separada

Durante este procedimiento cabe comprobar que el alternador esté desconectado de cualquier carga externa y examinar la caja de bornas para comprobar que las conexiones estén bien apretadas.

1) Parar el grupo, desconectar y aislar los hilos del regulador.
2) Para crear la excitación separada hay dos montajes posibles.

Montaje A : Conectar una batería de 12 V en serie con un reóstato de aproximadamente 50 ohmios - 300 W y un diodo en los 2 hilos del inductor (5+) y (6-).

MONTAJE A



Montaje B : Conectar una alimentación variable "Variac" y un puente de diodos en los 2 hilos del inductor (5+) y (6-).

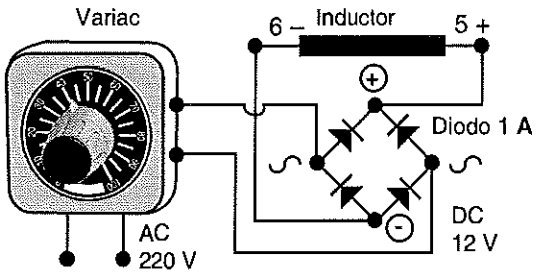
Estos dos sistemas han de tener características compatibles con la potencia de excitación de la máquina (ver la placa de características).

3) Hacer girar el grupo a su velocidad nominal.

4) Aumentar paulatinamente la intensidad de alimentación del inductor maniobrando el reóstato o el Variac y medir las tensiones de salida en L1 - L2 - L3, controlando las tensiones y las intensidades de excitación sin y con carga (ver la placa de características de la máquina o pedir la ficha de ensayos de fábrica).

Si las tensiones de salida están en sus valores nominales y equilibrados al < 1 % para el valor de excitación dado, la máquina está bien y el defecto procede de la parte de regulación (regulador – cableado – detección – bobinado auxiliar).

MONTAJE B



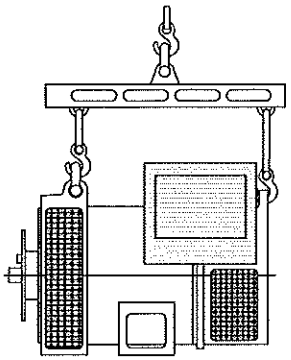
LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
MANTENIMIENTO

4.6 - Desmontaje, montaje (ver § 5.4.1. & 5.4.2.)

Esta operación ha de ser efectuada sólo durante el periodo de garantía en un taller autorizado LEROY-SOMER o en nuestros establecimientos, so pena de anular la garantía.

ATENCION

En caso de manutención, la máquina debe estar horizontal (rotor no bloqueado en translación).



4.6.1 - Herramientas necesarias

Para el desmontaje total de la máquina es mejor disponer de las siguientes herramientas:
- 1 llave de carraca + alargador
- 1 llave dinamométrica
- 1 llave plana de 7 mm
- 1 llave plana de 8 mm
- 1 llave plana de 10 mm
- 1 llave plana de 12 mm
- 1 vaso de 8 mm
- 1 vaso de 10 mm
- 1 vaso de 13 mm
- 1 taco hexagonal de 5 (ex. Facom : ET5)
- 1 taco hexagonal de 6 (ex. Facom : ET6)
- 1 taco TORX T20
- 1 taco TORX T30
- 1 extractor (ex. Facom : U35)
- 1 extractor (ex. Facom : U32/350).

4.6.2 - Par de apriete de los tornillos

IDENTIFICACION	Ø tornillos	Par N.m
Tornillo de la bornera inductor	M4	4 N.m
Tornillo inductor	M6	10 N.m
Tornillo puente de diodos	M 6	5 N.m
Tuerca de los diodos	M 5	4 N.m
Espárrago de montaje	M 8	20 N.m
Tornillos de masa	M 6	5 N.m
Pasador equilibrado	M 5	4 N.m
Tornillo disco/eje	M 10	66 N.m
Cáncamo de elevación	M 8	4 N.m
Tornillos de rejillas	M 6	5 N.m
Tornillo de la tapa	M 6	5 N.m

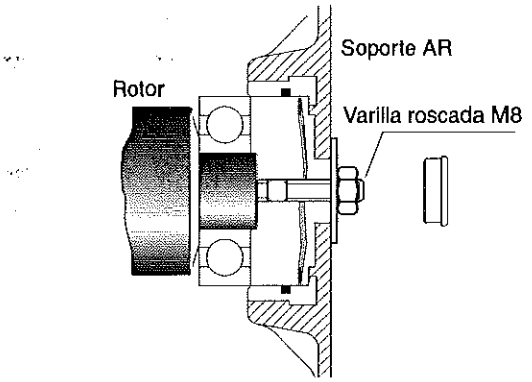
4.6.3 - Acceso a las conexiones y al sistema de regulación

El acceso a las bornas es directo tras quitar la tapa de caja de bornas [48].
Para acceder a los potenciómetros de ajuste del regulador hay que desmontar la placa lateral [367].

4.6.4 - Acceso, comprobación y sustitución de los diodos

4.6.4.1 - Desmontaje
- Quitar la tapa superior [48].
- Quitar la rejilla de entrada del aire [51].
- Desenroscar los collares de fijación de los cables de salida de potencia, desconectar E+, E- de la excitatriz y el módulo R 791.
- Quitar las 4 tuercas de los espárragos de montaje.
- Desmontar el soporte trasero [36] usando un extractor: ejemplo U.32 - 350 (Facom).
- Quitar el varistor [347].
- Desmontar los 4 tornillos de fijación de los puentes de diodos del inducido y desconectar los diodos
- Comprobar los 6 diodos con un ohmímetro o una lámpara (ver § 4.5.1.)

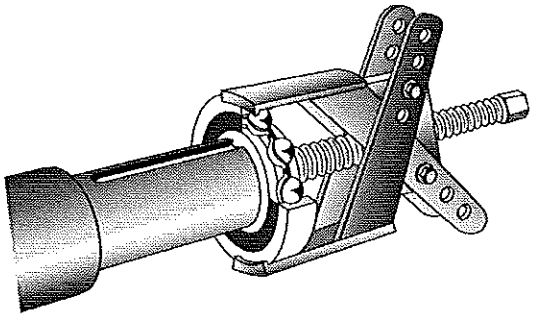
4.6.4.2 - Montaje
- Remontar los puentes respetando las polaridades (ver § 4.5.1.).
- Remontar el varistor [347].
- Poner una junta tórica nueva en el soporte.
- Remontar el soporte trasero, pasar el haz de cables entre las barritas superiores del soporte.
- Remontar los collares de fijación de los cables y el módulo R 791.
- Poner de nuevo la rejilla de entrada del aire [51].
- Remontar la tapa superior [48].



4.6.5 - Sustitución del rodamiento trasero en una máquina monopalier

4.6.5.1 - Desmontaje

- Quitar el soporte trasero [36] (ver § 4.6.2.1.)
- Quitar el rodamiento [70] con un extractor de tornillo.



4.6.5.2 - Montaje

- Montar un rodamiento nuevo tras haber calentado su anillo interno por inducción o en una estufa a 80 °C (no utilizar un baño de aceite).
- Poner la arandela de precarga [79] en el soporte y poner una junta tórica nueva [349].
- Remontar el soporte trasero [36] (ver § 4.6.2.2.)

4.6.6 - Cambio de los rodamientos en máquina bipalier

4.6.6.1 - Desmontaje

- Desacoplar el alternador del motor de accionamiento.
- Quitar los 8 tornillos de fijación.
- Quitar la brida delantera [30]
- Quitar el soporte trasero (ver § 4.6.2.1.)
- Quitar los dos rodamientos [60] y [70] con un extractor de tornillo central.

4.6.6.2 - Montaje

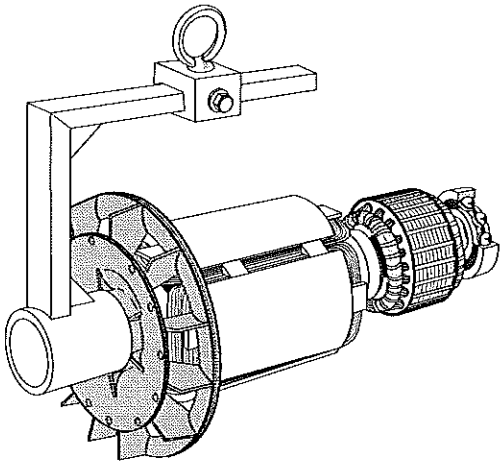
- Montar rodamientos nuevos tras haberlos calentados por inducción o en estufa a 80 °C (no utilizar un baño de aceite).
- Comprobar la presencia de la arandela de precarga (79) y de la junta tórica nueva [349] en el soporte trasero [36].
- Remontar la brida delantera [30], bloquear los 8 tornillos de fijación.
- Comprobar que sea correcto el montaje del conjunto de la máquina y el apriete de todos los tornillos.

4.6.7 - Acceso a rueda polar y estátor

4.6.7.1 - Desmontaje

Seguir el procedimiento de desmontaje de los rodamientos (ver § 4.6.5.1 y ver § 4.6.5.1)

- Desmontar el disco de acoplamiento (máquina monopalier) o el palier delantero (máquina bipalier) e introducir un tubo del diámetro correspondiente en el extremo de eje o un soporte realizado según el dibujo siguiente.



- Colocar el rotor apoyado en uno de sus polos, luego extraerlo deslizándolo. Hacer palanca con el tubo para facilitar el desmontaje.
- Tras extraer el rotor, cabe prestar atención a no perjudicar la turbina. En caso de desmontarla se debe obligatoriamente prever su sustitución.

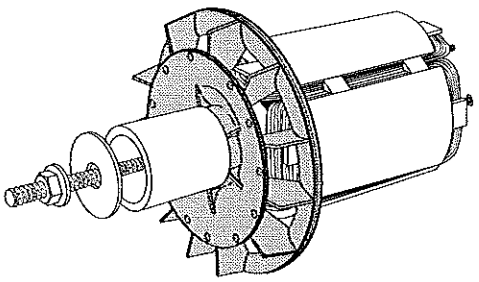
NOTA : En caso de operación sobre la rueda polar (rebobinado, cambio de elementos), se debe reequilibrar el conjunto rotor.

4.6.7.2 - Montaje de la rueda polar

- Seguir el procedimiento contrario al de desmontaje.

Tener cuidado en no golpear los bobinados durante el montaje del rotor en el estátor.

- En caso de cambio de la turbina, efectuar el montaje según el dibujo siguiente. Prever un tubo y una varilla roscada.



Seguir el procedimiento de montaje de los rodamientos (ver § 4.6.5.2 y ver § 4.6.6.2.)

Tras la puesta a punto hay que montar de nuevo en su sitio los paneles de acceso y las tapas.

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
MANTENIMIENTO

4.7 - Características eléctricas

Tabla de los valores medios:
Alternador - 2 y 4 polos - 50 Hz/60 Hz - Bobinado n° 6 y M ó M1 en monofásico específico. (400 V para las excitaciones)
Los valores de tensión e intensidad son valores para funcionamiento en vacío y con carga nominal, con excitación separada. Todos los valores son dados al ± 10 % (para los valores exactos consultar el informe de ensayo) que pueden cambiar sin previo aviso. Con 60 Hz, los valores de resistencia son los mismos y la intensidad de excitación "i exc" es aproximadamente menos fuerte entre un 5 y un 10%.

4.7.1 - Trifásico: 2 polos excitación SHUNT

Resistencia a 20 °C (Ω)

LSA 42.2	VS0*	VS2*	S3*	S4*	M5	M6	L7	VL8
Estátor L/N	1,01	0,76	0,61	0,4	0,22	0,22	0,16	0,1
Rotor	2,93	3,13	3,24	3,53	4,1	4,1	4,7	5,5
Inductor	23,5	23,5	23,5	23,5	23,5	23,5	23,5	23,5
Inducido	0,79	0,79	0,79	0,79	0,79	0,79	0,79	0,79

Intensidad de excitación i exc (A) - 400 V - 50 Hz
"i exc": intensidad de excitación del inductor de excitatriz.

LSA 42.2	VS0*	VS2*	S3*	S4*	M5	M6	L7	VL8
En vacío	0,45	0,4	0,4	0,4	0,45	0,45	0,4	0,4
Con carga	1,6	1,7	1,7	1,7	1,55	1,85	1,7	1,65

* Máquina específica Lister

4.7.2 - Monofásico específico: 2 polos excitación SHUNT

Resistencia a 20 °C (Ω)

LSA 42.2	VS2	S3	S4	M6	L7
Estátor L/N	0,36	0,294	0,190	0,108	0,077
Rotor	3,13	3,24	3,53	4,1	4,7
Inductor	23,5	23,5	23,5	23,5	23,5
Inducido	0,79	0,79	0,79	0,79	0,79

Intensidad de excitación i exc (A) -240 V -60 Hz
"i exc": intensidad de excitación del inductor de excitatriz.

LSA 42.2	VS2	S3	S4	M6	L7
En vacío	0,26	0,25	0,27	0,28	0,26
Con carga	0,9	0,9	0,91	0,9	0,92

4.7.3 - Trifásico: 4 polos excitación SHUNT

Resistencia a 20°C (Ω)

LSA 42.2	VS0*	VS2*	S3*	S4*	S5	M6	M7	L9
Estátor L/N	1,54	0,7	0,53	0,32	0,32	0,2	0,2	0,19
Rotor	1,71	2,1	2,3	2,7	2,7	3,3	3,3	3,7
Inductor	25,6	25,6	25,6	25,6	25,6	25,6	25,6	25,6
Inducido	0,51	0,51	0,51	0,51	0,51	0,51	0,51	0,51

Intensidad de excitación i exc (A) - 400 V - 50 Hz:
"i exc": intensidad de excitación del inductor de excitatriz.

LSA 42.2	VS0*	VS2*	S3*	S4*	S5	M6	M7	L9
En vacío	0,5	0,6	0,5	0,6	0,6	0,5	0,5	0,5
Con carga nominal	1,5	1,6	1,65	1,4	1,6	1,3	1,5	1,5

* Máquina específica Lister

4.7.4 - Trifásico: 4 polos excitación AREP

Resistencia a 20 °C (Ω) :

LSA 42.2	VS2*	S4	S5	M6	M7	L9
Estátor L/N	0,76	0,34	0,34	0,22	0,22	0,2
Rotor	2,1	2,7	2,7	3,3	3,3	3,7
Bob. auxil. X1, X2	0,5	0,3	0,3	0,26	0,26	0,23
Bob. auxil. Z1, Z2	0,6	0,5	0,5	0,44	0,44	0,41
Inductor	6	6	6	6	6	6
Inducido	0,5	0,51	0,51	0,51	0,51	0,51

Intensidad de excitación i exc (A) - 400 V - 50 Hz:
"i exc": intensidad de excitación del inductor de excitatriz.

TIPO 42.2	VS2*	S4	S5	M6	M7	L9
En vacío	0,9	0,9	0,9	0,8	0,8	0,7
Con carga nominal	2,4	2,1	2,3	2	2,3	2,3

* Máquina dedicada Lister

4.7.5 - Monofásico específico: 4 polos excitación SHUNT

Resistencia a 20 °C (Ω)

LSA 42.2	VS2	S3	S5	M7	L9
Estátor L/N	0,330	0,248	0,147	0,072	0,063
Rotor	2,1	2,3	2,7	3,3	3,7
Inductor	25,6	25,6	25,6	25,6	25,6
Inducido	0,51	0,51	0,51	0,51	0,51

Intensidad de excitación i exc (A) -240 V -60 Hz
"i exc": intensidad de excitación del inductor de excitatriz.

LSA 42.2	VS2	S3	S5	M7	L9
En vacío	0,45	0,43	0,46	0,61	0,62
Con carga	1,21	1,21	1,1	1,05	1,17

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
PIEZAS DE REPUESTO

5 - PIEZAS DE REPUESTO

5.1 - Piezas de primer mantenimiento

En opción hay disponibles kits de primera urgencia.
Su composición es la siguiente:

N.	Denominación	Ctd.	LSA 42.2 - SHUNT 2 & 4 P	Codificación
198	Regulador de tensión	1	R 250	AEM 110 RE 019
343	Conjunto puente de diodos	1	LSA 411.1.59/60	ESC 025 MD 008
347	Supresor de crestas	1	LSA 411.1.17A	CII 411 EQ 017
	Fusible del regulador	1	250 V - 8 A / lento	

N.	Denominación	Ctd.	LSA 42.2 - AREP 4 P	Codificación
198	Regulador de tensión	1	R 438	AEM 110 RE 003
343	Conjunto puente de diodos	1	LSA 411.1.59/60	ESC 025 MD 008
347	Supresor de crestas	1	LSA 411.1.17A	CII 411 EQ 017
	Fusible del regulador	1	250 V - 8 A / lento	

5.2 - Denominación de los rodamientos

N.	Denominación	Ctd.	LSA 42.2 - 2 & 4 P	Codificación
60	Rodamiento lado extremo de eje (bipalier)	1	6309 2RS/C3	RLT 045 TN 030
70	Rodamiento lado excitatriz	1	6305 2RS/C3	RLT 025 TN 030

5.3 - Servicio de asistencia técnica

Nuestro servicio de asistencia técnica está a su disposición para ofrecerle toda la información que necesite.

Para cualquier pedido de piezas de repuesto es preciso indicar el tipo completo de la máquina, su número de serie y las informaciones que figuran en la placa de características.

Diríjase a su corresponsal habitual o bien a:

MOTORES LEROY-SOMER
Establecimiento de Sillac/Alternadores
16015 ANGOULEME CEDEX - FRANCE
Tel. : (33) 05.45.64.45.64
Servicio de Asistencia Técnica:
(33) 05.45.64.43.66 - (33) 05.45.64.43.67 -
(33) 05.45.64.43.68 - (33) 05.45.64.43.69
fax : (33) 05.45.64.43.24
e. mail : sat.sil@leroysomer.com

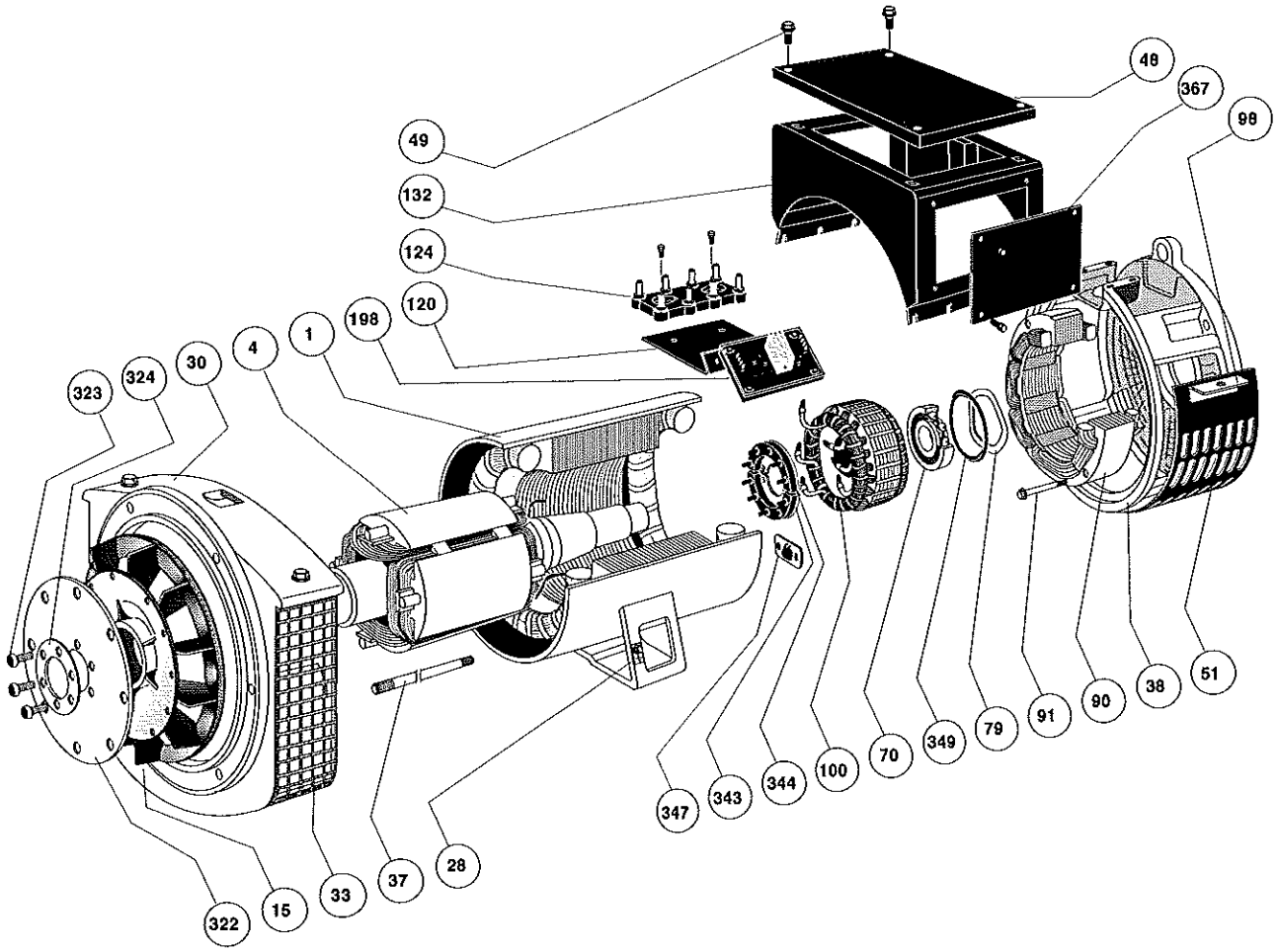
Las referencias de las piezas deben tomarse de los dibujos de despiece y su denominación de la nomenclatura.
Una amplia red de centros de servicio puede proporcionar rápidamente las piezas necesarias.
Para asegurar el buen funcionamiento y la seguridad de nuestras máquinas, recomendamos utilizar piezas de repuesto originales del fabricante.
En caso contrario el fabricante no será responsable si hubiera daños.

LEROY-SOMER	INSTALACIÓN Y MANTENIMIENTO	3433 es - 06.2007 / e

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
PIEZAS DE REPUESTO

5.4 - Despiece, nomenclatura

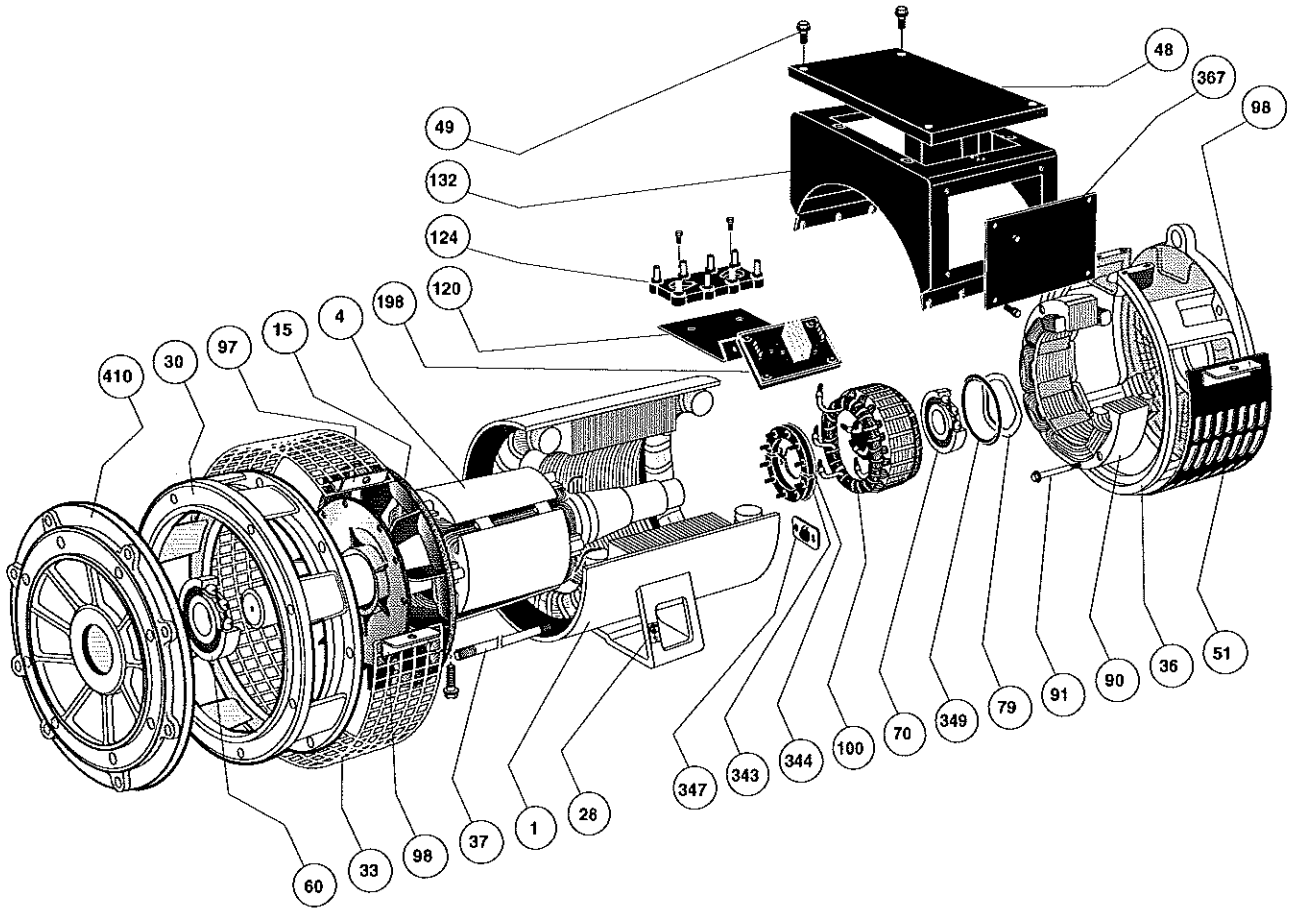
5.4.1 - LSA 42.2 monopalier, AREP o SHUNT



N°	N.	Descripción	N°	N.	Descripción
1	1	Conjunto estátor	98	3	Escuadra de fijación
4	1	Conjunto rotor	100	1	Inducido de la excitatriz
15	1	Turbina	120	1	Soporte de placa de bornas (AREP)
28	1	Borna de masa	124	1	Placa de bornas
30	1	Brida lado acoplamiento	132	1	Caja de bornas
33	1	Rejilla de salida del aire	198	1	Regulador
36	1	Soporte lado excitatriz	322	1	Disco de acoplamiento
37	4	Espárrago de fijación	323	6	Tornillo de fijación
48	1	Tapa de caja de bornas	324	1	Arandela de apriete
49	20	Tornillo de fijación	343	1	Croissant de diodos directos
51	1	Rejilla de entrada del aire	344	1	Croissant de diodos inversos
70	1	Rodamiento trasero	347	1	Supresor de crestas
79	1	Arandela de precarga	367	2	Ventanilla de inspección
90	1	Inductor de excitatriz	349	1	Junta tórica
91	4	Tornillo de fijación inductor			

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
PIEZAS DE REPUESTO

5.4.2 - LSA 42.2 bipalier, AREP o SHUNT



N°	N.	Descripción	N°	N.	Descripción
1	1	Conjunto estátor	91	4	Tornillo de fijación inductor
4	1	Conjunto rotor	97	1	Escuadra de fijación macho
15	1	Turbina	98	3	Escuadra de fijación
28	1	Borna de masa	100	1	Inducido de la excitatriz
30	1	Brida lado acoplamiento	120	1	Soporte de placa de bornas (AREP)
33	1	Rejilla de salida del aire	124	1	Placa de bornas
36	1	Soporte lado excitatriz	132	1	Caja de bornas
37	4	Espárrago de fijación	198	6	Regulador
48	1	Tapa de caja de bornas	343	1	Croissant de diodos directos
49	20	Tornillo de fijación	344	1	Croissant de diodos inversos
51	1	Rejilla de entrada del aire	347	1	Supresor de crestas
60	1	Rodamiento delantero	367	2	Ventanilla de inspección
70	1	Rodamiento trasero	349	1	Junta tórica
79	1	Arandela de precarga	410	1	Palier delantero
90	4	Inductor de excitatriz			

LSA 42.2 - 2 & 4 POLOS
ALTERNADORES
NOTES

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LEROY-SOMER 16015 ANGOULÊME CEDEX - FRANCE

RCS ANGOULÊME N° B 671 820 223
S.A. au capital de 62 779 000 €

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6 Test Results

WB065 SEIB STREET WATER BOOSTER

C63100 Queensland Urban Utilities

Design Report

Date	Description	Rev	Author	Reviewer
4/4/2013	RPEQ Certification	0		Justin Read (RPEQ)

Registered Professional Engineer of Queensland
MR. JUSTIN READ
RPEQ 7727
DIV: ELECTRICAL
Signature: Justin Read Date: 8.4.13

CONTENTS

1	INTRODUCTION	2
2	RESULTS SUMMARY	3
3	CONCLUSION / RECOMMENDATIONS	4
4	SUPPORTING DESIGN DATA	5

1 INTRODUCTION

The purpose of this document is to provide information on the Electrical Design for the **Seib Street Water Booster Main Switchboard.**

The design was undertaken under the direct supervision of an RPEQ registered electrical engineer in accordance with the requirements for the provision of professional engineering services as detailed in the Professional Engineers Act 2002.

2 RESULTS SUMMARY

The Seib Street Booster Pump Station operating under Energex Mains supply has a prospective Earth Fault Current of 532A with the switchboard having an acceptable Fault Rating of 20,000A for 0.2 second.

A prospective Touch Voltage of 110.81VAC is calculated, and as this value is more than the required 50VAC Touch Voltage, the clearance of this fault must occur within 0.33 seconds as per AS/NZS3000-2007 Figure B4 Maximum Duration of Prospective 50 Hz Touch Voltage. Inspection of the Time Current Curve for the 63A Main Circuit Breaker shows this to be the case.

The 15m long consumer's mains (1x16mm^2, 4C+E PVC/PVC) has a calculated voltage drop of 1.64V that is below the required 5% permitted between the Point of Supply and the switchboard installation. The calculated current carrying capacity of the above mentioned cabling is 73A. Short Circuit Temperature Rise calculations show that the Minimum Cable Size required is 0.83mm^2.

The maximum demand of the pump station is 45A with the switchboard main switch set to 63A.

The Pump Station operating under the standby Generator Supply with a prospective Short Circuit Fault Current at 0.02 seconds duration of 226A has a prospective Touch Voltage of 2.02VAC. This value exceeds the required Touch Voltage of 50VAC. The clearance of this fault must occur within 0.33 seconds. Inspection of the Time Current Curve for the 63A Generator Circuit Breaker shows this not to be the case.

3 CONCLUSION / RECOMMENDATIONS

The incomer design complies with the requirements of the applicable Australian Standards with respect to Voltage Drop, Fault Level, Fault Loop Impedance, Current Carrying Capacity and Short Circuit Temperature Rise when operating under the current Energex Mains Supply parameters.

When operating under Standby Generator Supply there is insufficient current flow in the event of an Earth Fault at either the load side of the Active Bus within the Switchboard, or at the Pump Enclosure to trip the appropriate circuit breaker in the required time.

A generator will typically not support a short circuit fault on the output. In the event of such a fault, depending on the type of controller installed, the fault current will decrease rapidly and the Generator will be shut down within 10 seconds.

Due to the low touch potential involved in either case, this poses no risk.

4 SUPPORTING DESIGN DATA

- *Touch Potential / Fault Current Calculations Sheets*
- *Industrial Maximum Demand Three Phase Calculation Sheet*
- *Consumers Mains Current Carrying Capacity Sheet*
- *Consumers Mains Short Circuit Temperature Rise Calculation Sheet*
- *Cable Schedule*
- *Circuit Breaker Time / Current Characteristic and Protection Discrimination Curves*

Q-Pulse Id: TMS1594

Active: 18/04/2016

Page 948 of 1068

WB196 Seib Street Water Booster - JPR - Operation and Maintenance Manual

WB065 Seib Street Water Booster

DESIGN CALCULATIONS

Developed By

J. & P. RICHARDSON INDUSTRIES PTY LTD
114 CAMPBELL AVENUE
WACOL 4076
Ph (07) 3271 2911
FAX (07) 3271 3623

Document Revision History

Revision	Date	By	Authorised By	Short Desc. of changes
A	4/04/2013	Neal Finch		Initial Text

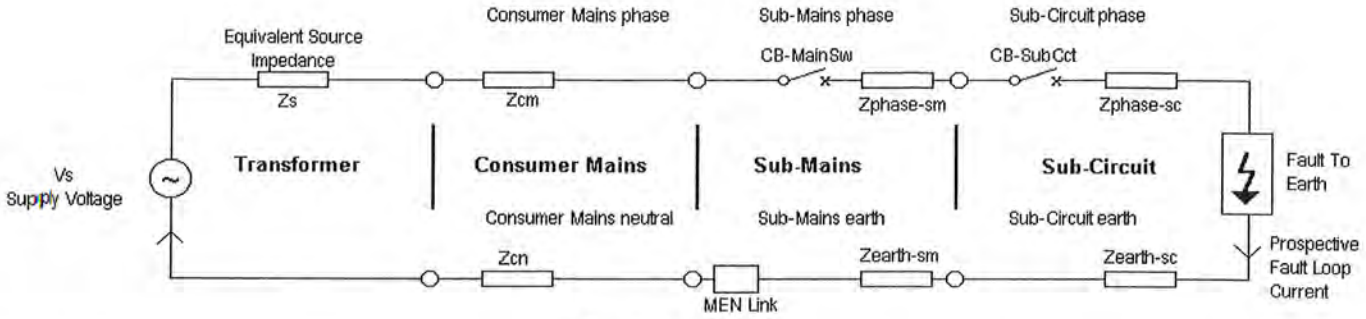
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TOUCH POTENTIAL/FAULT CURRENT CALCULATIONS

Main Switchboard

Site/Installation Description: WB065 Seib Street Water Booster

Equivalent Circuit



Enter data into grey areas

Transformer [1]		
Capacity	kVA	200
Impedance [2]	%	4
Prospective Fault Level of Transformer	MVA	5
Prospective Fault Current of Transformer	kA	6.95602734
Advised or Alternative Fault Current of Transformer [3]	kA	
Source Impedance Z_S at 230Vac	Ω	0.034502452

[1] *The transformer calcs neglect any impedance upstream of the transformer*
[2] *If left blank a transformer impedance of 5% will be assumed*
[3] *Leave blank to calculate Z_S based on Transformer Capacity & Impedance*

Energex Mains to Point of Connection Part 1		
Length of Energex Mains cable	m	173
Size of active conductor	mm^2	120LV/4C
Number of parallel active conductors		1
Size of associated earth-return conductor [1]	mm^2	120LV/4C
Number of parallel earth-return conductors		1
Impedance of single-core of active cable @ 75°C [2]	Ω/km	0.2834
Impedance of single-core of earth cable @ 75°C [2]	Ω/km	0.2834
Impedance of active conductors Z_{CM}	Ω	0.0490
Impedance of earth (neutral) conductors Z_{CN}	Ω	0.0490

[1] *If the MEN is at the switchboard, this is the neutral conductor; if the MEN is at the transformer, this is the earth conductor.*
[2] *From Table A4 of HB 301 - 2001*

Energex Mains to Point of Connection Part 2		
Length of Energex Mains cable	m	262
Size of active conductor	mm^2	MARS 7/3.75 AAC
Number of parallel active conductors		1
Size of associated earth conductor	mm^2	MARS 7/3.75 AAC
Number of parallel earth conductors		1
Impedance of single-core of active cable @ 75°C [1]	Ω/km	0.5265
Impedance of single-core of earth cable @ 75°C [1]	Ω/km	0.5265
Impedance of active conductors $Z_{PHASE-SM}$	Ω	0.1379
Impedance of earth (neutral) conductors $Z_{EARTH-SM}$	Ω	0.1379

[1] *From Table A4 of HB 301 - 2001*

Consumer Mains		
Length of Consumer Mains cable	m	15
Size of active conductor	mm^2	16
Number of parallel active conductors		1
Size of associated earth conductor	mm^2	16
Number of parallel earth conductors		1
Impedance of single-core of active cable @ 75°C [1]	Ω/km	1.4057
Impedance of single-core of earth cable @ 75°C [1]	Ω/km	1.4057
Impedance of active conductors $Z_{PHASE-SC}$	Ω	0.0211
Impedance of earth conductors $Z_{EARTH-SC}$	Ω	0.0211

[1] *From Table A4 of HB 301 - 2001*

Fault Current & Touch Potential		
Impedance of active circuit Z_A	Ω	0.2426
Impedance of earth/neutral circuit Z_E	Ω	0.2081
Fault Current I_{SC} (at 240Vac)	A	532.60
Touch Potential V_T at point of fault	Vac	110.81
Total Upstream Impedance	Ω	0.4506

The circuit breaker protecting the mains cable is a Terasaki E125NJ363, set to Ir=1, Im=8 (504A). A fault of 532A will cause the circuit breaker to trip in 0.03s. Therefore operating under current Energex supply parameters this installation complies with Fault Loop Impedance requirements.

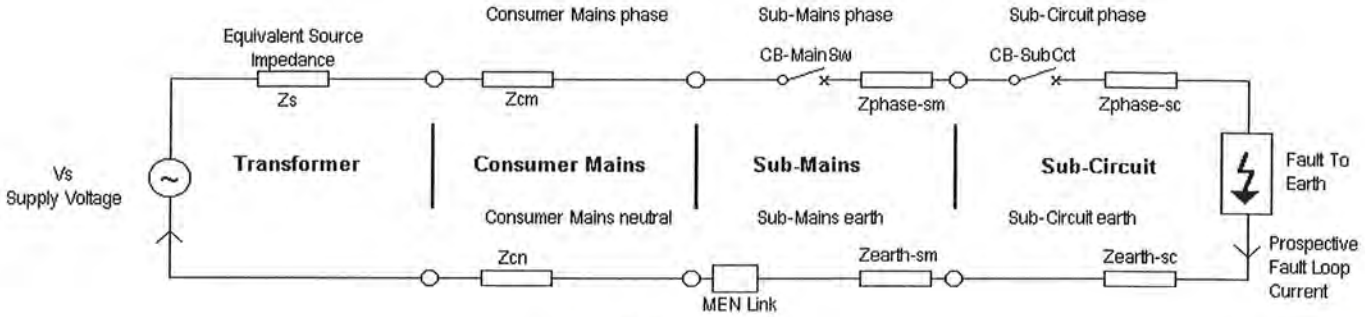
Examine the time-current curve for the circuit-breaker/fuse which is providing the overcurrent protection to ensure that I_{SC} is high enough to guarantee operation of the protective device within the specified time.

Use the table "Additional Earth" within this workbook to examine the effect on I_{SC} and V_T of adding additional earth conductors.

J. & P. RICHARDSON INDUSTRIES PTY LTD
TOUCH POTENTIAL/FAULT CURRENT CALCULATIONS
Main Switchboard

Site/Installation Description: WB065 Seib Street Water Booster

Equivalent Circuit



Enter data into grey areas

Generator		
Capacity	kVA	50
Impedance (Direct Axis Sub-Transient Reactance)		0.1
Full Load Current of Generator	A	69.54
Prospective Fault Current of Generator	A	695.41
Typical or Advised Fault Current of Generator at 0.02s duration.	A	230
Source Impedance Z_S at 230Vac	Ω	1.043478261

Generator Mains		
Length of Generator Mains cable	m	10
Size of active conductor	mm^2	25
Number of parallel active conductors		1
Size of associated earth-return conductor	mm^2	25
Number of parallel earth-return conductors		1
Impedance of single-core of active cable @ 75°C [1]	Ω/km	0.8922
Impedance of single-core of earth cable @ 75°C [1]	Ω/km	0.8922
Impedance of active conductors Z_{CM}	Ω	0.0089
Impedance of earth (neutral) conductors Z_{CN}	Ω	0.0089

[1] *From Table A4 of HB 301 - 2001*

Sub Mains		
Length of Sub-mains cable	m	0
Size of active conductor	mm^2	1
Number of parallel active conductors		1
Size of associated earth conductor	mm^2	1
Number of parallel earth conductors		1
Impedance of single-core of active cable @ 75°C [1]	Ω/km	25.8007
Impedance of single-core of earth cable @ 75°C [1]	Ω/km	25.8007
Impedance of active conductors $Z_{PHASE-SM}$	Ω	0.0000
Impedance of earth (neutral) conductors $Z_{EARTH-SM}$	Ω	0.0000

[1] *From Table A4 of HB 301 - 2001*

Sub-Circuit		
Length of Sub-circuit (motor) cable	m	0
Size of active conductor	mm^2	1
Number of parallel active conductors		1
Size of associated earth conductor	mm^2	1
Number of parallel earth conductors		1
Impedance of single-core of active cable @ 75°C [1]	Ω/km	25.8007
Impedance of single-core of earth cable @ 75°C [1]	Ω/km	25.8007
Impedance of active conductors $Z_{PHASE-SC}$	Ω	0.0000
Impedance of earth conductors $Z_{EARTH-SC}$	Ω	0.0000

[1] *From Table A4 of HB 301 - 2001*

Fault Current & Touch Potential		
Impedance of active circuit Z_A	Ω	1.0524
Impedance of earth/neutral circuit Z_E	Ω	0.0089
Fault Current I_{SC} (at 240Vac)	A	226.13
Touch Potential V_T at point of fault	Vac	2.02
Total Upstream Impedance	Ω	1.0613

Note: Generator size typical for maximum demand.
The circuit breaker protecting the generator cable is a Terasaki E125NJ363, set to Ir=1, Im=8 (504A). A fault of 226A is insufficient to trip the circuit breaker in the required time as per AS/NZS3000-2007 Figure B4 Maximum Duration of Prospective 50 Hz Touch Voltage.
A generator will typically not support a short circuit fault on the output. In the event of such a fault, depending on the type of controller installed, the fault current will decrease rapidly and the Generator will be shut down within 10 seconds.

Examine the time-current curve for the circuit-breaker/fuse which is providing the overcurrent protection to ensure that I_{SC} is high enough to guarantee operation of the protective device within the specified time.

Use the table "Additional Earth" within this workbook to examine the effect on I_{SC} and V_T of adding additional earth conductors.

Voltage Drop Calculation

Cable Size mm	16	No.In //	1
Volts	415		
Length m	15	Amps	45
Voltage Drop	1.64		

INDUSTRIAL MAXIMUM DEMAND THREE PHASE CALCULATION

Lighting — Full connected load

	Red Phase	White Phase	Blue Phase	Quantity	Power	Voltage
2x36W Fluoros	0.00				72	240
1x50W		0.00			50	240
1x70W Security Bulkheads			0.00		70	240
1x18W	0.00				18	240
2x36W Fluoros		0.00			72	240

Socket Outlets not exceeding 10Amps — 1000 Watts for first and 750 Watts for each additional outlet

				Quantity	Power	Voltage
PLC Programming			4.17	1	1000	240
RTU Cubicle outlet			3.13	1	750	240
					750	240
		0.00			750	240
			0.00		750	240
		0.00			750	240
			0.00		750	240
		0.00			750	240
			0.00		750	240
	0.00				750	240
		0.00			750	240
			0.00		750	240
	0.00				750	240
			0.00		750	240
	0.00				750	240

Socket Outlets exceeding 10Amps — Highest Rating for first and 75% of full current rating of remainder
Note: - If 3 phase then put calculation valve across all three phases

					Quantity	Amps	Phases
Sump Pump Outlet	1st Point single phase or	16.00				16	1
	1st Point three phase	0.00	0.00	0.00			3
			0.00			10	1
				0.00		10	1
			0.00			10	1
				0.00		10	1
		0.00				10	1
			0.00			10	1
				0.00		10	1
		0.00				10	1
		0.00	0.00	0.00		32	3

Air Conditioning, Ranges and Cooking Appliances
General Load — Highest Rating for first and 75% of full current rating of remainder
Note: - If 3 phase then put calculation value across all three phases

					Quantity	Amps	Phases
	1st Device single phase or		0.00			0	1
	1st Device three phase	0.00	0.00	0.00		0	3
General Loads	Control Power		3.75		1	5	1

Storage Heater (HWS) — Full load connected

		Power	Voltage
Hot Water System	0.00		240

Motors — Highest Rating for first and 75% of full current rating of second and 50% of full load of remainder

				Current	Power	Voltage	PF	Eff.
Pump No.1	15.34	15.34	15.34		7500	415	0.8	0.85
Pump No.2	11.51	11.51	11.51		7500	415	0.8	0.85
Pump No.3	0.00	0.00	0.00		7500	415	0.8	0.85
Vent Fan (unknown size, allowance only)	2.25	2.25	2.25		2200	415	0.8	0.85
	0.00	0.00	0.00			415	0.8	0.85
	0.00	0.00	0.00			415	0.8	0.85
	0.00	0.00	0.00			415	0.8	0.85
	0.00	0.00	0.00			415	0.8	0.85
	0.00	0.00	0.00			415	0.8	0.85
	0.00	0.00	0.00			415	0.8	0.85
	0.00	0.00	0.00			415	0.8	0.85

45.10	32.85	36.39	Amps	24.7	kW's

Note: Maximum demand based on Duty/Assist/Standby pump configuration.

Current Carrying Capacity Calculation

Cable Type	PVC/PVC	
Number of Cores	4C+E	
Cable Size	16	mm2
Maximum Demand	45	amps
Current Carrying Capacity	73	amps

Notes on Calculation:-

:- Enter Mains cable data from Cable Schedule.
:- Determine maximum demand from 'Industrial Maximum Demand' sheet.
:- Determine Current Carrying Capacity from appropriate tables in AS/NZ 3008.1.1:2009, depending on cable size, type and installation method.
ie. Table 7, 8, 13 or 14
:- IF Current Carrying Capacity exceeds maximum demand then the installation complies.

Short Circuit Temperature Rise Calculation

Cable Type	PVC/PVC	
Cable Size	16	mm2
Assume Initial Temp of Cable	75	Deg.
Value of Short CCT. Current	532	Amps
Trip Time of Protective Device	0.03	Secs
Value of K (temp. constant)	111	
Minimum Size Cable Required	0.83	mm2

Notes on calculation.

:- Enter Mains cable data from Cable Schedule.
:- Assume maximum initial temperature of cable type.
ie. XLPE/PVC 90 deg, PVC/PVC 75 deg
:- Value of Short CCT Current can be found on Main Switchboard Sheet.
:- Determine Trip Time of Protective Device from Circuit Breaker Trip Curve and Settings.
:- Determine Value of K (constant) from AS/NZ 3008.1.1:2009 Tables 52 and 53.
:- If value of 'Minimum Size Of Cable Required' is smaller or equal to the size of cable installed, then the installation complies.

J & P Richardson Industries Pty Ltd.

Cable List

	A	B	C	D	G	H	I	J	K	L	M	N	P	T	V	AE	AI	AJ	AK	AL	AN	AP	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC
1	Line	Comments	Feed from	To Location	Starter	Volts	Kw	FLA	Cable Size (mm2)	No In //	Cable Length (m)	Cable Type	Voltage Drop Cable	Cable Earth Size	Sup Earth Size	Active Earth Fault A (calculated)	Touch Potential	Circuit Status PASS / FAIL	Clearance Time - Actual	Clearance Time - Required	Margin 0.4s	Margin 5s	Circuit Breaker Part No.	Amps	Poles	KiloAmps	Make	Series	Supplier	5S Trip Amps	0.4S Trip Amps	Comments
2	1	Energex Supply	Main Switchboard	Pump No.1	VSD	415	7.5	14.5	2.5	1	15	3C & E PVC/PVC	3.39	2.5		332.9	114.3	PASS	0.030	0.330	96	108	DTCB15332C	32	3	15	Terasaki	Din T 15	NHP	225.0	237.0	
3	2	Energex Supply	Main Switchboard	Pump No.2	VSD	415	7.5	14.5	2.5	1	15	3C & E PVC/PVC	3.39	2.5		332.9	114.3	PASS	0.030	0.330	96	108	DTCB15332C	32	3	15	Terasaki	Din T 15	NHP	225.0	237.0	
4	3	Energex Supply	Main Switchboard	Pump No.3	VSD	415	7.5	14.5	2.5	1	15	3C & E PVC/PVC	3.39	2.5		332.9	114.3	PASS	0.030	0.330	96	108	DTCB15332C	32	3	15	Terasaki	Din T 15	NHP	225.0	237.0	
5	4	Energex Supply	Main Switchboard	Vent Fan	DOL	415	2.2		2.5	1	5	3C & E PVC/PVC		2.5		443.8	112.3	PASS	0.030	0.330	325	333	DTCB6316C	16	3	6	Terasaki	Din T 6	NHP	111.0	119.0	Unknown fan size, assumed 2.2kW
6	5	Energex Supply	Main Switchboard	Sump Pump Outlet	Supply	240			2.5	1	15	2C & E PVC/PVC		2.5		332.9	114.3	PASS	0.030	0.330	213	239	DSRCBH1630A	16	1	10	Terasaki	Mini CB Din-Safe MCBs RCBO 30mA	NHP	94.0	120.0	
7	6																															
8	7	Generator Supply	Main Switchboard	Pump No.1	VSD	415	7.5	14.5	2.5	1	15	3C & E PVC/PVC	3.39	2.5		180.2	26.0	FAIL	7.000	5.000	-57	-45	DTCB15332C	32	3	15	Terasaki	Din T 15	NHP	225.0	237.0	
9	8	Generator Supply	Main Switchboard	Pump No.2	VSD	415	7.5	14.5	2.5	1	15	3C & E PVC/PVC	3.39	2.5		180.2	26.0	FAIL	7.000	5.000	-57	-45	DTCB15332C	32	3	15	Terasaki	Din T 15	NHP	225.0	237.0	
10	9	Generator Supply	Main Switchboard	Pump No.3	VSD	415	7.5	14.5	2.5	1	15	3C & E PVC/PVC	3.39	2.5		180.2	26.0	FAIL	7.000	5.000	-57	-45	DTCB15332C	32	3	15	Terasaki	Din T 15	NHP	225.0	237.0	
11	10	Generator Supply	Main Switchboard	Vent Fan	DOL	415	2.2		2.5	1	5	3C & E PVC/PVC		2.5		208.4	11.3	PASS	0.030	5.000	89	97	DTCB6316C	16	3	6	Terasaki	Din T 6	NHP	111.0	119.0	Unknown fan size, assumed 2.2kW
12	11	Generator Supply	Main Switchboard	Sump Pump Outlet	Supply	240			2.5	1	15	2C & E PVC/PVC		2.5		180.2	26.0	PASS	0.030	5.000	60	86	DSRCBH1630A	16	1	10	Terasaki	Mini CB Din-Safe MCBs RCBO 30mA	NHP	94.0	120.0	
13	12																															

JPR

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TERASAKI

Selectivity Analysis Program

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

Project :

File : WB065 Seib Street Curve

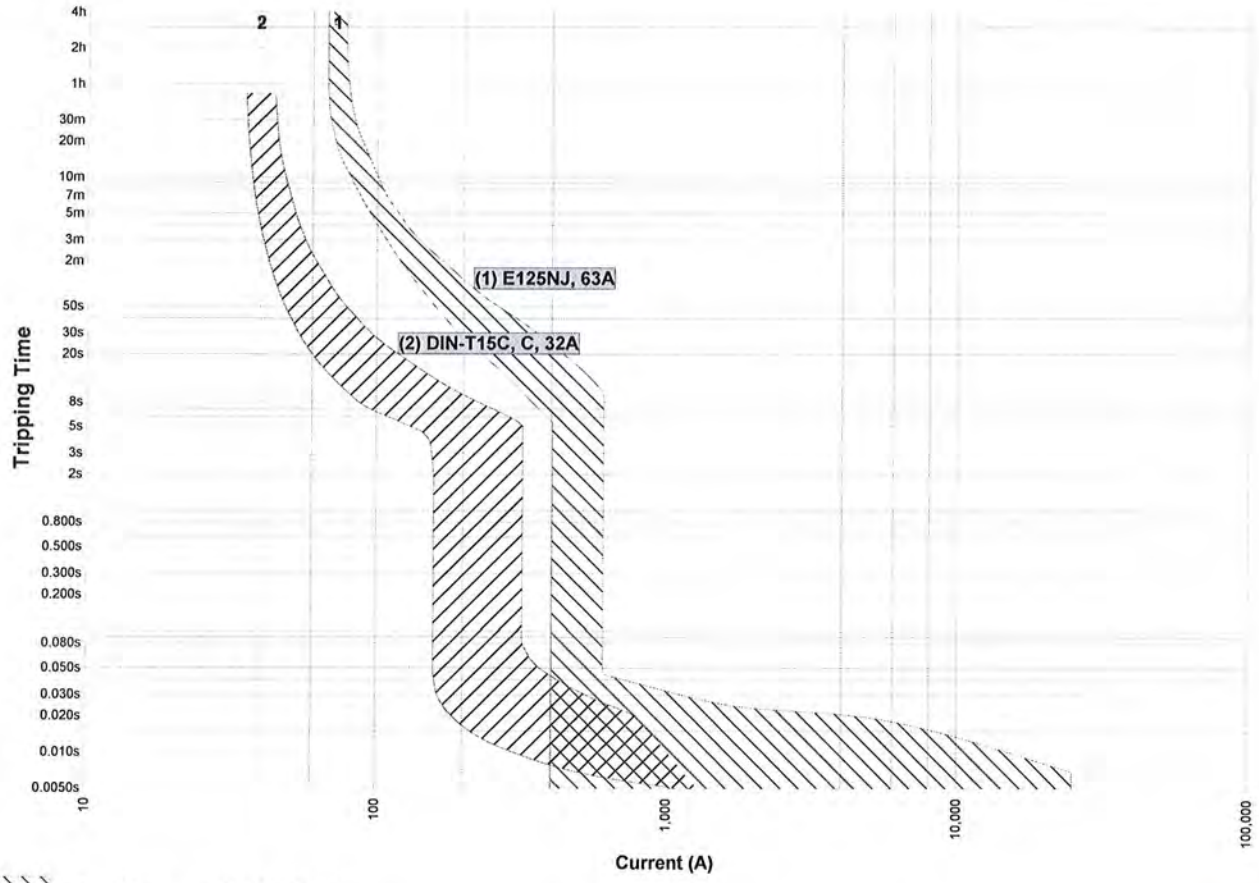
Printed : 04 Apr 2013
10:47 am

SUPPLY

200 kVA
415/240V 50Hz

Circuit: **MSB (3ø)2**

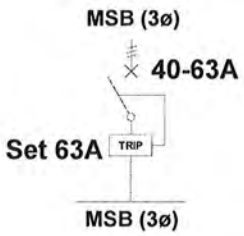
TIME/CURRENT CURVE



(1) Up Stream - MSB (3ø) :

Model : E125NJ
Trip Unit : 63
Trip Setting : 63 A
Breaking Capacity :

Catalogue # : E125NJ 3 63





NHP

Adjustable Settings:

Ir	Im
1	8
63 A	504 A

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TERASAK

Selectivity Analysis Program

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

Project :

File : WB065 Seib Street Curve

Printed : 04 Apr 2013
10:47 am

SUPPLY

200 kVA
415/240V 50Hz

Circuit: **MSB (3ø)2**

TIME/CURRENT CURVE

2 Down Stream - MSB (3ø) :

Circuit I.D. : C2 (3ø)

Circuit Breaker (MCB) Model : DIN-T15C

Breaking Capacity : 15 kA

Catalogue # : DTCB15332C



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

Project :

File : WB065 Seib Street Curve

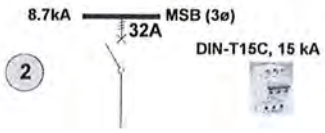
Printed : 04 Apr 2013
10:47 am

SUPPLY

200 kVA
415/240V 50Hz

Circuit: **MSB (3ø)2**

SELECTIVITY/CASCADE SETTINGS



25/25

No Adjustable Settings

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ABN 72 002 765 795

CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

WB065 Seib Street	1	**Date**	15/10/13.

A. Electrical Installation Test Records

AS/NZS 3000:2007 requires that prior to placing an electrical installation or any part thereof in service following its construction, alteration, addition or repair, it shall be inspected and tested to verify that the installation is safe to energize and that it will operate correctly in accordance with the requirements of AS3000:2007.

This section is aimed to ensure that the switchboard manufacturer has carried out and documented all applicable AS3000:2007 tests considered as mandatory, prior to execution of the Factory Acceptance Test.

AS/NZS 3017 Electrical Installations – Verification Guidelines provides inspection, test methods and test acceptance parameters to verify AS3000:2007 safety requirements, however these methods are provided for guidance and other alternative methods are acceptable, AS3017:2007 may be applied through legislative requirements made in each State and Territory of Australia and in New Zealand.

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CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

Item No.	Activity Description	Results			Signed QUU	Results and comments
		Acc	Rej	N/A		
A.1	Records for the verification of the continuity and resistance of the earthing system shall include: a) Main earthing conductor b) Protective earthing conductors c) Earth bonding conductors.	✓ ✓ ✓				For acceptance criteria and test methods refer to: AS3000:2007 Section 8.3.5 & AS3017:2007 Section 3.1

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector ..... **Date** .....

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CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

Item No.	Activity Description	Results			Signed QUU	Results and comments
		Acc	Rej	N/A		
A.2	Records for the verification of Insulation Resistance shall include: a) Insulation resistance test of complete installation ~~b) Insulation resistance test of consumers mains~~ c) Insulation resistance test of single circuits	✓				For acceptance criteria and test methods refer to AS3000:2007 Section 8.3.6 & AS3017:2007 Section 3.2

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John clayton **Date** 15/10/13

QUEENSLAND Urban Utilities
ABN 72 002 765 795

CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

Item No.	Activity Description	Results			Signed QUU	Results and comments
		Acc	Rej	N/A		
A.3	Records for the verification of Polarity Tests records shall include: ~~a) Consumer mains~~ ~~b) Submains incorporating an earthing conductor~~ ~~c) Submains not incorporating a protective earthing conductor~~ d) Subcircuit polarity connections test (including single pole switches) e) Phase sequence tests	✓ ✓				For acceptance criteria and test methods refer to AS3000:2007 Section 8.3.7 & AS3017:2007 Sections 3.3 and 3.5

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

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CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

Item No.	Activity Description	Results			Signed QUU	Results and comments
		Acc	Rej	N/A		
A.4	Records for the verification of Correct Circuit connection tests records shall include: a) Interconnection between conductors of different circuits b) Socket-Outlet Sub-Circuits c) Ligthing Points d) Equipment Sub-circuits	✓ ✓ ✓ ✓				For acceptance criteria and test methods refer to AS3000:2007 Section 8.3.8 & AS3017:2007 Section 3.4

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

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CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

Item No.	Activity Description	Results			Signed QUU	Results and comments
		Acc	Rej	N/A		
A.5	Records for the verification of earth fault-loop for impedance shall include: a) Circuits not protected by an RCD	✓				For acceptance criteria and test methods refer to AS3000:2007 Section 8.3.9 & AS3017:2007 Section 3.6
A.6	Records for the verification of operation of RCDs shall include: a) Circuits protected by an RCD	✓				For acceptance criteria and test methods refer to AS3000:2007 Section 8.3.10 & AS3017:2007 Section 3.7

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

B. Testing Area, Documentation and Test Set Up Arrangements

This section is aimed to ensure that all documentation and test set up arrangements have been provided to allow execution and readiness to carry out the FAT.

Item No.	Activity Description	Results			Signed QUU	Results and comments
		Acc	Rej	N/A		
B.1	Verify that a suitable test area has been provided, the test area shall be: • Clearly identified and barricaded • Test bench with enough space for testing equipment and documentation • Well ventilated	✓ ✓ ✓				
B.2	All testing equipment to simulate field inputs and outputs including field instruments and motors shall be pre-connected	✓				
B.3	"As Built" drawings marked up available.	✓				
B.4	"Point to Point" test drawing mark-ups provided	✓				

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

C. Visual Inspections - Sheet Metal / Mechanical Construction Works

The following visual inspections shall take place previous to energising the switchboard circuits. All power supplies shall be disconnected, including the main power supply, generator power supplies and battery power supplies.

Item No.	Activity Description	Results			Signed QUU	Results and comments
		Acc	Rej	N/A		
C.1	Switchboard dimensions correct as per contract drawings	✓				
C.2	Panel layout as per drawings	✓				
C.3	All equipment is to be removable from switchboard via front access.	✓				
C.4	Power distribution chassis not to be installed too close to the left of the door aperture			✓		NO CHASSIS FITTED
C.5	Check operation and orientation of doors and door handles	✓				
C.6	Switchboard mounting feet as per drawing	✓				
C.7	Material finish as per specification	✓				

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

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CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

C.8	IP Rating as per specifications. Fitting of sun shields shall maintain IP56 rating.	✓				GSM Mixer Antenna Entry are IP56
C.9	All bolts fitted / tight	✓				
C.10	All sheet metal edging to be de-burred, special attention given to handle/lock access heat shield cuts.	✓				
C.11	Door, hinges and locks are properly fitted to allow closing without forcing the door or being loose.	✓				
C.12	Lock barrels are mounted neatly. Door penetration and holes shall be suited to the particular lock barrel type.	✓				
C.13	Lock barrel types are provided as required and operate correctly	✓				
C.14	Energex Padlock Supplied	✓				

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayer **Date** 15/9/13

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CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

C.15	All doors sealing shall be properly fitted and firmly secured to the switchboard. Glue shall be provided if necessary.	✓				
C.16	Verify that proximity switch metal plates are fixed to doors as indicated in the drawings.			✓		
C.17	Ensure to pre-drill holes in plates that are difficult to access after the construction or installation of the switchboard on site. Particular attention shall be given to internal barrier plates and access plate on distribution board.	✓				
C.18	Cut outs from one cubicle to another ~~please~~ shall be large enough to accommodate all cables.	✓				
C.19	Sealing between plinth and switchboard.	✓		N/A		
C.20	Sealing of disconnect zone.	✓		N/A		NO DISCONNECT ZONE.

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

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CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

C.21	Verify that portable generator cable access plate allows the generator plug pass into the switchboard and reach the generator connection outlet.	✓				
C.22	Inspection plates are properly labelled and not used as gland plates. Inspection plates are only provided to ease access to field wiring.			✓		
C.23	Verify that all gland entries are sealed – No split gland plates	✓				
C.24	All spare holes to be plugged with conduit plugs.	✓				PLUG ALL SPARE HOLES
C.25	Enclosure free of debris	✓				

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

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Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

C.26	Lap top support tray provided including 1/4 turn wing knob on laptop support shelf. Knobs types that cannot be operated by hand are not acceptable.	✓				TOO HIGH.
C.27	Drawings & log book holder provided	✓				NO LOG BOOK.
C.28	Aerial support is adjustable	✓				NOT ADJUSTABLE.
C.29	A minimum clearance of 55mm shall be provided around the Redlion HMI to other components mounted in common controls door.			✓		
C.30	Check that selector switches are correctly engraved	✓				
C.31	Check that Indicators are fitted with correct coloured bezels	✓				

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

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Major Projects & Commercial Services
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C.32	Verify that all external labels are fitted to the switchboard.	✓				
C.33	Labelling is correct and complete - wording, size, fixing, material, level.	✓				
C.34	All internal and external labels are to have bevelled edges, sharp edges are not allowed.	✓				
C.35	Verify that 240VAC warning sign is fitted to the switchboard.	✓				

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

D. Visual Inspections- Neutral and Earthing

A visual inspection shall be made when work on an electrical installation has been completed in order to verify that the work complies with the requirements of AS/NZS 3000.

The visual inspection shall be carried out before, or in association with testing, and as far as possible it should be made before the electrical installation is placed in service.

Item No.	Activity Description	Results			Signed QUU	Results and comments
		Acc	Rej	N/A		
D.1	N/L & E/L have adequate bolts for main Neutral & Earth	✓				
D.2	Earth bar / earth connections fitted & OK	✓				
D.3	All neutral connections are accessible	✓				
D.4	MEN connections provided	✓				
D.5	Neutral & earth connections are not in CT section	✓				
D.6	Surge diverter earthed to adjacent stud.			✓		WIRED TO NEUTRAL NOT EARTH ✓
D.7	Confirm a Direct connection from main earth bar to switchboard chassis	✓				ASA 5.3

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

E. Visual Inspections - Electrical Components Mounting, Wiring and Labelling

As a minimum a visual inspection shall be made when work on an electrical installation has been completed in order to verify that the work complies with the requirements of AS/NZS 3000. This visual inspection section includes AS/NZS 3000 checks as well as several checks to verify that the electrical installation meets the specific design and quality requirements and scope of work.

The visual inspection shall be carried out before, or in association with testing, and as far as possible it should be made before the electrical installation is placed in service.

Item No.	Activity Description	Results			Signed QUU	Results and comments
		Acc	Rej	N/A		
E.1	Busbars appropriately shielded			✓		
E.2	Verify that main switches/circuit breakers and fuses are supplied to the specification (equipment schedule)	✓				
E.3	Main switches lockable/ defeatable as per spec.	✓				

Contractor's Signature ..... **Date** 25-9-13

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QUEENSLAND Urban Utilities

CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

E.4	Check operation of Main Supply and Generator supply mechanical and/or key interlocks as applicable.	✓				
E.5	~~Verify that metering fuses & CT's are fed off from main switch line side~~					
E.6	Verify that cable lugs are provided into CRITEC 20 kA surge filter circuit breaker (in most cases Q17)	✓				
E.7	Equipment fed from line side shall be appropriately labelled.	✓				
E.8	Include 2nd label for Surge Diverter and Surge Diverter fuses "FED FROM LINE SIDE OF MAIN SWITCH" as applicable (Items 37/38 on switchboard label schedule).	✓				
E.9	All Circuit Breakers shall be set as indicated in the electrical schematic drawings.	✓				

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

QUEENSLAND UrbanUtilities

CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

E.10	All circuit breakers shall be wired line side at the top / load side at the bottom			✓		BUS COMB MUST BE LOAD SIDE FITTED
E.11	Verify that cables current carrying capacity is as indicated in the electrical schematic drawings.	✓				
E.12	Colour coding of wiring as per specification.	✓				
E.13	Wiring in PVC ducting shall be kept tidy.	✓				
E.14	Check cable access dimensions	✓				
E.15	Check cable access & routes for field cabling.	✓				
E.16	Check phasing of circuits are as per drawing.	✓				
E.17	Electrical components fitted are as specified in the equipment schedule	✓				

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

QUEENSLAND UrbanUtilities

CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

E.18	Verify that quantity and location of GPOs are provided as required in the drawings.	✓				
E.19	Confirm all Idec relays are LED type and wired the correct polarity	✓				
E.20	Verify that ~~digital~~ timer is mounted on its own specific base ~~(IDEC base)~~ as specified in the equipment list (Item 99 -EMGDT)			✓		
E.21	Check that generator plug has protective cover fitted	✓				
E.22	Verify that power disconnection outlets and plugs are supplied with the switchboard as required			✓		
E.23	Verify that terminals & busbar connections are tight	✓				

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

QUEENSLAND UrbanUtilities

CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

E.24	Verify that terminals are identified as per drawings and spares are provided	✓				
E.25	All terminals shall be correct part number, shrouded to IP20 and labelled.	✓				
E.26	All cable cores ferruled & numbered.	✓				
E.27	24VDC power supply shall be mounted to prevent obstruction to the field instrument terminals.	✓				
E.28	Multicore cables shall be used for RTU harnesses to provide neat wiring installation. Use of individual wires for each I/O is not acceptable.					
E.29	Verify that adequate access to RTU and communication plug is provided	✓				

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

E.30	Modbus communication cables (RS 485) shall be 120ohm impedance twisted pair's.	✓				
E.31	Aerial surge arrestor shall be mounted with a small section of DIN rail the earthed as directly as possible	✓				
E.32	~~When externally installing soft starter CT's for bypass circuit, verify proper size to match the SS and wiring polarity. (if SS is MSF-017 the corresponding CT shall be CTS-017)~~					
E.33	~~When externally installing soft starter CT's for bypass circuit, please ensure proper Bypass operation parameter [340] shall be enabled.~~					
E.34	~~Motor Starter CT ratios are as specified and mounted to correct polarity~~					
E.35	~~Soft starter CT leads to be cut to size / kept short.~~					

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector ..... **Date** 15/10/13

F. Live Power and Operational Tests

The following tests shall be made with all switchboard electrical circuits energized in order to check that the switchboard meets all operational requirements.

Item No.	Activity Description	Results			Signed QUU	Results and comments
		Acc	Rej	N/A		
F.1	Verify that all circuit breakers isolate their stated circuits	✓				
F.2	Verify that all electrical components energize when power circuits are energized	✓				
F.3	Switchboard lights operate	✓				
F.4	Confirm that E-Stops actually stop its corresponding drive.	✓				
F.5	~~Thermal overloads or~~ soft starter protection appropriately set			✓		
F.6	Set up all of the soft starter parameters			✓		

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

QUEENSLAND UrbanUtilities

CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

F.7	Verify that all Soft starter operation and all display parameters are displaying correctly. ~~Confirm current CTs are the correct polarity~~			✓		
F.8	A copy of Soft Starter ~~and/or VSD parameter~~ configuration to match site equipment shall be provided to the switchboard manufacturer by the commissioning manager.					
F.9	Record output of 24VDC power supply when connected to 240 VAC main.	✓				
F.10	Record output of 24VDC power supply when disconnected to 240 VAC main.	✓				
F.11	~~Logica~~ RTU provided with corresponding firmware/ software					**Software Version:** # 258102 KingFisher.
F.12	Redlion HMI provided with corresponding software configuration			✓		**Software Version:** G#40258
F.13	I/O tested to RTU terminals	✓				
F.14	Manual functions tested	✓				

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Dayo **Date** 15/10/13

QUEENSLAND UrbanUtilities

CA17a - Factory Inspection Tests

Major Projects & Commercial Services
SQUV SP Reliability Improve – Stage2

G. Non-Conformances and Unauthorised Modifications

G.1	LAP TO TRAY TOO MUCH.
G.2	NO LOG BOOK HOLDER.
G.3	
G.4	GSM MODEM ANTENNA CABLE NOT IP56.
G.5	
G.6	PLUG ALL SPARE HOLES
G.7	
G.8	
G.9	
G.10	NO SPARE CORES OR PAIRS FROM SWITCH BOARD TO PUMPS.

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector John Clayton **Date** 15/10/13

This section is to be completed only at the conclusion of the FAT:

Final FAT Results	YES	NO	Results and comments
Pre-FAT Completed	✓		
Minor NCRs Generated	✓		
Major NCRs Generated		✓	
Pre-FAT Accepted			

Notes:

1. FAT results to be recorded above by Contractor.
2. FAT results to be approved by Queensland Urban Utilities Electrical Inspector.
3. Pre-FAT results to be approved by Queensland Urban Utilities Electrical Inspector at Pre-FAT (if present) or at the start of the FAT.
4. NCRs are to be generated by the Queensland Urban Utilities Electrical Inspector for all NCRs not resolved by the end of the test.

Contractor's Signature ..... **Date** 25-9-13

Company Name J & P Richardson Industries **Company Electrical Licence No.** 756

Queensland Urban Utilities Electrical Inspector ..... **Date** .....

DRAWING No.	Rev	DRAWING TITLE	Remarks
486/4/9-1194-000		CONCEPT DRAWING	
486/4/9-1194-001	2	ELECTRICAL DRAWING INDEX	RE-ISSUED FOR APPROVAL
486/4/9-1194-002	2	BLOCK DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-003	2	AC POWER DISTRIBUTION SCHEMATIC DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-004	2	PUMPS POWER & CONTROL SCHEMATIC DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-005	2	DC POWER DISTRIBUTION SCHEMATIC DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-006	2	COMMON CONTROLS SCHEMATIC DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-007	2	RTU DIGITAL INPUTS TERMINATION DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-008	2	RTU DIGITAL OUTPUTS & ANALOG INPUTS TERMINATION DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-009	2	PUMPS CONTROL TERMINATION DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-010	2	SWITCHBOARD EQUIPMENT LIST	RE-ISSUED FOR APPROVAL
486/4/9-1194-011	2	SWITCHBOARD CABLE SCHEDULE	RE-ISSUED FOR APPROVAL
486/4/9-1194-012	2	SWITCHBOARD LABEL SCHEDULE	RE-ISSUED FOR APPROVAL
486/4/9-1194-013	2	SWITCHBOARD CONSTRUCTION NOTES & DETAILS	RE-ISSUED FOR APPROVAL
486/4/9-1194-014	2	SWITCHBOARD CONSTRUCTION DETAILS	RE-ISSUED FOR APPROVAL
486/4/9-1194-015	2	SWITCHBOARD GENERAL ARRANGEMENT (Sheet 1 OF 2)	RE-ISSUED FOR APPROVAL
486/4/9-1194-016	2	SWITCHBOARD GENERAL ARRANGEMENT (Sheet 2 OF 2)	RE-ISSUED FOR APPROVAL
486/4/9-1194-017	2	SITE LAYOUT (REFER DWG: 486/4/9-1194-030-1)	RE-ISSUED FOR APPROVAL

STANDARD VARIABLES			
DESCRIPTION	VALUES		
WATER BOOSTER PLANT ID	WB065		
MAIN FLOWMETER ID,	T.B.C.		
PRESSURE INLET ID, PRESSURE OUTLET ID	P T.B.C., P T.B.C.		
STREETNAME, SUBURB	SEIB STREET, KILCOY		
DRAWING NUMBER	486/4/9-1194		
SUPPLY AUTHORITY POLE No.	101048		
INCOMING MAINS SUPPLY CABLE sqmm	16mm		
MAIN EARTHING CABLE sqmm	6mm		
METERING ISOLATION LINKS	IPD S7125BWQ		
NORMAL SUPPLY MAIN SWITCH	63A, E125NJ63		
GENERATOR SUPPLY MAIN SWITCH	63A, E125NJ63		
Grundfos PumpSet Assy Part No.	CRE45-2		
PUMP KW RATING (1, 2, 3)	7.5 kW	7.5 kW	7.5 kW
PUMP CIRCUIT BREAKER (1, 2, 3)	DTCB15332C	DTCB15332C	DTCB15332C
PUMP MOTOR SUPPLY CABLE sqmm (1, 2, 3)	2.5mm 3C+E	2.5mm 3C+E	2.5mm 3C+E
MAIN FLOWMETER RANGE	T.B.C.		
RADIO	RADTEL AD2006		

STANDARD DESIGN OPTIONS		
OPTION	DESCRIPTION	FITTED
A1	PUMP 3 FITTED	YES ☒
~~A2~~	~~PUMP 4 FITTED~~	☒ NO
~~A3~~	~~PUMP 5 FITTED~~	☒ NO
~~B~~	~~BYPASS FLOWMETER FITTED~~	☒ NO
C1	KINGFISHER	YES ☒
~~C2~~	~~MD3311 RTU~~	☒ NO
D1	GSM MODEM	YES ☒
~~D2~~	~~PSTN MODEM~~	☒ NO
E	MIRI AD2006	YES ☒
F1	PUMP BOX SUMP PUMP	YES ☒
~~F2~~	~~FLOWMETER PIT SUMP PUMP~~	☒ NO
G	PUMP BOX VENTILATION FAN	YES ☒

FUNCTION TEST
J & P RICHARDSON IND.
NAME: A.VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

QUEENSLAND Urban Utilities

WB065
SEIB STREET, KILCOY
WATER BOOSTER

SITE COVER SHEET

TEST
"ISSUED FOR CONSTRUCTION" S97
SIGN NF 4/6/13
QUU MG3100

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:
RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE
QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)
QUEENSLAND Urban Utilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
2	04.13	AMENDED FROM QUU COMMENTS	L.P.	M.F.		
1	03.13	RE-ISSUED FOR APPROVAL	B.J.	B.J.		
A	06.13	ISSUED FOR CONSTRUCTION	M.F.	M.F.		

FUNDING
DESIGN W.O. No. QUUXXX
CONSTRUCTION W.O. No. SOA XXXXX-XXX
FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No. DATE	
CAD FILE	49-1194-001-A.DWG	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No. DATE	

APPROVED BY SIGNATURE DATE
CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE ELECTRICAL DRAWING INDEX

SHEET No. 1 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No 486/4/9-1194-001
AMEND. A

QUU MG3100

NOTE:
double lines indicate
operator interface

WATER BOOSTER SWITCHBOARD

MTRG COMPARTMENT | POWER COMP. | CONTROL COMPARTMENT

NORMAL 415VAC (T.B.C.) | ISOL. LINKS | KWH | GENSET | SR1-3 | F1-3 63A | SURGE PROTN | PFRS | F4-6 6A | PHASE FAIL | Q3 MTS | Q2 MAIN SWITCH 63A | EARTH | GND

SF1 | AC FILTER | Q20 4A | Q22 4A | Q23 4A | Q21 4A | ALARM RLY | SDAR

24VDC BATT | PS1 | PWR SUPPLY | 240vac/24vdc | 24VDC

Grundfos CU351 | MPC | Grundfos CIU 200 | G'WAY | MODbus RTU

MIRI ANTENNA | GSM ANTENNA

SD2 | SURGE PROTN | MIRI RADIO | DATA | GSM MODEM | GND | 24VDC

STATION LOCAL/ REMOTE SELECTOR

PLG/SKT | DATA | KINGFISHER RTU

DIGITAL INPUTS | DIGITAL OUTPUTS | 4-20mA | 4-20mA | 4-20mA

ESR | PUMPS STOP | P1 P2 P3 ESR I/L | P1 P2 P3 MAN. RUN

SIGNAL SPLITTER | SIGNAL SPLITTER | GENIbus | GENIbus | GENIbus | 4-20mA | 24VDC

F/M

Q7 6A | Q8 6A | Q9 6A | Q12 16A 30mA | Q10 16A 30mA | J9 2A | Q4 32A | Q5 32A | Q6 32A

LR1 LEVEL RELAY | LCC

J10

(T.B.C) PinTx | VFD | ESR I/L | MAN RUN | 7.5 kW | P1 | P2 | P3

(T.B.C) PoutTx

0.17 kW SUPPLY AIR VENT FAN | 0.08 kW DISCHARGE AIR VENT FAN | SUMP HIGH LEVEL | AUTO SUMP PUMP

WATER IN | WATER OUT

WATER BOOSTER PUMP BOX

GRUNDFOS CRE45-2

WATER BOOSTER F/M FLOWMETER PIT

FUNCTION TEST
J & P RICHARDSON IND.
NAME: A.VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

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:
RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

J. & P. RICHARDSON
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A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
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JPR Project No.: E12-C63100

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QUEENSLAND Urban Utilities

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FUNDING			
DESIGN W.O. No.	QUUXXX	DRAFTED	LIEN LE
CONSTRUCTION W.O. No.	SOA XXXXX-XXX	DRAFTING CHECK	LUCAS WEDLEY
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	CAD FILE	49-1194-002-A.DWG
		Q.U.U. FILE No.	

LUCAS WEDLEY	24/01/13		
DESIGN	R.P.E.Q. No. DATE	APPROVED BY	SIGNATURE DATE
ORIGINAL SIGNED BY			
DESIGN CHECK	R.P.E.Q. No. DATE	CONSTRUCTION MANAGER	SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
BLOCK DIAGRAM

SHEET No. 2 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-002
AMEND. A

3 PHASE 415VAC
SUPPLY FROM POLE No. 101048
CABLE SIZE 16mm
N R W B
P01
MTRG ISOLATION LINKS
ENERGEX DIRECT METERING
LOCKABLE METERING COMPARTMENT

3 PHASE 415VAC
SUPPLY FROM 50kVA GENERATOR
TEMPORARY BACK-UP ONLY
R W B N E
P03
GENERATOR EXTERNAL CONNECTION PLUG 90A

P02
MAIN EARTH STAKE
MEN LINK
E

F1 610 SR1,2,3
F2 611
F3 612
63A
80kA
SDN-3
SDN-2
SDN-1

F4 620
F5 621
F6 622
6A N4
PFRS
SITE MAINS POWER FAILURE RELAY
REF 06:B2

MTS
MANUAL TRANSFER SWITCH

Q2
NORMAL SUPPLY MAIN SWITCH
63A
(NOTE 1, 2)
Ir=1 (63A) Im=8

Q3
GEN. SUPPLY MAIN SWITCH
63A
(NOTE 1, 2)
Ir=1 (63A) Im=8

EARTH
MAIN NEUTRAL

Q9
6A
630
N9
SF1
CRITEC SURGE FILTER
SN1
FILTERED NEUTRAL

623 Q20 4A 624 N20 RTU 24VDC POWER SUPPLY REF 05:B2
623 Q21 4A 625 N21
623 Q22 4A 626 N22 GRUNDFOS HYDRO CU351 REF 05:H3
623 Q23 4A 627 N23 ~~GRUNDFOS CIU200 GATEWAY REF 05:G11~~ SPARE

Q10
16A 30mA
640
N10
Q10-N
GPO IN RTU CUBICLE (LAPTOP)
GPO IN DISTRIBUTION CUBICLE
SPARE

Q12
16A 30mA
680
N12
Q12-N
PUMP BOX
SUMP PUMP
P-P5
10A OUTLET
PUMP BOX
AUTO SUMP PUMP

E N R W B
CONTINUED ON SHT 04:A1

NOTES

1. INCOMING MAIN, GENERATOR, & DIST. BOARD CIRCUIT BREAKERS SHALL BE SHROUDED ON BOTH LINE & LOAD SIDES.

FUNCTION TEST
J & P RICHARDSON IND.
NAME: A.VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

AC POWER SUPPLY

SURGE DIVERTERS SR1 SR2 SR3
FILTER SF1
SD12 SD23 SD3
SD ALARM RELAY
SD+ SDAR SD-
L N 12 16
CLOSE = HEALTHY
SURGE DIVERTER AND FILTER OK REF 06:B2
DI03+
DI03-

LEGEND:
- VFD TERMINAL
- RTU TERMINAL
- PLC/RTU MARSH. C/BREAKER TERM.
- PLC/RTU MARSH. LINK TERM.

RTU
- DI1-02 DIGITAL INPUT
- DO1-02 DIGITAL OUTPUT
- AI1-02 ANALOG INPUT
- AO1-02 ANALOG OUTPUT

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:
RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

J. & P. RICHARDSON
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ELECTRICAL CONTRACTORS AND ENGINEERS
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PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE
QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)
QUEENSLAND UrbanUtilities

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1	03.13	RE-ISSUED FOR APPROVAL	B.J.	B.J.		
A	06.13	ISSUED FOR CONSTRUCTION	M.F.	M.F.		

FUNDING
DESIGN W.O. No. QUUXXX
CONSTRUCTION W.O. No. SOA XXXXX-XXX
FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No.	DATE
CAD FILE	49-1194-003-A.DWG	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No.	DATE

APPROVED BY SIGNATURE DATE
CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
AC POWER DISTRIBUTION SCHEMATIC DIAGRAM

SHEET No. 3 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-003
AMEND. A

CONTINUED FROM SHT 03:J1

E N R W B

Q4 32A — P-P1

P1-VFD
GRUNDFOSS CRE32-1 7.5 kW
M ~3 BOOSTER PUMP No1 7.5 kW

PUMPS STOP RLY REF 04:E13
RTU DO MAN.RUN RLY REF 06:H4
ESR-2 P1RUN

C-P1
L1 L2 L3 PE
3 2 Start/stop (Closed=RunPermit)
9 GND (frame)
1 Digital input (Closed=Run@MaxSpeed) (Open=NormalRTUcontrol)

P1 FAULT DI-10 REF 06:D2 DI-12
C FAULT (NC) (Open=Fault)

FROM MPC REF 05:H6
CX-P1
A Y B GENIbus RS485

Q5 32A — P-P2

P2-VFD
GRUNDFOSS CRE32-1 7.5 kW
M ~3 BOOSTER PUMP No2 7.5 kW

PUMPS STOP RLY REF 04:E13
RTU DO MAN.RUN RLY REF 06:H4
ESR-3 P2RUN

C-P2
L1 L2 L3 PE
3 2 Start/stop (Closed=RunPermit)
9 GND (frame)
1 Digital input (Closed=Run@MaxSpeed) (Open=NormalRTUcontrol)

P2 FAULT DI-11 REF 06:D2 DI-13
C FAULT (NC) (Open=Fault)

FROM MPC REF 05:H6
CX-P2
A Y B GENIbus RS485

Q6 32A — P-P3

P3-VFD
GRUNDFOSS CRE32-1 7.5 kW
M ~3 BOOSTER PUMP No3 7.5 kW

PUMPS STOP RLY REF 04:E13
RTU DO MAN.RUN RLY REF 06:H4
ESR-4 P3RUN

C-P3
L1 L2 L3 PE
3 2 Start/stop (Closed=RunPermit)
9 GND (frame)
1 Digital input (Closed=Run@MaxSpeed) (Open=NormalRTUcontrol)

P1 FAULT DI-12 REF 06:D2 DI-14
C FAULT (NC) (Open=Fault)

FROM MPC REF 05:I6
CX-P3
A Y B GENIbus RS485

PUMPS

E N R W B

Q7 6A — K7 — P-VF1 — M ~1 SUPPLY AIR VENT FAN 0.17 kW 0.9 A

Q8 6A — K8 — P-VF2 — M ~1 DISCHARGE AIR VENT FAN 0.08 kW 0.35 A

E N R W B

J10+ + 24VDC POWER SUPPLY - REF 05:E7 J10-

S1 ES1 — ESR J10- — STOP ALL PUMPS RELAY REF 06:A2, 04:B3, 04:E3, 04:H3

DOOR SWITCHES CLOSED WHEN DOORS CLOSED
DS1 DS2 — PUMP BOX DS3 — LCC J10- — SECURITY & LIGHTING RELAY REF 05:E7, 06:B2

CLOSED = HATCH CLOSED

LR1 S10- — PIT LEVEL RELAY REF 06:D2

PROBE 300 mm ABOVE PIT FLOOR LEVEL REF 09:B12
TH7 PLR

P1RUN
P2RUN
P3RUN VF VFR J10- — VENT FAN START RELAY REF 04:H11, 04:H11

VFR VFR1 K7 J10- — SUPPLY AIR VENT FAN CONTACTOR REF 04:F12

VFR VFR2 K8 J10- — DOWN DISCHARGE VENT FAN CONTACTOR REF 04:F12

FUNCTION TEST
J & P RICHARDSON IND.
NAME: A.VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

LEGEND:
- VFD TERMINAL
- RTU TERMINAL
- PLC/RTU MARSH. C/BREAKER TERM.
- PLC/RTU MARSH. LINK TERM.

RTU
- DI1-02 DIGITAL INPUT
- DO1-02 DIGITAL OUTPUT
- AI1-02 ANALOG INPUT
- AO1-02 ANALOG OUTPUT

AS CONSTRUCTED DETAILS
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NAME of SIGNATORY:
RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE
QUEENSLAND URBAN UTILITIES DELEGATE (AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)
QUEENSLAND UrbanUtilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
2	04.13	AMENDED FROM QUU COMMENTS	L.P.	M.F.		
1	03.13	RE-ISSUED FOR APPROVAL	B.J.	B.J.		
A	06.13	ISSUED FOR CONSTRUCTION	M.F.	M.F.		

FUNDING: DESIGN W.O. No. QUUXXX; CONSTRUCTION W.O. No. SOA XXXXX-XXX; FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13	
DRAFTING CHECK	LUCAS WEDLEY	DESIGN	R.P.E.Q. No. DATE	APPROVED BY SIGNATURE DATE
CAD FILE	49-1194-004-A.DWG	ORIGINAL SIGNED BY		
Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No. DATE	CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE PUMP POWER & CONTROL SCHEMATIC DIAGRAM

SHEET No. 4 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-004 AMEND. A

PS2
RADIO POWER SUPPLY
24VDC / 13.8VDC

POWER BOX
PB251-24 CM-CC-T

240VAC SUPPLY (SHROUDED) REF 03:F7 — 624, N20

PS1

LOAD — J1+, J1- — 10AMP — J2+, J2-

BATT — J1B+, J1B- — 10AMP — J1A+, J1A- — 2 x 12V BATTERIES SERIES CONNECTED

BOK — DI04+, DI04- — BATTERY OK REF 06:B2 0 = Fault, 1 = Healthy

RTU — DI05+, DI05- — POWER ON REF 06:B2 0 = Fault, 1 = Healthy

TEMPERATURE PROBE LOCATED AT BATTERIES

RTU POWER SUPPLY 10A 24VDC

4AMP J3+, J3-

4AMP J4+, J4- — J4+ / J4- (PS2)

4AMP J5+, J5-

4AMP J6+, J6- — RTU 24VDC CARD SUPPLY REF 06:A8, 06:A2, 06:H4

4AMP J7+, J7-

4AMP J8+, J8- — DELIVERY FLOWMETER REF 06:B11

4AMP J9+, J9- — LCC — 651 — REF 04:H13 — LED LIGHT IN CUBICLE

4AMP J10+, J10- — MISCELLANEOUS DC CCTS REF 04:D12

J6+A, J6-A — 24VDC REF ~~05:C7~~ 06:B7

A103+, A103- — SUCTION PRESSURE REF 06:E10

A104+, A104- — DISCHARGE PRESSURE REF 06:F10

SIGNAL SPLITTER ECT/4-20MA/2x4-20MA/ 24DC/-RT[DIN]

SS1

SS2

PUMPS

SUCTION PRESSURE SENSOR PART OF GRUNFOSS PUMP PACK (T.B.C) — Wh 106, Bk 107, 108

DISCHARGE PRESSURE SENSOR PART OF GRUNFOSS PUMP PACK (T.B.C) — Wh 109, Bk 110, 111

CU351

AI1 — EXT GENIbus — B, Y, A

AI2

GND

DO1 — 70, 72 — DI10+, DI10- — MPC FAULT TO RTU REF 06:C2 AND 07:F10

(DISABLE MPC)

X1

240VAC SUPPLY (SHROUDED, SHROUD X1 AS WELL)) REF 03:G7 — 626, 626A, N22

INT GENIbus — A1, Y1, B1

Grundfos CU 351

CX-P1 — TO P1 REF 04:C2

CX-P2 — TO P2 REF 04:F2

CX-P3 — TO P3 REF 04:I2

LOW PROFILE ANTENNA
MAXON C3LA30-BD170F

Rx TBA
Tx TBA

X01 — SD2 — X02

X03

J7+, J7-

HSUPA ETHERNET ROUTER
MAXON MA-2025

KINGFISHER RTU

PS-22	CP-30	DI-5	DO-1	IO-3	
POWER SUPPLY	COMS MODULE	DIGITAL INPUT DRY CONTACTS 16 CHANNEL I/O MODULE	ISOLATED RELAY OUTPUTS NO/NC 8 CHANNEL I/O MODULE	MIXED I/O MODULE	SPARE SLOT

J3+, J3- — DC+, DC-, E — VA+, VA-, R+, R-, TS, B+, B-

REF. SHEET 7 — REF. SHEET 8 — REF. SHEET 8

CIU200 IS BUILT INTO CU351

Grundfos GIU 200
CIU200

CIM200 MODBUS MODULE — B, Y, A — L, N, E — 627, N23 — 240VAC SUPPLY (SHROUDED) REF 03:H7

X05

X04

X05 CIM200 TO KINGFISHER RTU CONFIGURATION NOTE 6

CIM200	KINGFISHER (RTU)	
(1) D1 (+)	ORANGE/WHITE	TX+
	ORANGE	RX+
(2) D0 (-)	BROWN	TX-
	BROWN/WHITE	RX-
(3) GND	BLUE/WHITE	GND

MIRI AD2006 RADIO

RS232 — RTU ENET — PORT 5

PORT 4 USB

PORT 3 RS485 — 1, 2, 3 — RS RJ45 ADAPTOR

PROG/RUN SWITCH

PIT TEST BUTTON

DOT — DIN — ALG

ANTENNA — PORT 1 RS232 — PORT 2 RS232

J4A+ — J4A-

LEGEND:
- ■ VDF TERMINAL
- ⊠ PLC/RTU MARSH. C/BREAKER TERM.
- ○ PLC/RTU MARSH. LINK TERM.

RTU
- DI1-02 — DIGITAL INPUT
- DO1-02 — DIGITAL OUTPUT
- AI1-02 — ANALOG INPUT
- AO1-02 — ANALOG OUTPUT

FUNCTION TEST
J & P RICHARDSON IND.
NAME: A. VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

NOTES
1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
6. SERIAL OPTION BOARD FITTED TO PORT CONFIGURED AS RS485

AS CONSTRUCTED DETAILS
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FUNDING			
DESIGN W.O. No.	QUUXXX	DRAFTED	LIEN LE
CONSTRUCTION W.O. No.	SOA XXXXX-XXX	DRAFTING CHECK	LUCAS WEDLEY
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	CAD FILE	49-1194-005-A.DWG
		Q.U.U. FILE No.	

LUCAS WEDLEY	24/01/13		
DESIGN	R.P.E.Q. No. DATE	APPROVED BY	SIGNATURE DATE
ORIGINAL SIGNED BY			
DESIGN CHECK	R.P.E.Q. No. DATE	CONSTRUCTION MANAGER	SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
DC POWER DISTRIBUTION SCHEMATIC DIAGRAM

SHEET No. 5 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-005
AMEND. A

RTU DIGITAL INPUTS

+ 24VDC POWER SUPPLY - REFER SHEET 05:C7

DI-01	PUMP STOP RELAY	REF 04:H13
DI-02	SITE MAINS POWER	REF 03:C3
DI-03	SURGE DIVERTER AND FILTER OK	REF 03:E11
DI-04	RTU BATTERY OK	REF 05:B3
DI-05	RTU CONTROL POWER	REF 05:C3
DI-06	DOOR STATUS	REF 04:H13
DI-07	STATION LOCAL REMOTE SWITCH	
DI-08	SUPPLY AIR VENT FAN RUNNING	REF 04:H13
DI-09	DISCHARGE AIR VENT FAN RUNNING	REF 04:H13
DI-10	MPC FAULT	REF 05:G5
DI-11	PIT FLOODED	REF 04:F14
DI-12	P1 FAULT	REF 04:C4
DI-13	P2 FAULT	REF 04:F4
DI-14	P3 FAULT	REF 04:I4
DI-15	RESERVED FOR P4 FAULT	
DI-16	RESERVED FOR P5 FAULT	

+ 24VDC POWER SUPPLY - REFER SHEET 05:C7

DI-17	GENERATOR FAULT	REF 08:B10
DI-18	GENERATOR RUNNING	REF 08:B10
DI-19	GENERATOR LOW FUEL	REF 08:B10

RTU DIGITAL OUTPUTS

+ 24VDC POWER SUPPLY - REFER SHEET 05:C7

DO-01	P1RUN	PUMP #1 MANUAL RUN COMMAND REF 04:C3 , 04:C12
DO-02	P2RUN	PUMP #2 MANUAL RUN COMMAND REF 04:F3 , 04:C12
DO-03	P3RUN	PUMP #3 MANUAL RUN COMMAND REF 04:I3 , 04:C12
DO-06	X1	DISABLE MPC REF 05:H4

+ 24VDC POWER SUPPLY - REFER SHEET 05:C7

FIELD

E+H PROMATIC 50 FLOWMETER SENSOR

IFM-D-1

IFM-D-2

FLOWMETER PIT

DELIVERY FLOWMETER

E+H PROMATIC 50 FLOWMETER Tx

24VDC SUPPLY REF 05:D7

RTU ANALOG INPUTS

AI1-01	DELIVERY FLOWMETER	
AI1-02	RESERVED FOR LOW ZONE FLOWMETER	
AI1-03	SUCTION PRESSURE SENSOR	SUCTION PRESSURE SENSOR part of GRUNDFOS PUMP PACK
AI1-04	DISCHARGE PRESSURE SENSOR	DISCHARGE PRESSURE SENSOR part of GRUNDFOS PUMP PACK

ANALOG INPUTS part of GRUNDFOS CU351

SIGNAL SPLITTERS ECT/4-20MA/2x4-20MA/24DC/-RF[DIN] SS1 SS2

4-20mA

NOTES

1. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

LEGEND:

- VFD TERMINAL
- RTU TERMINAL
- PLC/RTU MARSH. C/BREAKER TERM.
- PLC/RTU MARSH. LINK TERM.

RTU

- DI1-02 DIGITAL INPUT
- DO1-02 DIGITAL OUTPUT
- AI1-02 ANALOG INPUT
- AO1-02 ANALOG OUTPUT

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START DATE: FINISH DATE:

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JPR Project No.: E12-C63100

FUNCTION TEST
J & P RICHARDSON IND.
NAME: A.VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

NAME SIGNATURE DATE
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FUNDING			
DESIGN W.O. No.	QUUXXX	DRAFTED	LIEN LE
CONSTRUCTION W.O. No.	SOA XXXXX-XXX	DRAFTING CHECK	LUCAS WEDLEY
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	CAD FILE	49-1194-006-A.DWG
		Q.U.U. FILE No.	

LUCAS WEDLEY	24/01/13		
DESIGN	R.P.E.Q. No. DATE	APPROVED BY	SIGNATURE DATE
ORIGINAL SIGNED BY			
DESIGN CHECK	R.P.E.Q. No. DATE	CONSTRUCTION MANAGER	SIGNATURE DATE

ASSET/PROJECT WB065 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE COMMON CONTROLS SCHEMATIC DIAGRAM

SHEET No. 6 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-006

AMEND. A

SWITCHBOARD

FIELD

24VDC

REFER SHEET 05

REFER SHEET 05

RTU KINGFISHER I/O MODULE SLOT 3 DI-5

DIGITAL INPUTS

CH1	01	DI01	gy
CH2	02	DI02	gy
CH3	03	DI03	gy
CH4	04	DI04	gy
CH5	05	DI05	gy
CH6	06	DI06	gy
CH7	07	DI07	gy
CH8	08	DI08	gy
+12V	09		gy
0V	10		gy
CH9	11	DI09	gy
CH10	12	DI10	gy
CH11	13	DI11	gy
CH12	14	DI12	gy
CH13	15	DI13	gy
CH14	16	DI14	gy
CH15	17	DI15	
CH16	18	DI16	
+12V	19		
0V	20	DI1-COM	vi

DI1 +24V

DI1

DI1-COM

CONT ON SHEET 08

part of C-P1

part of C-P2

part of C-P3

DI12 DI13 DI14

CONT ON SHEET 09

DI01+ / DI01-	ESR-1 — PUMPS STOP PBUTTON OK
DI02+ / DI02-	PFRS-1 — SITE MAINS POWER OK
DI03+ / DI03-	SDAR-1 — SURGE DIVERTER OK
DI04+ / DI04-	PS1 — BATTERY SYSTEM OK
DI05+ / DI05-	PS1 — RTU POWER OK
	PS1 RTU POWER SUPPLY 10A 24VDC POWER BOX PB251-24CM
DI06+ / DI06-	LCC — ALL DOORS CLOSED
DI07+ / DI07-	REM LOC S10 — REMOTE CONTROL SELECTED
DI08+ / DI08-	K7 — SUPPLY AIR VENT FAN RUNNING
DI09+ / DI09-	K8 — DISCHARGE AIR VENT FAN RUNNING
DI10+ / DI10-	MPC-D01 — MPC OK
DI11+ / DI11-	LR1-1 — PIT FLOODED

FUNCTION TEST

J & P RICHARDSON IND.

NAME: A.VARY LICENCE: 756

DATE: 25-9-13

SIGNATURE:

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START DATE: FINISH DATE:

LEGEND:

C?? CABLE IDENTIFIER

10A RTU MINATURE CCT BREAKER TERMINAL

5 DISCONNECT LINK TERMINAL

NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.

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FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	CAD FILE	49-1194-007-A.DWG
		Q.U.U. FILE No.	

LUCAS WEDLEY			24/01/13
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ORIGINAL SIGNED BY			
DESIGN CHECK	R.P.E.Q. No.	DATE	

APPROVED BY	SIGNATURE	DATE
CONSTRUCTION MANAGER	SIGNATURE	DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
RTU DIGITAL INPUTS TERMINATION DIAGRAM

SHEET No. 7 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-007

AMEND. A

RTU KINGFISHER I/O MODULE SLOT 4 DO-1

DIGITAL OUTPUTS

CH1 NO 01 · CH1 NC 02 · CH2 NO 03 · CH2 NC 04 · COM 05 · CH3 NO 06 · CH3 NC 07 · CH4 NO 08 · CH4 NC 09 · COM 10 · CH5 NO 11 · CH5 NC 12 · CH6 NO 13 · CH6 NC 14 · COM 15 · CH7 NO 16 · CH7 NC 17 · CH8 NO 18 · CH8 NC 19 · COM 20

CONT FROM SHEET 07

SWITCHBOARD

DO1 — DO1+24V, DO1+24V, DO1+24V, DO1+24V; DO01 DO02 DO03 DO04 DO05 DO06 DO07 DO08

- DO01+ gy / DO01- gy — P1RUN PUMP1 MANUAL RUN COMMAND
- DO02+ gy / DO02- gy — P2RUN PUMP2 MANUAL RUN COMMAND
- DO03+ gy / DO03- gy — P3RUN PUMP3 MANUAL RUN COMMAND
- DO06+ gy / DO06- gy — X1 DISABLE MPC COMMAND

AI1 — or AI1+24V, AI1+24V, AI1+24V, AI1+24V; AI01+ AIG0 AI02+ AIG0 AI03+ AIG0 AI04+ AIG0; SC1 SC1 SC1 SC1

- AI01+ gy / AI01- gy
- AI03+ / AI03- / AI04+ / AI04-

AO1 — AO01+, AO01-

INST EARTH

REF 05:C7

SIGNAL SPLITTER ECT/4-20MA/2x4-20MA/24DC/-RF[DIN]

SS1: AI03+ +Out, AI03- -Out, AI03B+ +TX, AI03B- +IN; OUTPUT A: DC, DCC; OUTPUT B: +Out, -Out; J6+A, J6-A, AI03C+, GND

SS2: AI04+A +Out, AI04- -Out, AI04B+ +TX, AI04B- +IN; OUTPUT A: DC, DCC; OUTPUT B: +Out, -Out; J6+A, J6-A, AI04C+, GND

RTU KINGFISHER MIXED I/O MODULE IO-3

ANALOGUE INPUTS X 4: CH1 01, CH2 02, CH3 03, CH4 04, 0V 05, +24V 06

ANALOGUE OUTPUT X 1: AO+ 07, AO- 08, SHIELD 09

DIGITAL INPUTS X 4: CH1 10, CH2 11, CH3 12, CH4 13, DI COM 14

DIGITAL OUTPUTS X 4: CH1 15, CH2 16, CH3 17, CH4 18, DO COM 19, LINK 20

DI2 — DI2+24V, DI2-COM, DI17-, DI18-, DI19-, DI20-

DO2 — DO-COM, DO09, DO10, DO11, DO12

CU351 (Grundfos CU 351)

- 50+ AI1 — EXT GENIbus B Y A
- 53+ AI2
- 54 AI2
- 58 GND
- INT GENIbus A1 Y1 B1
- REF 05:H3 — 626A L, N23 N, E
- DO1 70 DI10+ / 72 DI10- — REF 06:C2 AND 07:F10

CIU200 IS BUILT INTO CU351

Grundfos GIU 200 CIU200 — B Y A; 1 Wh, 2 Bk; REF 05:H8

REF 03:F7 — 627 L, N23 N, E

27 PIN GENERATOR CONTROL PLUG

DI2+24V 1 · DI17- 2 · DI18- 3 · DI19- 4 · 5 · 6 · 26 · 27 · E

BASIC FEEDBACK CONNECTION

- GENERATOR FAULT
- GENERATOR RUNNING
- GENERATOR LOW FUEL

C-GEN

FIELD

PORTABLE GENERATOR

BASIC FEEDBACK CONNECTION (MANUAL START OPERATION): DI2+24V, DI17-, DI18-, DI19-

- GENERATOR FAULT
- GENERATOR RUNNING
- GENERATOR LOW FUEL

DELIVERY FLOWMETER

E+H PROMAG 50 FLOWMETER Tx (E+H PROMATIC 50 FLOWMETER Tx)

AI01+ 26+, AI01- 27-; INST. EARTH; 24VDC SUPPLY REF 05:D7 — J8+ 1, J8- 2

6-S1, 5-E1, 7-E2, 8-S2, 4-GND, 37-E, 36-S; E; 41, 42

IFM-D-1 · IFM-D-2

E+H PROMATIC 50 FLOWMETER SENSOR: 5-E1, 7-E2, 4-GND, 37-E, E, 41, 42

FLOWMETER PIT

FUNCTION TEST
J & P RICHARDSON IND.
NAME: A.VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

LEGEND:
- C?? CABLE IDENTIFIER
- × o 10A RTU MINATURE CCT BREAKER TERMINAL
- o 5 DISCONNECT LINK TERMINAL

NOTES
1. ALL WIRES & CABLE CORES ARE FERRULED

CX-P1 · CX-P2 · CX-P3 — A Y B Wh Bk

VFD1 · VFD2 · VFD3 — A Y B GENBUS RS485

PIN — 106 107 108 — + - SCN — SUCTION PRESSURE

POUT — 109 110 111 — + - SCN — DISCHARGE PRESSURE

AI03+B AI03B+ · AI03-A AI03B-

AI04+B AI04B+ · AI04-A AI04B-

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DRAFTED LUCAS WEDLEY 24/01/13 · DRAFTING CHECK LUCAS WEDLEY · CAD FILE 49-1194-008-A.DWG · Q.U.U. FILE No.

DESIGN R.P.E.Q. No. DATE · ORIGINAL SIGNED BY · DESIGN CHECK R.P.E.Q. No. DATE

APPROVED BY SIGNATURE DATE · CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE: RTU DIGITAL OUTPUTS & ANALOGUE INPUTS TERMINATION DIAGRAM

SHEET No. 8 OF 16 · QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-008 · AMEND A

SWITCHBOARD

FIELD

CONT ON SHEET 07

PUMP BOX

REF 04:E12 — DS2, DS3, PLR
MPC REF 05:G3 — Pout (Wh, Bk, Scr), Pin (Wh, Bk, Scr)
REF 04:B04 — 110, 115, 110, 112
REF 04:E04 — 120, 125, 120, 122
REF 04:H04 — 130, 135, 130, 132
REF 04:F12 — J10+, VF

PUMP BOX		
DS2	103	Rd
DS3	104	Bk
PLR	105	
A103-	106	Wh
A103-B	107	Bk
	108	Scr
A104-	109	Wh
A104-A	110	Bk
	111	Scr
110	112	1Wh
115	113	1Bk
110	114	2Wh
112	115	2Bk
120	116	1Wh
125	117	1Bk
120	118	2Wh
122	119	2Bk
130	120	1Wh
135	121	1Bk
130	122	2Wh
132	123	2Bk
J10+	124	Rd
VF	125	Bk
	126	
	127	
	128	
	129	
	130	
	131	

C-DS3, PLR, I-POUT, I-PIN, C-P1, C-P2, C-P3, C-TH7

DS2, DS3 — DS3 — CLOSED = ACCESS CLOSED

PUMP PRESSURES

PLR — PROBE 300 mm ABOVE PIT FLOOR LEVEL

Pout — OUTLET PRESSURE (Wh, Bk, Scr; +, -, E)

Pin — INLET PRESSURE (Wh, Bk, Scr; +, -, E)

110 1Wh	P1-VFD		PUMP 1
115 1Bk	2 Start/stop		(VFD DI Closed=RunPermit)
110 2Wh	3 GND (FRAME)		
112 2Bk	1 Digital input		(VFD DI Closed=MaxSpeed)
DI11+ 3Wh	C		
DI11- 3Bk	FAULT (NC)		(VFD DO Open=Fault)
	NC		
120 1Wh	P2-VFD		PUMP 2
125 1Bk	2 Start/stop		(VFD DI Closed=RunPermit)
120 2Wh	3 GND (FRAME)		
122 2Bk	1 Digital input		(VFD DI Closed=MaxSpeed)
DI12+ 3Wh	C		
DI12- 3Bk	FAULT (NC)		(VFD DO Open=Fault)
	NC		
130 1Wh	P3-VFD		PUMP 3
135 1Bk	2 Start/stop		(VFD DI Closed=RunPermit)
130 2Wh	3 GND (FRAME)		
132 2Bk	1 Digital input		(VFD DI Closed=MaxSpeed)
DI13+ 3Wh	C		
DI13- 3Bk	FAULT (NC)		(VFD DO Open=Fault)
	NC		

J10+, VF — TH7 — THERMOSTAT MOUNTED IN PUMP BOX

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:
RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3023
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

FUNCTION TEST
J & P RICHARDSON IND.
NAME: A.VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

NAME SIGNATURE DATE
QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
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FUNDING: FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DESIGN W.O. No.	QUUXXX	DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
CONSTRUCTION W.O. No.	SOA XXXXX-XXX	DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No.	DATE
		CAD FILE	49-1194-009-A.DWG	ORIGINAL SIGNED BY	
		Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No.	DATE

APPROVED BY SIGNATURE DATE
CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
PUMPS CONTROL TERMINATION DIAGRAM

SHEET No. 9 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-009
AMEND. A

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	REMARKS
1	3	METERING ISOLATION LINKS	IPD	S7125BWO	
2	1	Q2 NORMAL SUPPLY MAIN SWITCH 100A	TERASAKI	E125-NJ 63A + T2HS12RSGM	+ T2CF123SLNG + T2MW12CA + T2MW00SA
3	1	Q3 GENERATOR SUPPLY MAIN SWITCH 100A	TERASAKI	E125-NJ 63A + T2HS12RSGM	+ T2CF123SLNG + T2MW12CA
4.1	1	Q4 PUMP 1 CIRCUIT BREAKER 32A + CAPTIVE LOCK DOG	TERASAKI	DTCB15332C+DTLDC	15kA 3P 32A "C" curve
4.2	1	Q5 PUMP 2 CIRCUIT BREAKER 32A + CAPTIVE LOCK DOG	TERASAKI	DTCB15332C+DTLDC	15kA 3P 32A "C" curve
4.3	1	Q6 PUMP 3 CIRCUIT BREAKER 32A + CAPTIVE LOCK DOG	TERASAKI	DTCB15332C+DTLDC	15kA 3P 32A "C" curve
					DCLD6
5					
6	1	Q7 SUPPLY AIR VENT FAN CIRCUIT BREAKER	TERASAKI	DTCB10106C+DTLDC	10kA 1P 6A "C" curve
7	1	Q8 DISCHARGE AIR VENT FAN CIRCUIT BREAKER	TERASAKI	DTCB10106C+DTLDC	10kA 1P 6A "C" curve
8	1	Q9 DC PWR SUPPLY CB	TERASAKI	DTCB10106C	10kA 1P 6A "C" curve
9	1	Q10 SWBD GPO CIRCUIT BREAKER	TERASAKI	DSRCBH-16-30A	10kA 1P 16A 30mA RCD
10					
11	1	Q12 PUMP BOX SUMP PUMP CIRCUIT BREAKER	TERASAKI	DSRCBH-16-30A	10kA 1P 16A 30mA RCD
12					
13					
14					
15	1	INSULATED 3P BUS COMB	TERASAKI	ICL213	21 POLE
16					
17	1	Q20 DC POWER SUPPLY CIRCUIT BREAKER	TERASAKI	DTCB10104C	10kA 1P 4A "C" curve
18	1	Q21 SURGE DIVERTERS RELAY CIRCUIT BREAKER	TERASAKI	DTCB10104C	10kA 1P 4A "C" curve
19	1	Q22 GRUNDFOSS MPC CIRCUIT BREAKER	TERASAKI	DTCB10104C	10kA 1P 4A "C" curve
20	1	Q23 GRUNDFOSS CIU200 CIRCUIT BREAKER	TERASAKI	DTCB10104C	10kA 1P 4A "C" curve
21	1	INSULATED 3P BUS COMB	TERASAKI	ICL123	12 POLE
22	1	INSULATED 1P BUS COMB	TERASAKI	IBC108P	8 POLE
29	3	F1,2,3 - SURGE DIVERTER CIRCUIT FUSES	NHP	NC63FW + NTIS63	FUSES & 63A HOLDERS
30	3	SURGE DIVERTERS - SR1,SR2,SR3	CRITEC	TDS-1100-2SR-277	
31	1	SURGE DIVERTER ALARM RELAY - SDAR	CRITEC	DAR-275V	
32	1	SURGE REDUCTION FILTER - SF1	CRITEC	TDF-10A-240V	
33	3	F4,5,6 - PHASE FAILURE RELAY FUSES	NHP	NC32FW + NNIT6	FUSES & 32A HOLDERS
34	1	SITE MAINS PHASE FAILURE RELAY - PFRS	CARLO GAVAZZI	DPB01CM48W4	
35					
36					
37					
38	1	MAIN NEUTRAL LINK	DORE	165E24 + E/N FEET	INSULATED
39	1	MAIN EARTH LINK	DORE	165E24	
40	1	INSTRUMENT EARTH LINK	DORE	165E12 + E/N FEET	INSULATED
41	1	FILTERED SUPPLY NEUTRAL LINK	CLIPSAL	L7	INSULATED
42	2	1 PHASE OUTLET 15A	CLIPSAL	15/15+90B (SHROUD)	
43					
44					
45	1	3 PHASE N&E APPLIANCE INLET 90A - GEN POWER	PROCONECT	3PS6A3NE01	3p+N+E c/w 3PS6PC Protective Cover
46	1	GENERATOR I/O 27 PIN SOCKET OUTLET	WILCO	WIBM27	
47					
48					
49					
50					
51					
52					
53	1	PUMPS STOP RELAY - ESR	SPRECHER & SCHUH	CS 7C-40E24V	AUX BLOCK 2 N.O.
54	1	PUMPS STOP RELAY AUX CONTACT BLOCK	SPRECHER & SCHUH	CS 7-PV-22	AUX BLOCK 2 N.O.
55	1	PUMP 1 MANUAL RUN RELAY - P1RUN	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
56	1	PUMP 2 MANUAL RUN RELAY - P2RUN	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
57	1	PUMP 3 MANUAL RUN RELAY - P3RUN	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
58	1	VENT FAN START RELAY - VFR	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
59	1	DISABLE MPC RELAY - X1	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
60	1	VENT FAN THERMOSTAT IN PUMP BOX-TH7	COSMOTEC	KTS01141	THERMOSTAT
61	2	VENT FAN CONTACTOR - K7, K8	SPRECHER & SCHUH	CA7-9C-01 24VDC	24VDC CONTACTOR
62	2	VENT FAN CONTACTOR AUX CONTACT BLOCK " "	"	CS7-PV-11	AUX BLOCK 1NO+1NC

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	REMARKS
63					
64					
65	1	STOP ALL PUMPS PUSHBUTTON - S1	SPRECHER & SCHUH	D7P-MT44-PX01	
66					
67	1	REMOTE TELEMETRY UNIT BACKPLANE 6 SLOT	KINGFISHER	BA-6	
68	1	POWER SUPPLY - PS22	KINGFISHER	PS-22	
69	1	PROCESSOR MODULE	KINGFISHER	CP-30-II	
70	1	DIGITAL INPUT MODULE , 16 CHANNEL	KINGFISHER	DI-5	
71	1	DIGITAL OUTPUT MODULE , 8 CHANNEL	KINGFISHER	DO-1	
72	1	MIXED I/O MODULE , 4xAI , 1xAO , 4xDI , 4xDO	KINGFISHER	IO-3	
73					
74	1	LR1 - SUMP PUMP LEVEL RELAY	MULTITRODE	MTR-5	24VDC
75	1	SINGLE POINT PROBES	MULTITRODE	020130-FSP-SH (TBC!)	'x' = CABLE LENGTH TO SUIT
76					
77					
78					
79	1	LLC - SW/BD LIGHTING CONTROL RELAY	SPRECHER & SCHUH	CS 7C-22E24V	DIN RAIL MTG 2 C.O. 24VDC RELAY
80					
81				A22!	
82	1	S10 - STATION LOCAL/REMOTE SWITCH	KRAUS & NAIMER	CA10 A201-FT2	ENGRAVE 'LOCAL REMOTE'
83			ENDRESS+HAUSER		
84	1	FLOWMETER	ABB	WATERMASTER	
86	1	GRUNDFOS PUMP CONTROL PANEL	GRUNDFOS	CU351	PART OF GRUNDFOS HYDROPAK
87					
88	1	GRUNDFOS GATEWAY	GRUNDFOS	CIU200	PART OF GRUNDFOS HYDROPAK
89					
90					
91					
92					
93	1	RTU POWER SUPPLY 24VDC 10A	POWERBOX	PB251A-24CM-CC-T-S	
94	1	RADIO	RADTEL / MIRI	AD2006 RM5125-LN24	
95	1	ADAPTOR	WEIDMULLER	8611320000	
96					
97	2	BATTERIES	YUASA	NP7.2-12 LFR	WP7.2-12FR 12V7AH
98	1	INDUSTRIAL HSUPA ETHERNET ROUTER	MAXON	MA-2025	
99	1	LOW PROFILE CELLULAR ANTENNA	MAXON	C3LA30-BD170F	
100					
101	1	ANTENNA	T.B.C.	T.B.C.	c/w N Series connector
102	1	RADIO COAX SURGE PROTECTION UNIT - SD2	POLYPHASER CORP.	IS-50NX-C2	
103	1	ANTENNA MAST	SWBD BUILDER		
104	1	COAX CABLE (INTERNAL CABLE No. X01)	SCHNEIDER	TBUR SMAM/NM/TL23	RADIO TO SURGE DIVERTER
105	1	COAX CABLE (EXTERNAL CABLE No.X02)	R.F. INDUSTRIES	CNT400	SURGE DIVERTER TO ANTENNA
106	1	COAX PLUG	R.F. INDUSTRIES	N Series (MALE)	
107	1	U CLAMPS	R.F. INDUSTRIES	UNV	
108					
109					
110	1	PS2-RADIO POWER SUPPLY	POWERBOX	PBIH-2412J-CC	
111					
112	32	SW/BD DOOR MICRO SWITCHES	CAMSCO	SM202	3 OFF N/O
113	32	30mm 8 25vDC 36x5050 SMD LED Lightbar - Cool White	LED SHOP AU	#7700	www.ledshoponline.com
114	2	CORROSION INHIBITOR	CORTEC	VPCI-110 OR 111	FROM AP CONTROLS
115					
116		LED SWITCHBOARD LIGHT	LUMIFA	LFIB-C35-2TNWW4	
117					
118					
119					
120					
121					
122					
123					
124					

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	REMARKS
125					
126					
127					
128					
129					
		SWITCHBOARD TERMINALS			
130.1	2	10A MINIATURE THERMAL CIRCUIT BREAKERS	PHOENIX CONTACT	TCP 10A + UK 6-FSI/C	(0712314 + 3118203)
130.2	8	4A MINIATURE THERMAL CIRCUIT BREAKERS	PHOENIX CONTACT	TCP 4A + UK 6-FSI/C	(0712259 + 3118203)
130.3	5	2A MINIATURE THERMAL CIRCUIT BREAKERS	PHOENIX CONTACT	TCP 2A + UK 6-FSI/C	(0712217 + 3118203)
130.4	33	THROUGH TERMINALS (GREY)	PHOENIX CONTACT	PIT 2,5 (3209510)	
130.5	5	THROUGH TERMINAL ENDPLATE	PHOENIX CONTACT	D-ST 2,5 (3030417)	
130.6	90	DISCONNECT TERMINALS (GREY)	PHOENIX CONTACT	PIT 2,5-MT (3210156)	
130.7	10	DISCONNECT TERMINALS ENDPLATE	PHOENIX CONTACT	D-PIT 2,5-MT (3211003)	
130.8	10	TERMINAL END PLATE	PHOENIX CONTACT	D-PIT 2,5-MT (3211003)	
130.9	8	GROUP MARKER CARRIER	PHOENIX CONTACT	UBE (0800310)	
130.10	2	TEST PLUG ADAPTOR	PHOENIX CONTACT	PS-5 (3030983)	
130.11	1	SCREW DRIVER	PHOENIX CONTACT	SZS 0.6 x 3.5 (1205053)	
130.12	5	PLUG-IN BRIDGE	PHOENIX CONTACT	FBS 20-5 (3030226)	
130.13	1	TERMINAL NUMBERS	PHOENIX CONTACT	ZB 5 CUS (0824962)	NUMBERED 1-150
131	1	COVER PROFILE	PHOENIX CONTACT	AP 2 CM	(5022889)
131.1	10	COVER PROFILE CARRIER	PHOENIX CONTACT	AP 2-TU	(5022630)
132	2	ANALOGUE LOOP SIGNAL SPLITTER (SS1,SS2)	MOORE INDUSTRIES	ECT/4-20MA/2x4-20MA/24DC/-RF[DN]	
133					
134	1	ENERGEX PADLOCK (45mm BRASS PIN TUMBLER)	H-A-REED LOCK SMITH	KEY No. 2897	
135					
136					
137					
138					
139					
140					
141					
142					
143					
144					
145					
146					
147					
148					
149					
150					
151					

AS CONSTRUCTED DETAILS

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SIGNED: DATE:

NAME of SIGNATORY:

RPEQ No. or LICENCE:

COMPANY NAME:

START DATE: FINISH DATE:

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME	SIGNATURE	DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND Urban Utilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
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FUNDING: DESIGN W.O. No. QUUXXX; CONSTRUCTION W.O. No. SOA XXXXX-XXX; FUNDED BY Q.U.U. (✓) EXTERNAL ( ); Q.U.U. FILE No.

DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13	
DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No.	DATE	APPROVED BY SIGNATURE DATE
CAD FILE	49-1194-010-A.DWG	ORIGINAL SIGNED BY		
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No.	DATE	CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
SWITCHBOARD EQUIPMENT LIST

SHEET No. 10 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-010

AMEND. A

CABLE No.	STATUS	SIZE	CORES	TYPE	LENGTH (m)	FROM	TO	CABLE FUNCTION	NOTES
P01	NEW	16 mm^2	4C	PVC/CU/PVC	15m	ENERGEX Supply POINT	Switchboard	Incoming Mains Supply	
P02	NEW	6 mm^2	1C	Building Wire	3m	Switchboard	Earth stake	Main Earth	
P03	NEW	25 mm^2	5C	RUBBER/FLEX/RUBBER	20m	Switchboard	Temporary Generator	Incoming Generator Supply	Cable Supplied By Generator Vendor
P-P1	NEW	2.5 mm^2	3C+E	PVC/PVC	15m	Switchboard	Booster Pump 1 Motor	Pump 1 - 3 Phase supply	
P-P2	NEW	2.5 mm^2	3C+E	PVC/PVC	15m	Switchboard	Booster Pump 2 Motor	Pump 2 - 3 Phase supply	
P-P3	NEW	2.5 mm^2	3C+E	PVC/PVC	15m	Switchboard	Booster Pump 3 Motor	Pump 3 - 3 Phase supply	
P-P5	NEW	2.5 mm^2	2C+E	PVC/PVC	15m	Switchboard	Pump Box Sump Pump	Sump Pump - 1 Phase supply	
P-VF1	NEW	2.5 mm^2	2C+E	PVC/PVC	5m	Switchboard	Supply Air Vent Fan	Supply Air Vent Fan - 1 Phase supply	
P-VF2	NEW	2.5 mm	2C+E	PVC/PVC	5m	Switchboard	Discharge Air Vent Fan	Discharge Air Vent Fan - 1 Phase supply	
C-DS3	NEW	1.5mm^2	2C+E	PVC/PVC	15m	Switchboard	Door Switch	Pit Intruder Alarm	
PLR	NEW		Vendor	Vendor	15m	Switchboard	Multitrode Probe includes cable	Sump Pump	
C-TH7	NEW	1.5mm	2C+E	PVC/PVC	15m	Switchboard	Thermostat	Pump Box Thermostat	
C-P1	NEW	1.0mm^2	3PR	PVC/PVC	15m	Switchboard	Pump Box Pump 1	Pump 1 Control & Interlocks	
C-P2	NEW	1.0mm^2	3PR	PVC/PVC	15m	Switchboard	Pump Box Pump 2	Pump 2 Control & Interlocks	
C-P3	NEW	1.0mm^2	3PR	PVC/PVC	15m	Switchboard	Pump Box Pump 3	Pump 3 Control & Interlocks	
C-GEN	NEW	1.5mm^2	24C+E	PVC/FLEX/PVC	20m	Switchboard	Temporary Generator	Temporary Generator I/O	Cable Supplied By Generator Vendor
CX-P1	NEW		1PR	REXON B20	15m	Switchboard - MPC GENIbus	Pump Box Pump 1	GENIbus - Pump1	
CX-P2	NEW		1PR	REXON B20	15m	Switchboard - MPC GENIbus	Pump Box Pump 2	GENIbus - Pump2	
CX-P3	NEW		1PR	REXON B20	15m	Switchboard - MPC GENIbus	Pump Box Pump 3	GENIbus - Pump3	
I-PIN	NEW		1PR	Vendor	15m	Switchboard - MPC	Suction Pressure Transmitter	Suction Pressure	
I-POUT	NEW		1PR	Vendor	15m	Switchboard - MPC	Delivery Pressure Transmitter	Delivery Pressure	
IFM-D-1	NEW		Vendor	Vendor	17m	Switchboard - Flowmeter Tx	Flowmeter	Delivery Flowmeter	
IFM-D-2	NEW		Vendor	Vendor	17m	Switchboard - Flowmeter Tx	Flowmeter	24vdc	
X01	NEW		COAX	SMAM/NM/TL23	0.5m	Switchboard - RADIO	Switchboard - Surge Diverter SD2	Miri Radio Antenna Feeder	
X02	NEW		COAX	CNT400	8m	Switchboard - SURGE DIVERTER SD2	Switchboard - Antenna	Miri Radio Antenna Feeder	
X03	NEW		COAX	Special	2m	Switchboard - RTU	Switchboard - GSM Modem	Miri Radio Data, GSM Modem Data	
X04	NEW			Special	2m	Switchboard - Miri Radio	Switchboard - Kingfisher RTU	Miri Radio Data, Kingfisher Data	
X05	NEW			Special	2m	Switchboard - Grundfos CIU200	Switchboard - Kingfisher RTU	Grundfos CIU200 Data, Kingfisher Data	

NOTES:

1. THE CONTRACTOR IS RESPONSIBLE IN DETERMINING THE ACTUAL CABLE LENGTHS REQUIRED ON SITE.
2. SIZE MAINS CABLE FOR LENGTH OF CABLE RUN FROM ENERGEX POINT OF SUPPLY TO SWITCHBOARD.
3. CABLE LENGTHS TO BE MARKED UP ON AS BUILTS

AS CONSTRUCTED DETAILS

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NAME SIGNATURE DATE

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FUNDING
DESIGN W.O. No. QUUXXX
CONSTRUCTION W.O. No. SOA XXXXX-XXX
FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
DRAFTING CHECK	LUCAS WEDLEY	DESIGN	R.P.E.Q. No. DATE
CAD FILE	49-1194-011-A.DWG	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No. DATE

APPROVED BY SIGNATURE DATE
CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
CABLE SCHEDULE

SHEET No. 11 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9/-1194-011
AMEND. A

ITEM #	OPT.	DESCRIPTION	LABEL 1	LABEL 2 & 3 (IF NECESSARY)	TEXT HEIGHT	MATERIAL / COLOUR
02		ENERGEX SUPPLY	NORMAL SUPPLY MAIN SWITCH Q2		10mm 4mm	GRAVOPLY B/W
03		GENERATOR SUPPLY	GENERATOR SUPPLY MAIN SWITCH Q3		10mm 4mm	GRAVOPLY B/W
04.1		PUMP CIRCUIT BREAKER	BOOSTER PUMP No.1 Q4		4mm 4mm	GRAVOPLY W/B
04.2		PUMP CIRCUIT BREAKER	BOOSTER PUMP No.2 Q5		4mm 4mm	GRAVOPLY W/B
04.3		PUMP CIRCUIT BREAKER	BOOSTER PUMP No.3 Q6		4mm 4mm	GRAVOPLY W/B
04.4						
6		SUPPLY AIR VENT FAN CIRCUIT BREAKER	SUPPLY AIR VENT FAN Q7		4mm 4mm	GRAVOPLY W/B
7		DISCHARGE VENT FAN CIRCUIT BREAKER	DISCHARGE AIR VENT FAN Q8		4mm 4mm	GRAVOPLY W/B
8		DC POWER SUPPLY CIRCUIT BREAKER	DC POWER SUPPLY Q9		4mm 4mm	GRAVOPLY W/B
9		SWBD GPOs CIRCUIT BREAKER	SWBD GPO Q10		4mm 4mm	GRAVOPLY W/B
11		PUMP BOX SUMP PUMP CIRCUIT BREAKER	PUMP BOX SUMP PUMP Q12		4mm 4mm	GRAVOPLY W/B
11		SPARE CIRCUIT BREAKER				
17		DC POWER SUPPLY CIRCUIT BREAKER	24VDC POWER SUPPLY Q20		4mm 4mm	GRAVOPLY W/B
18		SURGE DIVERTER RELAY CIRCUIT BREAKER	SURGE DIVERTER RELAY Q21		4mm 4mm	GRAVOPLY W/B
19		GRUNDFOS MPC CIRCUIT BREAKER	GRUNDFOS MPC Q22		4mm 4mm	GRAVOPLY W/B
20		GRUNDFOS CRI200 CIRCUIT BREAKER	GRUNDFOS CRI200 Q23		4mm 4mm	GRAVOPLY W/B
29		SURGE DIVERTER FUSES	SURGE DIVERTER FUSES 63/63A	FED FROM LINE SIDE OF MAIN SWITCH	4mm 4mm	GRAVOPLY W/B - R/W/R
30		SURGE DIVERTERS	LIGHTNING ARRESTORS	SR1 SR2 SR3	4mm	GRAVOPLY W/B
31		SURGE DIVERTER ALARM RELAY	SDAR		4mm 4mm	GRAVOPLY W/B
32		SURGE REDUCTION FILTER	SURGE REDUCTION FILTER		4mm 4mm	GRAVOPLY W/B
33		PHASE FAILURE RELAY FUSES	PHASE FAILURE RELAY FUSES 6/20A	FED FROM LINE SIDE OF MAIN SWITCH	4mm 4mm	GRAVOPLY W/B - R/W
34		PHASE FAILURE RELAY	SITE MAINS POWER FAIL - PFRS		4mm 4mm	GRAVOPLY W/S/W
38		MAIN NEUTRAL LINK	MAIN NEUTRAL		4mm	GRAVOPLY W/B
39		MAIN EARTH LINK	MAIN EARTH		4mm	GRAVOPLY W/B
40		INSTRUMENT EARTH LINK	INSTRUMENT EARTH		4mm	GRAVOPLY W/B
41		FILTERED SUPPLY NEUTRAL LINK	FILTERED SUPPLY NEUTRAL		4mm 4mm	GRAVOPLY W/B
43		LAPTOP GPO	LAPTOP GPO ONLY		4mm	GRAVOPLY W/B
45		GENERATOR POWER CONNECTION SOCKET	GENERATOR CONNECTION		6mm 6mm	GRAVOPLY W/B
53		PUMPS EMERG STOP RELAY	ESR		4mm	GRAVOPLY W/B
54						
55		PUMP 1 MANUAL RUN RELAY	P1RUN		4mm	GRAVOPLY W/B
56		PUMP 2 MANUAL RUN RELAY	P2RUN		4mm	GRAVOPLY W/B
57		PUMP 3 MANUAL RUN RELAY	P3RUN		4mm	GRAVOPLY W/B
58		VENT FAN START RELAY	VFR		4mm	GRAVOPLY W/B
59		DISABLE MPC RELAY	X1		4mm	GRAVOPLY W/B
60		VENT FAN THERMOSTAT	TH7		4mm	GRAVOPLY W/B
61		VENT FAN CONTACTOR	K7	K8	4mm	GRAVOPLY W/B

ITEM #	OPT.	DESCRIPTION	LABEL 1	LABEL 2 & 3 (IF NECESSARY)	TEXT HEIGHT	MATERIAL / COLOUR
65		ALL PUMPS STOP PUSHBUTTON	STOP ALL PUMPS		4mm	GRAVOPLY W/B
74		PUMP BOX FLOODED RELAY	LR1		4mm	GRAVOPLY W/B
79		SWITCHBOARD LIGHTING CONTROL CONTACTOR	LCC		4mm	GRAVOPLY W/B
82		STATION LOCAL/REMOTE SELECTOR SWITCH	STATION CONTROL MODE		4mm	GRAVOPLY W/B
84		DELIVERY FLOWMETER TRANSMITTER	DELIVERY FLOWMETER		4mm	GRAVOPLY W/B
93	1	RTU 240VAC/24VDC POWER SUPPLY	RTU 24VDC POWER SUPPLY		4mm 4mm	GRAVOPLY W/B
94		TELEMETRY UNIT	RTU, RADIO		4mm 4mm	GRAVOPLY W/B
95	E	RADIO 24V/13.8VDC CONVERTER	24/12 VDC CONVERTER - RADIO		4mm 4mm	GRAVOPLY W/B
97		BATTERY	BATTERY		4mm	GRAVOPLY W/B
98		MODEM	MODEM		4mm	GRAVOPLY W/B
100						
102	E	RADIO COAX SURGE PROTECTION	RADIO SURGE PROTECTION		4mm	GRAVOPLY W/B
		TERMINAL HEADER	RTU POWER SUPPLIES		4mm 4mm	GRAVOPLY W/B
		TERMINAL HEADER	DIGITAL INPUTS DI1	DIGITAL INPUTS DI2	4mm 4mm	GRAVOPLY W/B
		TERMINAL HEADER	DIGITAL OUTPUTS DO1	DIGITAL OUTPUTS DO2	4mm 4mm	GRAVOPLY W/B
		TERMINAL HEADER	ANALOG INPUTS AI1	ANALOG OUTPUTS AO1	4mm 4mm	GRAVOPLY W/B
		TERMINAL HEADER	PUMP BOX		4mm 4mm	GRAVOPLY W/B
		HEADER LABEL (Incomer Section)	MEN BEHIND		6mm	GRAVOPLY W/B
		HEADER LABEL (MainSwitch Section)	SURGE DIVERTER FUSES BEHIND		6mm	GRAVOPLY W/B
		HEADER LABEL (Above Circuit Breakers)	NON FILTERED SUPPLY		6mm 6mm	GRAVOPLY W/B
		HEADER LABEL (Above Circuit Breakers)	FILTERED SUPPLY		6mm 6mm	GRAVOPLY W/B
132		ANALOGUE LOOP SIGNAL SPLITTER	SS1	SS2	4mm	GRAVOPLY W/B

EXTERNAL LABEL LIST

LABEL	TEXT	TEXT HEIGHT	PAINT FILL LETTERING	SIZE	QTY	OPT
A	WB065	20mm	Black	150x35	1	
B	RTU	10mm	Black	50x20	1	
		10mm	Black	100x20	1	
D	WARNING THIS SITE IS MONITORED BY NETWORK CONTROL. PLEASE INFORM THE OPERATOR BEFORE ISOLATING PUMPS OR STATION	8mm	Black	250x100	2	
E	PLEASE CHECK THAT THE STATION IS IN REMOTE MODE BEFORE LEAVING SITE	8mm	Black	210x60	1	
G	PHONE: 13 26 57 (AFFIX DIRECTLY UNDER LABEL D)	8mm	Black	60x30	1	
H	MAIN SWITCHES	10mm	Black	120x20	1	
I	DISTRIBUTION BOARD	10mm	Black	150x20	1	
K	GENERATOR INLET	10mm	Black	120x20	1	
M	SUPPLY AUTHORITY METERING	10mm	Black	200x20	1	
N	DANGER 415V	10mm	Red	100x20	1	
O	DANGER - 2 SOURCES OF SUPPLY	10mm	Red	220x20	1	
	EXTERNAL LABELS 1mm THICK. 316 GRADE STAINLESS STEEL. FIXED WITH M3 316 STAINLESS STEEL METAL THREADS.					

DETAIL Q

LABEL	TEXT
F	DANGER - ELECTRICAL EQUIPMENT QUEENSLAND URBAN UTILITIES PHONE: 13 26 57 NOTE: LABEL DESIGN IS ISSUED FROM QUU

DETAIL F SAFETY SIGN - DANGER ELECTRICAL EQUIPMENT etc

280x190x2mm (+ 4x4mm FIXING HOLES) ALUNIMUM POWDER COATED WHITE
5 COLOR SCREEN PRINTED +ANTI-GRAFITTI LAMINATE
FREE ISSUED BY BW TO SWBD MANUFACTURER

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:
RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE
QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
2	04.13	AMENDED FROM QUU COMMENTS	L.P.	M.F.		
1	03.13	RE-ISSUED FOR APPROVAL	B.J.	B.J.		
A	06.13	ISSUED FOR CONSTRUCTION	M.F.	M.F.		

FUNDING: DESIGN W.O. No. QUUXXX; CONSTRUCTION W.O. No. SOA XXXXX-XXX; FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
DRAFTING CHECK	LUCAS WEDLEY	DESIGN	R.P.E.Q. No. DATE
CAD FILE	49-1194-012-A.DWG	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No. DATE

APPROVED BY SIGNATURE DATE
CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE SWITCHBOARD LABLE SCHEDULE

SHEET No. 12 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-012
AMEND. A

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 lifting lugs in top of cubicle.
Plinth construction 152x63x6mm aluminium channel
Fully welded on fascia of cubicle and stiffened to prevent warping and form a rigid enclosure.
Cubicle is to be sealed to prevent the ingress of sewer well gases.
External doors and covers fitted with Dore Electrics ES60-053 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.
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 6mm 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. (Detail F)
Cable glands to be fitted with compression side installed within cubicle. (Detail G)
Gland/Inspection/Access plates to be fitted with seals attached to cubicle.
Gland/Inspection/Access plates to overlap opening by 25mm.
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°
Ventilation via punched louvers (Refer drawings for detail)
Switchboard Ventilation (except in breezeway) to be backed with stainless steel mesh gauze and removable filter material.
Fit laptop tray to rear of common control door. (Refer drawings for detail)
Fit drawing holder to rear of common control door. (Refer drawings for detail)

Locks Doors 1 & 3

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

Locks Door 2

DORE ELECTRICS - Stainless steel Padlockable Swing Handle.
DORE ELECTRICS - 3 point lock rod set with rollers.
ENERGEX padlock, S/Steel Shackle, 45mm brass pin tumbler.
Energex Key No. 2897. c/w 1 key.

Locks Gen Inlet Door

DORE ELECTRICS - Stainless steel Lockable Swing Handle. (Keyed 92268)

OPERATING PARAMETERS

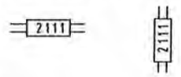
Standard	AS 3439.1
Current & Frequency	AC 50Hz
Rated Operational Voltage Ue	415 VAC
Rated Insulation Voltage Ui	0.6/1kV
Rated Auxiliary Voltage	240 VAC / 24 VDC
Rated Current (No Bus)	100A
Short Circuit Current Isc	20 kA
Duration of Isc	.2 sec
Degree of Protection	Weather Resistant (Nominally IP55)
Internal Degree of Protection	IP20B / IP10A to AS3000:2007
Service Conditions	Outdoors
Mass	Not exceeding 2000kg
Forms of Segregation	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.
Thickness	Minimum 50microns
Exterior/Doors Colour	Mist Green
Interior Colour	Mist Green
Equipment Panel Colour	Bright White
Escutcheon Colour	Bright White
Plinth Colour	Mist Green

WIRING

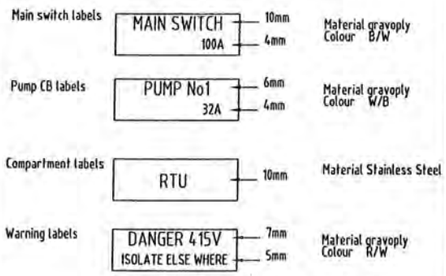
All control wiring to be PVC V90 HT 0.6/1Kv Grade with tinned conductor.
Control and instrumentation wiring has flexible copper conductors, and is colour coded as detailed below, numbered each end, and terminated by the use of appropriate pre-insulated crimp lugs or pins.
Separate lugs or pins shall be used for each conductor. A proprietary double pin lug may be used to terminate two conductors.
Not more than two wires shall be connected to any terminal.
Power wiring to be minimum 2.5sqmm V90 06./1Kv stranded copper conductors, phase colour coded as detailed below.
Control wiring to be minimum 1.0sqmm flexible copper conductors, colour coded as detailed below.
Low level control signals to be minimum 0.5sqmm flexible copper conductors. colour coded as detailed below.
4-20mA analog signals (internal & external) wired in shielded pair minimum size 0.5sqmm, overall screened, and earthed at one end only. (Switchboard end for external signals)
All 240VAC terminals located in the RTU or PLC sections shall be shrouded and labelled - ' Danger 240VAC'
Earth cables minimum 2.5sqmm flexible.
Doors and hinged escutcheons bonded with 4sqmm min. flexible earth wire.
Wire numbering will be equal to Brady marking system.
Wire numbers are readable left to right,bottom to top as shown.
Color of DC wiring beyond final fuse/link to be Grey.



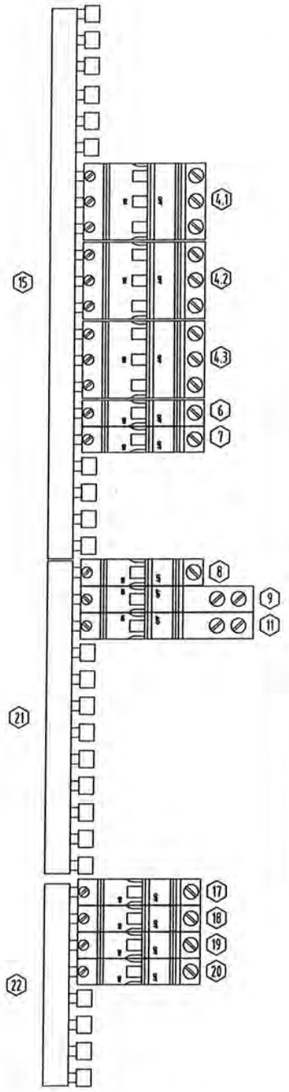
COLOUR CODE		
Phase wiring (A,B &C)	Red, White, Blue	2.5sqmm (min)
Potential Metering (240/415 VAC)	Red, White, Blue, Black	1.5sqmm
Current Metering (Secondary)	Red, White, Blue, Grey	2.5sqmm
240 VAC Control Active	Red	1.0sqmm
240 VAC Neutral	Black	1.0sqmm
24 VDC Positive supplies	Orange	1.0sqmm
24 VDC Negative supplies	Violet	1.0sqmm
24 VDC Wiring (Other than supplies)	Grey	1.0sqmm
RTU & PLC Wiring	Grey	0.5sqmm
Electrode Wiring	Salmon	1.0sqmm
Intrinsically safe wiring	Blue	1.5sqmm
Earth	Green/Yellow	2.5sqmm (min)
Door & Escutcheon Earth Bonds	Green/Yellow	4 sqmm
Instrument Shield Earth	Green/Yellow	1.5 sqmm (min)

LABELS

Internal labels W/B engraved gravoply to label schedule.
Warning labels R/W engraved gravoply to label schedule.
First letter = background colour. Second letter = lettering colour.

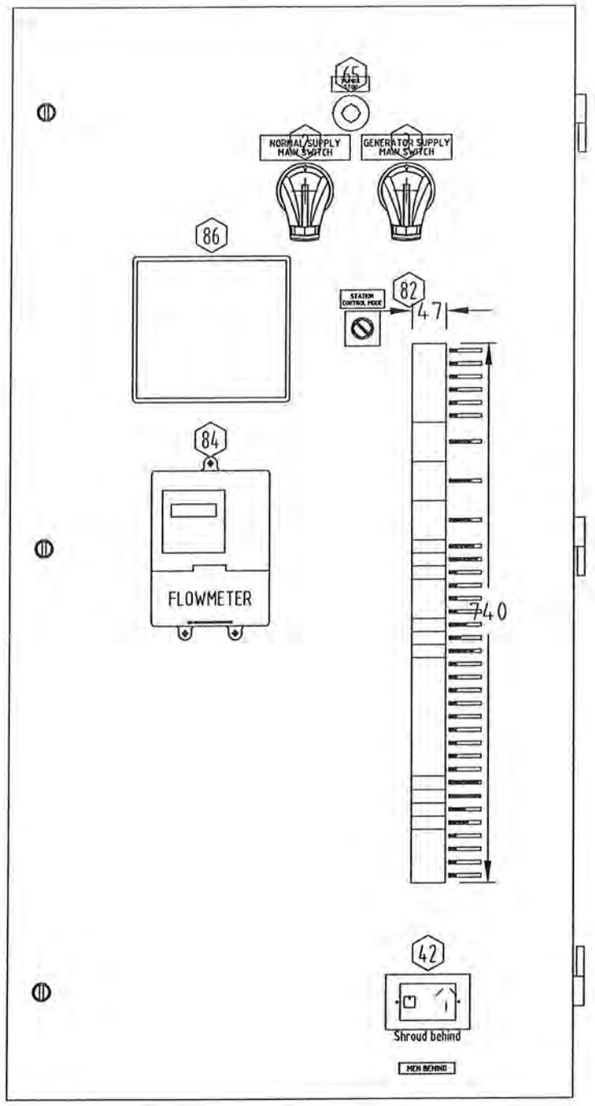


Internal labels secured by M3 316 grade stainless steel metal threads and adhesive.
CB's to be identified with individual labels as per label schedule
Labels obstructed by switchboard wiring are relocated to adjacent duct lid and secured by M3 nylon threads. Lid to be secured by a single cable tie at one corner.
External labels 1mm thick 316 grade s/steel secured by M3 316 s/steel metal threads.
Label on the internal side of the escutcheon for all equipment mounted on escutcheon.
Affix labels with double sided tape only



DETAIL M

SUB-DISTRIBUTION BOARD ARRANGEMENT



ESCUTCHEON LAYOUT

DETAIL S

AS CONSTRUCTED DETAILS

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RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

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INDUSTRIES PTY LTD
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A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

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QUEENSLAND UrbanUtilities

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FUNDING: FUNDED BY Q.U.U. (✓) EXTERNAL ( )
DESIGN W.O. No. QUUXXX
CONSTRUCTION W.O. No. SOA XXXXX-XXX
Q.U.U. FILE No.

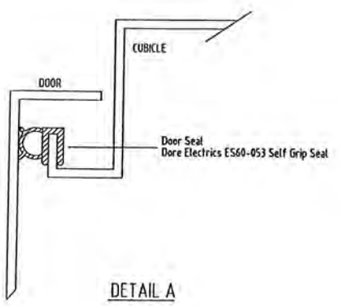
DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No.	DATE
CAD FILE	49-1194-013-A.DWG	ORIGINAL SIGNED BY	
		DESIGN CHECK R.P.E.Q. No.	DATE

APPROVED BY SIGNATURE DATE
CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

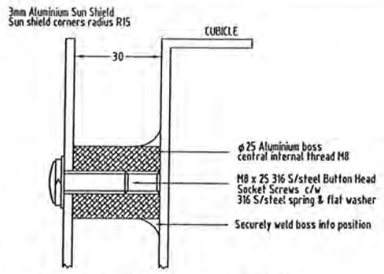
DRAWING TITLE
SWITCHBOARD CONSTRUCTION NOTES AND DETAILS

SHEET No. 13 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-013
AMEND. A



DETAIL A

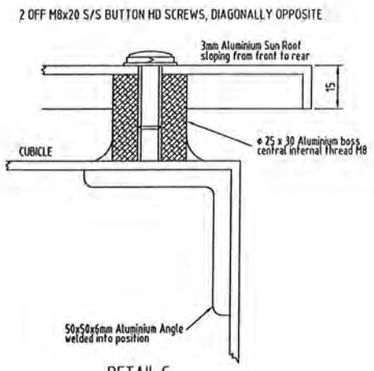
(DOOR SEAL)



Note: Screws are not to penetrate cubicle metalwork

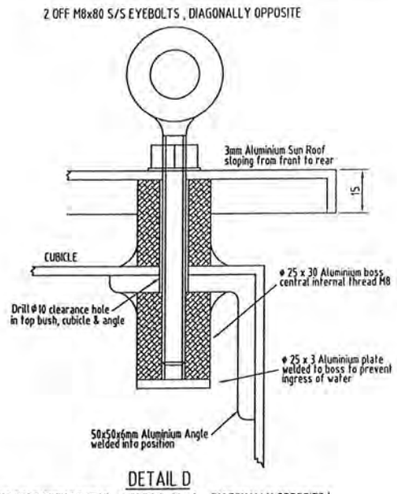
DETAIL B

(SUN SHIELD MOUNTING TO SIDES, REAR AND DOORS)



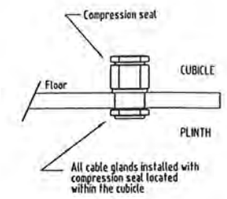
DETAIL C

(SUN ROOF FIXING DETAIL)
(2 OFF M8x20 S/S BUTTON HD DIAGONALLY OPPOSITE)
Note: Screws are not to penetrate cubicle metalwork



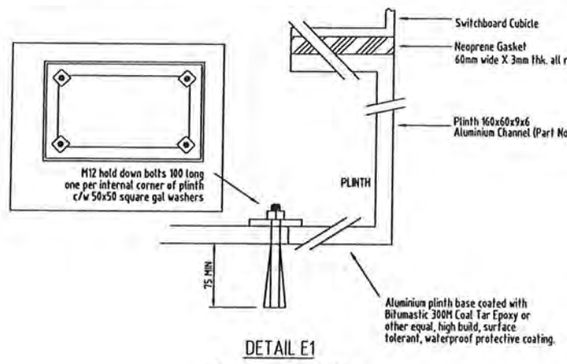
DETAIL D

(EYE BOLT FIXING DETAIL - 2 OFF M8x80 s/s , DIAGONALLY OPPOSITE)
(REPLACE EYEBOLTS WITH M8x50 s/s BUTTON SCREWS AT SITE)



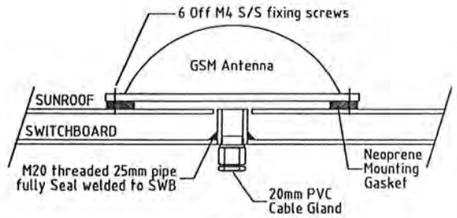
DETAIL G

(CABLE GLAND INSTALLATION DETAIL)



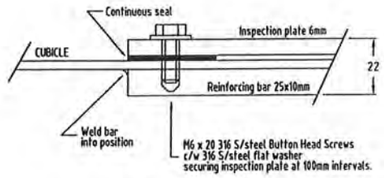
DETAIL E1

(PLINTH FIXING DETAIL)



DETAIL X

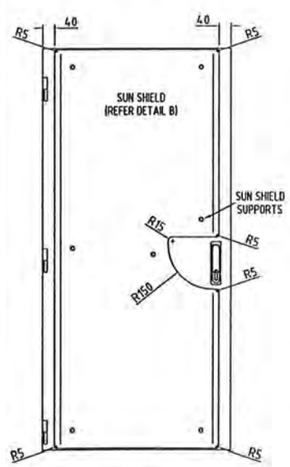
(GSM ANTENNA MOUNTING DETAIL)



Note: Screws are not to penetrate reinforcing bar

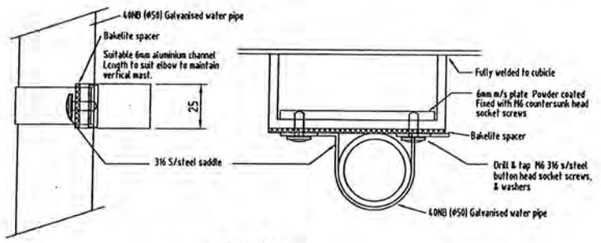
DETAIL F

(INSPECTION PLATE FIXING DETAIL)



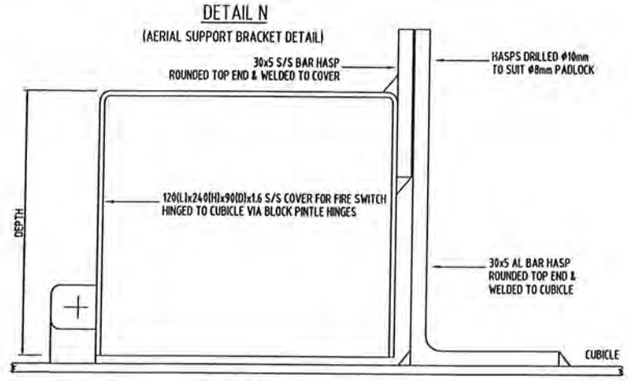
DETAIL K

(DOOR SUN SHIELD DETAIL)



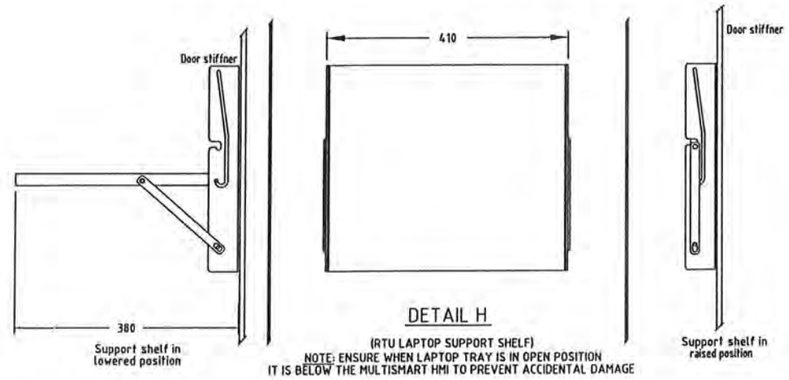
DETAIL N

(AERIAL SUPPORT BRACKET DETAIL)



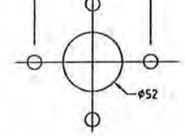
DETAIL R

(GEN INLET - HINGED PADLOCKABLE HANDLE)



DETAIL H

(RTU LAPTOP SUPPORT SHELF)
NOTE: ENSURE WHEN LAPTOP TRAY IS IN OPEN POSITION
IT IS BELOW THE MULTISMART HMI TO PREVENT ACCIDENTAL DAMAGE



(Fit 3mm neoprene gasket between plinth & flange)
(Fixings 316 s/steel bolts, nuts, flat & spring washers)

DETAIL P

(AERIAL FLANGE MOUNTING DETAIL)

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2	04.13	AMENDED FROM QUU COMMENTS	L.P.	M.F.		
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FUNDING		
DESIGN W.O. No.	QUUXXX	
CONSTRUCTION W.O. No.	SOA XXXXX-XXX	
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	

DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No.	DATE
CAD FILE	49-1194-014-A.DWG	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No.	DATE

	APPROVED BY	SIGNATURE DATE
	CONSTRUCTION MANAGER	SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE
SWITCHBOARD
GENERAL ARRANGEMENT

SHEET No. 14 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-014
AMEND. A

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:
RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

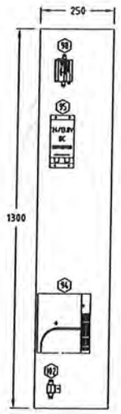
JPR Project No.: E12-C63100

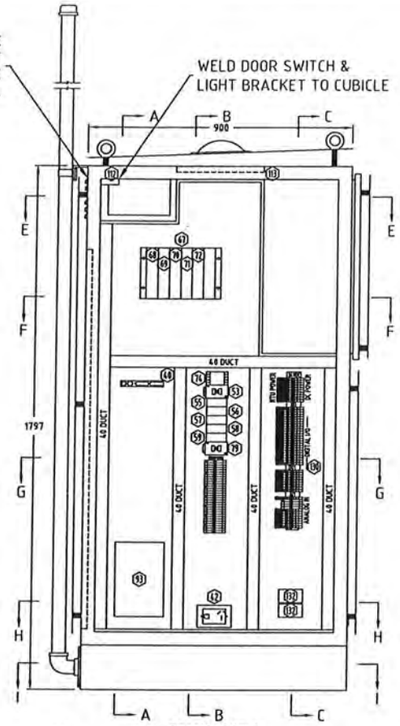
NAME SIGNATURE DATE
QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities

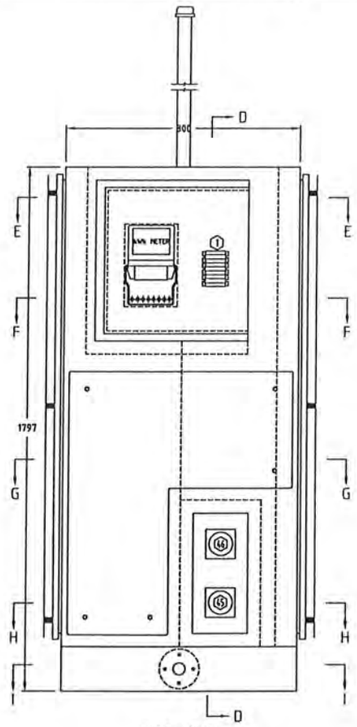
FIT MODIFIED VENT TO SIDE OF BATTERY COMPARTMENT S/S MESH GAUZE AND REMOVABLE FILTER MATERIAL

WELD DOOR SWITCH & LIGHT BRACKET TO CUBICLE



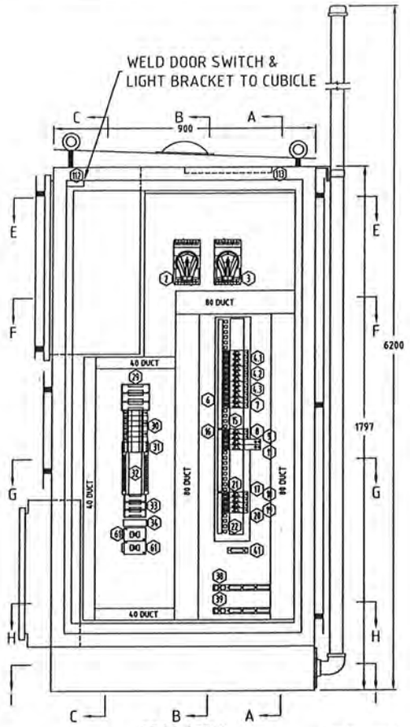


FRONT VIEW
DOOR & HINGED PANEL NOT SHOWN

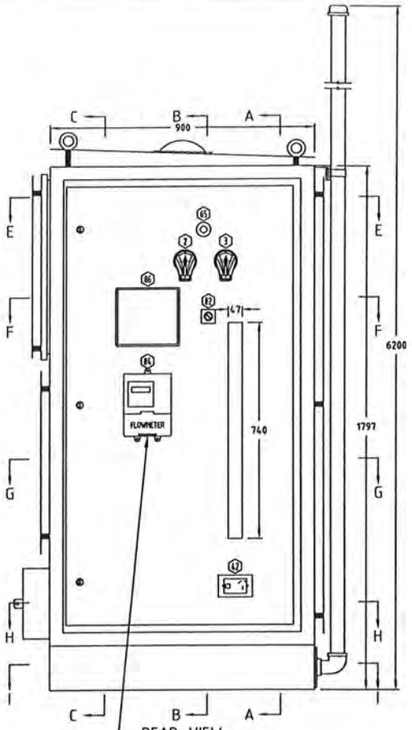


SIDE VIEW
DOORS NOT SHOWN

WELD DOOR SWITCH & LIGHT BRACKET TO CUBICLE

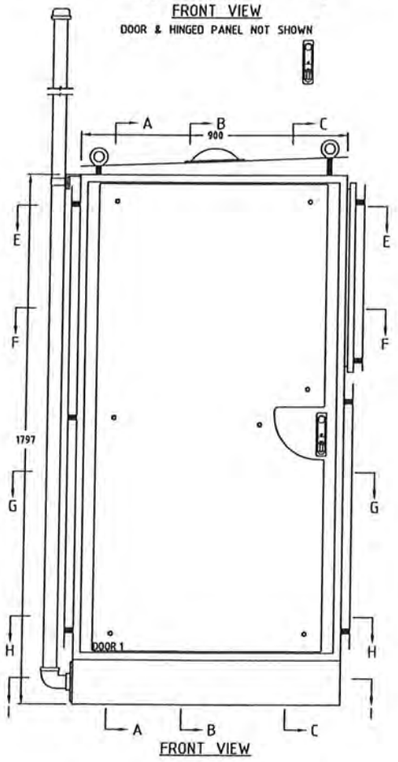


REAR VIEW
DOOR & HINGED PANEL NOT SHOWN

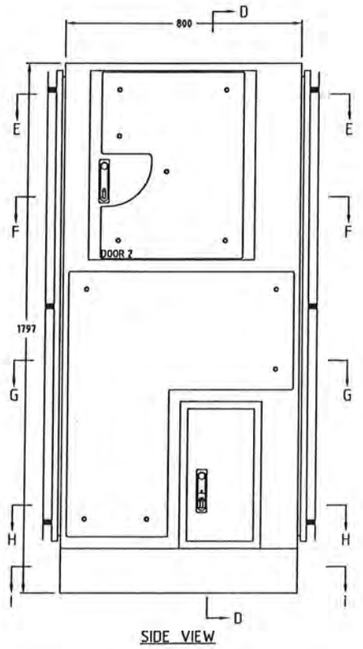


REAR VIEW
DOOR NOT SHOWN

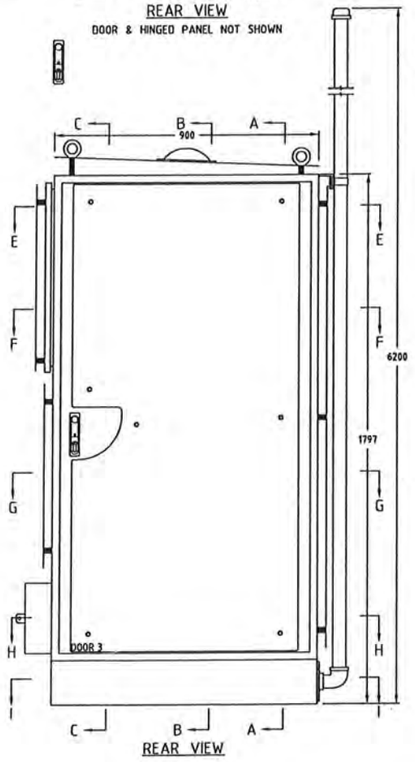
FLOWMETER TO BE MOUNTED TO BE MOUNTED THROUGH ESCUTCHEON CUTOUT TBA



FRONT VIEW



SIDE VIEW



REAR VIEW

AS CONSTRUCTED DETAILS

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JPR Project No.: E12-C63100

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APPROVED BY	SIGNATURE	DATE
CONSTRUCTION MANAGER	SIGNATURE	DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

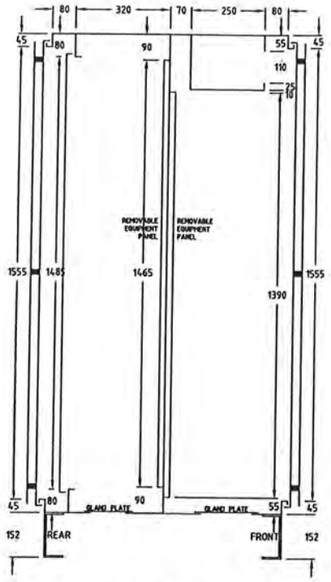
DRAWING TITLE
SWITCHBOARD GENERAL ARRANGEMENT

SHEET No. 15 OF 16

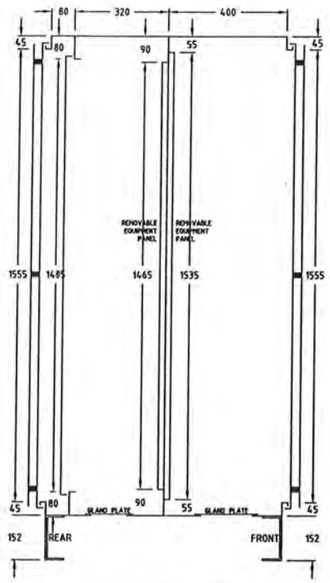
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AMEND. A

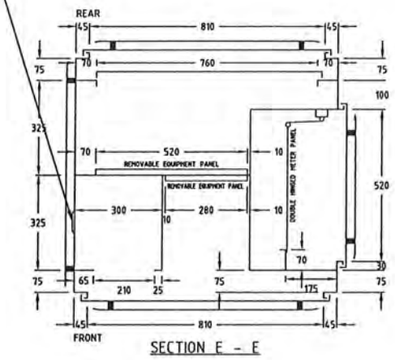
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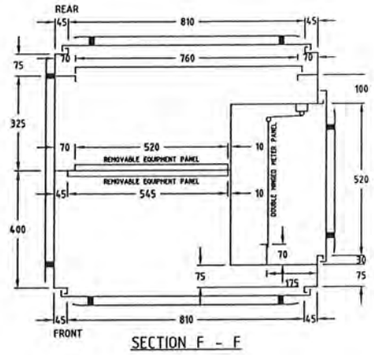
SECTION A - A



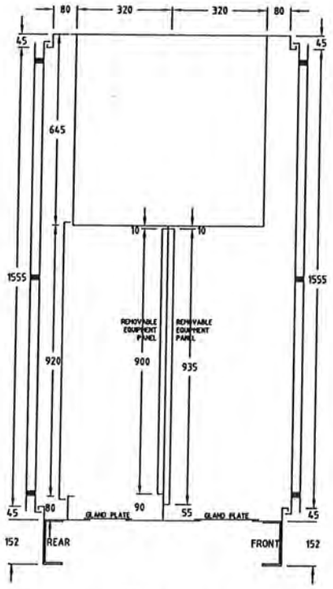
SECTION B - B



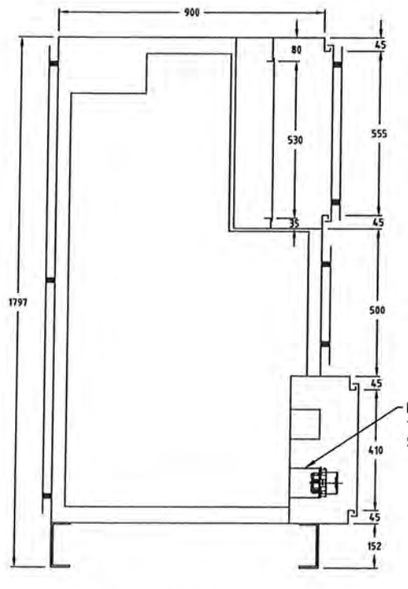
SECTION E - E



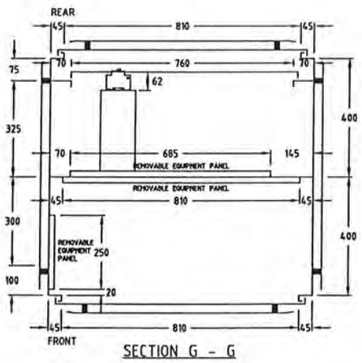
SECTION F - F



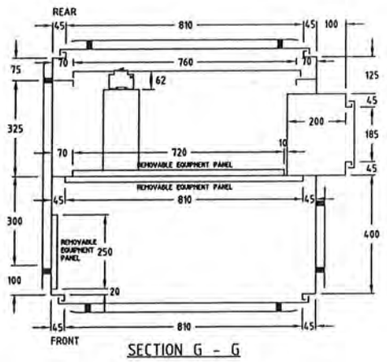
SECTION C - C



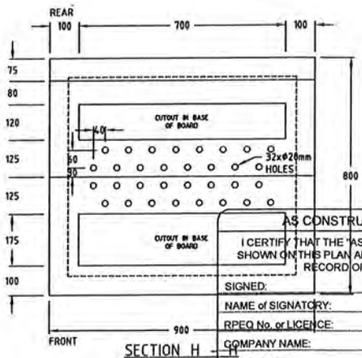
SECTION D - D



SECTION G - G



SECTION G - G



SECTION H - H

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A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
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EMAIL. jpr@jpr.com.au

JPR Project No.: E12--C63100

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND Urban Utilities

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FUNDING
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CONSTRUCTION W.O. No. SOA XXXXX-XXX
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DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No. DATE	APPROVED BY SIGNATURE DATE
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Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No. DATE	CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
SWITCHBOARD GENERAL ARRANGEMENT

SHEET No. 15 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-016

AMEND. A

REF TO DWG

486-4-9-1194-030

AS CONSTRUCTED DETAILS

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DRAFTING CHECK	LUCAS WEDLEY	DESIGN	R.P.E.Q. No.	DATE	APPROVED BY SIGNATURE DATE
CAD FILE	49-1194-017-A.DWG	ORIGINAL SIGNED BY			
Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No.	DATE	CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
SWITCHBOARD SITE ARRANGEMENT

SHEET No. 16 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-017

AMEND. A

DRAWING No.	Rev	DRAWING TITLE	Remarks
486/4/9-1194-000		CONCEPT DRAWING	
486/4/9-1194-001	2	ELECTRICAL DRAWING INDEX	RE-ISSUED FOR APPROVAL
486/4/9-1194-002	2	BLOCK DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-003	2	AC POWER DISTRIBUTION SCHEMATIC DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-004	2	PUMPS POWER & CONTROL SCHEMATIC DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-005	2	DC POWER DISTRIBUTION SCHEMATIC DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-006	2	COMMON CONTROLS SCHEMATIC DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-007	2	RTU DIGITAL INPUTS TERMINATION DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-008	2	RTU DIGITAL OUTPUTS & ANALOG INPUTS TERMINATION DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-009	2	PUMPS CONTROL TERMINATION DIAGRAM	RE-ISSUED FOR APPROVAL
486/4/9-1194-010	2	SWITCHBOARD EQUIPMENT LIST	RE-ISSUED FOR APPROVAL
486/4/9-1194-011	2	SWITCHBOARD CABLE SCHEDULE	RE-ISSUED FOR APPROVAL
486/4/9-1194-012	2	SWITCHBOARD LABEL SCHEDULE	RE-ISSUED FOR APPROVAL
486/4/9-1194-013	2	SWITCHBOARD CONSTRUCTION NOTES & DETAILS	RE-ISSUED FOR APPROVAL
486/4/9-1194-014	2	SWITCHBOARD CONSTRUCTION DETAILS	RE-ISSUED FOR APPROVAL
486/4/9-1194-015	2	SWITCHBOARD GENERAL ARRANGEMENT (Sheet 1 OF 2)	RE-ISSUED FOR APPROVAL
486/4/9-1194-016	2	SWITCHBOARD GENERAL ARRANGEMENT (Sheet 2 OF 2)	RE-ISSUED FOR APPROVAL
486/4/9-1194-017	2	SITE LAYOUT (REFER DWG: 486/4/9-1194-030-1)	RE-ISSUED FOR APPROVAL

STANDARD VARIABLES			
DESCRIPTION	VALUES		
WATER BOOSTER PLANT ID	WB065		
MAIN FLOWMETER ID,	T.B.C.		
PRESSURE INLET ID, PRESSURE OUTLET ID	P T.B.C., P T.B.C.		
STREETNAME, SUBURB	SEIB STREET, KILCOY		
DRAWING NUMBER	486/4/9-1194		
SUPPLY AUTHORITY POLE No.	101048		
INCOMING MAINS SUPPLY CABLE sqmm	16mm		
MAIN EARTHING CABLE sqmm	6mm		
METERING ISOLATION LINKS	IPD S7125BWQ		
NORMAL SUPPLY MAIN SWITCH	63A, E125NJ63		
GENERATOR SUPPLY MAIN SWITCH	63A, E125NJ63		
Grundfos PumpSet Assy Part No.	CRE45-2		
PUMP KW RATING (1, 2, 3)	7.5 kW	7.5 kW	7.5 kW
PUMP CIRCUIT BREAKER (1, 2, 3)	DTCB15332C	DTCB15332C	DTCB15332C
PUMP MOTOR SUPPLY CABLE sqmm (1, 2, 3)	2.5mm 3C+E	2.5mm 3C+E	2.5mm 3C+E
MAIN FLOWMETER RANGE	T.B.C.		
RADIO	RADTEL AD2006		

STANDARD DESIGN OPTIONS		
OPTION	DESCRIPTION	FITTED
A1	PUMP 3 FITTED	YES ☒ NO ☐
~~A2~~	~~PUMP 4 FITTED~~	YES ☐ NO ☒
~~A3~~	~~PUMP 5 FITTED~~	YES ☐ NO ☒
~~B~~	~~BYPASS FLOWMETER FITTED~~	YES ☐ NO ☒
C1	KINGFISHER	YES ☒ NO ☐
~~C2~~	~~MD3311 RTU~~	YES ☐ NO ☒
D1	GSM MODEM	YES ☒ NO ☐
~~D2~~	~~PSTN MODEM~~	YES ☐ NO ☒
E	MIRI AD2006	YES ☒ NO ☐
F1	PUMP BOX SUMP PUMP	YES ☒ NO ☐
~~F2~~	~~FLOWMETER PIT SUMP PUMP~~	YES ☐ NO ☒
G	PUMP BOX VENTILATION FAN	YES ☒ NO ☐

POINT TO POINT TEST
J & P RICHARDSON IND.
NAME: A. VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

QUEENSLAND Urban Utilities

WB065
SEIB STREET, KILCOY
WATER BOOSTER
SITE COVER SHEET

AS CONSTRUCTED DETAILS

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DRAFTED LIEN LE
DRAFTING CHECK LUCAS WEDLEY
CAD FILE 49-1194-001-A.DWG
Q.U.U. FILE No.

LUCAS WEDLEY 24/01/13
DESIGN R.P.E.Q. No. DATE
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ASSET/PROJECT WB065
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE
ELECTRICAL
DRAWING INDEX

SHEET No. 1 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-001
AMEND. A

NOTE:
double lines indicate operator interface

WATER BOOSTER SWITCHBOARD

MTRG COMPARTMENT | POWER COMP. | CONTROL COMPARTMENT

NORMAL 415VAC (T.B.C.) | ISOL. LINKS | KWH | GENSET | EARTH | GND

SR1-3 | F1-3 63A | SURGE PROTN | F4-6 6A | PFRS | PHASE FAIL

Q3 MTS | Q2 MAIN SWITCH 63A

SF1 | AC FILTER | Q20 4A | Q22 4A | Q23 4A | Q21 4A | ALARM RLY | SDAR

24VDC BATT | PS1 | PWR SUPPLY 240vac/24vdc

MIRI ANTENNA | GSM ANTENNA

SD2 | SURGE PROTN | MIRI RADIO | DATA | GSM MODEM | GND

STATION LOCAL/ REMOTE SELECTOR

24VDC | 24VDC | 24VDC | 24VDC | 24VDC

PLG/SKT | DATA

Grundfos CU351 | MPC | Grundfos CIU 200 | G'WAY | MODbus RTU

KINGFISHER RTU

DIGITAL INPUTS | DIGITAL OUTPUTS

4-20mA | 4-20mA | 4-20mA | 4-20mA

GENIbus | GENIbus | GENIbus

SIGNAL SPLITTER | SIGNAL SPLITTER

F/M

PUMPS STOP | ESR | P1 P2 P3 ESR I/L

P1 P2 P3 MAN. RUN

Q7 6A | Q8 6A | Q9 6A | Q12 16A 30mA | Q10 16A 30mA | J9 2A | Q4 32A | Q5 32A | Q6 32A

LR1 LEVEL RELAY

LCC

J10

(T.B.C) PinTx | (T.B.C) PoutTx

VFD | GENIbus | ESR I/L | MAN RUN | P1 7.5 kW | P2 7.5 kW | P3 7.5 kW

M 0.17 kW SUPPLY AIR VENT FAN | M 0.08 kW DISCHARGE AIR VENT FAN

SUMP HIGH LEVEL | AUTO SUMP PUMP

WATER IN | WATER OUT

WATER BOOSTER PUMP BOX

GRUNDFOS CRE45-2

WATER BOOSTER F/M FLOWMETER PIT

POINT TO POINT TEST
J & P RICHARDSON IND.
NAME: A. VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

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QUEENSLAND Urban Utilities

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2	04.13	AMENDED FROM QUU COMMENTS	L.P.	M.F.		
1	03.13	RE-ISSUED FOR APPROVAL	B.J.	B.J.		
A	06.13	ISSUED FOR CONSTRUCTION	M.F.	M.F.		

FUNDING: DESIGN W.O. No. QUUXXX | CONSTRUCTION W.O. No. SOA XXXXX-XXX | FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED LIEN LE | DRAFTING CHECK LUCAS WEDLEY | CAD FILE 49-1194-002-A.DWG | Q.U.U. FILE No.

LUCAS WEDLEY 24/01/13 | DESIGN R.P.E.Q. No. DATE | ORIGINAL SIGNED BY | DESIGN CHECK R.P.E.Q. No. DATE

APPROVED BY SIGNATURE DATE | CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE BLOCK DIAGRAM

SHEET No. 2 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-002 | AMEND. A

3 PHASE 415VAC
SUPPLY FROM POLE No. 101048
CABLE SIZE 16mm
N R W B
P01
MTRG ISOLATION LINKS
ENERGEX DIRECT METERING
LOCKABLE METERING COMPARTMENT

3 PHASE 415VAC
SUPPLY FROM 50kVA GENERATOR
TEMPORARY BACK-UP ONLY
R W B N E
P03
R W B N E
GENERATOR EXTERNAL CONNECTION PLUG 90A

NOTES

1. INCOMING MAIN, GENERATOR, & DIST. BOARD CIRCUIT BREAKERS SHALL BE SHROUDED ON BOTH LINE & LOAD SIDES.

POINT TO POINT TEST
J & P RICHARDSON IND.
NAME: A.VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

P02
MAIN EARTH STAKE
E
MEN LINK
F1 610 SR1,2,3
F2 611
F3 612
63A
80kA
SDN-3
SDN-2
SDN-1
F4 620
F5 621
F6 622
6A
N4
PFRS
SITE MAINS POWER FAILURE RELAY
REF 06:B2

MTS
MANUAL TRANSFER SWITCH
Q2
NORMAL SUPPLY MAIN SWITCH
63A
(NOTE 1, 2)
Ir=1 (63A) Im=8
Q3
GEN. SUPPLY MAIN SWITCH
63A
(NOTE 1, 2)
Ir=1 (63A) Im=8

EARTH
MAIN NEUTRAL

Q9
6A
630
N9
SF1
CRITEC SURGE FILTER
SN1
623 Q20 4A 624 N20 RTU 24VDC POWER SUPPLY REF 05:B2
623 Q21 4A 625 N21
623 Q22 4A 626 N22 GRUNDFOS HYDRO CU351 REF 05:H3
623 Q23 4A 627 N23 ~~GRUNDFOS CIU200 GATEWAY REF 05:G11~~ SPARE
FILTERED NEUTRAL

GPO IN RTU CUBICLE (LAPTOP)
Q10-N
Q10
16A = 30mA
640
N10
GPO IN DISTRIBUTION CUBICLE
SPARE

Q12-N
Q12
16A = 30mA
680
N12
PUMP BOX
SUMP PUMP
P-P5
10A OUTLET
PUMP BOX
AUTO SUMP PUMP

E N R W B
CONTINUED ON SHT 04:A1

AC POWER SUPPLY
SURGE DIVERTERS
SR1 SR2 SR3
FILTER
SF1
SD12 SD23 SD3
SD ALARM RELAY
SD+ SDAR SD-
L N 12 16
CLOSE = HEALTHY
SURGE DIVERTER AND FILTER OK REF 06:B2
DI03+
DI03-

LEGEND:
- VFD TERMINAL
- RTU TERMINAL
- PLC/RTU MARSH. C/BREAKER TERM.
- PLC/RTU MARSH. LINK TERM.

RTU
- DI1-02 DIGITAL INPUT
- DO1-02 DIGITAL OUTPUT
- AI1-02 ANALOG INPUT
- AO1-02 ANALOG OUTPUT

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:
RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE
QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)
QUEENSLAND Urban Utilities

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DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
DRAFTING CHECK	LUCAS WEDLEY	DESIGN	R.P.E.Q. No. DATE
CAD FILE	49-1194-003-A.DWG	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No. DATE

APPROVED BY	SIGNATURE	DATE
CONSTRUCTION MANAGER	SIGNATURE	DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
AC POWER DISTRIBUTION SCHEMATIC DIAGRAM

SHEET No. 3 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-003
AMEND. A

CONTINUED FROM SHT 03:J1

E N R W B

Q4 32A — P-P1 — P1-VFD

GRUNDFOSS CRE32-1 7.5 kW

M ~3 BOOSTER PUMP No1 7.5 kW

PUMPS STOP RLY REF 04:E13
RTU DO MAN.RUN RLY REF 06:H4
ESR-2 P1RUN

110 1Wh	112	Gr	L1
115 1Bk	113	Br	L2
110 2Wh	114	Pi	L3
2Bk	115	Wh	PE

C-P1

Gr	3	
Br	2 Start/stop	(Closed=RunPermit)
Pi	9 GND (frame)	
Wh	1 Digital input	(Closed=Run@MaxSpeed) (Open=NormalRTUcontrol)

P1 FAULT ~~DI-10~~ DI-12 REF 06:D2

3Wh	25	Bl	DI12+
3Bk	26	Ye	DI12-

CX-P1 — C: FAULT (NC) (Open=Fault)

FROM MPC REF 05:H6 — Wh, Bk — A, Y, B: GENIbus RS485

Q5 32A — P-P2 — P2-VFD

GRUNDFOSS CRE32-1 7.5 kW

M ~3 BOOSTER PUMP No2 7.5 kW

PUMPS STOP RLY REF 04:E13
RTU DO MAN.RUN RLY REF 06:H4
ESR-3 P2RUN

120 1Wh	116	Gr	L1
125 1Bk	117	Br	L2
120 2Wh	118	Pi	L3
2Bk	119	Wh	PE

C-P2

Gr	3	
Br	2 Start/stop	(Closed=RunPermit)
Pi	9 GND (frame)	
Wh	1 Digital input	(Closed=Run@MaxSpeed) (Open=NormalRTUcontrol)

P2 FAULT ~~DI-11~~ DI-13 REF 06:D2

3Wh	27	Bl	DI13+
3Bk	28	Ye	DI13-

CX-P2 — C: FAULT (NC) (Open=Fault)

FROM MPC REF 05:H6 — Wh, Bk — A, Y, B: GENIbus RS485

Q6 32A — P-P3 — P3-VFD

GRUNDFOSS CRE32-1 7.5 kW

M ~3 BOOSTER PUMP No3 7.5 kW

PUMPS STOP RLY REF 04:E13
RTU DO MAN.RUN RLY REF 06:H4
ESR-4 P3RUN

130 1Wh	120	Gr	L1
135 1Bk	121	Br	L2
130 2Wh	122	Pi	L3
2Bk	123	Wh	PE

C-P3

Gr	3	
Br	2 Start/stop	(Closed=RunPermit)
Pi	9 GND (frame)	
Wh	1 Digital input	(Closed=Run@MaxSpeed) (Open=NormalRTUcontrol)

P1 FAULT ~~DI-12~~ DI-14 REF 06:D2

3Wh	29	Bl	DI14+
3Bk	30	Ye	DI14-

CX-P3 — C: FAULT (NC) (Open=Fault)

FROM MPC REF 05:I6 — Wh, Bk — A, Y, B: GENIbus RS485

PUMPS

E N R W B

Q7 6A — K7 — P-VF1 — M ~1 SUPPLY AIR VENT FAN 0.17 kW 0.9 A

Q8 6A — K8 — P-VF2 — M ~1 DISCHARGE AIR VENT FAN 0.08 kW 0.35 A

E N R W B

POINT TO POINT TEST
J & P RICHARDSON IND.
NAME: A.VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

+ 24VDC POWER SUPPLY - REF 05:E7

J10+ — S1 ES1 — ESR J10- — STOP ALL PUMPS RELAY REF 06:A2, 04:B3, 04:E3, 04:H3

DOOR SWITCHES CLOSED WHEN DOORS CLOSED — PUMP BOX

J10+ DS1 DS1 — DS2 DS2 — 103 — DS3 — 104 DS3 — LCC J10- — SECURITY & LIGHTING RELAY REF 05:E7, 06:B2

CLOSED = HATCH CLOSED

J10+ — LR1 S10- — PIT LEVEL RELAY REF 06:D2

PROBE 300 mm ABOVE PIT FLOOR LEVEL REF 09:B12
TH7 — 124 — PLR — 105 — 125

P1RUN
P2RUN
P3RUN

J10+ — VF — VFR J10- — VENT FAN START RELAY REF 04:H11, 04:H11

J10+ — VFR — VFR1 — K7 J10- — SUPPLY AIR VENT FAN CONTACTOR REF 04:F12

J10+ — VFR — VFR2 — K8 J10- — DOWN DISCHARGE VENT FAN CONTACTOR REF 04:F12

LEGEND:
- ■ VFD TERMINAL
- ◪ RTU TERMINAL
- ⊠ PLC/RTU MARSH. C/BREAKER TERM.
- ○ PLC/RTU MARSH. LINK TERM.

RTU
- DI1-02 DIGITAL INPUT
- DO1-02 DIGITAL OUTPUT
- AI1-02 ANALOG INPUT
- AO1-02 ANALOG OUTPUT

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COMPANY NAME:
START DATE: FINISH DATE:

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ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE, WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE
QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND Urban Utilities

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DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13		
DRAFTING CHECK	LUCAS WEDLEY	DESIGN	R.P.E.Q. No. DATE	APPROVED BY	SIGNATURE DATE
CAD FILE	49-1194-004-A.DWG	ORIGINAL SIGNED BY			
Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No. DATE	CONSTRUCTION MANAGER	SIGNATURE DATE

ASSET/PROJECT: WB065 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE: PUMP POWER & CONTROL SCHEMATIC DIAGRAM

SHEET No. 4 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-004

AMEND. A

PS2
RADIO POWER SUPPLY
24VDC/13.8VDC

POWER BOX
PB251-24 CM-CC-T

LOAD
PS1
BATT
BOK
RTU

240VAC SUPPLY (SHROUDED) REF 03:F7
624
N20

10AMP J1+ J1- J2+ J2-
2 x 12V BATTERIES SERIES CONNECTED
10AMP J1B+ J1B- J1A+ J1A-

DI04+ DI04- BATTERY OK REF 06:B2 0 = Fault, 1 = Healthy
DI05+ DI05- POWER ON REF 06:B2 0 = Fault, 1 = Healthy
TEMPERATURE PROBE LOCATED AT BATTERIES

RTU POWER SUPPLY 10A 24VDC

4AMP J3+ J3-
4AMP J4+ J4-
4AMP J5+ J5-
4AMP J6+ J6- RTU 24VDC CARD SUPPLY REF 06:A8, 06:A2, 06:H4
4AMP J7+ J7-
4AMP J8+ J8- DELIVERY FLOWMETER REF 06:B11
4AMP J9+ J9- LCC 651 REF 04:H13 LED LIGHT IN CUBICLE
4AMP J10+ J10- MISCELLANEOUS DC CCTS REF 04:D12

J6+A J6-A 24VDC REF ~~05:C7~~ 06:B7
AI03+ AI03- SUCTION PRESSURE REF 06:E10
AI04+ AI04- DISCHARGE PRESSURE REF 06:F10

SIGNAL SPLITTER ECT/4-20MA/2x4-20MA/24DC/-RF(DIN)
SS1
SS2

PUMPS
SUCTION PRESSURE SENSOR PART OF GRUNFOSS PUMP PACK (T.B.C)
DISCHARGE PRESSURE SENSOR PART OF GRUNFOSS PUMP PACK (T.B.C)
106 107 108 109 110 111

(DISABLE MPC)
X1
240VAC SUPPLY (SHROUDED, SHROUD X1 AS WELL) REF 03:G7
626 626A N22

CU351
Grundfos CU 351
AI1 EXT GENIbus
AI2
GND
DO1 DI10+ DI10- MPC FAULT TO RTU REF 06:C2 AND 07:F10
INT GENIbus
CX-P1 TO P1 REF 04:C2
CX-P2 TO P2 REF 04:F2
CX-P3 TO P3 REF 04:I2

CIU200 IS BUILT INTO CU351
Grundfos GIU 200
CIU200
CIM200 MODBUS MODULE
627 N23 240VAC SUPPLY (SHROUDED) REF 03:H7

LOW PROFILE ANTENNA
MAXON C3LA30-BD170F
Rx TBA
Tx TBA
X01 SD2 X02
X03
J7+ J7-
HSUPA ETHERNET ROUTER
MAXON MA-2025

KINGFISHER RTU
PS-22 CP-30 DI-5 DO-1 IO-3
POWER SUPPLY
COMS MODULE
DIGITAL INPUT DRY CONTACTS 16 CHANNEL I/O MODULE
ISOLATED RELAY OUTPUTS NO/NC 8 CHANNEL I/O MODULE
MIXED I/O MODULE
SPARE SLOT
J3+ J3-
DC+ DC- E
VA+ VA- R+ R- TS B+ B-
REF. SHEET 7
REF. SHEET 8
REF. SHEET 8

POINT TO POINT TEST
J & P RICHARDSON IND.
NAME: A.VARY LICENCE: 756
DATE: 25-4-13
SIGNATURE:

X05 CIM200 TO KINGFISHER RTU CONFIGURATION NOTE 6

CIM200		KINGFISHER (RTU)
1 DI (+)	ORANGE/WHITE	TX+
	ORANGE	RX+
2 DO (-)	BROWN	TX-
	BROWN/WHITE	RX-
3 GND	BLUE/WHITE	GND

MIRI AD2006 RADIO
RS232 RTU ENET PORT 5
PORT 4 USB
PORT 3 RS485
RS RJ45 ADAPTOR
PROG/RUN SWITCH
PIT TEST BUTTON
DOT DIN ALG
ANTENNA PORT 1 RS232 PORT 2 RS232
J4A+ J5+ J5- J4A-

LEGEND:
- ■ VDF TERMINAL
- ⊠ PLC/RTU MARSH. C/BREAKER TERM.
- ○ PLC/RTU MARSH. LINK TERM.

RTU
- DI1-02 DIGITAL INPUT
- DO1-02 DIGITAL OUTPUT
- AI1-02 ANALOG INPUT
- AO1-02 ANALOG OUTPUT

NOTES
1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
6. SERIAL OPTION BOARD FITTED TO PORT CONFIGURED AS RS485

AS CONSTRUCTED DETAILS
I CERTIFY THAT THE "AS CONSTRUCTED" DETAILS SHOWN ON THIS PLAN ARE A TRUE AND ACCURATE RECORD OF THE WORKS.
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NAME of SIGNATORY:
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COMPANY NAME:
START DATE: FINISH DATE:

J. & P. RICHARDSON INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME	SIGNATURE	DATE
QUEENSLAND URBAN UTILITIES DELEGATE (AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)		

QUEENSLAND Urban Utilities

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DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13	
DRAFTING CHECK	LUCAS WEDLEY	DESIGN	R.P.E.Q. No. DATE	APPROVED BY SIGNATURE DATE
CAD FILE	49-1194-005-A.DWG	ORIGINAL SIGNED BY		
Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No. DATE	CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT: WB065 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE: DC POWER DISTRIBUTION SCHEMATIC DIAGRAM

SHEET No. 5 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-005
AMEND. A

RTU DIGITAL INPUTS

+ 24VDC POWER SUPPLY - REFER SHEET 05:C7

DI1-24V

DI-01	ESR-1	PUMP STOP RELAY REF 04:H13
DI-02	PFRS-1	SITE MAINS POWER REF 03:C3
DI-03	SADR-1	SURGE DIVERTER AND FILTER OK REF 03:E11
DI-04	BOK	RTU BATTERY OK REF 05:B3
DI-05	RTU	RTU CONTROL POWER REF 05:C3
DI-06	LCC-2	DOOR STATUS REF 04:H13
DI-07	REM LOC S10	STATION LOCAL REMOTE SWITCH
DI-08	K7	SUPPLY AIR VENT FAN RUNNING REF 04:H13
DI-09	K8	DISCHARGE AIR VENT FAN RUNNING REF 04:H13
DI-10	MPC-DO1	MPC FAULT REF 05:G5
DI-11	LR1-1	PIT FLOODED REF 04:F14
DI-12	P1-FAULT	P1 FAULT REF 04:C4
DI-13	P2-FAULT	P2 FAULT REF 04:F4
DI-14	P3-FAULT	P3 FAULT REF 04:I4
DI-15		RESERVED FOR P4 FAULT
DI-16		RESERVED FOR P5 FAULT

+ 24VDC POWER SUPPLY - REFER SHEET 05:C7

DI2-24 V

DI-17	2 DI17	GENERATOR FAULT REF 08:B10
DI-18	3 DI18	GENERATOR RUNNING REF 08:B10
DI-19	4 DI19	GENERATOR LOW FUEL REF 08:B10

RTU DIGITAL OUTPUTS

+ 24VDC POWER SUPPLY - REFER SHEET 05:C7

DO-01	P1RUN	PUMP #1 MANUAL RUN COMMAND REF 04:C3 , 04:C12
DO-02	P2RUN	PUMP #2 MANUAL RUN COMMAND REF 04:F3 , 04:C12
DO-03	P3RUN	PUMP #3 MANUAL RUN COMMAND REF 04:I3 , 04:C12
DO-04		
DO-05		
DO-06	X1	DISABLE MPC REF 05:H4
DO-07		
DO-08		

+ 24VDC POWER SUPPLY - REFER SHEET 05:C7

AI1+24V

J6+A

J6-A

FIELD

E+H PROMATIC 50 FLOWMETER SENSOR

IFM-D-1

IFM-D-2

FLOWMETER PIT

DELIVERY FLOWMETER

E+H PROMATIC 50 FLOWMETER Tx

24VDC SUPPLY REF 05:D7

RTU ANALOG INPUTS

AI1-01 DELIVERY FLOWMETER

AI1-02 RESERVED FOR LOW ZONE FLOWMETER

ANALOG INPUTS part of GRUNDFOS CU351

4-20mA AI2 Pout

4-20mA AI1 Pin

SIGNAL SPLITTERS ECT/4-20MA/2x4-20MA/24DC/-RF[OIN]

SS1

SS2

AI1-03 SUCTION PRESSURE SENSOR

SUCTION PRESSURE SENSOR part of GRUNDFOS PUMP PACK

AI1-04 DISCHARGE PRESSURE SENSOR

DISCHARGE PRESSURE SENSOR part of GRUNDFOS PUMP PACK

NOTES

1. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

LEGEND:

- VFD TERMINAL
- RTU TERMINAL
- PLC/RTU MARSH. C/BREAKER TERM.
- PLC/RTU MARSH. LINK TERM.

RTU

- DI1-02 DIGITAL INPUT
- DO1-02 DIGITAL OUTPUT
- AI1-02 ANALOG INPUT
- AO1-02 ANALOG OUTPUT

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A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
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EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

POINT TO POINT TEST
J & P RICHARDSON IND.
NAME: A. VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
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DRAFTED LIEN LE | DRAFTING CHECK LUCAS WEDLEY | CAD FILE 49-1194-006-A.DWG | Q.U.U. FILE No.

LUCAS WEDLEY 24/01/13 DESIGN R.P.E.Q. No. DATE | ORIGINAL SIGNED BY | DESIGN CHECK R.P.E.Q. No. DATE

APPROVED BY SIGNATURE DATE | CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE: COMMON CONTROLS SCHEMATIC DIAGRAM

SHEET No. 6 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-006

AMEND. A

SWITCHBOARD

FIELD

24VDC

REFER SHEET 05

REFER SHEET 05

RTU KINGFISHER I/O MODULE SLOT 3 DI-5

DIGITAL INPUTS

DI1+24V

DI1-COM

DI1

CONT ON SHEET 08

CONT ON SHEET 09

D12 D13 D14

part of C-P1

part of C-P2

part of C-P3

ESR-1 PUMPS STOP PBUTTON OK

PFRS-1 SITE MAINS POWER OK

SDAR-1 SURGE DIVERTER OK

PS1 RTU POWER SUPPLY 10A 24VDC POWER BOX PB251-24CM

BATTERY SYSTEM OK

RTU POWER OK

LCC ALL DOORS CLOSED

REM LOC S10 REMOTE CONTROL SELECTED

K7 SUPPLY AIR VENT FAN RUNNING

K8 DISCHARGE AIR VENT FAN RUNNING

MPC-DO1 MPC OK

LR1-1 PIT FLOODED

POINT TO POINT TEST
J & P RICHARDSON IND.
NAME: A. VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:

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NAME of SIGNATORY:
RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

LEGEND:

C?? CABLE IDENTIFIER

10A RTU MINATURE CCT BREAKER TERMINAL

5 DISCONNECT LINK TERMINAL

NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE
QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND Urban Utilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
2	04.13	AMENDED FROM QUU COMMENTS	L.P.	M.F.		
1	03.13	RE-ISSUED FOR APPROVAL	B.J.	B.J.		
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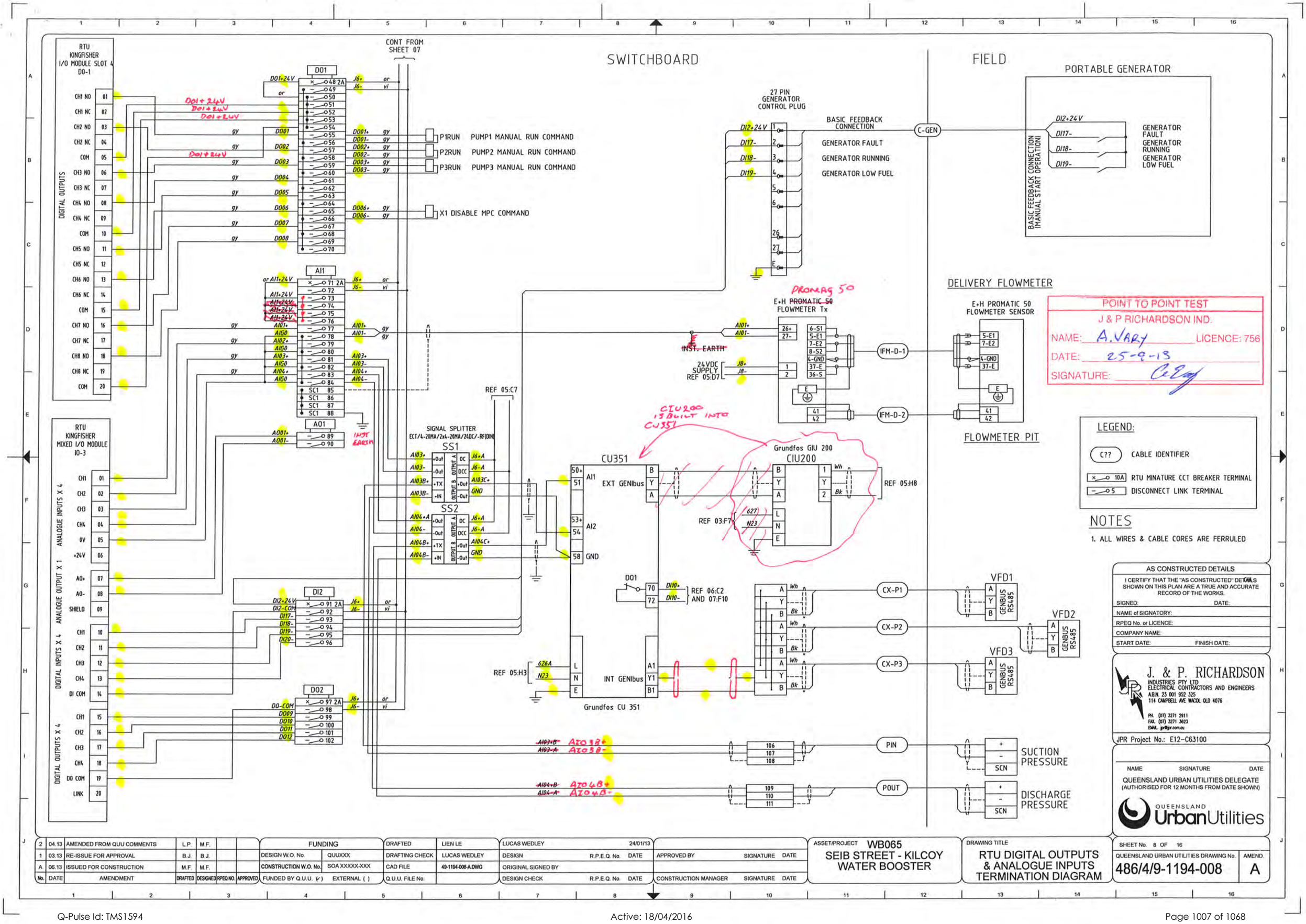
FUNDING		DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13	
DESIGN W.O. No.	QUUXXX	DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No.	DATE	APPROVED BY SIGNATURE DATE
CONSTRUCTION W.O. No.	SOA XXXXX-XXX	CAD FILE	49-1194-007-A.DWG	ORIGINAL SIGNED BY		
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No.	DATE	CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
RTU DIGITAL INPUTS TERMINATION DIAGRAM

SHEET No. 7 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-007 AMEND. A


RTU KINGFISHER I/O MODULE SLOT 4 DO-1
DIGITAL OUTPUTS
CONT FROM SHEET 07
SWITCHBOARD
FIELD
PORTABLE GENERATOR
27 PIN GENERATOR CONTROL PLUG
BASIC FEEDBACK CONNECTION
GENERATOR FAULT
GENERATOR RUNNING
GENERATOR LOW FUEL
C-GEN
BASIC FEEDBACK CONNECTION (MANUAL START OPERATION)
P1RUN PUMP1 MANUAL RUN COMMAND
P2RUN PUMP2 MANUAL RUN COMMAND
P3RUN PUMP3 MANUAL RUN COMMAND
X1 DISABLE MPC COMMAND
DO1
AI1
AO1
DI2
DO2
SIGNAL SPLITTER
SS1
SS2
REF 05:C7
PROMAG 50
E+H PROMATIC 50 FLOWMETER Tx
INST. EARTH
24VDC SUPPLY REF 05:D7
IFM-D-1
IFM-D-2
DELIVERY FLOWMETER
E+H PROMATIC 50 FLOWMETER SENSOR
FLOWMETER PIT
CIU200 IS BUILT INTO CU351
CU351
Grundfos GIU 200
CIU200
EXT GENIbus
INT GENIbus
Grundfos CU 351
REF 05:H8
REF 03:F7
REF 06:C2 AND 07:F10
REF 05:H3
CX-P1
CX-P2
CX-P3
VFD1
VFD2
VFD3
GENBUS RS485
PIN
POUT
SUCTION PRESSURE
DISCHARGE PRESSURE
RTU KINGFISHER MIXED I/O MODULE IO-3
ANALOGUE INPUTS X 4
ANALOGUE OUTPUT X 1
DIGITAL INPUTS X 4
DIGITAL OUTPUTS X 4
POINT TO POINT TEST
J & P RICHARDSON IND.
NAME: A.VARY LICENCE: 756
DATE: 25-9-13
SIGNATURE:
LEGEND:
C?? CABLE IDENTIFIER
10A RTU MINATURE CCT BREAKER TERMINAL
5 DISCONNECT LINK TERMINAL
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CAD FILE 49-1194-008-A.DWG
Q.U.U. FILE No.
LUCAS WEDLEY 24/01/13
DESIGN R.P.E.Q. No. DATE
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CONSTRUCTION MANAGER SIGNATURE DATE
ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER
DRAWING TITLE
RTU DIGITAL OUTPUTS & ANALOGUE INPUTS TERMINATION DIAGRAM
SHEET No. 8 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-008
AMEND. A

SWITCHBOARD

FIELD

CONT ON SHEET 07

PUMP BOX

REF 04:E12	DS2	103	Rd
	DS3	104	Bk
	PLR	105	
MPC REF 05:G3	Pout Wh	A103- 106	Wh
	Pout Bk	A103-B 107	Bk
	Pout Scr	108	Scr
	Pin Wh	A104- 109	Wh
	Pin Bk	A104-A 110	Bk
	Pin Scr	111	Scr
REF 04:B04	110	112	1Wh
	115	113	1Bk
	110	114	2Wh
	112	115	2Bk
REF 04:E04	120	116	1Wh
	125	117	1Bk
	120	118	2Wh
	122	119	2Bk
REF 04:H04	130	120	1Wh
	135	121	1Bk
	130	122	2Wh
	132	123	2Bk
REF 04:F12	J10+	124	Rd
	VF	125	Bk
		126	
		127	
		128	
		129	
		130	
		131	

PLR

C-DS3

I-POUT

I-PIN

C-P1

C-P2

C-P3

C-TH7

DS2
DS3 DS3
CLOSED = ACCESS CLOSED

PUMP PRESSURES

PLR PROBE 300 mm ABOVE PIT FLOOR LEVEL

Pout OUTLET PRESSURE

Pin INLET PRESSURE

110 1Wh	P1-VFD		PUMP 1
115 1Bk	2 Start/stop		(VFD DI Closed=RunPermit)
110 2Wh	3 GND (FRAME)		
112 2Bk	1 Digital input		(VFD DI Closed=MaxSpeed)
DI11+ 3Wh	C		
DI11- 3Bk	FAULT (NC) NC		(VFD DO Open=Fault)
120 1Wh	P2-VFD		PUMP 2
125 1Bk	2 Start/stop		(VFD DI Closed=RunPermit)
120 2Wh	3 GND (FRAME)		
122 2Bk	1 Digital input		(VFD DI Closed=MaxSpeed)
DI12+ 3Wh	C		
DI12- 3Bk	FAULT (NC) NC		(VFD DO Open=Fault)
130 1Wh	P3-VFD		PUMP 3
135 1Bk	2 Start/stop		(VFD DI Closed=RunPermit)
130 2Wh	3 GND (FRAME)		
132 2Bk	1 Digital input		(VFD DI Closed=MaxSpeed)
DI13+ 3Wh	C		
DI13- 3Bk	FAULT (NC) NC		(VFD DO Open=Fault)

J10+ VF TH7 THERMOSTAT MOUNTED IN PUMP BOX

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APPROVED BY	SIGNATURE	DATE
CONSTRUCTION MANAGER	SIGNATURE	DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
PUMPS CONTROL TERMINATION DIAGRAM

SHEET No. 9 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-009

AMEND. A

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	REMARKS
1	3	METERING ISOLATION LINKS	IPD	S7125BWQ	
2	1	Q2 NORMAL SUPPLY MAIN SWITCH 100A	TERASAKI	E125-NJ 63A + T2HS12R5GM	+ T2CF123SLNG + T2HW12CA + T2HW005A
3	1	Q3 GENERATOR SUPPLY MAIN SWITCH 100A	TERASAKI	E125-NJ 63A + T2HS12R5GM	+ T2CF123SLNG + T2HW12CA
4.1	1	Q4 PUMP 1 CIRCUIT BREAKER 32A + CAPTIVE LOCK DOG	TERASAKI	DTCB15332C+DTLDC	15kA 3P 32A "C" curve
4.2	1	Q5 PUMP 2 CIRCUIT BREAKER 32A + CAPTIVE LOCK DOG	TERASAKI	DTCB15332C+DTLDC	15kA 3P 32A "C" curve
4.3	1	Q6 PUMP 3 CIRCUIT BREAKER 32A + CAPTIVE LOCK DOG	TERASAKI	DTCB15332C+DTLDC	15kA 3P 32A "C" curve
5					
6	1	Q7 SUPPLY AIR VENT FAN CIRCUIT BREAKER	TERASAKI	DTCB10106C+DTLDC	10kA 1P 6A "C" curve
7	1	Q8 DISCHARGE AIR VENT FAN CIRCUIT BREAKER	TERASAKI	DTCB10106C+DTLDC	10kA 1P 6A "C" curve
8	1	Q9 DC PWR SUPPLY CB	TERASAKI	DTCB10106C	10kA 1P 6A "C" curve
9	1	Q10 SWBD GPO CIRCUIT BREAKER	TERASAKI	DSRCBH-16-30A	10kA 1P 16A 30mA RCD
10					
11	1	Q12 PUMP BOX SUMP PUMP CIRCUIT BREAKER	TERASAKI	DSRCBH-16-30A	10kA 1P 16A 30mA RCD
12					
13					
14					
15	1	INSULATED 3P BUS COMB	TERASAKI	ICL213	21 POLE
16					
17	1	Q20 DC POWER SUPPLY CIRCUIT BREAKER	TERASAKI	DTCB10104C	10kA 1P 4A "C" curve
18	1	Q21 SURGE DIVERTERS RELAY CIRCUIT BREAKER	TERASAKI	DTCB10104C	10kA 1P 4A "C" curve
19	1	Q22 GRUNDFOSS MPC CIRCUIT BREAKER	TERASAKI	DTCB10104C	10kA 1P 4A "C" curve
20	1	Q23 GRUNDFOSS CIU200 CIRCUIT BREAKER	TERASAKI	DTCB10104C	10kA 1P 4A "C" curve
21	1	INSULATED 3P BUS COMB	TERASAKI	ICL123	12 POLE
22	1	INSULATED 1P BUS COMB	TERASAKI	IBC108P	8 POLE
29	3	F1,2,3 - SURGE DIVERTER CIRCUIT FUSES	NHP	NC63FW + NTIS63	FUSES & 63A HOLDERS
30	3	SURGE DIVERTERS - SR1,SR2,SR3	CRITEC	TDS-1100-2SR-277	
31	1	SURGE DIVERTER ALARM RELAY - SDAR	CRITEC	DAR-275V	
32	1	SURGE REDUCTION FILTER - SF1	CRITEC	TDF-10A-240V	
33	3	F4,5,6 - PHASE FAILURE RELAY FUSES	NHP	NC32FW + NNIT6	FUSES & 32A HOLDERS
34	1	SITE MAINS PHASE FAILURE RELAY - PFRS	CARLO GAVAZZI	DPB01CM48W4	
35					
36					
37					
38	1	MAIN NEUTRAL LINK	DORE	165E24 + E/N FEET	INSULATED
39	1	MAIN EARTH LINK	DORE	165E24	
40	1	INSTRUMENT EARTH LINK	DORE	165E12 + E/N FEET	INSULATED
41	1	FILTERED SUPPLY NEUTRAL LINK	CLIPSAL	L7	INSULATED
42	2	1 PHASE OUTLET 15A	CLIPSAL	15/15+90B (SHROUD)	
43					
44					
45	1	3 PHASE N&E APPLIANCE INLET 90A - GEN POWER	PROCONECT	3PS6A3NE01	3p+N+E c/w 3PS6PC Protective Cover
46	1	GENERATOR I/O 27 PIN SOCKET OUTLET	WILCO	WIBM27	
47					
48					
49					
50					
51					
52					
53	1	PUMPS STOP RELAY - ESR	SPRECHER & SCHUH	CS 7C-40E24V	AUX BLOCK 2 N.O.
54	1	PUMPS STOP RELAY AUX CONTACT BLOCK	SPRECHER & SCHUH	CS 7-PV-22	AUX BLOCK 2 N.O.
55	1	PUMP 1 MANUAL RUN RELAY - P1RUN	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
56	1	PUMP 2 MANUAL RUN RELAY - P2RUN	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
57	1	PUMP 3 MANUAL RUN RELAY - P3RUN	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
58	1	VENT FAN START RELAY - VFR	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
59	1	DISABLE MPC RELAY - X1	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
60	1	VENT FAN THERMOSTAT IN PUMP BOX-TH7	COSMOTEC	KTS01141	THERMOSTAT
61	2	VENT FAN CONTACTOR - K7, K8	SPRECHER & SCHUH	CA7-9C-01 24VDC	24VDC CONTACTOR
62					

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	REMARKS
63					
64					
65	1	STOP ALL PUMPS PUSHBUTTON - S1	SPRECHER & SCHUH	D7P-MT44-PX01	
66					
67	1	REMOTE TELEMETRY UNIT BACKPLANE 6 SLOT	KINGFISHER	BA-6	
68	1	POWER SUPPLY - PS22	KINGFISHER	PS-22	
69	1	PROCESSOR MODULE	KINGFISHER	CP-30-II	
70	1	DIGITAL INPUT MODULE , 16 CHANNEL	KINGFISHER	DI-5	
71	1	DIGITAL OUTPUT MODULE , 8 CHANNEL	KINGFISHER	DO-1	
72	1	MIXED I/O MODULE , 4xAI , 1xAO , 4xDI , 4xDO	KINGFISHER	IO-3	
73					
74	1	LR1 - SUMP PUMP LEVEL RELAY	MULTITRODE	MTR-5	24VDC
75	1	SINGLE POINT PROBES	MULTITRODE	020130-FSP-SH (TBC!)	'x' = CABLE LENGTH TO SUIT
76					
77					
78					
79	1	LLC - SW/BD LIGHTING CONTROL RELAY	SPRECHER & SCHUH	CS 7C-22E24V	DIN RAIL MTG 2 C.O. 24VDC RELAY
80					
81					
82	1	S10 - STATION LOCAL/REMOTE SWITCH	KRAUS & NAIMER	CA10 A201-FT2	ENGRAVE 'LOCAL REMOTE'
83					
84	1	FLOWMETER	ABB	WATERMASTER	
86	1	GRUNDFOS PUMP CONTROL PANEL	GRUNDFOS	CU351	PART OF GRUNDFOS HYDROPAK
87					
88	1	GRUNDFOS GATEWAY	GRUNDFOS	CIU200	PART OF GRUNDFOS HYDROPAK
89					
90					
91					
92					
93	1	RTU POWER SUPPLY 24VDC 10A	POWERBOX	PB251A-24CM-CC-T-S	
94	1	RADIO	RADTEL / MIRI	AD2006 RM512S-LN24	
95	1	ADAPTOR	WEIDMULLER	8611320000	
96					
97	2	BATTERIES	YUASA		WP7-12FR 12V7AH
98	1	INDUSTRIAL HSUPA ETHERNET ROUTER	MAXON	MA-2025	
99	1	LOW PROFILE CELLULAR ANTENNA	MAXON	C3LA30-BD170F	
100					
101	1	ANTENNA	T.B.C.	T.B.C.	c/w N Series connector
102	1	RADIO COAX SURGE PROTECTION UNIT - SD2	POLYPHASER CORP.	IS-50NX-C2	
103	1	ANTENNA MAST	SWBD BUILDER		
104	1	COAX CABLE (INTERNAL CABLE No. X01)	SCHNEIDER	TBUR SMAM/NM/TL23	RADIO TO SURGE DIVERTER
105	1	COAX CABLE (EXTERNAL CABLE No.X02)	R.F. INDUSTRIES	CNT400	SURGE DIVERTER TO ANTENNA
106	1	COAX PLUG	R.F. INDUSTRIES	N Series (MALE)	
107	1	U CLAMPS	R.F. INDUSTRIES	UNV	
108					
109					
110					
111					
112	3	SW/BD DOOR MICRO SWITCHES	CAMSCO	SM202	3 OFF N/O
113	1	300mm 8 25vDC 36x5050 SMD LED Lightbar - Cool White	LED SHOP AU	#7700	www.ledshoponline.com
114	2	CORROSION INHIBITOR	CORTEC	VPCI-110 OR 111	FROM AP CONTROLS
115					
116					
117					
118					
119					
120					
121					
122					
123					
124					

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	REMARKS
125					
126					
127					
128					
129					
		SWITCHBOARD TERMINALS			
130.1	2	10A MINIATURE THERMAL CIRCUIT BREAKERS	PHOENIX CONTACT	TCP 10A + UK 6-FSI/C	(0712314 + 3118203)
130.2	8	4A MINIATURE THERMAL CIRCUIT BREAKERS	PHOENIX CONTACT	TCP 4A + UK 6-FSI/C	(0712259 + 3118203)
130.3	5	2A MINIATURE THERMAL CIRCUIT BREAKERS	PHOENIX CONTACT	TCP 2A + UK 6-FSI/C	(0712217 + 3118203)
130.4	33	THROUGH TERMINALS (GREY)	PHOENIX CONTACT	PIT 2,5 (3209510)	
130.5	5	THROUGH TERMINAL ENDPLATE	PHOENIX CONTACT	D-ST 2,5 (3030417)	
130.6	90	DISCONNECT TERMINALS (GREY)	PHOENIX CONTACT	PIT 2,5-MT (3210156)	
130.7	10	DISCONNECT TERMINALS ENDPLATE	PHOENIX CONTACT	D-PIT 2,5-MT (3211003)	
130.8	10	TERMINAL END PLATE	PHOENIX CONTACT	D-PIT 2,5-MT (3211003)	
130.9	8	GROUP MARKER CARRIER	PHOENIX CONTACT	UBE (0800310)	
130.10	2	TEST PLUG ADAPTOR	PHOENIX CONTACT	PS-5 (3030983)	
130.11	1	SCREW DRIVER	PHOENIX CONTACT	SZS 0.6 x 3.5 (1205053)	
130.12	5	PLUG-IN BRIDGE	PHOENIX CONTACT	FBS 20-5 (3030226)	
130.13	1	TERMINAL NUMBERS	PHOENIX CONTACT	ZB 5 CUS (0824962)	NUMBERED 1-150
131	1	COVER PROFILE	PHOENIX CONTACT	AP 2 CM	(5022889)
131.1	10	COVER PROFILE CARRIER	PHOENIX CONTACT	AP 2-TU	(5022630)
132	2	ANALOGUE LOOP SIGNAL SPLITTER (SS1,SS2)	MOORE INDUSTRIES	ECT/4-20MA/2x4-20MA/24DC/-RSEDNO	
133					
134	1	ENERGEX PADLOCK (45mm BRASS PIN TUMBLER)	H-A-REED LOCK SMITH	KEY No. 2897	
135					
136					
137					
138					
139					
140					
141					
142					
143					
144					
145					
146					
147					
148					
149					
150					
151					

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ASSET/PROJECT: WB065 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE: SWITCHBOARD EQUIPMENT LIST

SHEET No. 10 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-010 AMEND. A

CABLE No.	STATUS	SIZE	CORES	TYPE	LENGTH (m)	FROM	TO	CABLE FUNCTION	NOTES
P01	NEW	16 mm^2	4C	PVC/CU/PVC	15m	ENERGEX Supply POINT	Switchboard	Incoming Mains Supply	
P02	NEW	6 mm^2	1C	Building Wire	3m	Switchboard	Earth stake	Main Earth	
P03	NEW	25 mm^2	5C	RUBBER/FLEX/RUBBER	20m	Switchboard	Temporary Generator	Incoming Generator Supply	Cable Supplied By Generator Vendor
P-P1	NEW	2.5 mm^2	3C+E	PVC/PVC	15m	Switchboard	Booster Pump 1 Motor	Pump 1 - 3 Phase supply	
P-P2	NEW	2.5 mm^2	3C+E	PVC/PVC	15m	Switchboard	Booster Pump 2 Motor	Pump 2 - 3 Phase supply	
P-P3	NEW	2.5 mm^2	3C+E	PVC/PVC	15m	Switchboard	Booster Pump 3 Motor	Pump 3 - 3 Phase supply	
P-P5	NEW	2.5 mm^2	2C+E	PVC/PVC	15m	Switchboard	Pump Box Sump Pump	Sump Pump - 1 Phase supply	
P-VF1	NEW	2.5 mm^2	2C+E	PVC/PVC	5m	Switchboard	Supply Air Vent Fan	Supply Air Vent Fan - 1 Phase supply	
P-VF2	NEW	2.5 mm	2C+E	PVC/PVC	5m	Switchboard	Discharge Air Vent Fan	Discharge Air Vent Fan - 1 Phase supply	
C-DS3	NEW	1.5mm^2	2C+E	PVC/PVC	15m	Switchboard	Door Switch	Pit Intruder Alarm	
PLR	NEW		Vendor	Vendor	15m	Switchboard	Multitrode Probe includes cable	Sump Pump	
C-TH7	NEW	1.5mm	2C+E	PVC/PVC	15m	Switchboard	Thermostat	Pump Box Thermostat	
C-P1	NEW	1.0mm^2	3PR	PVC/PVC	15m	Switchboard	Pump Box Pump 1	Pump 1 Control & Interlocks	
C-P2	NEW	1.0mm^2	3PR	PVC/PVC	15m	Switchboard	Pump Box Pump 2	Pump 2 Control & Interlocks	
C-P3	NEW	1.0mm^2	3PR	PVC/PVC	15m	Switchboard	Pump Box Pump 3	Pump 3 Control & Interlocks	
C-GEN	NEW	1.5mm^2	24C+E	PVC/FLEX/PVC	20m	Switchboard	Temporary Generator	Temporary Generator I/O	Cable Supplied By Generator Vendor
CX-P1	NEW		1PR	REXON B20	15m	Switchboard - MPC GENIbus	Pump Box Pump 1	GENIbus - Pump1	
CX-P2	NEW		1PR	REXON B20	15m	Switchboard - MPC GENIbus	Pump Box Pump 2	GENIbus - Pump2	
CX-P3	NEW		1PR	REXON B20	15m	Switchboard - MPC GENIbus	Pump Box Pump 3	GENIbus - Pump3	
I-PIN	NEW		1PR	Vendor	15m	Switchboard - MPC	Suction Pressure Transmitter	Suction Pressure	
I-POUT	NEW		1PR	Vendor	15m	Switchboard - MPC	Delivery Pressure Transmitter	Delivery Pressure	
IFM-D-1	NEW		Vendor	Vendor	17m	Switchboard - Flowmeter Tx	Flowmeter	Delivery Flowmeter	
IFM-D-2	NEW		Vendor	Vendor	17m	Switchboard - Flowmeter Tx	Flowmeter	24vdc	
X01	NEW		COAX	SMAM/NM/TL23	0.5m	Switchboard - RADIO	Switchboard - Surge Diverter SD2	Miri Radio Antenna Feeder	
X02	NEW		COAX	CNT400	8m	Switchboard - SURGE DIVERTER SD2	Switchboard - Antenna	Miri Radio Antenna Feeder	
X03	NEW		COAX	Special	2m	Switchboard - RTU	Switchboard - GSM Modem	Miri Radio Data, GSM Modem Data	
X04	NEW			Special	2m	Switchboard - Miri Radio	Switchboard - Kingfisher RTU	Miri Radio Data, Kingfisher Data	
X05	NEW			Special	2m	Switchboard - Grundfos CIU200	Switchboard - Kingfisher RTU	Grundfos CIU200 Data, Kingfisher Data	

NOTES:

1. THE CONTRACTOR IS RESPONSIBLE IN DETERMINING THE ACTUAL CABLE LENGTHS REQUIRED ON SITE.
2. SIZE MAINS CABLE FOR LENGTH OF CABLE RUN FROM ENERGEX POINT OF SUPPLY TO SWITCHBOARD.
3. CABLE LENGTHS TO BE MARKED UP ON AS BUILTS

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
2	04.13	AMENDED FROM QUU COMMENTS	L.P.	M.F.		
1	03.13	RE-ISSUED FOR APPROVAL	B.J.	B.J.		
A	06.13	ISSUED FOR CONSTRUCTION	M.F.	M.F.		

FUNDING: DESIGN W.O. No. QUUXXX; CONSTRUCTION W.O. No. SOA XXXXX-XXX; FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
DRAFTING CHECK	LUCAS WEDLEY	DESIGN	R.P.E.Q. No. DATE
CAD FILE	49-1194-011-A.DWG	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No. DATE

APPROVED BY SIGNATURE DATE

CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE: CABLE SCHEDULE

SHEET No. 11 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9/-1194-011 AMEND. A

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:

RPEQ No. or LICENCE:

COMPANY NAME:

START DATE: FINISH DATE:

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND Urban Utilities

ITEM #	OPT.	DESCRIPTION	LABEL 1	LABEL 2 & 3 (IF NECESSARY)	TEXT HEIGHT	MATERIAL / COLOUR
02		ENERGEX SUPPLY	NORMAL SUPPLY MAIN SWITCH Q2		10mm 4mm	GRAVOPLY B/W
03		GENERATOR SUPPLY	GENERATOR SUPPLY MAIN SWITCH Q3		10mm 4mm	GRAVOPLY B/W
04.1		PUMP CIRCUIT BREAKER	BOOSTER PUMP No.1 Q4		4mm 4mm	GRAVOPLY W/B
04.2		PUMP CIRCUIT BREAKER	BOOSTER PUMP No.2 Q5		4mm 4mm	GRAVOPLY W/B
04.3		PUMP CIRCUIT BREAKER	BOOSTER PUMP No.3 Q6		4mm 4mm	GRAVOPLY W/B
04.4						
6		SUPPLY AIR VENT FAN CIRCUIT BREAKER	SUPPLY AIR VENT FAN Q7		4mm 4mm	GRAVOPLY W/B
7		DISCHARGE VENT FAN CIRCUIT BREAKER	DISCHARGE AIR VENT FAN Q8		4mm 4mm	GRAVOPLY W/B
8		DC POWER SUPPLY CIRCUIT BREAKER	DC POWER SUPPLY Q9		4mm 4mm	GRAVOPLY W/B
9		SWBD GPOs CIRCUIT BREAKER	SWBD GPO Q10		4mm 4mm	GRAVOPLY W/B
11		PUMP BOX SUMP PUMP CIRCUIT BREAKER	PUMP BOX SUMP PUMP Q12		4mm 4mm	GRAVOPLY W/B
11		SPARE CIRCUIT BREAKER				
17		DC POWER SUPPLY CIRCUIT BREAKER	24VDC POWER SUPPLY Q20		4mm 4mm	GRAVOPLY W/B
18		SURGE DIVERTER RELAY CIRCUIT BREAKER	SURGE DIVERTER RELAY Q21		4mm 4mm	GRAVOPLY W/B
19		GRUNDFOS MPC CIRCUIT BREAKER	GRUNDFOS MPC Q22		4mm 4mm	GRAVOPLY W/B
20		GRUNDFOS CRI200 CIRCUIT BREAKER	GRUNDFOS CRI200 Q23		4mm 4mm	GRAVOPLY W/B
29		SURGE DIVERTER FUSES	SURGE DIVERTER FUSES 63/63A	FED FROM LINE SIDE OF MAIN SWITCH	4mm 4mm	GRAVOPLY W/B - R/W/R
30		SURGE DIVERTERS	LIGHTNING ARRESTORS	SR1 SR2 SR3	4mm	GRAVOPLY W/B
31		SURGE DIVERTER ALARM RELAY	SDAR		4mm 4mm	GRAVOPLY W/B
32		SURGE REDUCTION FILTER	SURGE REDUCTION FILTER		4mm 4mm	GRAVOPLY W/B
33		PHASE FAILURE RELAY FUSES	PHASE FAILURE RELAY FUSES 6/20A	FED FROM LINE SIDE OF MAIN SWITCH	4mm 4mm	GRAVOPLY W/B - R/W
34		PHASE FAILURE RELAY	SITE MAINS POWER FAIL - PFRS		4mm 4mm	GRAVOPLY W/S/W
38		MAIN NEUTRAL LINK	MAIN NEUTRAL		4mm	GRAVOPLY W/B
39		MAIN EARTH LINK	MAIN EARTH		4mm	GRAVOPLY W/B
40		INSTRUMENT EARTH LINK	INSTRUMENT EARTH		4mm	GRAVOPLY W/B
41		FILTERED SUPPLY NEUTRAL LINK	FILTERED SUPPLY NEUTRAL		4mm 4mm	GRAVOPLY W/B
43		LAPTOP GPO	LAPTOP GPO ONLY		4mm	GRAVOPLY W/B
45		GENERATOR POWER CONNECTION SOCKET	GENERATOR CONNECTION		6mm 6mm	GRAVOPLY W/B
53		PUMPS EMERG STOP RELAY	ESR		4mm	GRAVOPLY W/B
54						
55		PUMP 1 MANUAL RUN RELAY	P1RUN		4mm	GRAVOPLY W/B
56		PUMP 2 MANUAL RUN RELAY	P2RUN		4mm	GRAVOPLY W/B
57		PUMP 3 MANUAL RUN RELAY	P3RUN		4mm	GRAVOPLY W/B
58		VENT FAN START RELAY	VFR		4mm	GRAVOPLY W/B
59		DISABLE MPC RELAY	X1		4mm	GRAVOPLY W/B
60		VENT FAN THERMOSTAT	TH1		4mm	GRAVOPLY W/B
61		VENT FAN CONTACTOR	K7	K8	4mm	GRAVOPLY W/B

ITEM #	OPT.	DESCRIPTION	LABEL 1	LABEL 2 & 3 (IF NECESSARY)	TEXT HEIGHT	MATERIAL / COLOUR
65		ALL PUMPS STOP PUSHBUTTON	STOP ALL PUMPS		4mm	GRAVOPLY W/B
74		PUMP BOX FLOODED RELAY	LR1		4mm	GRAVOPLY W/B
79		SWITCHBOARD LIGHTING CONTROL CONTACTOR	LCC		4mm	GRAVOPLY W/B
82		STATION LOCAL/REMOTE SELECTOR SWITCH	STATION CONTROL MODE		4mm	GRAVOPLY W/B
84		DELIVERY FLOWMETER TRANSMITTER	DELIVERY FLOWMETER		4mm	GRAVOPLY W/B
93	1	RTU 240VAC/24VDC POWER SUPPLY	RTU 24VDC POWER SUPPLY		4mm 4mm	GRAVOPLY W/B
94		TELEMETRY UNIT	RTU, RADIO		4mm 4mm	GRAVOPLY W/B
95	E	RADIO 24V/13.8VDC CONVERTER	24/12 VDC CONVERTER - RADIO		4mm 4mm	GRAVOPLY W/B
97		BATTERY	BATTERY		4mm	GRAVOPLY W/B
98		MODEM	MODEM		4mm	GRAVOPLY W/B
100						
102	E	RADIO COAX SURGE PROTECTION	RADIO SURGE PROTECTION		4mm	GRAVOPLY W/B
		TERMINAL HEADER	RTU POWER SUPPLIES		4mm 4mm	GRAVOPLY W/B
		TERMINAL HEADER	DIGITAL INPUTS DI1		4mm 4mm	GRAVOPLY W/B
		TERMINAL HEADER	DIGITAL OUTPUTS DO1		4mm 4mm	GRAVOPLY W/B
		TERMINAL HEADER	ANALOG INPUTS AI1		4mm 4mm	GRAVOPLY W/B
		TERMINAL HEADER	PUMP BOX		4mm 4mm	GRAVOPLY W/B
		HEADER LABEL (Incomer Section)	MEN BEHIND		6mm	GRAVOPLY W/B
		HEADER LABEL (MainSwitch Section)	SURGE DIVERTER FUSES BEHIND		6mm	GRAVOPLY W/B
		HEADER LABEL (Above Circuit Breakers)	NON FILTERED SUPPLY		6mm 6mm	GRAVOPLY W/B
		HEADER LABEL (Above Circuit Breakers)	FILTERED SUPPLY		6mm 6mm	GRAVOPLY W/B
132		ANALOGUE LOOP SIGNAL SPLITTER	SS1	SS2	4mm	GRAVOPLY W/B

EXTERNAL LABEL LIST

LABEL	TEXT	TEXT HEIGHT	PAINT FILL LETTERING	SIZE	QTY	OPT
A	WB065	20mm	Black	150x35	1	
B	RTU	10mm	Black	50x20	1	
		10mm	Black	100x20	1	
D	WARNING THIS SITE IS MONITORED BY NETWORK CONTROL. PLEASE INFORM THE OPERATOR BEFORE ISOLATING PUMPS OR STATION	8mm	Black	250x100	2	
E	PLEASE CHECK THAT THE STATION IS IN REMOTE MODE BEFORE LEAVING SITE	8mm	Black	210x60	1	
G	PHONE: 13 26 57 (AFFIX DIRECTLY UNDER LABEL D)	8mm	Black	60x30	1	
H	MAIN SWITCHES	10mm	Black	120x20	1	
I	DISTRIBUTION BOARD	10mm	Black	150x20	1	
K	GENERATOR INLET	10mm	Black	120x20	1	
M	SUPPLY AUTHORITY METERING	10mm	Black	200x20	1	
N	DANGER 415V	10mm	Red	100x20	1	
Q	DANGER - 2 SOURCES OF SUPPLY	10mm	Red	220x20	1	
	EXTERNAL LABELS 1mm THICK, 316 GRADE STAINLESS STEEL. FIXED WITH M3 316 STAINLESS STEEL METAL THREADS.					

DETAIL Q

LABEL	TEXT
F	DANGER - ELECTRICAL EQUIPMENT QUEENSLAND URBAN UTILITIES PHONE: 13 26 57 NOTE: LABEL DESIGN IS ISSUED FROM QUU

DETAIL F SAFETY SIGN - DANGER ELECTRICAL EQUIPMENT etc

280x190x2mm (+ 4x4mm FIXING HOLES) ALUNIMUM POWDER COATED WHITE
5 COLOR SCREEN PRINTED +ANTI-GRAFITTI LAMINATE
FREE ISSUED BY BW TO SWBD MANUFACTURER

AS CONSTRUCTED DETAILS

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114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

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(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities

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1	03.13	RE-ISSUED FOR APPROVAL	B.J.	B.J.		
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DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No. DATE	APPROVED BY SIGNATURE DATE
CAD FILE	49-1194-012-A.DWG	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No. DATE	CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE SWITCHBOARD LABLE SCHEDULE

SHEET No. 12 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-012

AMEND. A

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 lifting lugs in top of cubicle.
Plinth construction 152x63x6mm aluminium channel
Fully welded on fascia of cubicle and stiffened to prevent warping and form a rigid enclosure.
Cubicle is to be sealed to prevent the ingress of sewer well gases.
External doors and covers fitted with Dore Electrics ES60-053 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.
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 6mm 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. (Detail F)
Cable glands to be fitted with compression side installed within cubicle. (Detail G)
Gland/Inspection/Access plates to be fitted with seals attached to cubicle.
Gland/Inspection/Access plates to overlap opening by 25mm.
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°
Ventilation via punched louvers (Refer drawings for detail)
Switchboard Ventilation (except in breezeway) to be backed with stainless steel mesh gauze and removable filter material.
Fit laptop tray to rear of common control door. (Refer drawings for detail)
Fit drawing holder to rear of common control door. (Refer drawings for detail)

Locks Doors 1 & 3
DORE ELECTRICS - Stainless steel Lockable Swing Handle. (Keyed 92268)
DORE ELECTRICS - 3 point lock rod set with rollers.

Locks Door 2
DORE ELECTRICS - Stainless steel Padlockable Swing Handle.
DORE ELECTRICS - 3 point lock rod set with rollers.
ENERGEX padlock, S/Steel Shackle, 45mm brass pin tumbler.
Energex Key No. 2897. c/w 1 key.

Locks Gen Inlet Door
DORE ELECTRICS - Stainless steel Lockable Swing Handle. (Keyed 92268)

OPERATING PARAMETERS

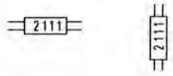
Standard	AS 3439.1
Current & Frequency	AC 50Hz
Rated Operational Voltage Ue	415 VAC
Rated Insulation Voltage Ui	0.6/1kV
Rated Auxiliary Voltage	240 VAC / 24 VDC
Rated Current (No Bus)	100A
Short Circuit Current Isc	20 kA
Duration of Isc	.2 sec
Degree of Protection	Weather Resistant (Nominally IP55)
Internal Degree of Protection	IP20B / IP10A to AS3000:2007
Service Conditions	Outdoors
Mass	Not exceeding 2000kg
Forms of Segregation	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.
Thickness	Minimum 50microns
Exterior/Doors Colour	Mist Green
Interior Colour	Mist Green
Equipment Panel Colour	Bright White
Escutcheon Colour	Bright White
Plinth Colour	Mist Green

WIRING

All control 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, 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.
Not more than two wires shall be connected to any terminal.
Power wiring to be minimum 2.5sqmm V90 06./1Kv stranded copper conductors, phase colour coded as detailed below.
Control wiring to be minimum 1.0sqmm flexible copper conductors, colour coded as detailed below.
Low level control signals to be minimum 0.5sqmm flexible copper conductors. colour coded as detailed below.
4-20mA analog signals (internal & external) wired in shielded pair minimum size 0.5sqmm, overall screened, and earthed at one end only. (Switchboard end for external signals)
All 240VAC terminals located in the RTU or PLC sections shall be shrouded and labelled - ' Danger 240VAC'
Earth cables minimum 2.5sqmm flexible.
Doors and hinged escutcheons bonded with 4sqmm min. flexible earth wire.
Wire numbering will be equal to Brady marking system.
Wire numbers are readable left to right,bottom to top as shown.
Color of DC wiring beyond final fuse/link to be Grey.



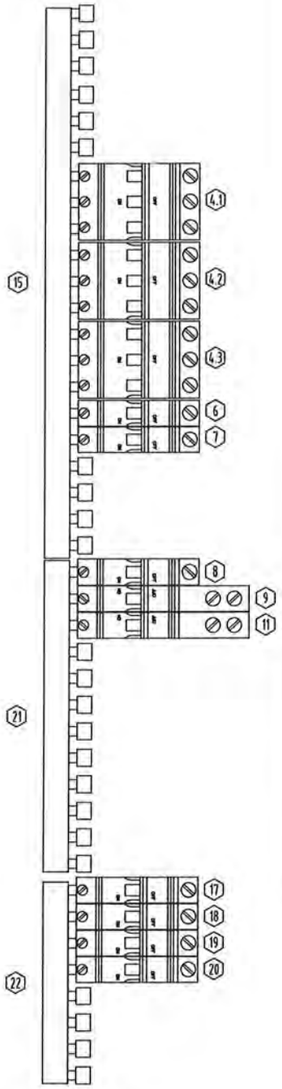
COLOUR CODE		
Phase wiring (A,B &C)	Red, White, Blue	2.5sqmm (min)
Potential Metering (240/415 VAC)	Red, White, Blue, Black	1.5sqmm
Current Metering (Secondary)	Red, White, Blue, Grey	2.5sqmm
240 VAC Control Active	Red	1.0sqmm
240 VAC Neutral	Black	1.0sqmm
24 VDC Positive supplies	Orange	1.0sqmm
24 VDC Negative supplies	Violet	1.0sqmm
24 VDC Wiring (Other than supplies)	Grey	1.0sqmm
RTU & PLC Wiring	Grey	0.5sqmm
Electrode Wiring	Salmon	1.0sqmm
Intrinsically safe wiring	Blue	1.5sqmm
Earth	Green/Yellow	2.5sqmm (min)
Door & Escutcheon Earth Bonds	Green/Yellow	4 sqmm
Instrument Shield Earth	Green/Yellow	1.5 sqmm (min)

LABELS

Internal labels W/B engraved gravoply to label schedule.
Warning labels R/W engraved gravoply to label schedule.
First letter = background colour. Second letter = lettering colour.

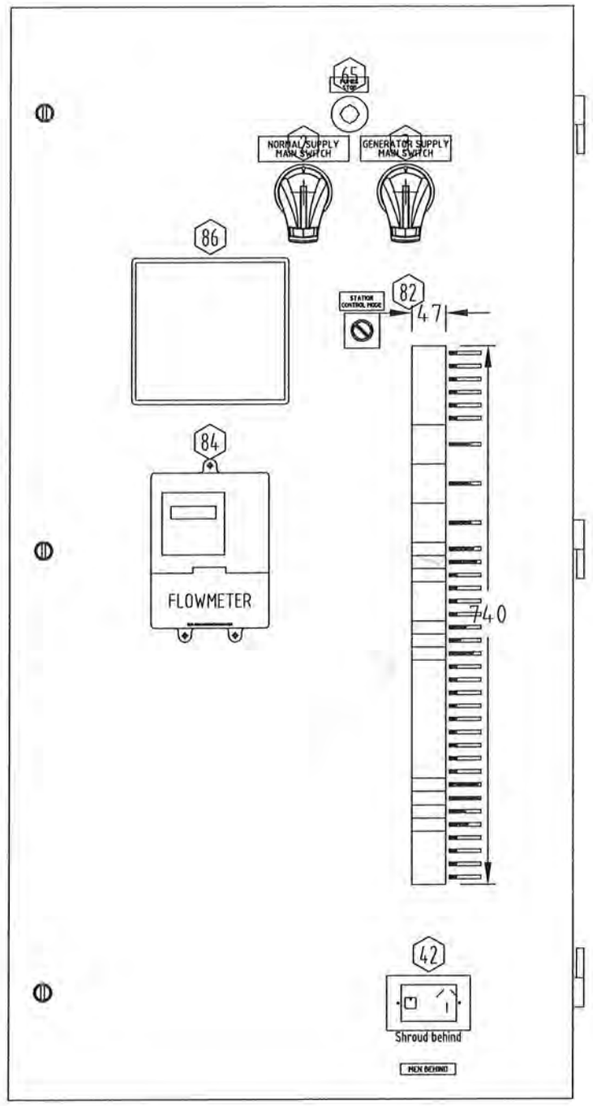
Main switch labels	MAIN SWITCH 100A	10mm / 4mm	Material gravoply Colour B/W
Pump CB labels	PUMP No1 32A	6mm / 4mm	Material gravoply Colour W/B
Compartment labels	RTU	10mm	Material Stainless Steel
Warning labels	DANGER 415V ISOLATE ELSE WHERE	7mm / 5mm	Material gravoply Colour R/W

Internal labels secured by M3 316 grade stainless steel metal threads and adhesive.
CB's to be identified with individual labels as per label schedule
Labels obstructed by switchboard wiring are relocated to adjacent duct lid and secured by M3 nylon threads. Lid to be secured by a single cable tie af one corner.
External labels 1mm thick 316 grade s/steel secured by M3 316 s/steel metal threads.
Label on the internal side of the escutcheon for all equipment mounted on escutcheon.
Affix labels with double sided tape only



DETAIL M

SUB-DISTRIBUTION BOARD ARRANGEMENT



ESCUTCHEON LAYOUT

DETAIL S

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:
RPEQ No. or LICENCE:
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ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 552 325
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JPR Project No.: E12-C63100

NAME SIGNATURE DATE
QUEENSLAND URBAN UTILITIES DELEGATE
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QUEENSLAND Urban Utilities

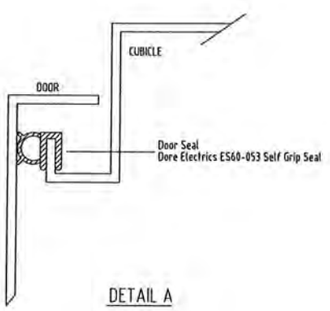
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DRAFTED LIEN LE; DRAFTING CHECK LUCAS WEDLEY; CAD FILE 49-1194-013-A.DWG; Q.U.U. FILE No.
LUCAS WEDLEY 24/01/13; DESIGN R.P.E.Q. No. DATE; ORIGINAL SIGNED BY; DESIGN CHECK R.P.E.Q. No. DATE
APPROVED BY SIGNATURE DATE; CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065 SEIB STREET - KILCOY WATER BOOSTER

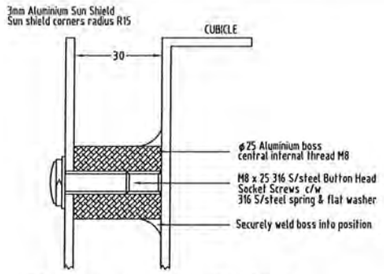
DRAWING TITLE: SWITCHBOARD CONSTRUCTION NOTES AND DETAILS

SHEET No. 13 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-013
AMEND A



DETAIL A

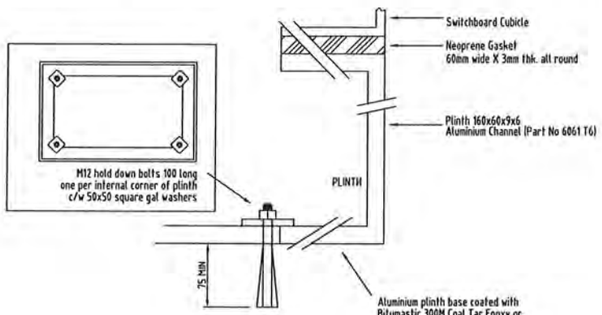
(DOOR SEAL)



Note: Screws are not to penetrate cubicle metalwork

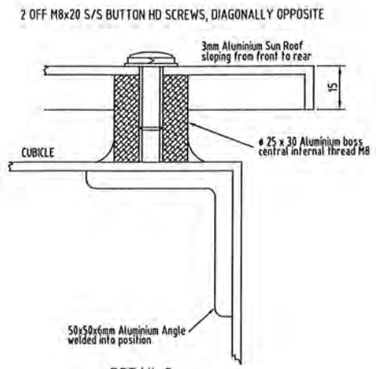
DETAIL B

(SUN SHIELD MOUNTING TO SIDES, REAR AND DOORS)



DETAIL E1

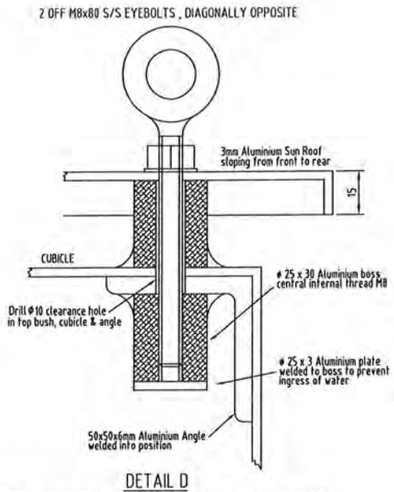
(PLINTH FIXING DETAIL)



DETAIL C

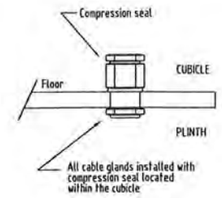
(SUN ROOF FIXING DETAIL)
(2 OFF M8x20 S/S BUTTON HD DIAGONALLY OPPOSITE)

Note: Screws are not to penetrate cubicle metalwork



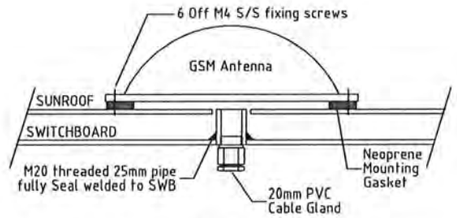
DETAIL D

(EYE BOLT FIXING DETAIL- 2 OFF M8x80 s/s , DIAGONALLY OPPOSITE)
(REPLACE EYEBOLTS WITH M8x50 s/s BUTTON SCREWS AT SITE)



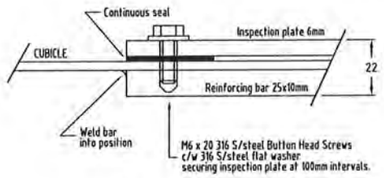
DETAIL G

(CABLE GLAND INSTALLATION DETAIL)



DETAIL X

(GSM ANTENNA MOUNTING DETAIL)



Note: Screws are not to penetrate reinforcing bar

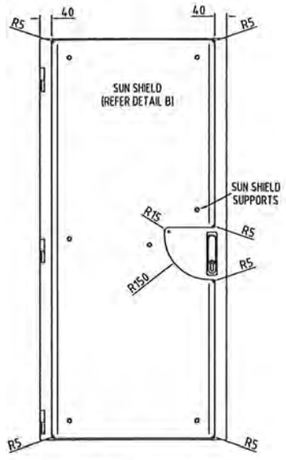
DETAIL F

(INSPECTION PLATE FIXING DETAIL)

(Fit 3mm neoprene gasket between plinth & flange)
(Fixings 316 s/steel bolts, nuts, flat & spring washers)

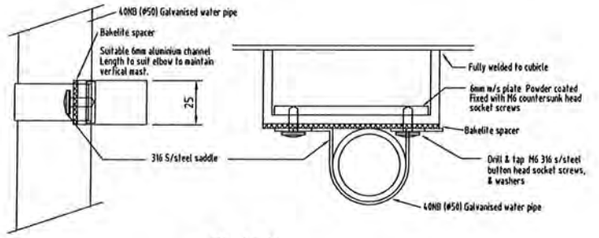
DETAIL P

(AERIAL FLANGE MOUNTING DETAIL)



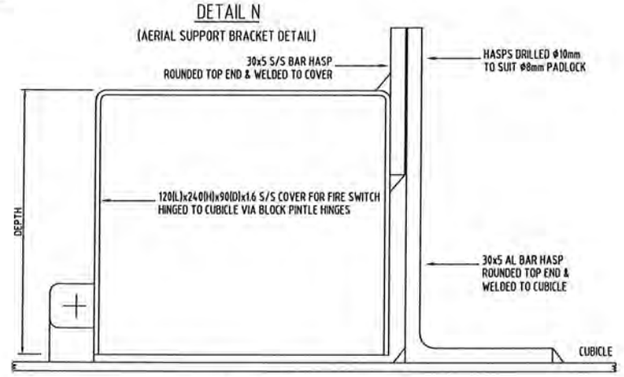
DETAIL K

(DOOR SUN SHIELD DETAIL)



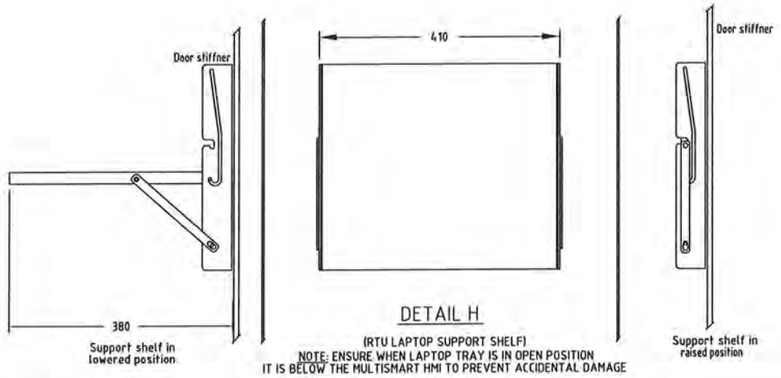
DETAIL N

(AERIAL SUPPORT BRACKET DETAIL)



DETAIL R

(GEN INLET - HINGED PADLOCKABLE HANDLE)



DETAIL H

(RTU LAPTOP SUPPORT SHELF)
NOTE: ENSURE WHEN LAPTOP TRAY IS IN OPEN POSITION
IT IS BELOW THE MULTISMART HMI TO PREVENT ACCIDENTAL DAMAGE

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:

RPEQ No. or LICENCE:

COMPANY NAME:

START DATE: FINISH DATE:

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND Urban Utilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
2	04.13	AMENDED FROM QUU COMMENTS	L.P.	M.F.		
1	03.13	RE-ISSUED FOR APPROVAL	B.J.	B.J.		
A	06.13	ISSUED FOR CONSTRUCTION	M.F.	M.F.		

FUNDING: DESIGN W.O. No. QUUXXX; CONSTRUCTION W.O. No. SOA XXXXX-XXX; FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED LUCAS WEDLEY 24/01/13; DRAFTING CHECK LUCAS WEDLEY; CAD FILE 49-1194-014-A.DWG; Q.U.U. FILE No.

DESIGN LUCAS WEDLEY R.P.E.Q. No. DATE; ORIGINAL SIGNED BY; DESIGN CHECK R.P.E.Q. No. DATE

APPROVED BY SIGNATURE DATE; CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE
SWITCHBOARD
GENERAL ARRANGEMENT

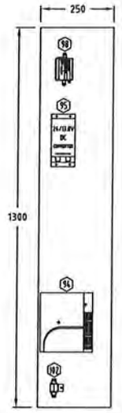
SHEET No. 14 OF 16

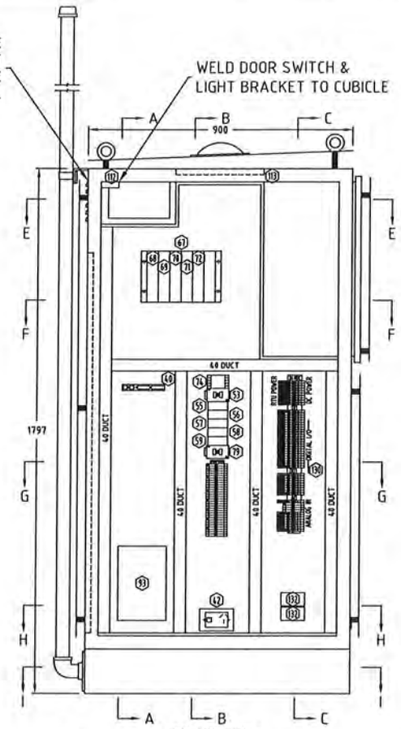
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-014

AMEND. A

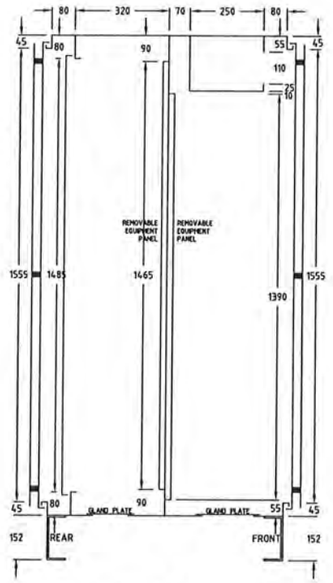
FIT MODIFIED VENT TO SIDE OF BATTERY COMPARTMENT S/S MESH GAUZE AND REMOVABLE FILTER MATERIAL

WELD DOOR SWITCH & LIGHT BRACKET TO CUBICLE

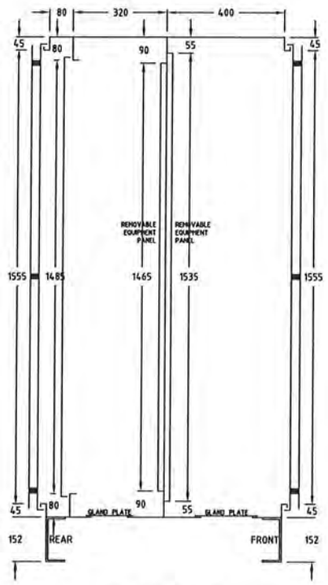



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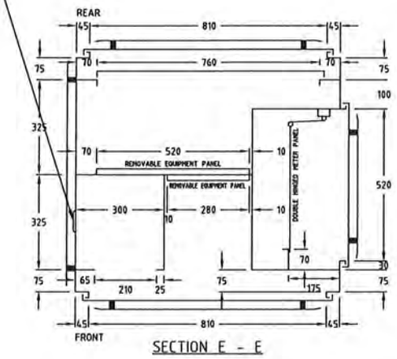
FIT MODIFIED VENT TO SIDE OF BATTERY COMPARTMENT S/S MESH GAUZE AND REMOVABLE FILTER MATERIAL



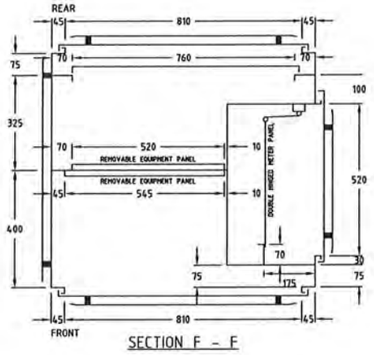
SECTION A - A



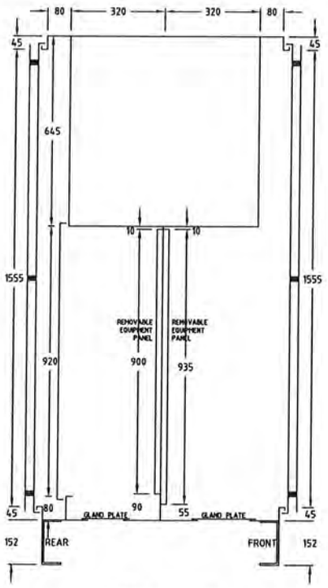
SECTION B - B



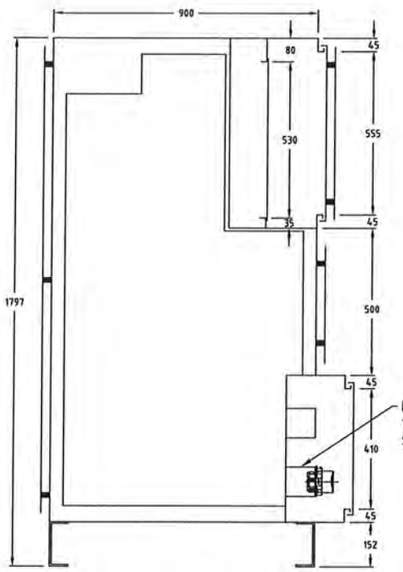
SECTION E - E



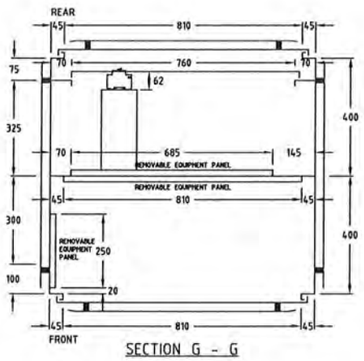
SECTION F - F



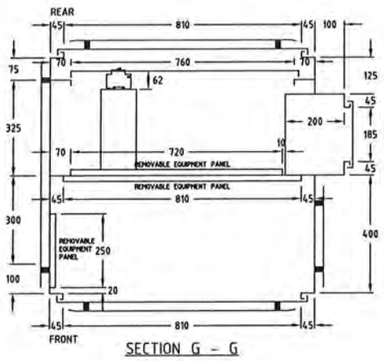
SECTION C - C



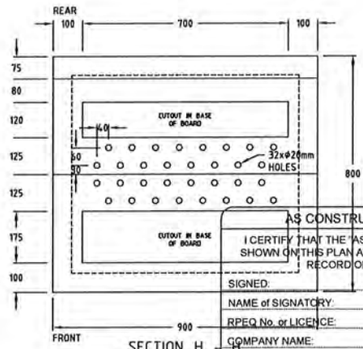
SECTION D - D



SECTION G - G



SECTION G - G



SECTION H

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:

RPEQ No. or LICENCE:

COMPANY NAME:

START DATE: FINISH DATE:

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
2	04.13	AMENDED FROM QUU COMMENTS	L.P.	M.F.		
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A	06.13	ISSUED FOR CONSTRUCTION	M.F.	M.F.		

FUNDING
DESIGN W.O. No. QUUXXX
CONSTRUCTION W.O. No. SOA XXXXX-XXX
FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No.	DATE
CAD FILE	49-1194-015&16-A.DWG	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No.	DATE

APPROVED BY SIGNATURE DATE
CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
SWITCHBOARD GENERAL ARRANGEMENT

SHEET No. 15 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-016

AMEND. A

REF TO DWG

486-4-9-1194-030

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:
RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

J. & P. RICHARDSON
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JPR Project No.: E12-C63100

NAME SIGNATURE DATE

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QUEENSLAND UrbanUtilities

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FUNDING					
DESIGN W.O. No.	QUUXXX	DRAFTING CHECK	LUCAS WEDLEY	LUCAS WEDLEY	24/01/13
CONSTRUCTION W.O. No.	SOA XXXXX-XXX	CAD FILE	49-1194-017-A.DWG	DESIGN R.P.E.Q. No.	DATE
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	Q.U.U. FILE No.		ORIGINAL SIGNED BY	
				DESIGN CHECK R.P.E.Q. No.	DATE

APPROVED BY	SIGNATURE	DATE
CONSTRUCTION MANAGER	SIGNATURE	DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE
SWITCHBOARD
SITE ARRANGEMENT

SHEET No. 16 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No.	AMEND.
486/4/9-1194-017	A

Form No. F1017/3

J. & P. RICHARDSON INDUSTRIES PTY LTD
114 Campbell Avenue, WACOL QLD 4076
Ph: (07) 3271 2911 - Fax: (07) 3271 3623
E-mail: jpr@jpr.com.au

SWITCHBOARD & SHEETMETAL INSPECTION REPORT

Customer Name: QUU | **Job No:** M+S 63100
Item: WB065 Seib St Kilcoy Water Booster | **Drawing No:** 486/4/9-1194-

TASK	PRODUCT DETAIL	INSPECTED BY	DATE	PASS / FAIL	CORRECTIVE ACTION REQUEST OR COMMENTS
Design	Documents	MF	4/6/13	Pass	
Drafting	Documents	MF	4/6/13	Pass	
Sheetmetal (Refer F1018 for details)	Switchboard	DC	3-7	P	
	Doors				
	Cell/Panels				
Painting					
Process	Powder / Wet				
Min DFT (40 STD)					
Cure Test					
Colour Exterior		HW	05/07/13	P	HW
Colour Internal					
Colour Panels					
Cubicle Erection					
Electrical Fitout (In accordance with drawings)		B. Allison			
Inspection & Test (Refer to F1019)		A. Varley	30-7-13	PASS	
Packing					

Comments:
* Hold on escutcheon, await flowmeter All Rgt Dom 05/07/13

NOTE: - Manufacture is not to proceed to the next process until the item has passed inspection

Affix Status Here: -

Yellow	Awaiting Inspection
Green	Inspection & Test Passed
Red	Inspection & Test Failed, Awaiting Rectification

1-8-13

Form No. F1018/4
Page 1 of 2

J. & P. RICHARDSON INDUSTRIES PTY. LTD.
114 Campbell Avenue, WACOL QLD 4076
Ph: (07) 3271 2911 - Fax: (07) 3271 3623
E-mail: jpr@jpr.com.au

SWITCHBOARD / SHEETMETAL INSPECTION CHECKLIST

CLIENT: QUU					JOB NO: M/S 63100
PRODUCT DESCRIPTION: WB065 Seib St Kilcoy Water booster.			DRAWING & SCHEDULE NUMBERS 486/4/9 -1194-		
CONSTRUCTION	QUALITY		COMPLIANCE WITH DRAWINGS		REMARKS OR ACTION
	GOOD	POOR	YES	NO	
1. Folds	✓		✓		
2. Welds	✓		✓		
3. Edges / File			✓		
4. Gauge			✓		
5. Material			✓		
6. Ventilation Openings / Filter Bracket			✓		
7. Water Ingress Test			/		
8. Equipment Mounting Arrangement			✓		
9. Doors Stiffened			✓		
10. Escutcheons and Lexan Covers			✓		
11. Cable Saddles			✓		
12. Grinding			✓		
13. Door Stays Fitted			✓		
14. Earth Studs			✓		
15. Rubber Retainer			–		
16. Drawing Holder			✓		
17. Hat Sections			✓		
18. Locking Bars Fitted			✓		
19. External Crevice Welded and Ground			–		
20. Legend Cards			✓		
21. General Conditions Satisfactory			✓		
22. Cabinet Clean			✓		
23. Job Name and Number Marked on Board and Panels			✓		
24. Lap Top Tray			✓		
25. Gland Plates Fitted			✓		
26. Sunshields Fitted			✓		

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E-mail: jpr@jpr.com.au

SWITCHBOARD / SHEETMETAL INSPECTION CHECKLIST

CONSTRUCTION	QUALITY		COMPLIANCE WITH DRAWINGS		REMARKS OR ACTION
	GOOD	POOR	YES	NO	
27. Mullion Welded to Divider			–		
28. Double Hinge Meter Panel Fitted			✓		
29. Plinth Fitted			✓		
30. Wall Mount Brackets			–		
31. Light Switch Brackets			✓		
32. Cowls			–		
INSPECTED BY: D. CRANE	DATE: 3-B-13				

AFFIX STATUS HERE

Yellow	Awaiting Inspection
Green	Inspected/Tested Passed
Red	Inspected/Tested Awaiting Rectification



J. & P. RICHARDSON INDUSTRIES PTY LTD
114 Campbell Avenue, WACOL QLD 4076
Ph: (07) 3271 2911 - Fax: (07) 3271 3623
E-mail: jpr@jpr.com.au

SWITCHBOARD ELECTRICAL INSPECTION & TEST REPORT

Customer Name:	QUU						
Project:	SEIB ST KILCOY WATER BOOSTER						
JPR Job No:	M 63100		**Item:**	WB065			
Constructed by:	B. ALLISON		**Tested by:**	A. VARY		**Date:**	30-7-13

Item check list:	*To comply with Drawings, Documents & Specification*						
Main Functional Unit/s	Qty	✓	Size	✓	Settings	✓	
Fuse Fittings	Qty	✓	Size	✓	Fuse Size	✓	
Circuit Breakers	Qty	✓	Size	✓	Settings	✓	
Motor Protection C.B.	Rating		Setting		Function		
Neutral	Reqd	✓	Size	✓	ID	✓	
Equipment Earthing	Checked	✓	Size	✓			
C.T.s	Qty		Rating		Pri Inject.		
Meters	Qty		Rating		Function		
Contactors	Qty	✓	Rating	✓	Voltage	✓	
Overloads	Qty		Rating		Function		
Relays	Qty	✓	Rating	✓	Voltage	✓	
Timers	Qty		Rating		Voltage		
Control Switches	Qty	✓	Rating	✓	Function	✓	
Push Buttons	Qty	✓	Rating	✓	Function	✓	
Pilot Lights	Qty		Rating		Voltage		
Transformers	Qty	✓	Rating	✓	Voltage	✓	
ATT/VFD/Soft Starter	Qty		Rating		Function		
DC Supply	Qty	✓	Rating	✓	Voltage	✓	
Terminals	Qty	✓	Size	✓	ID	✓	
Engraving	Qty	✓	Size	✓	ID	✓	
Cabling	Type	✓	Size	✓	ID	✓	
Busbars	Type		Size		ID		
Escutcheons / Shrouds	Type	✓	Label	✓	IP rating	✓	
S.A. Metering CTs	Qty		Rating				
S.A Metering Links	Type						
S.A. Meters	Type		Size				
JPR Label	Fitted	✓	Stamped	✓	Safety Stkr	✓	
Legend Card	Qty		Correct				
PLC/Telemetry	Qty	✓	Size	✓			
Power Monitor Relay	Qty		Rating		Function		

General Check List:							
IP Sealing	Rating	✓				✓	
Door Latches/Hinges	Qty	✓	Type	✓	Operation		
Ventilation	Required		Type		Operation		
Circuit Schedule	Markup	✓	Checked		Supplied	✓	
Terminal Tightness	Power	✓	Control	✓	Result		
Busbar System	Clearances		Joints		ID	✓	
Earth Continuity	Body to E	✓	Doors to E	✓	Panels to E		
Cubicle Cleaned	✓						
Paint Finish Intact	✓						
Polarity Check	R - R	✓	W - W	✓	B - B	✓	
Function	Power	✓	Control	✓	PLC/Telem	✓	
Continuity Check	R - R	✓	W - W	✓	B - B	✓	N - N ✓

Insulation Test	*R to E*	*W to E*	*B to E*	*R to W*	*R to B*	*W to B*	*N to E*
1000v Test (MΩ)	500	500	500	500	500	500	
MAINS GENERATOR " " "	500	500	500	500	500	500	

Earth Leakage						
Earth Leakage Test		Rated Current		Trip Current		Trip Time	
Q10		30		25		28.6	
Q11		30		25		28.6	

Comments:

JOB SAFETY ANALYSIS

LIVE LOW VOLTAGE WORK

TESTING SWITCHBOARDS AND CONTROL PANELS WITHIN OUR MANUFACTURING PREMISE

APPROVED BY: Eric McCulloch (WHSO)

LOCATION: WACOL WORKSHOP DATE: 31/7/13

AUTHORISATIONS	PERSONAL PROTECTIVE EQUIPMENT
• Authorisation from person in charge ☑ YES (Signature)	• Long cotton clothing ☑ YES • Insulating work gloves in test ☑ YES • Insulating mats / covers in test ☑ YES • Switchboard rescue kit in test ☑ YES

TASK		
LIVE LOW VOLTAGE WORK	• Isolation points identified and accessible	☑ YES
	• Work area clear of obstructions	☑ YES
	• Unauthorised access prevented to work area	☑ YES
	• P.P.E. is fit for purpose	☑ YES
	• Test equipment is fit for purpose	☑ YES
	• Written authority to proceed has been obtained from a person in charge	☑ YES
TESTING SWITCHBOARDS AND CONTROL PANELS WITHIN OUR MANUFACTURING PREMISES	• JPR authorisation to conduct live work is current	☑ YES
	• Approved dedicated power supply only used for testing.	☐ YES
	• Approved dedicated power supply in current test	☐ YES
OPTION	(A) RCD protected outputs used at power supply	☑ YES
	> RCD protection checked daily prior to use	☑ YES
	> Safety Observer is / is not required	☑ YES
OPTION	(B) Non RCD protected outputs used at power supply	☐ YES
	> Supervisor consulted prior to use	☐ YES
	> Safety Observer is in attendance	☐ YES

I understand and am fully aware of the requirements of this job safety analysis.

Signatures:	1.	2.	3.	4.	5.

FILE: EMC0381/BL 03/01/03 PAGE 1

JOB SAFETY ANALYSIS

LIVE LOW VOLTAGE WORK

TESTING SWITCHBOARDS AND CONTROL PANELS WITHIN OUR MANUFACTURING PREMISE

APPROVED BY: Eric McCulloch (WHSO)

LOCATION: WACOL WORKSHOP DATE: 1/8/13

AUTHORISATIONS		PERSONAL PROTECTIVE EQUIPMENT	
• Authorisation from person in charge (Signature)	☑ YES	• Long cotton clothing • Insulating work gloves in test • Insulating mats / covers in test • Switchboard rescue kit in test	☑ YES ☑ YES ☑ YES ☑ YES

TASK		
LIVE LOW VOLTAGE WORK	• Isolation points identified and accessible	☑ YES
	• Work area clear of obstructions	☑ YES
	• Unauthorised access prevented to work area	☑ YES
	• P.P.E. is fit for purpose	☑ YES
	• Test equipment is fit for purpose	☑ YES
	• Written authority to proceed has been obtained from a person in charge	☑ YES
TESTING SWITCHBOARDS AND CONTROL PANELS WITHIN OUR MANUFACTURING PREMISES	• JPR authorisation to conduct live work is current	☑ YES
	• Approved dedicated power supply only used for testing.	☐ YES
	• Approved dedicated power supply in current test	☐ YES
OPTION	(A) RCD protected outputs used at power supply	☑ YES
	> RCD protection checked daily prior to use	☐ YES
	> Safety Observer is / is not required	☑ YES
OPTION	(B) Non RCD protected outputs used at power supply	☐ YES
	> Supervisor consulted prior to use	☐ YES
	> Safety Observer is in attendance	☐ YES

I understand and am fully aware of the requirements of this job safety analysis.

Signatures:	1.	2.	3.	4.	5.

FOR

LIVE LOW VOLTAGE WORK

TESTING SWITCHBOARDS AND CONTROL PANELS WITHIN JPR MANUFACTURING PREMISES AN INDEPENDENT BODY

APPROVED BY: Eric McCulloch (WHSO)

LOCATION: WACOL WORKSHOP **DATE:** 15.10.13.

AUTHORISATIONS		MINIMUM PERSONAL PROTECTIVE EQUIPMENT	
• JPR induction completed	☑ YES	• Long cotton clothing	☑ YES
• Authorisation from JPR person in control to perform live work	☐ YES	• Insulating work gloves in test	☑ YES
• Independent body employee Qualifications in accordance with requirements of Electrical Safety Act.	☑ YES	• Insulating mats / covers in test	☑ YES
		• Switchboard rescue kit in test	☑ YES
(Signature) JPR Person in Control		Note:- Items 2,3,4 are to be supplied by the independent body and submitted to JPR for inspection prior to initial use	

HAZARDS	CONTROL MEASURES	
• CONTACT WITH LIVE LOW VOLTAGE • ELECTRIC SHOCK • BURNS	• Isolation points identified and accessible	☑ YES
	• Work area clear of obstructions	☑ YES
	• Unauthorised access prevented to work area Barriers and signage provided by independent body	☑ YES
	• P.P.E. is fit for purpose and in test	☑ YES
	• Test equipment is fit for purpose and in test	☑ YES
	• Authority to proceed has been obtained from JPR person in control	☑ YES
	• Independent body authorisation to conduct live work is current (documentation required to support evidence)	☑ YES
	• Approved dedicated power supply only used for testing. (JPR supplied)	☑ YES
	• Approved dedicated power supply in current test	☑ YES
	OPTION (A) RCD protected outputs used at power supply	☑ YES
	> RCD protection checked daily prior to use	☑ YES
	> Safety Observer is / is not required (Competent safety observer supplied by independent body for duration of live work, documentation required to support evidence)	☐ YES
	OPTION (B) Non RCD protected outputs used at power supply	☐ YES
	> JPR person in control prior to use	☐ YES
	> Safety Observer is in attendance (Competent safety observer supplied by independent body for duration of live work, documentation required to support evidence)	☐ YES

I understand and am fully aware of the requirements of this job safety analysis.

ALL INDEPENDENT BODY EMPLOYEES ON SITE PERFORMING LIVE WORK TO SIGN

Signatures:	R Rios	D Clayton			
Name Printed:	RIOS M	Brian Clayton			
Date:	15/10/13	15/10/13			

Compliance Certificate for building Design or Specification **15**

NOTE

This is to be used for the purposes of section 10 of the *Building Act 1975* and/or section 46 of the *Building Regulation 2006.*

RESTRICTION: A building certifier (class B) can only give a compliance certificate about whether building work complies with the BCA or a provision of the QDC. A building certifier (Class B) can not give a certificate regarding QDC boundary clearance and site cover provisions.

1. Property description

This section need only be completed if details of street address and property description are applicable.
EG. In the case of (standard/generic) pool design/shell manufacture and/or patio and carport systems this section may not be applicable.

The description must identify all land the subject of the application.

The lot & plan details (eg. SP / RP) are shown on title documents or a rates notice.

If the plan is not registered by title, provide previous lot and plan details.

Street address *(include no., street, suburb / locality & postcode)*

Sieb Street KILCOY

Postcode

Lot & plan details *(attach list if necessary)*

In which local government area is the land situated?

2. Description of component/s certified

Clearly describe the extent of work covered by this certificate, e.g. all structural aspects of the steel roof beams.

Pump well and valve pit plus aluminium cover to pump well

3. Basis of certification

Detail the basis for giving the certificate and the extent to which tests, specifications, rules, standards, codes of practice and other publications, were relied upon.

AS3996 : 2006 - Australian Standard Load Classifications - Class B

AS1170.2 - 2002 Loading Code

AS/NZS1664.1 - 1997 Aluminium Structures

AS3600 - 2001 Concrete Structures

Principles of structural mechanics

LOCAL GOVERNMENT USE ONLY

Date received		Reference Number/s		Approved form 15 Version 2 11/11

Form 15 continued

4. Reference documentation

Clearly identify any relevant documentation, e.g. numbered structural engineering plans.

Hughes, Beal and Wright Pty Ltd drawings 2013-067-1C, 2C, 3A, 4A, 5A, 6A, 7A,
Drawings 1 and 12 dated the latter five dated 18/08/13

5. Building certifier reference number

Building certifier reference number

6. Competent person details

A competent person for building work, means a person who is assessed by the building certifier for the work as competent to practise in an aspect of the building and specification design, of the building work because of the individual's skill, experience and qualifications in the aspect. The competent person must also be registered or licensed under a law applying in the State to practice the aspect.

If no relevant law requires the individual to be licensed or registered to be able to give the help, the certifier must assess the individual as having appropriate experience, qualifications or skills to be able to give the help.

If the chief executive issues any guidelines for assessing a competent person, the building certifier must use the guidelines when assessing the person.

Name (*in full*)
Peter Geoffrey Wright

Company name (*if applicable*)
Hughes, Beal and Wright Pty Ltd

Contact person
Peter Wright

Phone no. *business hours*
07 3814 4993

Mobile no.
0418 745 342

Fax no.

Email address
peterwright01@optusnet.com.au

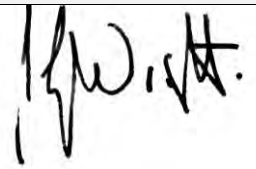
Postal address
11 Wilkie Avenue
REDBANK PLAINS Postcode 4301

Licence or registration number (*if applicable*)
RPEQ 1193

7. Signature of competent person

This certificate must be signed by the individual assessed by the building certifier as competent.

Signature



Date
13 December 2013

The *Building Act 1975* is administered by the Department of Local Government and Planning

Queensland Government

Version 4 – March 2013

Form 16—Inspection Certificate / Aspect Certificate / QBSA Licensee Aspect Certificate

NOTE

This form is to be used for the purposes of section 10(c) and 239 of the *Building Act 1975* and/or sections 32, 35B, 43, 44 and 47 of the *Building Regulation 2006*.

1. Indicate the type of certificate

The stages of assessable building work are listed in section 24 of the *Building Regulation 2006* or as conditioned by the building certifier.

An aspect of building work is part of a stage (e.g. waterproofing).

☐ **Inspection Certificate** for

☐ Stage of building work (for single detached class 1a or class 10 building or structure)

(indicate the stage) _____

■ Aspect of building work

(indicate the aspect) **Pump and valve pit**

☐ **QBSA Licensee Aspect Certificate**

Scope of the work

Scope of the work covered by the licence class under the *Queensland Building Services Authority Regulation 2003* for the aspect being certified, e.g. scope of work for a waterproofing licence is "installing waterproofing materials or systems for preventing moisture penetration". An aspect being certified may include "wet area sealing to showers".

2. Property description

The description must identify all land the subject of the application.

The lot & plan details (eg. SP / RP) are shown on title documents or a rates notice. If the plan is not registered by title, provide previous lot and plan details.

Street address *(Include no., street, suburb / locality & postcode)*

Sieb Street KILCOY

Postcode

Lot & plan details *(Attach list if necessary)*

In which local government area is the land situated?

3. Building/structure description

Building/structure description	Class of building / structure

LOCAL GOVERNMENT USE ONLY

DATE RECEIVED		REFERENCE NUMBER/S	

4. Description of component/s certified
Clearly describe the extent of work covered by this certificate, e.g. all structural aspects of the steel roof beams.

Prefabricated Concrete Pump Pit floor and wall reinforcing gages prior to placement in excavations.
Prefabricated Concrete Pump Pit roof reinforcement in place prior to placement of concrete.
Prefabricated Concrete Valve Pump Pit floor and wall reinforcing gages prior to placement of concrete.

5. Basis of certification
Detail the basis for giving the certificate and the extent to which tests, specifications, rules, standards, codes of practice and other publications, were relied upon.

The floor and wall reinforcement was of the specified size and spacing.
The reinforcement in the pump pit lit was of the required size, spacing and in the correct location prior to casting concrete.

6. Reference documentation
Clearly identify any relevant documentation, e.g. numbered structural engineering plans.

Hughes, Beal and Wright Pty Ltd drawings 2013-067-1C, 2C, 3A, 4A, 5A, 6A, 7A, dated 18/08/13

7. Building certifier reference number and development approval number

Building certifier reference number

Development approval number

8. Building Certifier, competent person or QBSA licensee details

A **competent person** must be assessed as competent before carrying out the inspection.

The builder for the work cannot give a stage certificate of inspection.

A competent person is assessed by the building certifier for the work as competent to practice in an aspect of the building and specification design, because of the individual's skill, experience and qualifications. The competent person must be registered or licensed under a law applying in the State to practice the aspect.

If no relevant law requires the individual to be licensed or registered, the certifier must assess the individual as having appropriate experience, qualifications or skills to be able to give the help.

If the chief executive issues any guidelines for assessing a competent person, the building certifier must use the guidelines when assessing the person.

Name (*in full*)
Peter Wright

Company name *if applicable*
Hughes, Beal & Wright Pty Ltd

Contact person
Peter Wright

Phone no. *business hours*
07 3814 4993

Mobile no.

Fax no.

Email address
peterwright01@optusnet.com.au

Postal address
11 Wilkie Avenue REDBANK PLAINS
Postcode 4301

Licence class

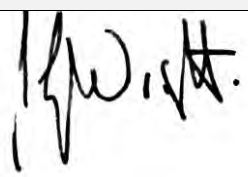
Licence number
RPEQ 1193

Date approval to inspect received from building certifier

9. Signature of building certifier, competent person or QBSA licensee

Note: A building certifier must sign this form for temporary swimming pool fencing under section 4 of Schedule 1 of QDC MP 3.4.

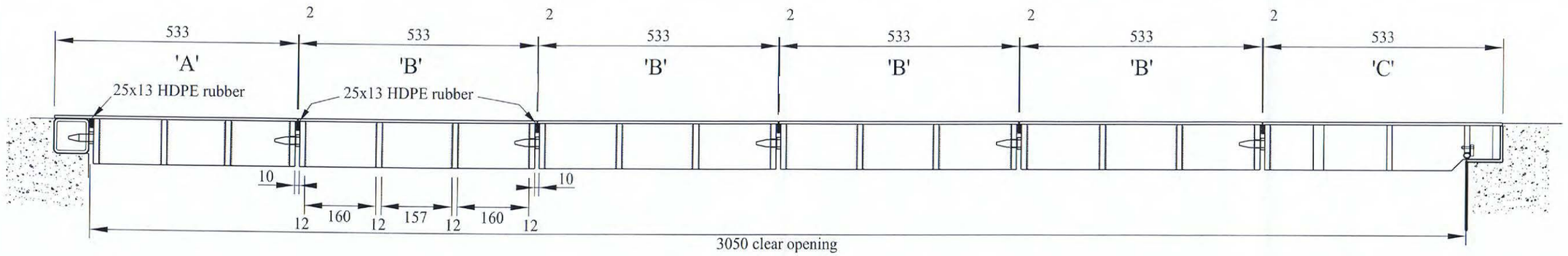
Signature

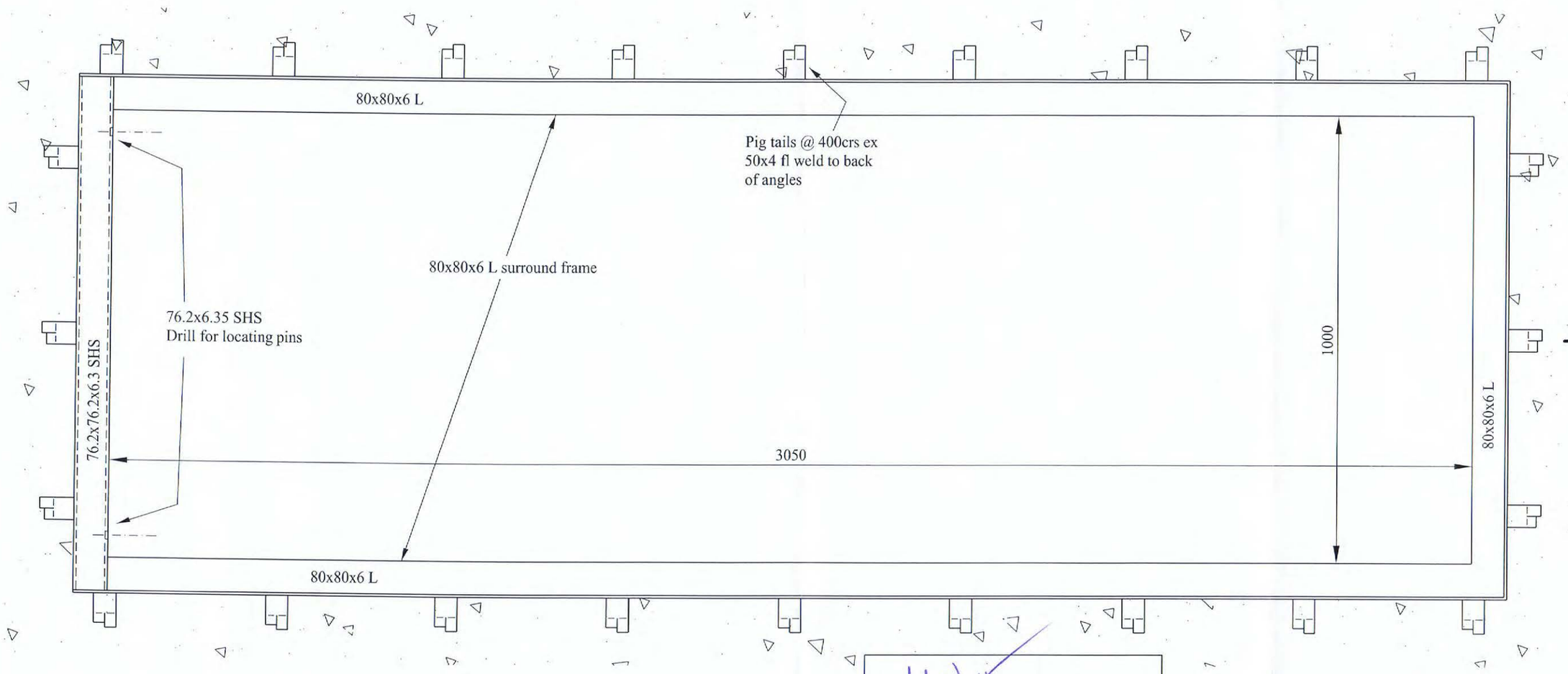


Date
13 December 2013

The *Building Act 1975* is administered by the Department of Housing and Public Works

Queensland Government





Peter Wright 18/08/13 RPEQ 1193

Issue B Rubber Seals added 11/06/13
Issue A Drip Channels added 26/5/13

This drawing was originally produced as A3

HUGHES, BEAL & WRIGHT Pty. Ltd.
A.C.N. 010 588 548 A.B.N. 96 010 588 548
CONSULTING ENGINEERS
Structural, Civil & Geotechnical
11 Wilkie Avenue
REDBANK PLAINS 4301
Tel (07) 3814 4993 f (07) 3814 4883

Client
Hallco Engineering
55 William Street
CALOUNDRA

Project
Aluminum Covers
3.05m x 1.0m Pit

Surround Frame Cover Long Section

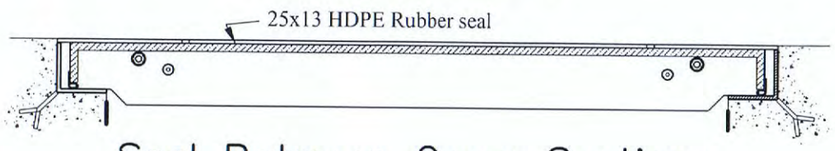
Dwg No. 2013-067 - 1C
Date 18/08/13
Drawn PGW



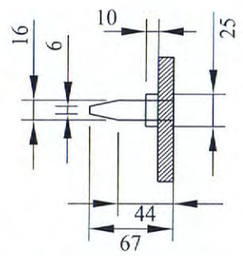
Typr 'B' Cover

End Cover

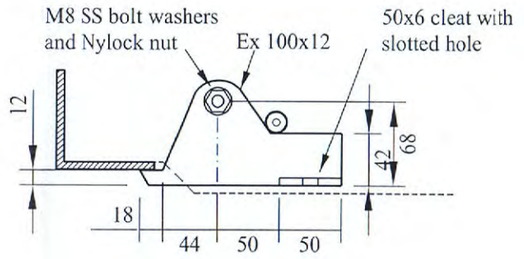
Cover Section



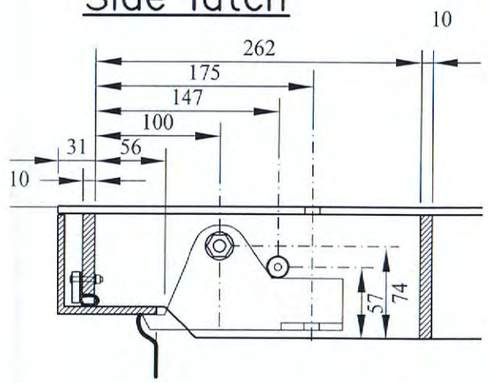
Seal Between Cover Sections



Locating Pin



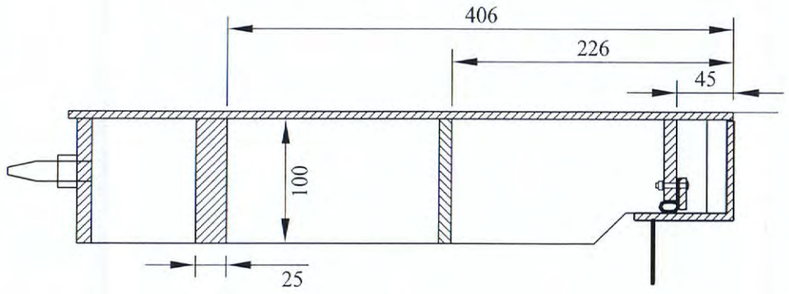
Side latch



Side Latch Setout

Hallco Standard Latch box with 100x50x6 surround angles in lieu of 80x50x6.

Section Z



Section Y

1. Covers designed to Class D load classificatrion in accordance with AS 3996 - 2006.
2. All components to be fabricated from Grade 6061-T6 aluminium u.n.o.
3. All nuts bolts and washers to be Grade 316 Stainless Steel.
4. All welds to be weld quality 'B' in accordance with AS1665.
5. All welds to be 6mm continuous fillet welds with weld alloy 4043.
6. Welds omitted from drawing for clarity.

Peter Wright 18/08/13 RPEQ 1193

Issue B	Rubber Seals added	11/06/13
Issue A	Drip Channels added	26/5/13

This drawing was originally produced as A3

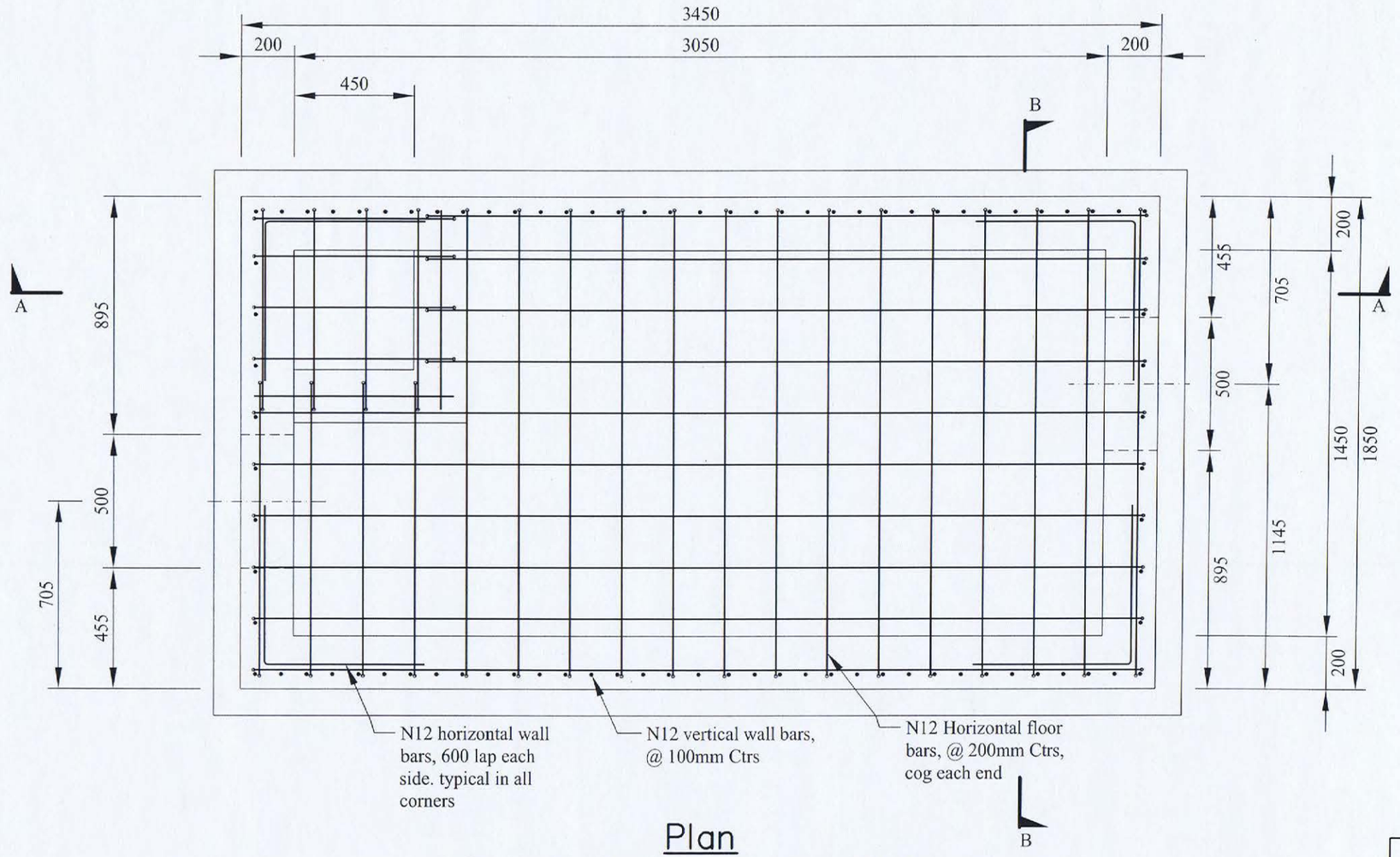
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A.C.N. 010 588 548 A.B.N. 96 010 588 548
CONSULTING ENGINEERS
Structural, Civil & Geotechnical
11 Wilkie Avenue
REDBANK PLAINS 4301
Tel (07) 3814 4993 f (07) 3814 4883

Client: Hallco Engineering, 55 William Street, CALOUNDRA

Project: Aluminum Covers, 3.05m x 1.0m Pit

Details

Dwg No. 2013-067 - 2C
Date 18/08/13
Drawn PGW



Plan
Pump Well Base and Walls

AS CONSTRUCTED

Peter Wright — 18/08/13 RPEQ 1193

This drawing was originally produced as A3

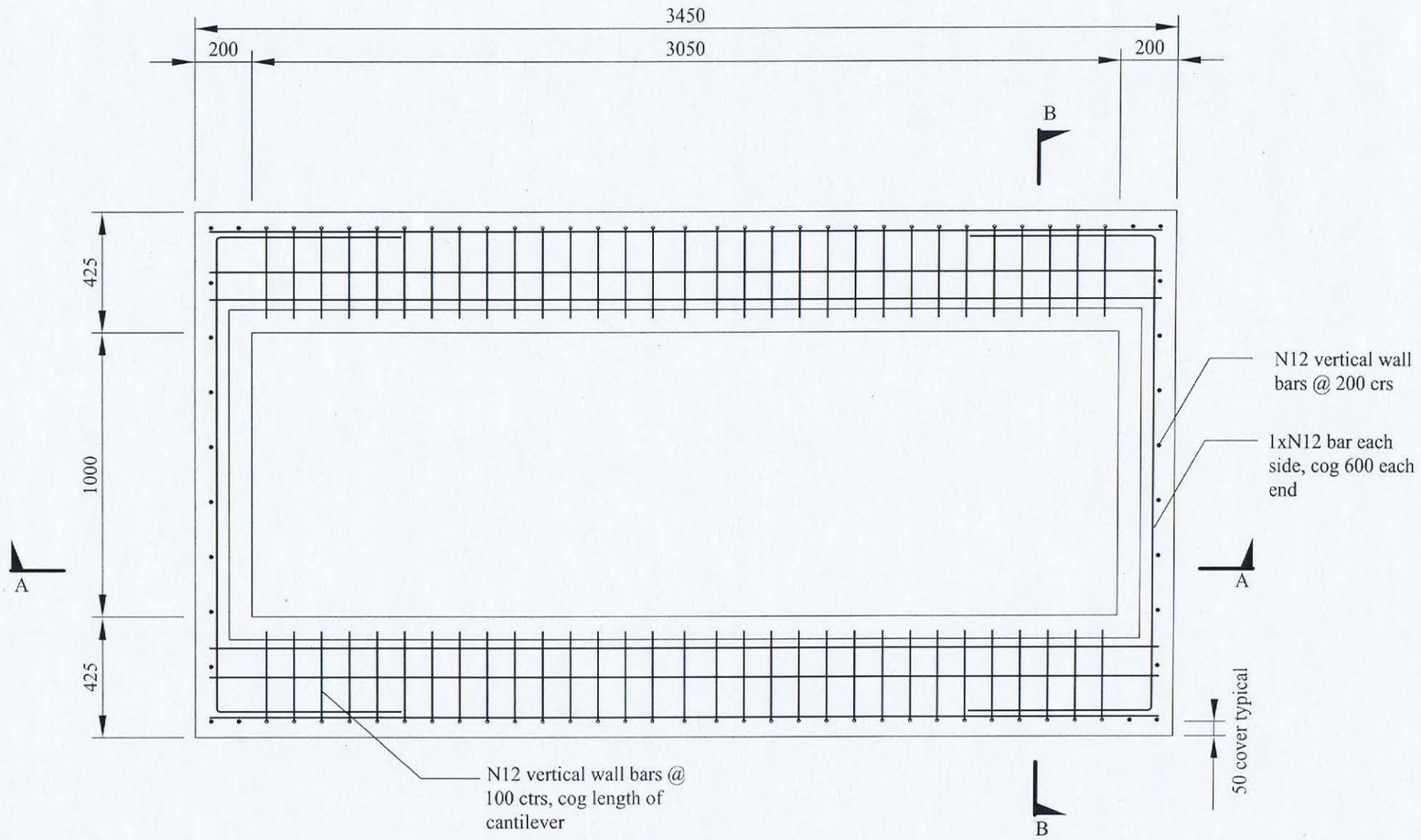
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CONSULTING ENGINEERS
Structural, Civil & Geotechnical
11 Wilkie Avenue
REDBANK PLAINS 4301
Tel (07) 3814 4993 f (07) 3814 4883

Client: Hallco Engineering, 55 William Street, CALOUNDRA

Project: Pump & Valve Pits, Kilcoy

Details

Dwg No. 2013-067 - 3A
Date 18/08/13
Drawn PGW



Plan
Pump Well Roof

AS CONSTRUCTED

Peter Wright 18/08/13 RPEQ 1193

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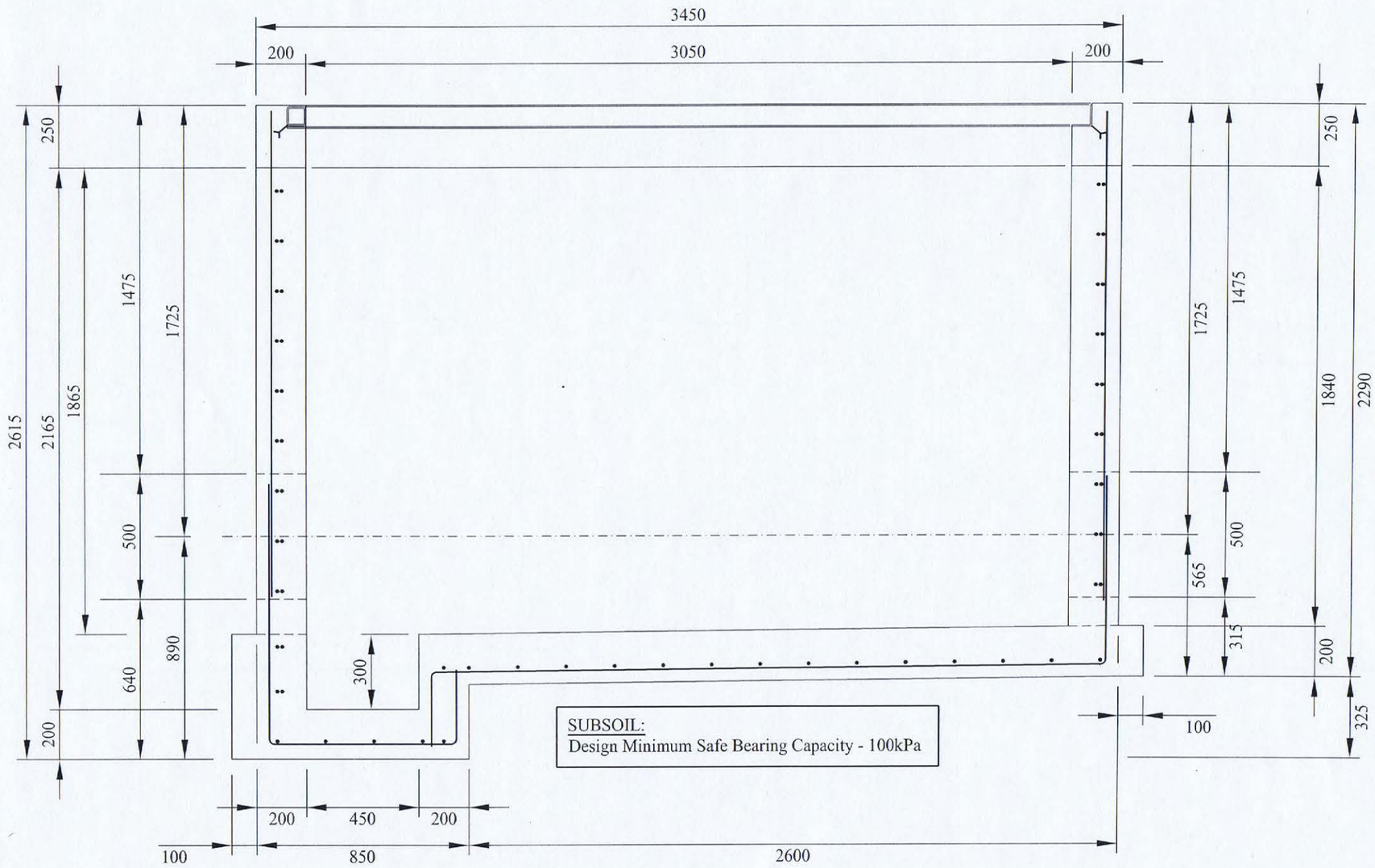
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Structural, Civil & Geotechnical
11 Wilkie Avenue
REDBANK PLAINS 4301
Tel (07) 3814 4993 f (07) 3814 4883

Client: Hallco Engineering
55 William Street
CALOUNDRA

Project: Pump & Valve Pits
Kilcoy

Details

Dwg No. 2013-067 - 4A
Date 18/08/13
Drawn PGW



Section A–A
Pump Well

AS CONSTRUCTED

Peter Wright 18/08/13 RPEQ 1193

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Structural, Civil & Geotechnical
11 Wilkie Avenue
REDBANK PLAINS 4301
Tel (07) 3814 4993 f (07) 3814 4883

Client: Hallco Engineering
55 William Street
CALOUNDRA

Project: Pump & Valve Pits
Kilcoy

Details

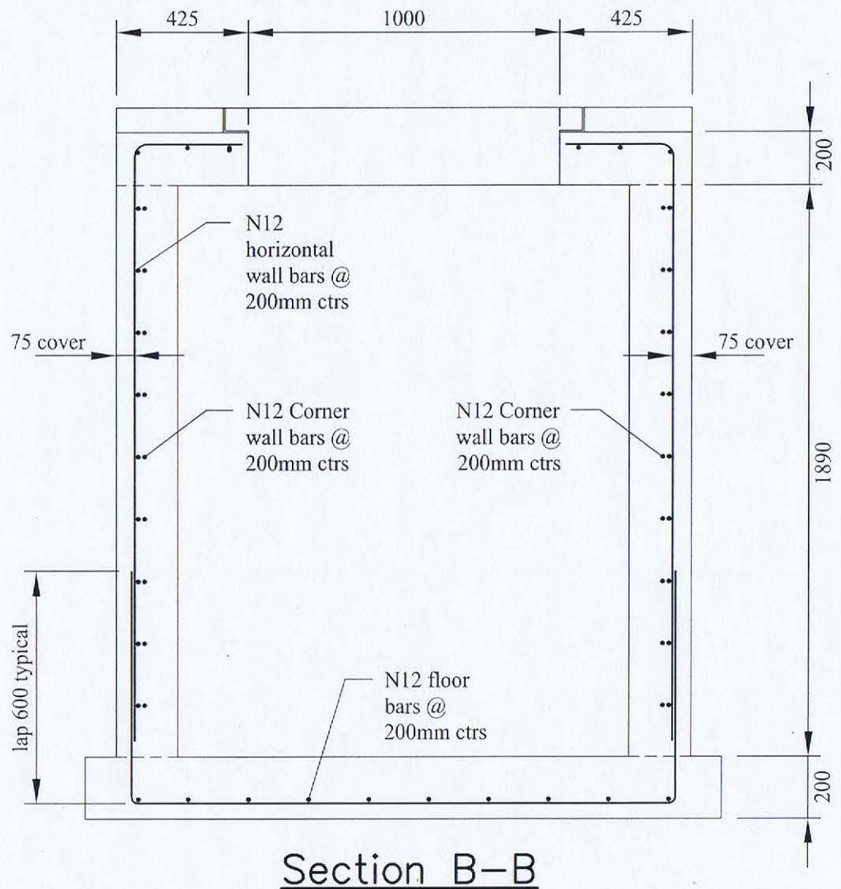
Dwg No. 2013-067 - 5A
Date 18/08/13
Drawn PGW

GENERAL NOTES

The builder shall verify all dimensions with those shown on the J & P Richardson Drawings. .
Setout dimensions to be taken from J & P Richardson Drawings.
Footings to be founded in natural ground (not fill) with the minimum safe bearing capacity of 100kPa.
All proprietary products are to be supplied and installed strictly in accordance with the manufacturer's recommendations.

CONCRETE

All concrete work shall be carried out in accordance with AS3600 and all codes referred to therein.
Concrete to pad and pier footings shall be Grade S40 as per required by Urban Utilities.
Roof slab shall be cast in-situ and shall remain propped for 7 days.
All concrete slabs shall be cured using a continuous polythene sheet with water applied under to maintain the concrete surface in a saturated condition for 14 days.
Reinforcement to conform to AS/NZ 4671:2001 and shall be as follows:-
All bar to be D500N
unless noted otherwise.
All concrete to properly compacted using a mechanical vibrator.



Section B–B
Pump Well

AS CONSTRUCTED

Peter Wright — 18/08/13 RPEQ 1193

This drawing was originally produced as A3

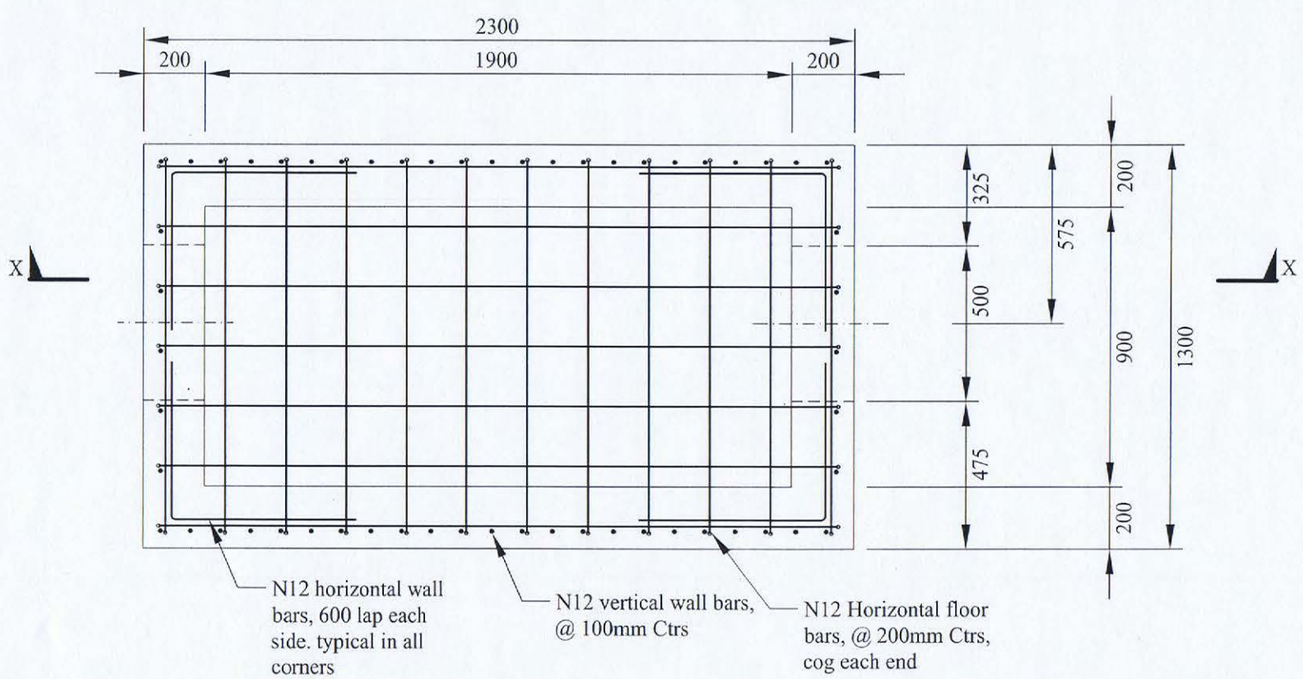
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Structural, Civil & Geotechnical
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REDBANK PLAINS 4301
Tel (07) 3814 4993 f (07) 3814 4883

Client: Hallco Engineering
55 William Street
CALOUNDRA

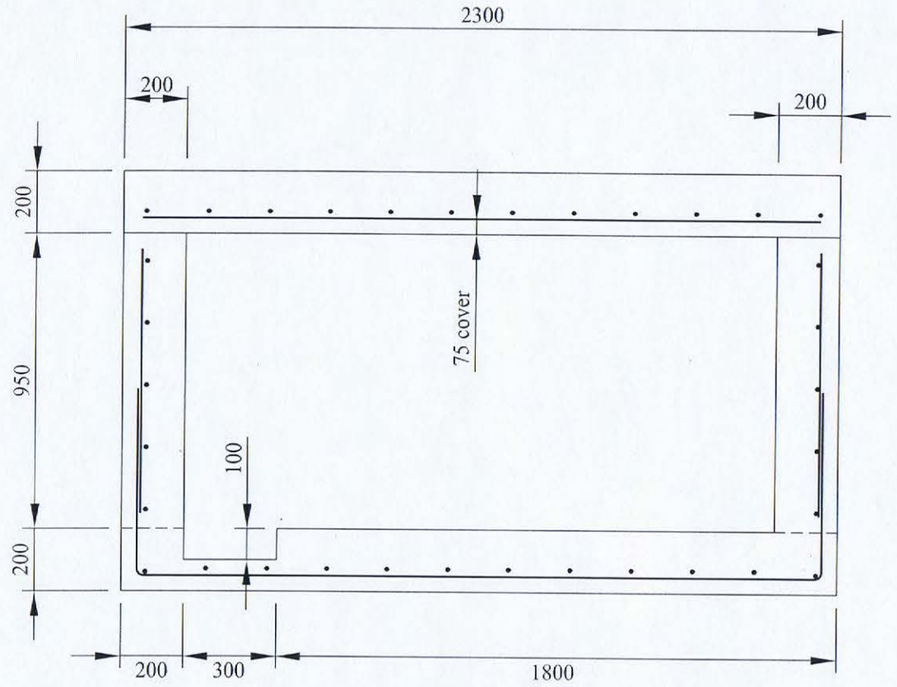
Project: Pump & Valve Pits
Kilcoy

Details

Dwg No. 2013–067 - 6A
Date 18/08/13
Drawn PGW



Plan
Valve Pit Base and Walls



Valve Pit Section X–X

AS CONSTRUCTED

Peter Wright — 18/08/13 RPEQ 1193

This drawing was originally produced as A3

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Structural, Civil & Geotechnical
11 Wilkie Avenue
REDBANK PLAINS 4301
Tel (07) 3814 4993 f (07) 3814 4883

Client: Hallco Engineering
55 William Street
CALOUNDRA

Project: Pump & Valve Pits
Kilcoy

Details

Dwg No. 2013–067 - 7A
Date 18/08/13
Drawn PGW

Queensland Urban Utilities WB 065 Sieb Street , Kilcoy Water Booster		Sieb St , Kilcoy Site Acceptance Test(SAT) for Miri- Kingfisher Modbus Comms		Testing Officer: Rishabh Doshi Date: 31/10/13		
Plant	**Quantity**	**Alarm Description**	**Alarm Required**	**#NR Register**	**Modbus Address**	**SAT Initial**
Flow_meter	High	Delivery flowmeter high	#R130.10	#R1702.10	**41402.1**	RD
Flow_meter	Invalid	Delivery Flowmeter invalid	#R130.7	#R1702.12	**41402.12**	RD
MPC	Disable	MPC Controller disable relay active	#R1000.3	#R1703.3	**41403.3**	RD
MPC	Fault	MPC system in Alarm	#R918.5	#R1704.5	**41404.5**	RD
Power_Supply	Surge_diverter_fault	Surge protection fail	#R915.2	#R1705.2	**41405.2**	RD
Pressure_gauge	Low	Suction pressure low	#R170.9	#R1706.9	**41406.9**	RD
Pressure_gauge	High	Delivery pressure high	#R190.10	#R1707.10	**41407.1**	RD
Pressure_gauge	Invalid	Delivery pressure invalid	#R190.7	#R1708.7	**41408.7**	RD
Pressure_gauge	Low	Delivery pressure low	#R190.9	#R1707.9	**41407.9**	RD
Rtu	Abnormal_operation	Abnormal operation of RTU	#R929.8	#R1708.8	**41408.8**	RD
Rtu	Battery	RTU power failure (battery)	#R915.3	#R1705.3	**41405.3**	RD
Rtu	Isagraph_stopped	ISaGRAF application halted. (if applicable)	N/A			
Rtu	Mains_fail	RTU power failure (mains)	#R915.4	#R1705.4	**41405.4**	RD
Security	Intruder	Security intruder alarm	#R915.7	#R1705.7	**41405.7**	RD
Water_site	All_pumps_disabled_Fbk	Station all pumps disabled status feedback	#R1000.8	#R1703.8	**41403.8**	RD
Water_site	Local_control	Site in Local Mode	#R946.2	#R1712.2	**41412.2**	RD
			.			
Water_site	Mains_fail	Site main power fails	#R915.1	#R1705.1	**41405.1**	RD
Water_site	Emergency_stop	Station emergency stop active	#R915.5	#R1705.5	**41405.5**	RD

Queensland Urban Utilities WB 065 Sieb Street , Kilcoy Water Booster		Sieb St , Kilcoy Site Acceptance Test(SAT) for Miri- Kingfisher Modbus Comms		Testing Officer: Rishabh Dash Date: 31/10/13		
Plant	**Quantity**	**Alarm Description**	**Buffered Events**	**#NR Register**	**Modbus Address**	**SAT Initial**
Flow_meter	Low	Delivery flowmeter low	#R130.9	#R1702.9	**41402.9**	N/A
Flow_meter	Volume_invalid	Delivery flowmeter volume invalid	#R130.12	#R1725.12	**41425.12**	Could not trigger bit from PLC
MPC	Comms_fail	MPC Modbus/GENIbus communications failed.	#R929.3	#R1708.3	**41408.3**	RD
MPC	Controller_fail	MPC controller failed	#R929.4	#R1708.4	**41408.4**	RD
MPC	Warning	MPC warning	#R918.5	#R1704.5	**41404.5**	RD
MPC_pump	Fault	MPC pump fault				
MPC_pump	Running_fbk	MPC pump running				
Pressure_gauge	High	Suction pressure high	#R170.10	#R1706.10	**41406.1**	RD
Pressure_gauge	Invalid	Suction pressure invalid	N/A			
Security	Door_limit_switch	Security doors open	#R915.7	#R1705.7	**41405.7**	RD
Water_site	Remote	Site in remote mode	#R946.1	#R1712.1	**41412.1**	RD

Queensland Urban Utilities WB 065 Sieb Street , Kilcoy Water Booster		Sieb St , Kilcoy Site Acceptance Test(SAT) for Miri- Kingfisher Modbus Comms		Testing Officer: Rishabh Dashy Date: 31/10/13		
Plant	**Quantity**	**Description**	**SCADA Control**	**#NR Register**	**Modbus Address**	**SAT Initial**
Flow_meter	High_limit	Delivery flow high alarm set point	#F1537	#NR21.201	**41201**	RD
Flow_meter	Low_limit	Delivery flow low alarm set point	#F1539	#NR21.202	**41202**	RD
MPC	Alarm_reset	MPC Controller Alarm reset	#R1000.15	#NR21.205.15	**41205.15**	RD
MPC	Controller_re_enable	MPC controller re-enable	#R760.1	#NR21.204.1	**41204.1**	RD
MPC	Hardware_reset	MPC Controller hardware reset	#R1000.5	#NR21.205.5	**41205.5**	RD
Pressure_gauge	High_limit	Suction pressure high alarm set point	#F1533	#NR21.206	**41206**	RD
Pressure_gauge	High_limit	Delivery pressure high alarm set point	#F1529	#NR21.207	**41207**	RD
Pressure_gauge	Low_limit	Suction pressure low alarm set point	#F1535	#NR21.208	**41208**	RD
Pressure_gauge	Low_limit	Delivery pressure low alarm set point	#F1531	#NR21.209	**41209**	RD
Rtu	Abnormal_operation_reset	Abnormal Operation Reset	#R1000.14	#NR21.205.14	**41205.14**	RD
Water_pumping_station	All_pumps_disable	All pumps disable	#R1000.8	#NR21.210.8	**41210.8**	RD
Water_pumping_station	Control_mode	Station remote Control Mode Select	#R923	#NR21.1211	N/A as mode is writtern over by MPC	
Water_pumping_station	Delivery_mode_setpoint	Delivery mode pressure set point	#F1563	#NR21.212	**41212**	RD

Queensland Urban Utilities WB 065 Sieb Street , Kilcoy Water Booster		Sieb St , Kilcoy Site Acceptance Test(SAT) for Miri- Kingfisher Modbus Comms		Testing Officer: Rishabh Doshi Date: 31/10/13		
Plant	**Quantity**	**Description**	**Control Feedback Values**	**#NR Register**	**Modbus Address**	**SAT Initial**
Flow_meter	High_limit_fbk	Delivery flow high alarm set point	#F1537	#R1713	**41413**	RD
Flow_meter	Low_limit_fbk	Delivery flow low alarm set point	#F1539	#R1714	**41414**	RD
Pressure_gauge	High_limit_fbk	Suction pressure high alarm set point	#F1533	#R1715	**41415**	RD
Pressure_gauge	High_limit_fbk	Delivery pressure high alarm set point	#F1529	#R1716	**41416**	RD
Pressure_gauge	Low_limit_fbk	Suction pressure low alarm set point	#F1535	#R1717	**41417**	RD
Pressure_gauge	Low_limit_fbk	Delivery pressure low alarm set point	#F1531	#R1718	**41418**	RD
Water_pumping_station	All_pumps_disable_fbk	All pumps disable	#R1000.8	#R1703.8	**41403.8**	RD
Water_pumping_station	Control_mode_fbk	Station remote Control Mode Select	#R947	#R1719	**41419**	RD
Water_pumping_station	Delivery_mode_setpoint_fbk	Delivery mode pressure set point	#F1563	#R1720	**41420**	RD

Queensland Urban Utilities WB 065 Sieb Street , Kilcoy Water Booster		Sieb St , Kilcoy Site Acceptance Test(SAT) for Miri- Kingfisher Modbus Comms		Testing Officer: Rishabh Doshi Date: 31/10/13		
Plant	**Quantity**	**Description**	**Trended Points**	**#NR Register**	**Modbus Address**	**SAT Initial**
Flow_meter	Flow_rate	Delivery flow rate in l/s	#F1601	#R1721	**41421**	RD
Flow_meter	Volume_ml	Delivery flow meter volume since midnight in Ml	#F133	#R1722	**41422**	RD
MPC	Control_loop_setpoint_fbk	Control Loop Setpoint feedback (mAHD)				
MPC	Control_signal	MPC Actual CV to pump set in %				
MPC	Mode_fbk	Current MPC Mode (enumeration)	#R1013			
MPC_pump	Mode_fbk	Current MPC Pump Mode (enumeration)				
MPC_pump	Motor_power	Motor power in kW				
MPC_pump	Speed_fbk	MPC pump frequency in %				
Pressure_gauge	Pressure_mahd	Suction pressure in mAHD	#F1609	#R1723	**41423**	RD
Pressure_gauge	Pressure_mahd	Delivery pressure in mAHD	#F1611	#R1724	**41424**	RD
Rtu	Heartbeat	Integer that increments every 5 seconds				
Water_pump	Motor_current	Motor current in A				
Water_pump	Motor_power	Motor power in kW				
Water_pumping_station	Actual_Control_mode_Fbk	Station Actual Control Mode	#R947	#R1719	**41419**	RD
Water_pumping_station	Current_mode_pressure_setpoint	Pressure setpoint of current mode	#F1563	#R1720	**41420**	RD
Water_pumping_station	Selected_Control_mode_Fbk	Station Selected Control Mode	#R947			
	P1 Run		#R210.7	#R1727.7	**41427.7**	RD
	P1 Fault		#R210.6	#R1727.6	**41427.6**	RD
	P2 Run		#R310.7	#R1728.7	**41428.7**	RD
	P2 Fault		#R310.6	#R1728.6	**41428.6**	RD
	P3 Run		#R410.7	#R1729.7	**41429.7**	RD
	P3 Fault		#R410.6	#R1729.6	**41429.6**	RD

SITE COMMISSIONING REPORT PUMPS (ELECTRICAL/SWITCHBOARD)

FORM NO. F1014/0

JOB NO.C62700 CUSTOMER NYHOLT LOCATION: SP455 Scenic Rise Beaudesert DRAWING NO.

FIELD INSPECTION BY: DATE / / SUPERVISOR: DATE / / PAGE OF PAGES

CIRCUIT/DRIVE IDENTIFICATION	K.W	F.L.C.	O/L SETTING	WATERVOID PROTECTION			SHUT VALVE CURRENT	SUPPLY NO. LOAD VOLTS	ROTATION CHECK	MANUAL OPER.CHECKED	AUTO OPER. CHECKED	TRANSITION TIMER SETTINGS	REMARKS
				CURRENT SETTING	TIME SETTING	TESTED							
PUMP 1	7.5	15	15					415	✓	✓	✓		
PUMP 2	7.5	15	15					415	✓	✓	✓		
PUMP 3	7.5	15	15					415	✓	✓	✓		
PUMP 4													
OTHERS (SPECIFY)													

FLOWMETER	CALIBRATED: RANGE:	REMARKS:
LEVEL CONTROL	RL SETTINGS:	REMARKS:
VFD OR SOFTSTARTER	RAMP TIME: DEC: ACC:	REMARKS:
POWER RESTORATION TIMER	SETTINGS:	REMARKS:
OTHER		

J. & P. RICHARDSON INDUSTRIES PTY LTD
SITE INSPECTION REPORT ELECTRICAL INSTALLATION (MAJOR)

Form No. F1015/6

JOB No: **C62700** CUSTOMER: **NYHOLT** LOCATION: **SP455 Scenic Rise Beaudesert** DRAWING No:

FIELD INSPECTION BY: DATE: SUPERVISOR:

CIRCUIT - DRIVE IDENTIFICATION	KW	F.L.C. (A)	RCD TRIP TIME (ms)	RCD TEST TRIP CURRENT (mA)	INSUL (M ohm)	CONT (ohm)	Local Stop Operating	Local E/Stop Operating	CB - O/L SETTINGS (A)	MAGNET SETTING (A)	WHOLE CURRENT ISOLATOR OPERATING	THERMISTOR PROTECTION OPERATING	LOCK OFF OPERATING	MOTOR No LOAD CURRENT (A)	PHASE ROTATION / POLARITY CHECK	CABLE SIZE-TYPE (mm^2)	DATE TESTED	TESTED BY	REMARKS
Pump 1	7.5	15	✓	✓	250	0.05		✓	15		✓		✓		✓	2.5	29/10/13	MD	
Pump 2	7.5	15	✓	✓	250	0.05		✓	15		✓		✓		✓	2.5	29/10/13	MD	
Pump 3	7.5	15	✓	✓	250	0.05		✓	15		✓		✓		✓	2.5	29/10/13	MD	
Sump Pump				30	250	0.05		✓	16		✓		✓		✓	2.5	29/10/13	MD	
UNILIFT KP150																			
MAINS	✓	✓	✓	✓	250	0.05	✓	✓	63		✓		✓		✓	16	29/10/13	MD	

Form No. F1124/7

J. & P. RICHARDSON INDUSTRIES PTY. LTD.
114 Campbell Avenue, WACOL QLD 4076
Ph: (07) 3271 2911 - Fax: (07) 3271 3623
E-mail: jpr@jpr.com.au ABN: 23 001 952 325

LV CIRCUIT TEST SHEET

CUSTOMER: NYHOLT

JOB NO: C62700 **DESCRIPTION:** SP455 Scenic Rise Beaudesert

MCC / DISTRIBUTION BOARD NO:

Tested By:	Date: / /	Certificate No:

CIRCUIT EQUIPMENT	INSULATION RESISTANCE	EARTH CONTINUITY	FAULT LOOP IMPEDANCE	PHASE ROTATION	RCD TRIP TIME	RCD TEST TRIP CURRENT	REMARKS

Form No. F1323

Pump Commissioning Test Sheet

Date: _____ Customer: _____ Job Number: _____

Pump Station: _____ kW: _____ Amps: _____

Duty: Flow: _____ Head: _____ kWH/kL: _____

Test Description		Diameter of Well (m)	Centre of gauge to water level (m)	Reading of gauge (m)	Total Head in metres	Amps	Volts	Draw Down Test		Litres/Sec	kWH/1000	Insulation Testing Thermistor Reading Earth Continuity	
								Metres drawn Down	Seconds Taken				
Pump No.1	Shut Off Head											R:____MΩ W:____MΩ B:____MΩ	Thermistor Reading ____Ω
	Duty Point												
	Extra Point (if required)											Earth Continuity____Ω	
Pump No.2	Shut Off Head											R:____MΩ W:____MΩ B:____MΩ	Thermistor Reading ____Ω
	Duty Point												
	Extra Point (if required)											Earth Continuity____Ω	
Pump No.3	Shut Off Head											R:____MΩ W:____MΩ B:____MΩ	Thermistor Reading ____Ω
	Duty Point												
	Extra Point (if required)											Earth Continuity____Ω	

1. kW = (R ÷ t) x (3600 ÷ c)
   - R – Number of revs counted
   - t – Time taken in seconds
   - c – Meter constant

2. kWH/1000 = (kW x 1000) ÷ (Litres/Sec x 3600)

3. $V = \pi \times r^2 \times h$
   - V – Volume (metres cubed)
   - r – Radius of Well
   - h – Height

4. Litres/Sec = V ÷ Sec. Taken

Person Testing: _____

Person Testing (Witness): _____

WB065 Site Acceptance Test - Sieb St

	Pump 1 Start	Pump 2 Starts	Pump 3 Starts	SAT Contractor Initial	QUU Initial
The water pump station is required to provide a constant pressure output for a varying system demand flow. To achieve this requirement with acceptable reliability, redundancy of equipment and energy efficiency, QUU requires a multi-pump cascade control arrangement with each pump operating on a separate variable speed drive. As demand flow increases the controller will start more pumps (1-3) to match setpoint 4.5 bar. The controller will also increase or decress the common motor speed, so that output pressure matches the required system set point pressure. The Discharge pressure was dropped by opening the discharge section of the valve. The Suction pressure valve was cracked closed & open slowly so the pressure is varied .					
Local (Motor Decoupled)	✓	✓	✓	RD	
Local	✓	✓	✓	RD	
Remote	✓	✓	✓	RD	
RTU Based	✓	✓	✓	RD	

Contractor Signature ..... Date 1/11/13

Company Name J & P Richardson Industries Company Electrical Licence No. 756

Queensland Urban Utilities Electrical Inspector ..... Date 1/11/2013

7 “AS INSTALLED” Drawings

DRAWING No.	Rev	DRAWING TITLE	Remarks
486/4/9-1194-000		CONCEPT DRAWING	
486/4/9-1194-001	D	ELECTRICAL DRAWING INDEX	AS INSTALLED
486/4/9-1194-002	D	BLOCK DIAGRAM	AS INSTALLED
486/4/9-1194-003	D	AC POWER DISTRIBUTION SCHEMATIC DIAGRAM	AS INSTALLED
486/4/9-1194-004	D	PUMPS POWER & CONTROL SCHEMATIC DIAGRAM	AS INSTALLED
486/4/9-1194-005	D	DC POWER DISTRIBUTION SCHEMATIC DIAGRAM	AS INSTALLED
486/4/9-1194-006	D	COMMON CONTROLS SCHEMATIC DIAGRAM	AS INSTALLED
486/4/9-1194-007	D	RTU DIGITAL INPUTS TERMINATION DIAGRAM	AS INSTALLED
486/4/9-1194-008	D	RTU DIGITAL OUTPUTS & ANALOG INPUTS TERMINATION DIAGRAM	AS INSTALLED
486/4/9-1194-009	D	PUMPS CONTROL TERMINATION DIAGRAM	AS INSTALLED
486/4/9-1194-010	D	SWITCHBOARD EQUIPMENT LIST	AS INSTALLED
486/4/9-1194-011	D	SWITCHBOARD CABLE SCHEDULE	AS INSTALLED
486/4/9-1194-012	D	SWITCHBOARD LABEL SCHEDULE	AS INSTALLED
486/4/9-1194-013	D	SWITCHBOARD CONSTRUCTION NOTES & DETAILS	AS INSTALLED
486/4/9-1194-014	D	SWITCHBOARD CONSTRUCTION DETAILS	AS INSTALLED
486/4/9-1194-015	D	SWITCHBOARD GENERAL ARRANGEMENT (Sheet 1 OF 2)	AS INSTALLED
486/4/9-1194-016	D	SWITCHBOARD GENERAL ARRANGEMENT (Sheet 2 OF 2)	AS INSTALLED
486/4/9-1194-017	D	SITE LAYOUT (REFER DWG: 486/4/9-1194-030-1)	AS INSTALLED

STANDARD VARIABLES			
DESCRIPTION	VALUES		
WATER BOOSTER PLANT ID	WB196		
MAIN FLOWMETER ID,	T.B.C.		
PRESSURE INLET ID, PRESSURE OUTLET ID	P T.B.C., P T.B.C.		
STREETNAME, SUBURB	SEIB STREET, KILCOY		
DRAWING NUMBER	486/4/9-1194		
SUPPLY AUTHORITY POLE No.	101048		
INCOMING MAINS SUPPLY CABLE sqmm	16mm		
MAIN EARTHING CABLE sqmm	6mm		
METERING ISOLATION LINKS	IPD S7125BWQ		
NORMAL SUPPLY MAIN SWITCH	63A, E125NJ63		
GENERATOR SUPPLY MAIN SWITCH	63A, E125NJ63		
Grundfos PumpSet Assy Part No.	CRE45-2		
PUMP KW RATING (1, 2, 3)	7.5 kW	7.5 kW	7.5 kW
PUMP CIRCUIT BREAKER (1, 2, 3)	DTCB15332C	DTCB15332C	DTCB15332C
PUMP MOTOR SUPPLY CABLE sqmm (1, 2, 3)	2.5mm 3C+E	2.5mm 3C+E	2.5mm 3C+E
MAIN FLOWMETER RANGE	T.B.C.		
RADIO	RADTEL AD2006		

STANDARD DESIGN OPTIONS		
OPTION	DESCRIPTION	FITTED
A1	PUMP 3 FITTED	YES ☒
~~A2~~	~~PUMP 4 FITTED~~	~~YES~~ ☒ NO
~~A3~~	~~PUMP 5 FITTED~~	~~YES~~ ☒ NO
~~B~~	~~BYPASS FLOWMETER FITTED~~	~~YES~~ ☒ NO
C1	KINGFISHER	YES ☒
~~C2~~	~~MD3311 RTU~~	~~YES~~ ☒ NO
D1	GSM MODEM	YES ☒
~~D2~~	~~PSTN MODEM~~	~~YES~~ ☒ NO
E	MIRI AD2006	YES ☒
F1	PUMP BOX SUMP PUMP	YES ☒
~~F2~~	~~FLOWMETER PIT SUMP PUMP~~	~~YES~~ ☒ NO
G	PUMP BOX VENTILATION FAN	YES ☒

QUEENSLAND UrbanUtilities

WB196
SEIB STREET, KILCOY
WATER BOOSTER

SITE COVER SHEET

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:

RPEQ No. or LICENCE:

COMPANY NAME:

START DATE: FINISH DATE:

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
C	12.13	AMEND PUMP ID	P.C.	P.C.		
B	10.13	AS CONSTRUCTED	L.L.	M.F.		
D	12.13	AS INSTALLED	L.L.	M.F.		

FUNDING
DESIGN W.O. No. QUUXXX
CONSTRUCTION W.O. No. SOA XXXXX-XXX
FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13	
DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No. DATE		APPROVED BY SIGNATURE DATE
CAD FILE	49-1194-001-D.DWG	ORIGINAL SIGNED BY		
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No. DATE		CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB196
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE
ELECTRICAL
DRAWING INDEX

SHEET No. 1 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No.	AMEND.
486/4/9-1194-001	D

NOTE:
double lines indicate
operator interface

WATER BOOSTER SWITCHBOARD

MTRG COMPARTMENT

POWER COMP.

CONTROL COMPARTMENT

NORMAL
415VAC
(T.B.C.)

ISOL. LINKS

KWH

GENSET

SR1-3
SURGE PROTN

F1-3
63A

PFRS
PHASE FAIL

F4-6
6A

Q3
MTS

Q2
MAIN SWITCH
63A

EARTH

GND

SF1
AC FILTER

Q20
4A

Q22
4A

Q23
4A

Q21
4A

ALARM RLY

SDAR

24VDC BATT

PS1
PWR SUPPLY
240vac/24vdc

24VDC

Grundfos CU351
MPC

Grundfos CIU 200
G'WAY

MODbus

RTU

4-20mA

GENIbus

GENIbus

GENIbus

4-20mA

SIGNAL SPLITTER

SIGNAL SPLITTER

24VDC

MIRI ANTENNA

GSM ANTENNA

SD2
SURGE PROTN

MIRI RADIO

DATA

GSM MODEM

GND

24VDC

24VDC

24VDC

STATION LOCAL/ REMOTE SELECTOR

PLG/SKT

DATA

KINGFISHER RTU

DIGITAL INPUTS

DIGITAL OUTPUTS

4-20mA

4-20mA

4-20mA

F/M

ESR

PUMPS STOP

P1 P2 P3
ESR I/L

P1 P2 P3
MAN. RUN

Q7 6A

Q8 6A

Q9 6A

Q12 16A 30mA

LR1
LEVEL RELAY

Q10 16A 30mA

J9 2A

LCC

Q4 32A

Q5 32A

Q6 32A

J10

(T.B.C)
PinTx

VFD
GENIbus
ESR I/L
MAN RUN
7.5 kW
P1

VFD
GENIbus
ESR I/L
MAN RUN
7.5 kW
P2

VFD
GENIbus
ESR I/L
MAN RUN
7.5 kW
P3

(T.B.C)
PoutTx

M 0.17 kW
SUPPLY AIR
VENT FAN

M 0.08 kW
DISCHARGE AIR
VENT FAN

SUMP HIGH LEVEL

AUTO SUMP PUMP

WATER IN

WATER OUT

WATER BOOSTER F/M
FLOWMETER PIT

GRUNDFOS CRE45-2

WATER BOOSTER PUMP BOX

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:

RPEQ No. or LICENCE:

COMPANY NAME:

START DATE: FINISH DATE:

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NAME SIGNATURE DATE

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(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
C	12.13	AMEND PUMP ID	P.C.	P.C.		
B	10.13	AS CONSTRUCTED	L.L.	M.F.		
D	12.13	AS INSTALLED	L.L.	M.F.		

FUNDING
DESIGN W.O. No. QUUXXX
CONSTRUCTION W.O. No. SOA XXXXX-XXX
FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	LIEN LE	LUCAS WEDLEY		24/01/13	
DRAFTING CHECK	LUCAS WEDLEY	DESIGN	R.P.E.Q. No.	DATE	APPROVED BY SIGNATURE DATE
CAD FILE	49-1194-002-D.DWG	ORIGINAL SIGNED BY			
Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No.	DATE	CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB196
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE
BLOCK DIAGRAM

SHEET No. 2 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-002

AMEND. D

3 PHASE 415VAC
SUPPLY FROM POLE No. 101048
CABLE SIZE 16mm
N R W B

P01

MTRG ISOLATION LINKS

ENERGEX DIRECT METERING

LOCKABLE METERING COMPARTMENT

3 PHASE 415VAC
SUPPLY FROM 50kVA GENERATOR
TEMPORARY BACK-UP ONLY
R W B N E

P03

R W B N E
GENERATOR EXTERNAL CONNECTION PLUG 90A

P02
E
MAIN EARTH STAKE
MEN LINK

F1 610 SR1,2,3
F2 611
F3 612
63A
80kA
SDN-3
SDN-2
SDN-1

F4 620
F5 621
F6 622
6A
N4
PFRS
SITE MAINS POWER FAILURE RELAY
REF 06:B2

MTS
MANUAL TRANSFER SWITCH

Q2
NORMAL SUPPLY MAIN SWITCH
63A
(NOTE 1, 2)
Ir=1 (63A) Im=8

Q3
GEN. SUPPLY MAIN SWITCH
63A
(NOTE 1, 2)
Ir=1 (63A) Im=8

EARTH
MAIN NEUTRAL

Q9
6A
630
N9
SF1
CRITEC SURGE FILTER
SN1

Q20 623
4A
624
N20
RTU 24VDC POWER SUPPLY
REF 05:B2

Q21 623
4A
625
N21

Q22 623
4A
626
N22
GRUNDFOS HYDRO CU351
REF 05:H3

Q23 623
4A
627
N23
SPARE

FILTERED NEUTRAL

GPO IN RTU CUBICLE (LAPTOP)

Q10
Q10-N
640
N10
16A = 30mA
GPO IN DISTRIBUTION CUBICLE

SPARE

Q12
Q12-N
680
N12
16A = 30mA
PUMP BOX
SUMP PUMP
P-P5
10A OUTLET
PUMP BOX
AUTO SUMP PUMP

E N R W B
CONTINUED ON SHT 04:A1

NOTES

1. INCOMING MAIN, GENERATOR, & DIST. BOARD CIRCUIT BREAKERS SHALL BE SHROUDED ON BOTH LINE & LOAD SIDES.

AC POWER SUPPLY

SURGE DIVERTERS
SR1 SR2 SR3
FILTER
SF1

SD12 SD23 SD3

SD ALARM RELAY
SD+
SDAR
SD-
L
N
12
16
CLOSE = HEALTHY

SURGE DIVERTER AND FILTER OK REF 06:B2
DI03+
DI03-

LEGEND:

- VFD TERMINAL
- RTU TERMINAL
- PLC/RTU MARSH. C/BREAKER TERM.
- PLC/RTU MARSH. LINK TERM.

RTU
- DI1-02 DIGITAL INPUT
- DO1-02 DIGITAL OUTPUT
- AI1-02 ANALOG INPUT
- AO1-02 ANALOG OUTPUT

AS CONSTRUCTED DETAILS

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RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

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INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
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FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

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QUEENSLAND UrbanUtilities

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CONSTRUCTION W.O. No. SOA XXXXX-XXX
FUNDED BY Q.U.U. (✓) EXTERNAL ( )

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CAD FILE	49-1194-003-D.DWG	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No. DATE	CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB196
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
AC POWER DISTRIBUTION SCHEMATIC DIAGRAM

SHEET No. 3 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-003
AMEND. D

CONTINUED FROM SHT 03:J1

E N R W B

Q4 32A → P-P1

P1-VFD
GRUNDFOSS CRE32-1 7.5 kW

Rd → L1
Wh → L2
Bl → L3
Gn → PE

M 3 BOOSTER PUMP No1 7.5 kW

C-P1

PUMPS STOP RLY REF 04:E13
RTU DO MAN.RUN RLY REF 06:H4
ESR-2 111 P1RUN
110 1Wh 112 — 115 1Bk 113 — 110 2Wh 114 — 2Bk 115

Gr → 3
Br → 2 Start/stop (Closed=RunPermit)
Pi → 9 GND (frame)
Wh → 1 Digital input (Closed=Run@MaxSpeed) (Open=NormalRTUcontrol)

P1 FAULT DI-12 REF 06:D2
3Wh 25 — 3Bk 26
Bl DI12+ → C
Ye DI12- → FAULT (NC) (Open=Fault)

CX-P1

FROM MPC REF 05:H6
Wh, Bk → A, Y, B GENIbus RS485

Q5 32A → P-P2

P2-VFD
GRUNDFOSS CRE32-1 7.5 kW

Rd → L1
Wh → L2
Bl → L3
Gn → PE

M 3 BOOSTER PUMP No2 7.5 kW

C-P2

PUMPS STOP RLY REF 04:E13
RTU DO MAN.RUN RLY REF 06:H4
ESR-3 121 P2RUN
120 1Wh 116 — 125 1Bk 117 — 120 2Wh 118 — 2Bk 119

Gr → 3
Br → 2 Start/stop (Closed=RunPermit)
Pi → 9 GND (frame)
Wh → 1 Digital input (Closed=Run@MaxSpeed) (Open=NormalRTUcontrol)

P2 FAULT DI-13 REF 06:D2
3Wh 27 — 3Bk 28
Bl DI13+ → C
Ye DI13- → FAULT (NC) (Open=Fault)

CX-P2

FROM MPC REF 05:H6
Wh, Bk → A, Y, B GENIbus RS485

Q6 32A → P-P3

P3-VFD
GRUNDFOSS CRE32-1 7.5 kW

Rd → L1
Wh → L2
Bl → L3
Gn → PE

M 3 BOOSTER PUMP No3 7.5 kW

C-P3

PUMPS STOP RLY REF 04:E13
RTU DO MAN.RUN RLY REF 06:H4
ESR-4 131 P3RUN
130 1Wh 120 — 135 1Bk 121 — 130 2Wh 122 — 2Bk 123

Gr → 3
Br → 2 Start/stop (Closed=RunPermit)
Pi → 9 GND (frame)
Wh → 1 Digital input (Closed=Run@MaxSpeed) (Open=NormalRTUcontrol)

P1 FAULT DI-14 REF 06:D2
3Wh 29 — 3Bk 30
Bl DI14+ → C
Ye DI14- → FAULT (NC) (Open=Fault)

CX-P3

FROM MPC REF 05:I6
Wh, Bk → A, Y, B GENIbus RS485

E N R W B

PUMPS

E N R W B

Q7 6A → K7 → P-VF1 → M 1 SUPPLY AIR VENT FAN 0.17 kW 0.9 A

Q8 6A → K8 → P-VF2 → M 1 DISCHARGE AIR VENT FAN 0.08 kW 0.35 A

E N R W B

J10+ + 24VDC POWER SUPPLY - J10-
REF 05:E7

J10+ S1 ES1 → ESR J10- → STOP ALL PUMPS RELAY REF 06:A2, 04:B3, 04:E3, 04:H3

DOOR SWITCHES CLOSED WHEN DOORS CLOSED
J10+ DS1 DS1 DS2 DS2 103 — DS3 104 DS3 → LCC J10- → SECURITY & LIGHTING RELAY REF 05:E7, 06:B2

PUMP BOX
CLOSED = HATCH CLOSED

J10+ → LR1 S10- → PIT LEVEL RELAY REF 06:D2

PROBE 300 mm ABOVE PIT FLOOR LEVEL REF 09:B12
PLR 105
TH7 124 — 125
P1RUN
P2RUN
P3RUN

J10+ P3RUN VF → VFR J10- → VENT FAN START RELAY REF 04:H11, 04:H11

J10+ VFR VFR1 → K7 J10- → SUPPLY AIR VENT FAN CONTACTOR REF 04:F12

J10+ VFR VFR2 → K8 J10- → DOWN DISCHARGE VENT FAN CONTACTOR REF 04:F12

LEGEND:
- ■ VFD TERMINAL
- ◪ RTU TERMINAL
- ⊠ PLC/RTU MARSH. C/BREAKER TERM.
- ○ PLC/RTU MARSH. LINK TERM.

RTU
- DI1-02 DIGITAL INPUT
- DO1-02 DIGITAL OUTPUT
- AI1-02 ANALOG INPUT
- AO1-02 ANALOG OUTPUT

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Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No.	DATE

APPROVED BY	SIGNATURE	DATE
CONSTRUCTION MANAGER	SIGNATURE	DATE

ASSET/PROJECT WB196
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
PUMP POWER & CONTROL SCHEMATIC DIAGRAM

SHEET No. 4 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-004
AMEND. D

POWER BOX
PB251-24 CM-CC-T

PS1
LOAD
BATT
BOK
RTU

240VAC SUPPLY (SHROUDED) REF 03:F7
624
N20
L
N
E

10AMP J1+ J2+ / J1- J2-
10AMP J1B+ J1A+ / J1B- J1A-
2 x 12V BATTERIES SERIES CONNECTED

DI04+ DI04- BATTERY OK REF 06:B2 0 = Fault, 1 = Healthy
DI05+ DI05- POWER ON REF 06:B2 0 = Fault, 1 = Healthy
TEMPERATURE PROBE LOCATED AT BATTERIES

RTU POWER SUPPLY 10A 24VDC

4AMP J3+ J3-

PS2
RADIO POWER SUPPLY
24VDC/13.8VDC
4AMP J5+ J5-
4AMP J4A+ J4A-

4AMP J6+ J6- RTU 24VDC CARD SUPPLY REF 06:A8, 06:A2, 06:H4

4AMP J7+ J7-

4AMP J8+ J8- DELIVERY FLOWMETER REF 06:B11

4AMP J9+ J9- LCC 651 REF 04:H13 LED LIGHT IN CUBICLE

4AMP J10+ J10- MISCELLANEOUS DC CCTS REF 04:D12

J6+A J6-A 24VDC REF 06:B7
AI03+ AI03- SUCTION PRESSURE REF 06:E10
AI04+ AI04- DISCHARGE PRESSURE REF 06:F10

SIGNAL SPLITTER
ECT/4-20MA/2x4-20MA/
24DC/-RF[DIN]
SS1
SS2
AI03B+ AI03B- AI03+ AI03- AI03C+ GND
AI04B+ AI04B- AI04+ AI04- AI04C+ GND

PUMPS
SUCTION PRESSURE SENSOR PART OF GRUNFOSS PUMP PACK (T.B.C)
DISCHARGE PRESSURE SENSOR PART OF GRUNFOSS PUMP PACK (T.B.C)
Wh Bk
106 107 108
109 110 111

CU351
CIM200 MODBUS MODULE
50+ 51 AI1
53+ 54 AI2
58 GND
DO1
70 72 DI10+ DI10- MPC FAULT TO RTU REF 06:C2 AND 07:F10
L N E
A1 Y1 B1 INT GENIbus
Grundfos CU 351

(DISABLE MPC)
X1
240VAC SUPPLY (SHROUDED, SHROUD X1 AS WELL) REF 03:G7
626 626A N22

A Y B Wh Bk
CX-P1 TO P1 REF 04:C2
CX-P2 TO P2 REF 04:F2
CX-P3 TO P3 REF 04:I2

LOW PROFILE ANTENNA
MAXON C3LA30-BD170F
Rx TBA
Tx TBA
X01 SD2 X02
X03
J7+ J7-
HSUPA ETHERNET ROUTER
MAXON MA-2025

KINGFISHER RTU
PS-22 | CP-12 | DI-5 | DO-1 | IO-3 | SPARE SLOT
POWER SUPPLY
VA+ VA- R+ R- TS B+ B-
COMS MODULE
DIGITAL INPUT DRY CONTACTS 16 CHANNEL I/O MODULE
ISOLATED RELAY OUTPUTS NO/NC 8 CHANNEL I/O MODULE
MIXED I/O MODULE
J3+ J3- DC+ DC- E
REF. SHEET 7 | REF. SHEET 8 | REF. SHEET 8

X05 X04

X05 CIM200 TO KINGFISHER RTU CONFIGURATION NOTE 6

CIM200		KINGFISHER (RTU)
(1) D1 (+)	ORANGE/WHITE	TX+
	ORANGE	RX+
(2) D0 (-)	BROWN	TX-
	BROWN/WHITE	RX-
(3) GND	BLUE/WHITE	GND

MIRI AD2006 RADIO
RS232 RTU ENET PORT 5
PORT 4 USB
PORT 3 RS485 1 2 3
RS RJ45 ADAPTOR
PROG/RUN SWITCH
PIT TEST BUTTON
DOT 1 2 3 4 — 1A 2A 3A 4A
DIN 1 2 3 4 5 6 7 8 C1 — 9 10 11 12 13 14 15 16 C2
ALG 1 2 3 4 G — 5 6 7 8 G
ANTENNA PORT 1 RS232 PORT 2 RS232
J4A+ J4A-

LEGEND:
- ■ VDF TERMINAL
- ⊠ PLC/RTU MARSH. C/BREAKER TERM.
- ○ PLC/RTU MARSH. LINK TERM.

RTU
- DI1-02 DIGITAL INPUT
- DO1-02 DIGITAL OUTPUT
- AI1-02 ANALOG INPUT
- AO1-02 ANALOG OUTPUT

NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED WITH GRAFOPLAST SI2000 COMPATIBLE LABELLING.
6. SERIAL OPTION BOARD FITTED TO PORT CONFIGURED AS RS485

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CAD FILE	49-1194-005-D.DWG	ORIGINAL SIGNED BY	
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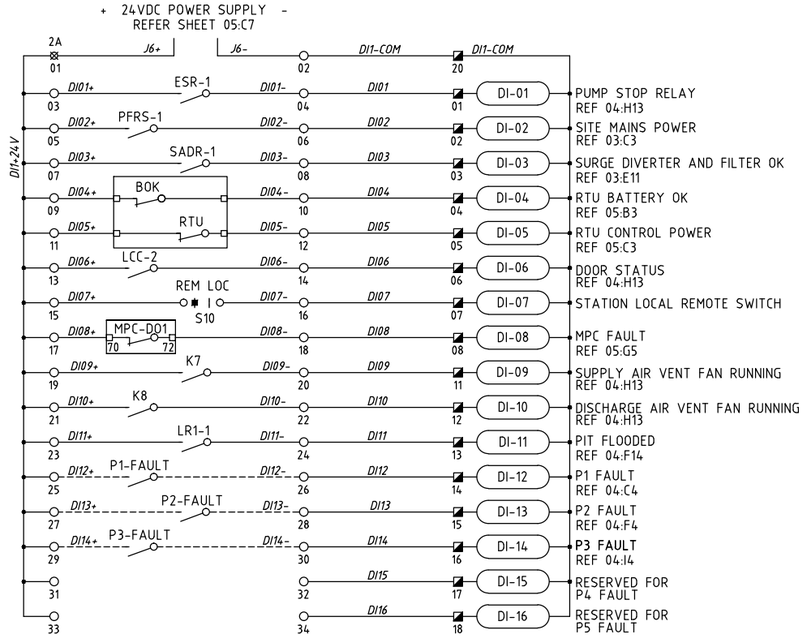
APPROVED BY SIGNATURE DATE
CONSTRUCTION MANAGER SIGNATURE DATE

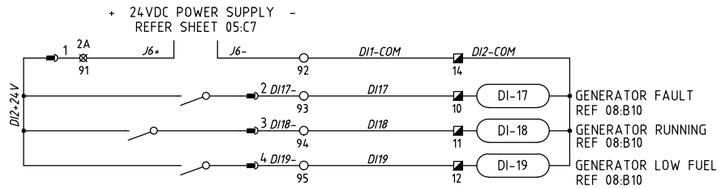
ASSET/PROJECT WB196
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
DC POWER DISTRIBUTION SCHEMATIC DIAGRAM

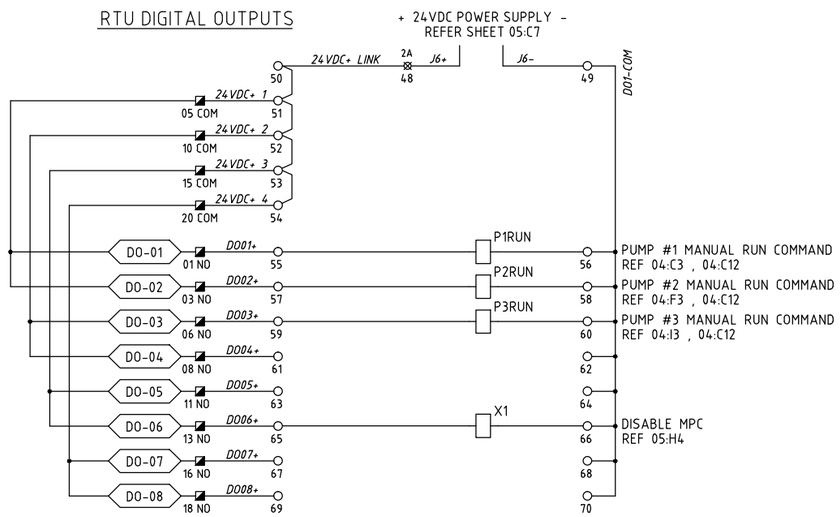
SHEET No. 5 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-005
AMEND. D

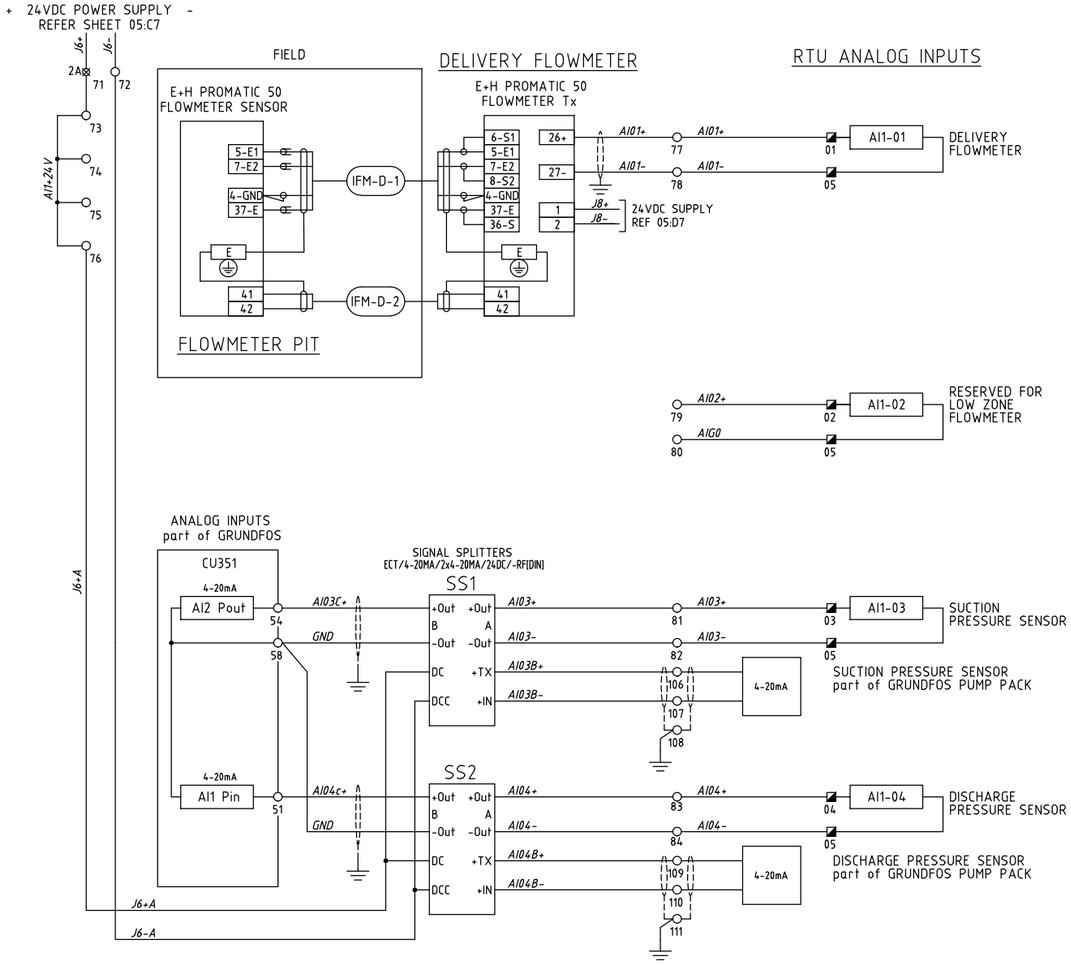
RTU DIGITAL INPUTS





RTU DIGITAL OUTPUTS





NOTES

1. ALL FUSES ARE 500mA EXCEPT WHERE NOTED OTHERWISE.

LEGEND:

- ■ VFD TERMINAL
- ◪ RTU TERMINAL
- ⊠ PLC/RTU MARSH. C/BREAKER TERM.
- ○ PLC/RTU MARSH. LINK TERM.

RTU

- DI1-02 DIGITAL INPUT
- DO1-02 DIGITAL OUTPUT
- AI1-02 ANALOG INPUT
- AO1-02 ANALOG OUTPUT

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FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	CAD FILE	49-1194-006-D.DWG
		Q.U.U. FILE No.	

LUCAS WEDLEY			24/01/13	
DESIGN	R.P.E.Q. No.	DATE	APPROVED BY	SIGNATURE DATE
ORIGINAL SIGNED BY				
DESIGN CHECK	R.P.E.Q. No.	DATE	CONSTRUCTION MANAGER	SIGNATURE DATE

ASSET/PROJECT: WB196 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE: COMMON CONTROLS SCHEMATIC DIAGRAM

SHEET No. 6 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No.: 486/4/9-1194-006

AMEND.: D

SWITCHBOARD

FIELD

24VDC

REFER SHEET 05

REFER SHEET 05

RTU KINGFISHER I/O MODULE SLOT 3 DI-5

DIGITAL INPUTS

CH1	01	DI01	gy
CH2	02	DI02	gy
CH3	03	DI03	gy
CH4	04	DI04	gy
CH5	05	DI05	gy
CH6	06	DI06	gy
CH7	07	DI07	gy
CH8	08	DI08	gy
+12V	09		gy
0V	10		gy
CH9	11	DI09	gy
CH10	12	DI10	gy
CH11	13	DI11	gy
CH12	14	DI12	gy
CH13	15	DI13	gy
CH14	16	DI14	gy
CH15	17	DI15	
CH16	18	DI16	
+12V	19		
0V	20	DI1-COM	vi

DI1

DI1+24V	1 2A	J6+	or
DI1-COM	2	J6-	vi
DI01	3	DI01+	gy
	4	DI01-	gy
DI02	5	DI02+	gy
	6	DI02-	gy
DI03	7	DI03+	gy
	8	DI03-	gy
DI04	9	DI04+	gy
	10	DI04-	gy
DI05	11	DI05+	gy
	12	DI05-	gy
DI06	13	DI06+	gy
	14	DI06-	gy
DI07	15	DI07+	gy
	16	DI07-	gy
DI08	17	DI08+	gy
	18	DI08-	gy
DI09	19	DI09+	gy
	20	DI09-	gy
DI10	21	DI10+	gy
	22	DI10-	gy
DI11	23	DI11+	gy
	24	DI11-	gy
DI12	25	DI12+	3Wh
	26	DI12-	3Bk
DI13	27	DI13+	3Wh
	28	DI13-	3Bk
DI14	29	DI14+	3Wh
	30	DI14-	3Bk
DI15	31		
	32		
DI16	33		
	34		

or J1B+	J1A+ or
vi J1B-	J1A- vi
	J1+ or
	J1- vi
	J3+ or
	J3- vi
	J5+ or
	J5- vi
	J6+ or
	J6- vi
	J7+ or
	J7- vi
	J8+ or
	J8- vi
	J9+
	J9-
	J10+ or
	J10- vi

part of C-P1

part of C-P2

part of C-P3

D12 D13 D14

CONT ON SHEET 09

CONT ON SHEET 08

DI01+ ESR-1 DI01-	PUMPS STOP PBUTTON OK
DI02+ PFRS-1 DI02-	SITE MAINS POWER OK
DI03+ SDAR-1 DI03-	SURGE DIVERTER OK
DI04+ NC, DI04- C	PS1 RTU POWER SUPPLY 10A 24VDC POWER BOX PB251-24CM — BATTERY SYSTEM OK
DI05+ NC, DI05- C	RTU POWER OK
DI06+ LCC DI06-	ALL DOORS CLOSED
DI07+ REM LOC S10 DI07-	REMOTE CONTROL SELECTED
DI08+ K7 DI08-	SUPPLY AIR VENT FAN RUNNING
DI09+ K8 DI09-	DISCHARGE AIR VENT FAN RUNNING
DI10+ MPC-DO1 DI10-	MPC OK
DI11+ LR1-1 DI11-	PIT FLOODED

LEGEND:

- C?? — CABLE IDENTIFIER
- 10A — RTU MINATURE CCT BREAKER TERMINAL
- 5 — DISCONNECT LINK TERMINAL

NOTES

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FUNDING		DRAFTED	LIEN LE
DESIGN W.O. No.	QUUXXX	DRAFTING CHECK	LUCAS WEDLEY
CONSTRUCTION W.O. No.	SOA XXXXX-XXX	CAD FILE	49-1194-007-D.DWG
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	Q.U.U. FILE No.	

LUCAS WEDLEY				24/01/13
DESIGN	R.P.E.Q. No.	DATE	APPROVED BY	SIGNATURE DATE
ORIGINAL SIGNED BY				
DESIGN CHECK	R.P.E.Q. No.	DATE	CONSTRUCTION MANAGER	SIGNATURE DATE

ASSET/PROJECT WB196
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
RTU DIGITAL INPUTS TERMINATION DIAGRAM

SHEET No. 7 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-007

AMEND. D

RTU KINGFISHER I/O MODULE SLOT 4 DO-1

DIGITAL OUTPUTS

CH1 NO 01 · CH1 NC 02 · CH2 NO 03 · CH2 NC 04 · COM 05 · CH3 NO 06 · CH3 NC 07 · CH4 NO 08 · CH4 NC 09 · COM 10 · CH5 NO 11 · CH5 NC 12 · CH6 NO 13 · CH6 NC 14 · COM 15 · CH7 NO 16 · CH7 NC 17 · CH8 NO 18 · CH8 NC 19 · COM 20

CONT FROM SHEET 07

SWITCHBOARD

DO1

DO1+24V (or) DO1+24V DO1+24V DO1+24V DO1+24V

gy DO01 P1RUN PUMP1 MANUAL RUN COMMAND

gy DO02 P2RUN PUMP2 MANUAL RUN COMMAND

gy DO03 P3RUN PUMP3 MANUAL RUN COMMAND

gy DO04 · gy DO05 · gy DO06 · gy DO07 · gy DO08

DO06+ gy / DO06- gy X1 DISABLE MPC COMMAND

AI1

or AI1+24V · AI1+24V

gy AI01+ AIG0 · gy AI02+ AIG0 · gy AI03+ AIG0 · gy AI04+ AIG0

AI01+ gy / AI01- gy · AI03+ / AI03- · AI04+ / AI04-

SC1 85 · SC1 86 · SC1 87 · SC1 88

AO1

AO01+ · AO01-

INST. EARTH

RTU KINGFISHER MIXED I/O MODULE IO-3

ANALOGUE INPUTS X 4: CH1 01 · CH2 02 · CH3 03 · CH4 04

0V 05 · +24V 06

ANALOGUE OUTPUT X 1: AO+ 07 · AO- 08 · SHIELD 09

DIGITAL INPUTS X 4: CH1 10 · CH2 11 · CH3 12 · CH4 13 · DI COM 14

DIGITAL OUTPUTS X 4: CH1 15 · CH2 16 · CH3 17 · CH4 18 · DO COM 19 · LINK 20

SIGNAL SPLITTER ECT/4-20MA/2x4-20MA/24DC/-RF[DIN]

SS1: AI03+ +Out · AI03- -Out · AI03B+ +TX · AI03B- -IN · OUTPUT A DC J6+A DCC J6-A · OUTPUT B +Out AI03C+ -Out GND

SS2: AI04+A +Out · AI04- -Out · AI04B+ +TX · AI04B- -IN · OUTPUT A DC J6+A DCC J6-A · OUTPUT B +Out AI04C+ -Out GND

REF 05:C7

DI2

DI2+24V DI2-COM DI17- DI18- DI19- DI20-

DO2

DO-COM DO09 DO10 DO11 DO12

CU351

50+ AI1 · 51 · 53+ AI2 · 54 · 58 GND

Grundfos CIM200: 1 Wh · Y · 2 Bk

REF 05:G12

DO1: 70 DI10+ · 72 DI10-

REF 06:C2 AND 07:F10

626A L · N23 N · E

REF 05:H3

INT GENIbus A1 · Y1 · B1

Grundfos CU 351

27 PIN GENERATOR CONTROL PLUG

DI2+24V 1 · DI17- 2 · DI18- 3 · DI19- 4 · 5 · 6 · 26 · 27 · E

BASIC FEEDBACK CONNECTION

GENERATOR FAULT · GENERATOR RUNNING · GENERATOR LOW FUEL

C-GEN

FIELD

PORTABLE GENERATOR

BASIC FEEDBACK CONNECTION (MANUAL START OPERATION)

DI2+24V · DI17- GENERATOR FAULT · DI18- GENERATOR RUNNING · DI19- GENERATOR LOW FUEL

DELIVERY FLOWMETER

E+H PROMAG 50 FLOWMETER Tx

AI01+ · AI01-

26+ 6-S1 · 27- 5-E1 · 7-E2 · 8-S2 · 4-GND · 37-E · 36-S · E · 41 · 42

24VDC SUPPLY REF 05:D7 — J8+ 1 · J8- 2

IFM-D-1 · IFM-D-2

E+H PROMAG 50 FLOWMETER SENSOR

5-E1 · 7-E2 · 4-GND · 37-E · E · 41 · 42

FLOWMETER PIT

CX-P1 · CX-P2 · CX-P3

VFD1 · VFD2 · VFD3

A · Y · B GENBUS RS485

PIN · POUT

AI03B+ / AI03B- — 106 · 107 · 108

AI04B+ / AI04B- — 109 · 110 · 111

+ · - · SCN SUCTION PRESSURE

+ · - · SCN DISCHARGE PRESSURE

LEGEND:

C?? CABLE IDENTIFIER

×—○ 10A RTU MINATURE CCT BREAKER TERMINAL

—○ 5 DISCONNECT LINK TERMINAL

NOTES

1. ALL WIRES & CABLE CORES ARE FERRULED

AS CONSTRUCTED DETAILS

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

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FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE

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(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities

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ASSET/PROJECT WB196 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE: RTU DIGITAL OUTPUTS & ANALOGUE INPUTS TERMINATION DIAGRAM

SHEET No. 8 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-008 AMEND. D

SWITCHBOARD

FIELD

CONT ON SHEET 07

PUMP BOX

REF 04:E12	DS2	103	Rd
	DS3	104	Bk
	PLR	105	
MPC REF 05:G3	Pout Wh	A103- 106	Wh
	Bk	A103-B 107	Bk
	Scr	108	Scr
	Pin Wh	A104- 109	Wh
	Bk	A104-A 110	Bk
	Scr	111	Scr
REF 04:B04	110	112	1Wh
	115	113	1Bk
	110	114	2Wh
	112	115	2Bk
REF 04:E04	120	116	1Wh
	125	117	1Bk
	120	118	2Wh
	122	119	2Bk
REF 04:H04	130	120	1Wh
	135	121	1Bk
	130	122	2Wh
	132	123	2Bk
REF 04:F12	J10+	124	Rd
	VF	125	Bk
		126	
		127	
		128	
		129	
		130	
		131	

PLR

C-DS3

I-POUT

I-PIN

C-P1

C-P2

C-P3

C-TH7

DS2
DS3 DS3
CLOSED = ACCESS CLOSED

PLR — PROBE 300 mm ABOVE PIT FLOOR LEVEL

PUMP PRESSURES

Wh / Bk / Scr — Pout — OUTLET PRESSURE

Wh / Bk / Scr — Pin — INLET PRESSURE

P1-VFD — PUMP 1

110 1Wh	2 Start/stop	(VFD DI Closed=RunPermit)
115 1Bk		
110 2Wh	3 GND (FRAME)	
112 2Bk	1 Digital input	(VFD DI Closed=MaxSpeed)
DI11+ 3Wh	C	
	FAULT (NC)	(VFD DO Open=Fault)
DI11- 3Bk	NC	

P2-VFD — PUMP 2

120 1Wh	2 Start/stop	(VFD DI Closed=RunPermit)
125 1Bk		
120 2Wh	3 GND (FRAME)	
122 2Bk	1 Digital input	(VFD DI Closed=MaxSpeed)
DI12+ 3Wh	C	
	FAULT (NC)	(VFD DO Open=Fault)
DI12- 3Bk	NC	

P3-VFD — PUMP 3

130 1Wh	2 Start/stop	(VFD DI Closed=RunPermit)
135 1Bk		
130 2Wh	3 GND (FRAME)	
132 2Bk	1 Digital input	(VFD DI Closed=MaxSpeed)
DI13+ 3Wh	C	
	FAULT (NC)	(VFD DO Open=Fault)
DI13- 3Bk	NC	

J10+ / VF — TH7 — THERMOSTAT MOUNTED IN PUMP BOX

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ASSET/PROJECT: WB196 SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE: PUMPS CONTROL TERMINATION DIAGRAM

SHEET No. 9 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-009

AMEND. D

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	REMARKS
1	3	METERING ISOLATION LINKS	IPD	S7125BWQ	
2	1	Q2 NORMAL SUPPLY MAIN SWITCH 100A	TERASAKI	E125-NJ 63A + T2HS12R5GM	+ T2CF123SLNG + T2MW12CA + T2MW00SA
3	1	Q3 GENERATOR SUPPLY MAIN SWITCH 100A	TERASAKI	E125-NJ 63A + T2HS12R5GM	+ T2CF123SLNG + T2MW12CA
4.1	1	Q4 PUMP 1 CIRCUIT BREAKER 32A + CAPTIVE LOCK DOG	TERASAKI	DTCB15332C+DCLD6	15kA 3P 32A "C" curve
4.2	1	Q5 PUMP 2 CIRCUIT BREAKER 32A + CAPTIVE LOCK DOG	TERASAKI	DTCB15332C+DCLD6	15kA 3P 32A "C" curve
4.3	1	Q6 PUMP 3 CIRCUIT BREAKER 32A + CAPTIVE LOCK DOG	TERASAKI	DTCB15332C+DCLD6	15kA 3P 32A "C" curve
5					
6	1	Q7 SUPPLY AIR VENT FAN CIRCUIT BREAKER	TERASAKI	DTCB10106C+DCLD6	10kA 1P 6A "C" curve
7	1	Q8 DISCHARGE AIR VENT FAN CIRCUIT BREAKER	TERASAKI	DTCB10106C+DCLD6	10kA 1P 6A "C" curve
8	1	Q9 DC PWR SUPPLY CB	TERASAKI	DTCB10106C	10kA 1P 6A "C" curve
9	1	Q10 SWBD GPO CIRCUIT BREAKER	TERASAKI	DSRCBH-16-30A	10kA 1P 16A 30mA RCD
10					
11	1	Q12 PUMP BOX SUMP PUMP CIRCUIT BREAKER	TERASAKI	DSRCBH-16-30A	10kA 1P 16A 30mA RCD
12					
13					
14					
15	1	INSULATED 3P BUS COMB	TERASAKI	ICL213	21 POLE
16					
17	1	Q20 DC POWER SUPPLY CIRCUIT BREAKER	TERASAKI	DTCB10104C	10kA 1P 4A "C" curve
18	1	Q21 SURGE DIVERTERS RELAY CIRCUIT BREAKER	TERASAKI	DTCB10104C	10kA 1P 4A "C" curve
19	1	Q22 GRUNDFOSS MPC CIRCUIT BREAKER	TERASAKI	DTCB10104C	10kA 1P 4A "C" curve
20	1	Q23 GRUNDFOSS CIU200 CIRCUIT BREAKER	TERASAKI	DTCB10104C	10kA 1P 4A "C" curve
21	1	INSULATED 3P BUS COMB	TERASAKI	ICL123	12 POLE
22	1	INSULATED 1P BUS COMB	TERASAKI	IBC108P	8 POLE
29	3	F1,2,3 - SURGE DIVERTER CIRCUIT FUSES	NHP	NC63FW + NTIS63	FUSES & 63A HOLDERS
30	3	SURGE DIVERTERS - SR1,SR2,SR3	CRITEC	TDS-1100-2SR-277	
31	1	SURGE DIVERTER ALARM RELAY - SDAR	CRITEC	DAR-275V	
32	1	SURGE REDUCTION FILTER - SF1	CRITEC	TDF-10A-240V	
33	3	F4,5,6 - PHASE FAILURE RELAY FUSES	NHP	NC32FW + NNIT6	FUSES & 32A HOLDERS
34	1	SITE MAINS PHASE FAILURE RELAY - PFRS	CARLO GAVAZZI	DPB01CM48W4	
35					
36					
37					
38	1	MAIN NEUTRAL LINK	DORE	165E24 + E/N FEET	INSULATED
39	1	MAIN EARTH LINK	DORE	165E24	
40	1	INSTRUMENT EARTH LINK	DORE	165E12 + E/N FEET	INSULATED
41	1	FILTERED SUPPLY NEUTRAL LINK	CLIPSAL	L7	INSULATED
42	2	1 PHASE OUTLET 15A	CLIPSAL	15/15+90B (SHROUD)	
43					
44					
45	1	3 PHASE N&E APPLIANCE INLET 90A - GEN POWER	PROCONECT	3PS6A3NE01	3p+N+E c/w 3PS6PC Protective Cover
46	1	GENERATOR I/O 27 PIN SOCKET OUTLET	WILCO	WIBM27	
47					
48					
49					
50					
51					
52					
53	1	PUMPS STOP RELAY - ESR	SPRECHER & SCHUH	CS 7C-40E24V	AUX BLOCK 2 N.O.
54	1	PUMPS STOP RELAY AUX CONTACT BLOCK	SPRECHER & SCHUH	CS 7-PV-22	AUX BLOCK 2 N.O.
55	1	PUMP 1 MANUAL RUN RELAY - P1RUN	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
56	1	PUMP 2 MANUAL RUN RELAY - P2RUN	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
57	1	PUMP 3 MANUAL RUN RELAY - P3RUN	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
58	1	VENT FAN START RELAY - VFR	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
59	1	DISABLE MPC RELAY - X1	IDEC	RH2B-ULD-D24VDC	c/w SH2B-05 BASE
60	1	VENT FAN THERMOSTAT IN PUMP BOX-TH7	COSMOTEC	KTS01141	THERMOSTAT
61	2	VENT FAN CONTACTOR - K7, K8	SPRECHER & SCHUH	CA7-9C-01 24VDC	24VDC CONTACTOR
62	2	VENT FAN CONTACTOR - AUX. CONTACT BLOCK	SPRECHER & SCHUH	CS7-PV-11	AUX. BLOCK 1N/O + 1N/C

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	REMARKS
63					
64					
65	1	STOP ALL PUMPS PUSHBUTTON - S1	SPRECHER & SCHUH	D7P-MT44-PX01	
66					
67	1	REMOTE TELEMETRY UNIT BACKPLANE 6 SLOT	KINGFISHER	BA-6	
68	1	POWER SUPPLY - PS22	KINGFISHER	PS-22	
69	1	PROCESSOR MODULE	KINGFISHER	CP-12-II	
70	1	DIGITAL INPUT MODULE , 16 CHANNEL	KINGFISHER	DI-5	
71	1	DIGITAL OUTPUT MODULE , 8 CHANNEL	KINGFISHER	DO-1	
72	1	MIXED I/O MODULE , 4xAI , 1xAO , 4xDI , 4xDO	KINGFISHER	IO-3	
73					
74	1	LR1 - SUMP PUMP LEVEL RELAY	MULTITRODE	MTR-5	24VDC
75	1	SINGLE POINT PROBES	MULTITRODE	020130-FSP-SH (TBC!)	'x' = CABLE LENGTH TO SUIT
76					
77					
78					
79	1	LLC - SW/BD LIGHTING CONTROL RELAY	SPRECHER & SCHUH	CS 7C-22E24V	DIN RAIL MTG 2 C.O. 24VDC RELAY
80					
81					
82	1	S10 - STATION LOCAL/REMOTE SWITCH	KRAUS & NAIMER	CA10 A221-FT2	ENGRAVE 'LOCAL REMOTE'
83					
84	1	FLOWMETER	ENDRESS & HAUSER	50W1F-S50A1AK4ABAD	
86	1	GRUNDFOS PUMP CONTROL PANEL	GRUNDFOS	CU351	PART OF GRUNDFOS HYDROPAK
87					
88	1	GRUNDFOS GATEWAY	GRUNDFOS	CIU200	PART OF GRUNDFOS HYDROPAK
89					
90					
91					
92					
93	1	RTU POWER SUPPLY 24VDC 10A	POWERBOX	PB251A-24CM-CC-T-S	
94	1	RADIO	RADTEL / MIRI	AD2006 RM5125-LN24	
95	1	ADAPTOR	WEIDMULLER	8611320000	
96					
97	2	BATTERIES	YUASA	NP7.2-12 LFR	12V7AH
98	1	INDUSTRIAL HSUPA ETHERNET ROUTER	MAXON	MA-2025	
99	1	LOW PROFILE CELLULAR ANTENNA	MAXON	C3LA30-BD170F	
100					
101	1	ANTENNA (6 ELEMENT YAGI)	R.F. INDUSTRIES	YB6-61	c/w N Series connector
102	1	RADIO COAX SURGE PROTECTION UNIT - SD2	POLYPHASER CORP.	IS-50NX-C2	
103	1	ANTENNA MAST	SWBD BUILDER		
104	1	COAX CABLE (INTERNAL CABLE No. X01)	SCHNEIDER	TBUR SMAM/NM/TL23	RADIO TO SURGE DIVERTER
105	1	COAX CABLE (EXTERNAL CABLE No.X02)	R.F. INDUSTRIES	CNT400	SURGE DIVERTER TO ANTENNA
106	2	COAX PLUG (MALE)	R.F. INDUSTRIES	N201	
107	1	U CLAMPS	R.F. INDUSTRIES	UNV	
108					
109					
110	1	PS2 RADIO POWER SUPPLY	POWERBOX	PBIH-2412J-CC	
111					
112	2	SW/BD DOOR MICRO SWITCHES	CAMSCO	SM202	3 OFF N/O
113	2	LED SWITCHBOARD LIGHT	LUMIFA	LF1B-C3S-2THWW4	
114	2	CORROSION INHIBITOR	CORTEC	VPCI-110 OR 111	FROM AP CONTROLS
115					
116					
117					
118					
119					
120					
121					
122					
123					
124					

ITEM	QTY	DESCRIPTION	MANUFACTURER	CATALOGUE No	REMARKS
125					
126					
127					
128					
129					
		SWITCHBOARD TERMINALS			
130.1	2	10A MINIATURE THERMAL CIRCUIT BREAKERS	PHOENIX CONTACT	TCP 10A + UK 6-FSI/C	(0712314 + 3118203)
130.2	8	4A MINIATURE THERMAL CIRCUIT BREAKERS	PHOENIX CONTACT	TCP 4A + UK 6-FSI/C	(0712259 + 3118203)
130.3	5	2A MINIATURE THERMAL CIRCUIT BREAKERS	PHOENIX CONTACT	TCP 2A + UK 6-FSI/C	(0712217 + 3118203)
130.4	47	THROUGH TERMINALS (GREY)	PHOENIX CONTACT	PIT 2,5 (3209510)	
130.5	5	THROUGH TERMINAL ENDPLATE	PHOENIX CONTACT	D-ST 2,5 (3030417)	
130.6	92	DISCONNECT TERMINALS (GREY)	PHOENIX CONTACT	PIT 2,5-MT (3210156)	
130.7	8	DISCONNECT TERMINALS ENDPLATE	PHOENIX CONTACT	D-PIT 2,5-MT (3211003)	
130.8					
130.9	8	GROUP MARKER CARRIER	PHOENIX CONTACT	UBE (0800310)	
130.10	2	TEST PLUG ADAPTOR	PHOENIX CONTACT	PS-5 (3030983)	
130.11	1	SCREW DRIVER	PHOENIX CONTACT	SZS 0.6x3.5 (1205053)	
130.12	5	PLUG-IN BRIDGE	PHOENIX CONTACT	FBS 20-5 (3030226)	
130.13	1	TERMINAL NUMBERS	PHOENIX CONTACT	ZB 5 CUS (0824962)	NUMBERED 1-150
131	1	COVER PROFILE	PHOENIX CONTACT	AP 2 CM	(5022889)
131.1	4	COVER PROFILE CARRIER	PHOENIX CONTACT	AP 2-TU	(5022630)
132	2	ANALOGUE LOOP SIGNAL SPLITTER (SS1,SS2)	MOORE INDUSTRIES	ECT/4-20MA/2x4-20MA/24DC/-RF[DIN]	
133					
134	1	ENERGEX PADLOCK (45mm BRASS PIN TUMBLER)	H-A-REED LOCK SMITH	KEY No. 2897	
135					
136					
137					
138					
139					
140					
141					
142					
143					
144					
145					
146					
147					
148					
149					
150					
151					

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DRAFTED LIEN LE
DRAFTING CHECK LUCAS WEDLEY
CAD FILE 49-1194-010-D.DWG
Q.U.U. FILE No.

LUCAS WEDLEY 24/01/13
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ASSET/PROJECT WB196
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE
SWITCHBOARD
EQUIPMENT LIST

SHEET No. 10 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-010

AMEND. D

CABLE No.	STATUS	SIZE	CORES	TYPE	LENGTH (m)	FROM	TO	CABLE FUNCTION	NOTES
P01	NEW	16 mm^2	4C	PVC/CU/PVC	15m	ENERGEX Supply POINT	Switchboard	Incoming Mains Supply	
P02	NEW	6 mm^2	1C	Building Wire	3m	Switchboard	Earth stake	Main Earth	
P03	NEW	25 mm^2	5C	RUBBER/FLEX/RUBBER	20m	Switchboard	Temporary Generator	Incoming Generator Supply	Cable Supplied By Generator Vendor
P-P1	NEW	2.5 mm^2	3C+E	PVC/PVC	15m	Switchboard	Booster Pump 1 Motor	Pump 1 - 3 Phase supply	
P-P2	NEW	2.5 mm^2	3C+E	PVC/PVC	15m	Switchboard	Booster Pump 2 Motor	Pump 2 - 3 Phase supply	
P-P3	NEW	2.5 mm^2	3C+E	PVC/PVC	15m	Switchboard	Booster Pump 3 Motor	Pump 3 - 3 Phase supply	
P-P5	NEW	2.5 mm^2	2C+E	PVC/PVC	15m	Switchboard	Pump Box Sump Pump	Sump Pump - 1 Phase supply	
P-VF1	NEW	2.5 mm^2	2C+E	PVC/PVC	5m	Switchboard	Supply Air Vent Fan	Supply Air Vent Fan - 1 Phase supply	
P-VF2	NEW	2.5 mm	2C+E	PVC/PVC	5m	Switchboard	Discharge Air Vent Fan	Discharge Air Vent Fan - 1 Phase supply	
C-DS3	NEW	1.5mm^2	2C+E	PVC/PVC	15m	Switchboard	Door Switch	Pit Intruder Alarm	
PLR	NEW		Vendor	Vendor	15m	Switchboard	Multitrode Probe includes cable	Sump Pump	
C-TH7	NEW	1.5mm	2C+E	PVC/PVC	15m	Switchboard	Thermostat	Pump Box Thermostat	
C-P1	NEW	1.0mm^2	3PR	PVC/PVC	15m	Switchboard	Pump Box Pump 1	Pump 1 Control & Interlocks	
C-P2	NEW	1.0mm^2	3PR	PVC/PVC	15m	Switchboard	Pump Box Pump 2	Pump 2 Control & Interlocks	
C-P3	NEW	1.0mm^2	3PR	PVC/PVC	15m	Switchboard	Pump Box Pump 3	Pump 3 Control & Interlocks	
C-GEN	NEW	1.5mm^2	24C+E	PVC/FLEX/PVC	20m	Switchboard	Temporary Generator	Temporary Generator I/O	Cable Supplied By Generator Vendor
CX-P1	NEW		1PR	REXON B20	15m	Switchboard - MPC GENIbus	Pump Box Pump 1	GENIbus - Pump1	
CX-P2	NEW		1PR	REXON B20	15m	Switchboard - MPC GENIbus	Pump Box Pump 2	GENIbus - Pump2	
CX-P3	NEW		1PR	REXON B20	15m	Switchboard - MPC GENIbus	Pump Box Pump 3	GENIbus - Pump3	
I-PIN	NEW		1PR	Vendor	15m	Switchboard - MPC	Suction Pressure Transmitter	Suction Pressure	
I-POUT	NEW		1PR	Vendor	15m	Switchboard - MPC	Delivery Pressure Transmitter	Delivery Pressure	
IFM-D-1	NEW		Vendor	Vendor	17m	Switchboard - Flowmeter Tx	Flowmeter	Delivery Flowmeter	
IFM-D-2	NEW		Vendor	Vendor	17m	Switchboard - Flowmeter Tx	Flowmeter	24vdc	
X01	NEW		COAX	SMAM/NM/TL23	0.5m	Switchboard - RADIO	Switchboard - Surge Diverter SD2	Miri Radio Antenna Feeder	
X02	NEW		COAX	CNT400	8m	Switchboard - SURGE DIVERTER SD2	Switchboard - Antenna	Miri Radio Antenna Feeder	
X03	NEW		COAX	Special	2m	Switchboard - RTU	Switchboard - GSM Modem	Miri Radio Data, GSM Modem Data	
X04	NEW			Special	2m	Switchboard - Miri Radio	Switchboard - Kingfisher RTU	Miri Radio Data, Kingfisher Data	
X05	NEW			Special	2m	Switchboard - Grundfos CIU200	Switchboard - Kingfisher RTU	Grundfos CIU200 Data, Kingfisher Data	

NOTES:

1. THE CONTRACTOR IS RESPONSIBLE IN DETERMINING THE ACTUAL CABLE LENGTHS REQUIRED ON SITE.
2. SIZE MAINS CABLE FOR LENGTH OF CABLE RUN FROM ENERGEX POINT OF SUPPLY TO SWITCHBOARD.
3. CABLE LENGTHS TO BE MARKED UP ON AS BUILTS

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:

RPEQ No. or LICENCE:

COMPANY NAME:

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J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076

PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities

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FUNDING
DESIGN W.O. No. QUUXXX
CONSTRUCTION W.O. No. SOA XXXXX-XXX
FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No.	DATE
CAD FILE	49-1194-011-D.DWG	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No.	DATE

APPROVED BY	SIGNATURE	DATE	
CONSTRUCTION MANAGER	SIGNATURE	DATE	

ASSET/PROJECT WB196
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE
CABLE SCHEDULE

SHEET No. 11 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-011

AMEND. D

ITEM #	OPT.	DESCRIPTION	LABEL 1	LABEL 2 & 3 (IF NECESSARY)	TEXT HEIGHT	MATERIAL / COLOUR
02		ENERGEX SUPPLY	NORMAL SUPPLY MAIN SWITCH Q2		10mm 4mm	GRAVOPLY B/W
03		GENERATOR SUPPLY	GENERATOR SUPPLY MAIN SWITCH Q3		10mm 4mm	GRAVOPLY B/W
04.1		PUMP CIRCUIT BREAKER	BOOSTER PUMP No.1 Q4		4mm 4mm	GRAVOPLY W/B
04.2		PUMP CIRCUIT BREAKER	BOOSTER PUMP No.2 Q5		4mm 4mm	GRAVOPLY W/B
04.3		PUMP CIRCUIT BREAKER	BOOSTER PUMP No.3 Q6		4mm 4mm	GRAVOPLY W/B
04.4						
6		SUPPLY AIR VENT FAN CIRCUIT BREAKER	SUPPLY AIR VENT FAN Q7		4mm 4mm	GRAVOPLY W/B
7		DISCHARGE VENT FAN CIRCUIT BREAKER	DISCHARGE AIR VENT FAN Q8		4mm 4mm	GRAVOPLY W/B
8		DC POWER SUPPLY CIRCUIT BREAKER	DC POWER SUPPLY Q9		4mm 4mm	GRAVOPLY W/B
9		SWBD GPOs CIRCUIT BREAKER	SWBD GPO Q10		4mm 4mm	GRAVOPLY W/B
11		PUMP BOX SUMP PUMP CIRCUIT BREAKER	PUMP BOX SUMP PUMP Q12		4mm 4mm	GRAVOPLY W/B
11		SPARE CIRCUIT BREAKER				
17		DC POWER SUPPLY CIRCUIT BREAKER	24VDC POWER SUPPLY Q20		4mm 4mm	GRAVOPLY W/B
18		SURGE DIVERTER RELAY CIRCUIT BREAKER	SURGE DIVERTER RELAY Q21		4mm 4mm	GRAVOPLY W/B
19		GRUNDFOS MPC CIRCUIT BREAKER	GRUNDFOS MPC Q22		4mm 4mm	GRAVOPLY W/B
20		GRUNDFOS GIU200 CIRCUIT BREAKER	GRUNDFOS CIU200 Q23		4mm 4mm	GRAVOPLY W/B
29		SURGE DIVERTER FUSES	SURGE DIVERTER FUSES 63/63A	FED FROM LINE SIDE OF MAIN SWITCH	4mm 4mm	GRAVOPLY W/B - R/W/R
30		SURGE DIVERTERS	LIGHTNING ARRESTORS	SR1 SR2 SR3	4mm	GRAVOPLY W/B
31		SURGE DIVERTER ALARM RELAY	SDAR		4mm 4mm	GRAVOPLY W/B
32		SURGE REDUCTION FILTER	SURGE REDUCTION FILTER		4mm 4mm	GRAVOPLY W/B
33		PHASE FAILURE RELAY FUSES	PHASE FAILURE RELAY FUSES 6/20A	FED FROM LINE SIDE OF MAIN SWITCH	4mm 4mm	GRAVOPLY W/B - R/W
34		PHASE FAILURE RELAY	SITE MAINS POWER FAIL - PFRS		4mm 4mm	GRAVOPLY W/S/W
38		MAIN NEUTRAL LINK	MAIN NEUTRAL		4mm	GRAVOPLY W/B
39		MAIN EARTH LINK	MAIN EARTH		4mm	GRAVOPLY W/B
40		INSTRUMENT EARTH LINK	INSTRUMENT EARTH		4mm	GRAVOPLY W/B
41		FILTERED SUPPLY NEUTRAL LINK	FILTERED SUPPLY NEUTRAL		4mm 4mm	GRAVOPLY W/B
43		LAPTOP GPO	LAPTOP GPO ONLY		4mm	GRAVOPLY W/B
45		GENERATOR POWER CONNECTION SOCKET	GENERATOR CONNECTION		6mm 6mm	GRAVOPLY W/B
53		PUMPS EMERG STOP RELAY	ESR		4mm	GRAVOPLY W/B
54						
55		PUMP 1 MANUAL RUN RELAY	P1RUN		4mm	GRAVOPLY W/B
56		PUMP 2 MANUAL RUN RELAY	P2RUN		4mm	GRAVOPLY W/B
57		PUMP 3 MANUAL RUN RELAY	P3RUN		4mm	GRAVOPLY W/B
58		VENT FAN START RELAY	VFR		4mm	GRAVOPLY W/B
59		DISABLE MPC RELAY	X1		4mm	GRAVOPLY W/B
61		VENT FAN CONTACTOR	K7	K8	4mm	GRAVOPLY W/B

ITEM #	OPT.	DESCRIPTION	LABEL 1	LABEL 2 & 3 (IF NECESSARY)	TEXT HEIGHT	MATERIAL / COLOUR
65		ALL PUMPS STOP PUSHBUTTON	STOP ALL PUMPS		4mm	GRAVOPLY W/B
74		PUMP BOX FLOODED RELAY	LR1		4mm	GRAVOPLY W/B
79		SWITCHBOARD LIGHTING CONTROL CONTACTOR	LCC		4mm	GRAVOPLY W/B
82		STATION LOCAL/REMOTE SELECTOR SWITCH	STATION CONTROL MODE		4mm	GRAVOPLY W/B
84		DELIVERY FLOWMETER TRANSMITTER	DELIVERY FLOWMETER		4mm	GRAVOPLY W/B
93	1	RTU 240VAC/24VDC POWER SUPPLY	RTU 24VDC POWER SUPPLY		4mm 4mm	GRAVOPLY W/B
94		TELEMETRY UNIT	RTU, RADIO		4mm 4mm	GRAVOPLY W/B
95	E	RADIO 24V/13.8VDC CONVERTER	24/12 VDC CONVERTER - RADIO		4mm 4mm	GRAVOPLY W/B
97		BATTERY	BATTERY		4mm	GRAVOPLY W/B
98		MODEM	MODEM		4mm	GRAVOPLY W/B
100						
102	E	RADIO COAX SURGE PROTECTION	RADIO SURGE PROTECTION		4mm	GRAVOPLY W/B
		TERMINAL HEADER	RTU POWER SUPPLIES		4mm 4mm	GRAVOPLY W/B
		TERMINAL HEADER	DIGITAL INPUTS DI1	DIGITAL INPUTS DI2	4mm 4mm	GRAVOPLY W/B
		TERMINAL HEADER	DIGITAL OUTPUTS DO1	DIGITAL OUTPUTS DO2	4mm 4mm	GRAVOPLY W/B
		TERMINAL HEADER	ANALOG INPUTS AI1	ANALOG OUTPUTS AO1	4mm 4mm	GRAVOPLY W/B
		TERMINAL HEADER	PUMP BOX		4mm 4mm	GRAVOPLY W/B
		HEADER LABEL (Incomer Section)	MEN BEHIND		6mm	GRAVOPLY W/B
		HEADER LABEL (MainSwitch Section)	SURGE DIVERTER FUSES BEHIND		6mm	GRAVOPLY W/B
		HEADER LABEL (Above Circuit Breakers)	NON FILTERED SUPPLY		6mm 6mm	GRAVOPLY W/B
		HEADER LABEL (Above Circuit Breakers)	FILTERED SUPPLY		6mm 6mm	GRAVOPLY W/B
132		ANALOGUE LOOP SIGNAL SPLITTER	SS1	SS2	4mm	GRAVOPLY W/B

EXTERNAL LABEL LIST

LABEL	TEXT	TEXT HEIGHT	PAINT FILL LETTERING	SIZE	QTY	OPT
A	WB196	20mm	Black	150x35	1	
B	RTU	10mm	Black	50x20	1	
		10mm	Black	100x20	1	
D	WARNING THIS SITE IS MONITORED BY NETWORK CONTROL. PLEASE INFORM THE OPERATOR BEFORE ISOLATING PUMPS OR STATION	8mm	Black	250x100	2	
E	PLEASE CHECK THAT THE STATION IS IN REMOTE MODE BEFORE LEAVING SITE	8mm	Black	210x60	1	
G	PHONE: 13 26 57 (AFFIX DIRECTLY UNDER LABEL D)	8mm	Black	60x30	1	
H	MAIN SWITCHES	10mm	Black	120x20	1	
I	DISTRIBUTION BOARD	10mm	Black	150x20	1	
K	GENERATOR INLET	10mm	Black	120x20	1	
M	SUPPLY AUTHORITY METERING	10mm	Black	200x20	1	
N	DANGER 415V	10mm	Red	100x20	1	
O	DANGER - 2 SOURCES OF SUPPLY	10mm	Red	220x20	1	
	EXTERNAL LABELS 1mm THICK. 316 GRADE STAINLESS STEEL. FIXED WITH M3 316 STAINLESS STEEL METAL THREADS.					

DETAIL Q

LABEL	TEXT
F	DANGER - ELECTRICAL EQUIPMENT NOTE: LABEL DESIGN IS ISSUED FROM QUU QUEENSLAND URBAN UTILITIES PHONE: 13 26 57

DETAIL F SAFETY SIGN - DANGER ELECTRICAL EQUIPMENT etc

280x190x2mm (+ 4x4mm FIXING HOLES) ALUNIMUM POWDER COATED WHITE
5 COLOR SCREEN PRINTED +ANTI-GRAFITTI LAMINATE
FREE ISSUED BY BW TO SWBD MANUFACTURER

AS CONSTRUCTED DETAILS

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A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
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JPR Project No.: E12-C63100

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FUNDING: DESIGN W.O. No. QUUXXX; CONSTRUCTION W.O. No. SOA XXXXX-XXX; FUNDED BY Q.U.U. (✓) EXTERNAL ( )

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DRAFTING CHECK	LUCAS WEDLEY	DESIGN	R.P.E.Q. No. DATE	APPROVED BY	SIGNATURE DATE
CAD FILE	49-1194-012-D.DWG	ORIGINAL SIGNED BY			
Q.U.U. FILE No.		DESIGN CHECK	R.P.E.Q. No. DATE	CONSTRUCTION MANAGER	SIGNATURE DATE

ASSET/PROJECT WB196
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE
SWITCHBOARD
LABLE SCHEDULE

SHEET No. 12 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-012

AMEND. D

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 lifting lugs in top of cubicle.
Plinth construction 152x63x6mm aluminium channel
Fully welded on fascia of cubicle and stiffened to prevent warping and form a rigid enclosure.
Cubicle is to be sealed to prevent the ingress of sewer well gases.
External doors and covers fitted with Dore Electrics ES60-053 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.
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. (Detail F)
Cable glands to be fitted with compression side installed within cubicle. (Detail G)
Gland/Inspection/Access plates to be fitted with seals attached to cubicle.
Gland/Inspection/Access plates to overlap opening by 25mm.
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°
Ventilation via punched louvers (Refer drawings for detail)
Switchboard Ventilation (except in breezeway) to be backed with stainless steel mesh gauze and removable filter material.
Fit laptop tray to rear of common control door. (Refer drawings for detail)
Fit drawing holder to rear of common control door. (Refer drawings for detail)

Locks Doors 1 & 3

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

Locks Door 2

DORE ELECTRICS - Stainless steel Padlockable Swing Handle.
DORE ELECTRICS - 3 point lock rod set with rollers.
ENERGEX padlock, S/Steel Shackle, 45mm brass pin tumbler.
Energex Key No. 2897. c/w 1 key.

Locks Gen Inlet Door

DORE ELECTRICS - Stainless steel Lockable Swing Handle. (Keyed 92268)

OPERATING PARAMETERS

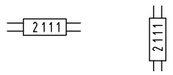
Standard	AS 3439.1
Current & Frequency	AC 50Hz
Rated Operational Voltage Ue	415 VAC
Rated Insulation Voltage Ui	0.6/1kV
Rated Auxiliary Voltage	240 VAC / 24 VDC
Rated Current (No Bus)	100A
Short Circuit Current Isc	20 kA
Duration of Isc	.2 sec
Degree of Protection	Weather Resistant (Nominally IP55)
Internal Degree of Protection	IP20B / IP10A to AS3000:2007
Service Conditions	Outdoors
Mass	Not exceeding 2000kg
Forms of Segregation	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.
Thickness	Minimum 50microns
Exterior/Doors Colour	Mist Green
Interior Colour	Mist Green
Equipment Panel Colour	Bright White
Escutcheon Colour	Bright White
Plinth Colour	Mist Green

WIRING

All control 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, 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.
Not more than two wires shall be connected to any terminal.
Power wiring to be minimum 2.5sqmm V90 06./1Kv stranded copper conductors, phase colour coded as detailed below.
Control wiring to be minimum 1.0sqmm flexible copper conductors, colour coded as detailed below.
Low level control signals to be minimum 0.5sqmm flexible copper conductors. colour coded as detailed below.
4-20mA analog signals (internal & external) wired in shielded pair minimum size 0.5sqmm, overall screened, and earthed at one end only. (Switchboard end for external signals)
All 240VAC terminals located in the RTU or PLC sections shall be shrouded and labelled - ' Danger 240VAC'
Earth cables minimum 2.5sqmm flexible.
Doors and hinged escutcheons bonded with 4sqmm min. flexible earth wire.
Wire numbering will be equal to Brady marking system.
Wire numbers are readable left to right,bottom to top as shown.
Color of DC wiring beyond final fuse/link to be Grey.



COLOUR CODE

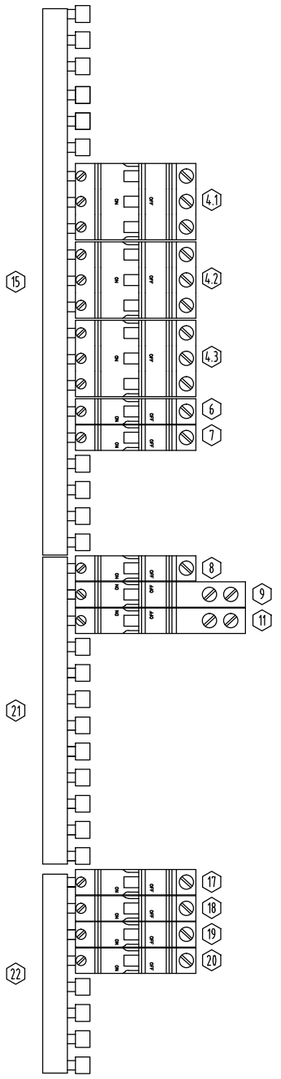
Phase wiring (A,B &C)	Red, White, Blue	2.5sqmm (min)
Potential Metering (240/415 VAC)	Red, White, Blue, Black	1.5sqmm
Current Metering (Secondary)	Red, White, Blue, Grey	2.5sqmm
240 VAC Control Active	Red	1.0sqmm
240 VAC Neutral	Black	1.0sqmm
24 VDC Positive supplies	Orange	1.0sqmm
24 VDC Negative supplies	Violet	1.0sqmm
24 VDC Wiring (Other than supplies)	Grey	1.0sqmm
RTU & PLC Wiring	Grey	0.5sqmm
Electrode Wiring	Salmon	1.0sqmm
Intrinsically safe wiring	Blue	1.5sqmm
Earth	Green/Yellow	2.5sqmm (min)
Door & Escutcheon Earth Bonds	Green/Yellow	4 sqmm
Instrument Shield Earth	Green/Yellow	1.5 sqmm (min)

LABELS

Internal labels W/B engraved gravoply to label schedule.
Warning labels R/W engraved gravoply to label schedule.
First letter = background colour. Second letter = lettering colour.

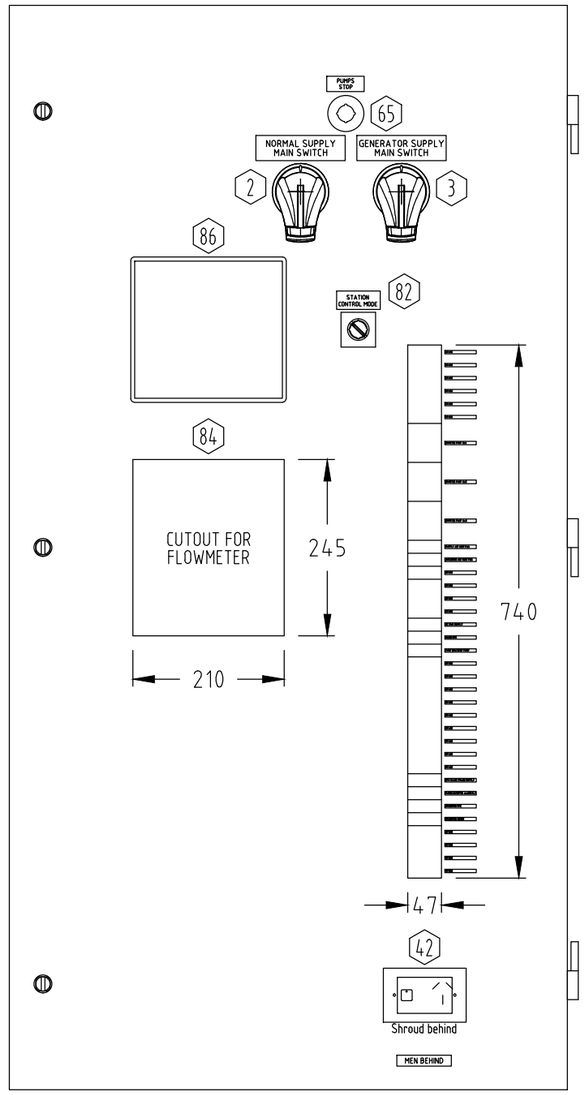
Main switch labels	MAIN SWITCH 100A	10mm, 4mm	Material gravoply Colour B/W
Pump CB labels	PUMP No1 32A	6mm, 4mm	Material gravoply Colour W/B
Compartment labels	RTU	10mm	Material Stainless Steel
Warning labels	DANGER 415V ISOLATE ELSE WHERE	7mm, 5mm	Material gravoply Colour R/W

Internal labels secured by M3 316 grade stainless steel metal threads and adhesive.
CB's to be identified with individual labels as per label schedule
Labels obstructed by switchboard wiring are relocated to adjacent duct lid and secured by M3 nylon threads. Lid to be secured by a single cable tie at one corner.
External labels 1mm thick 316 grade s/steel secured by M3 316 s/steel metal threads.
Label on the internal side of the escutcheon for all equipment mounted on escutcheon.
Affix labels with double sided tape only



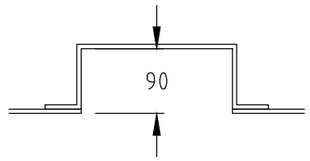
DETAIL M

SUB-DISTRIBUTION BOARD ARRANGEMENT



ESCUTCHEON LAYOUT

DETAIL S



WELD HAT SECTION TO REAR OF ESCUTCHEON FOR MOUNTING OF FLOW METER

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:
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D	12.13	AS INSTALLED	L.L.	M.F.		

FUNDING: DESIGN W.O. No. QUUXXX; CONSTRUCTION W.O. No. SOA XXXXX-XXX; FUNDED BY Q.U.U. (✓) EXTERNAL ( )

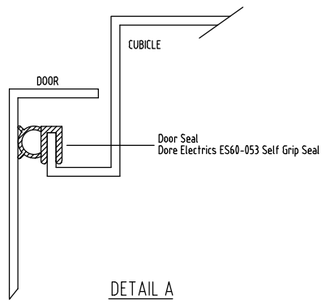
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DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No. DATE	
CAD FILE	49-1194-013-D.DWG	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No. DATE	

APPROVED BY SIGNATURE DATE
CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB196 SEIB STREET - KILCOY WATER BOOSTER

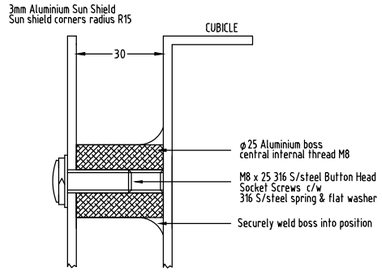
DRAWING TITLE: SWITCHBOARD CONSTRUCTION NOTES AND DETAILS

SHEET No. 13 OF 16
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-013
AMEND. D



DETAIL A

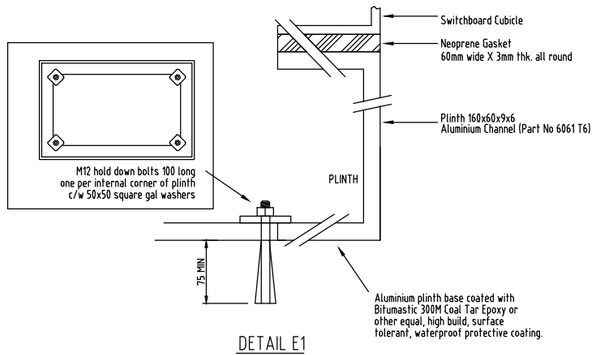
(DOOR SEAL)



Note: Screws are not to penetrate cubicle metalwork

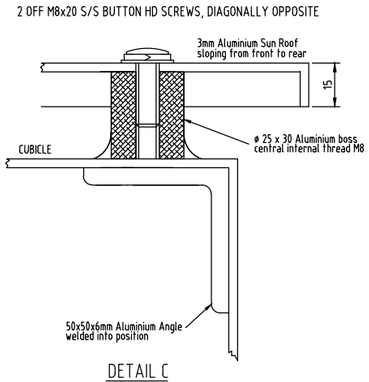
DETAIL B

(SUN SHIELD MOUNTING TO SIDES, REAR AND DOORS)



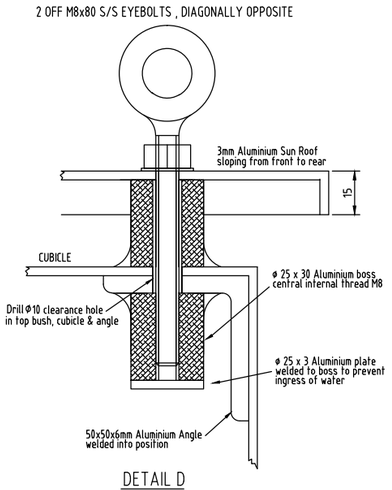
DETAIL E1

(PLINTH FIXING DETAIL)



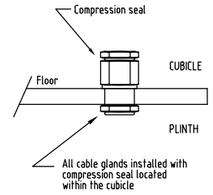
DETAIL C

(SUN ROOF FIXING DETAIL)
(2 OFF M8x20 S/S BUTTON HD DIAGONALLY OPPOSITE)
Note: Screws are not to penetrate cubicle metalwork



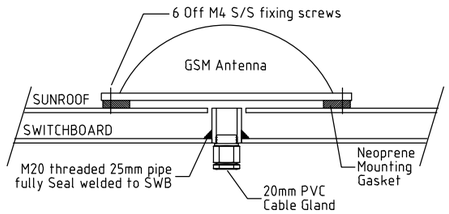
DETAIL D

(EYE BOLT FIXING DETAIL- 2 OFF M8x80 s/s , DIAGONALLY OPPOSITE)
(REPLACE EYEBOLTS WITH M8x50 s/s BUTTON SCREWS AT SITE)



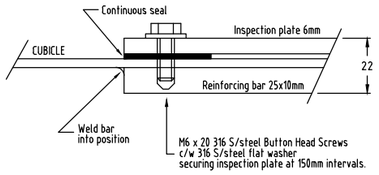
DETAIL G

(CABLE GLAND INSTALLATION DETAIL)



DETAIL X

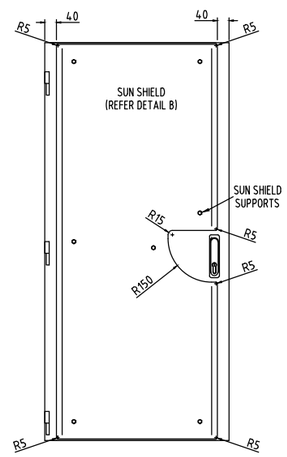
(GSM ANTENNA MOUNTING DETAIL)



Note: Screws are not to penetrate reinforcing bar

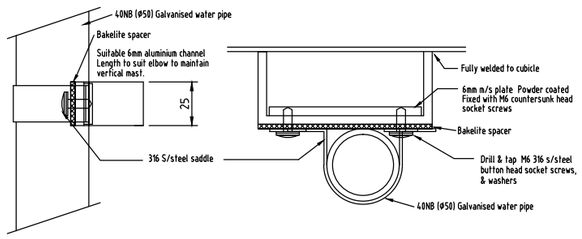
DETAIL F

(INSPECTION PLATE FIXING DETAIL)



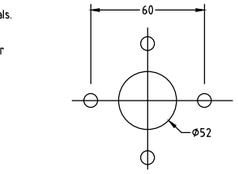
DETAIL K

(DOOR SUN SHIELD DETAIL)



DETAIL N

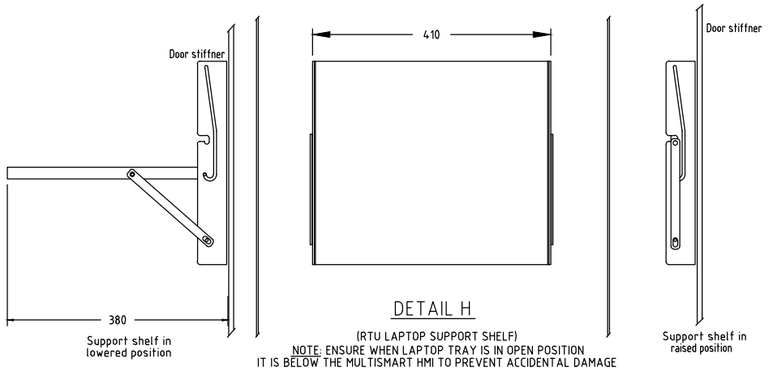
(AERIAL SUPPORT BRACKET DETAIL)



(Fit 3mm neoprene gasket between plinth & flange)
(Fixings 316 s/steel bolts, nuts, flat & spring washers)

DETAIL P

(AERIAL FLANGE MOUNTING DETAIL)



DETAIL H

(RTU LAPTOP SUPPORT SHELF)
NOTE: ENSURE WHEN LAPTOP TRAY IS IN OPEN POSITION
IT IS BELOW THE MULTISMART HMI TO PREVENT ACCIDENTAL DAMAGE

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:

RPEQ No. or LICENCE:

COMPANY NAME:

START DATE: FINISH DATE:

J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND Urban Utilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
C	12.13	AMEND PUMP ID	P.C.	P.C.		
B	10.13	AS CONSTRUCTED	L.L.	M.F.		
D	12.13	AS INSTALLED	L.L.	M.F.		

FUNDING			
DESIGN W.O. No.	QUUXXX	DRAFTING CHECK	LUCAS WEDLEY
CONSTRUCTION W.O. No.	SOA XXXXX-XXX	CAD FILE	49-1194-014-D.DWG
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	Q.U.U. FILE No.	

DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13	
DESIGN		R.P.E.Q. No.	DATE	APPROVED BY
ORIGINAL SIGNED BY				
DESIGN CHECK		R.P.E.Q. No.	DATE	CONSTRUCTION MANAGER

SIGNATURE DATE

SIGNATURE DATE

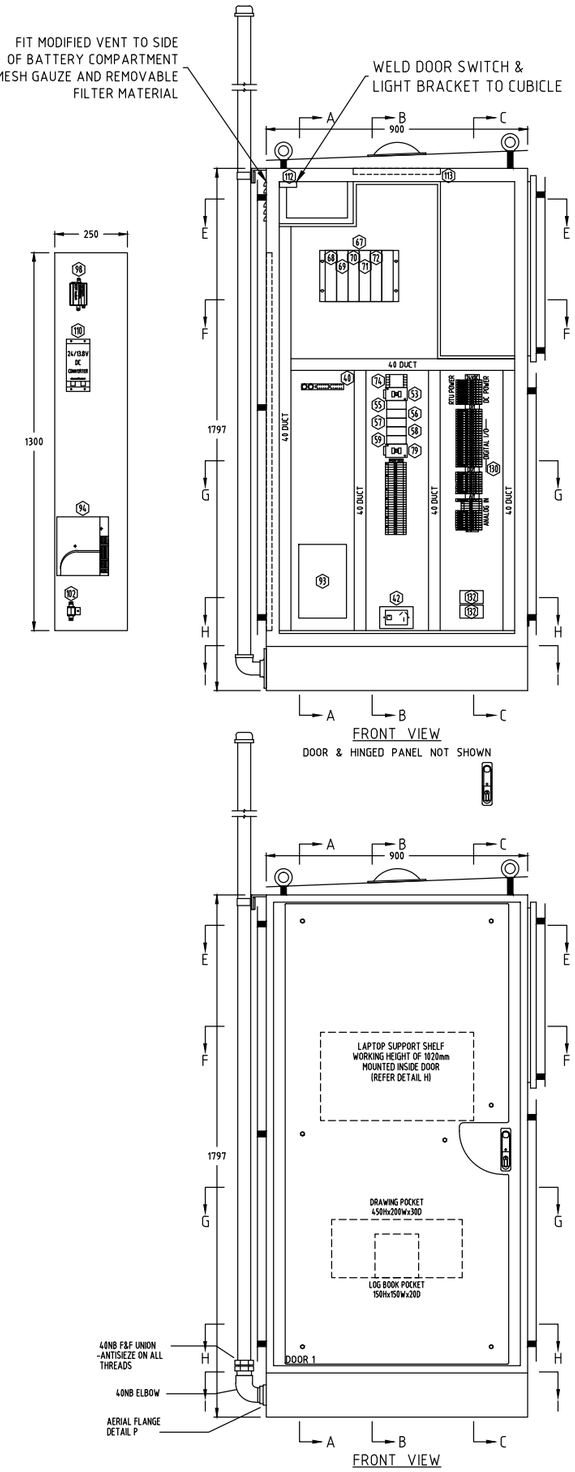
ASSET/PROJECT WB196
SEIB STREET - KILCOY
WATER BOOSTER

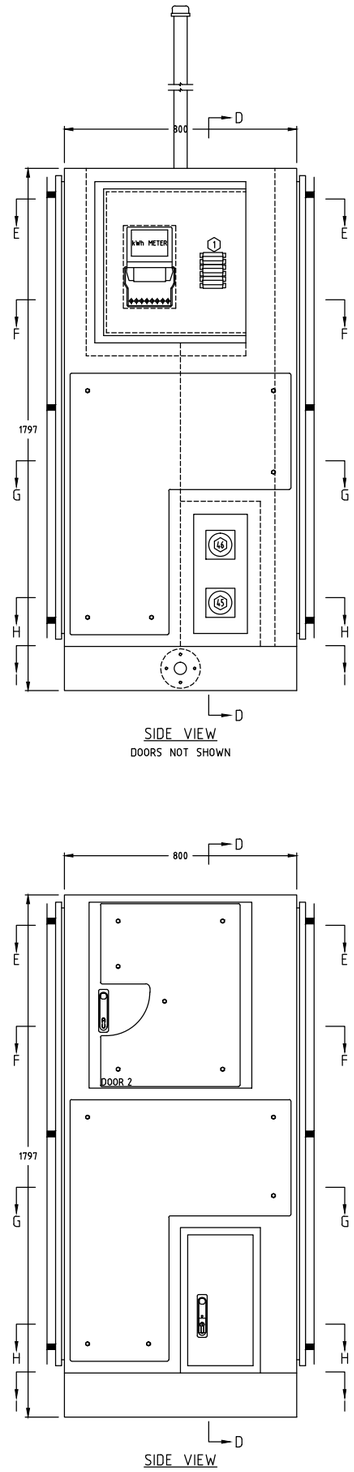
DRAWING TITLE
SWITCHBOARD
GENERAL ARRANGEMENT

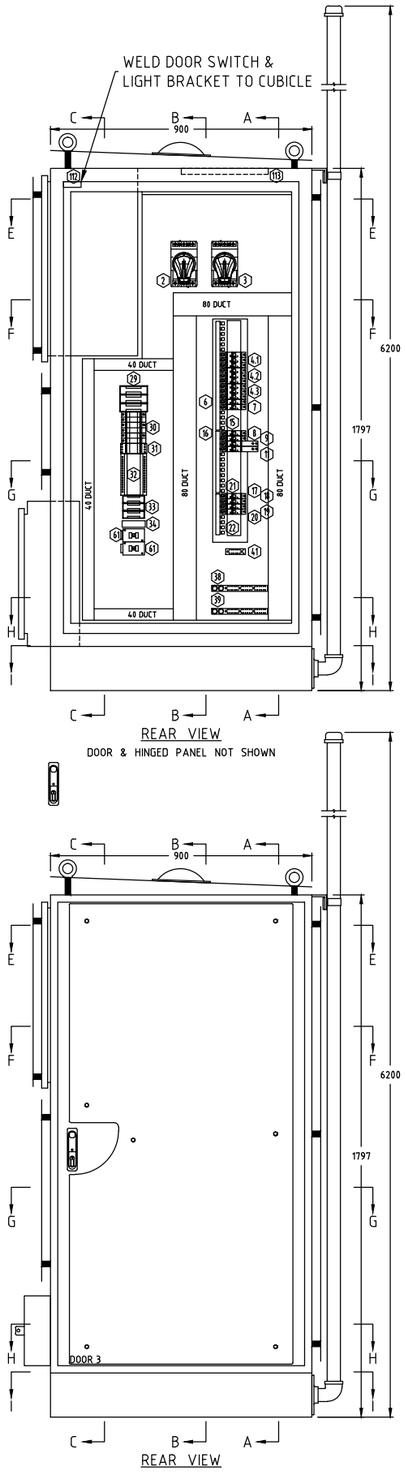
SHEET No. 14 OF 16

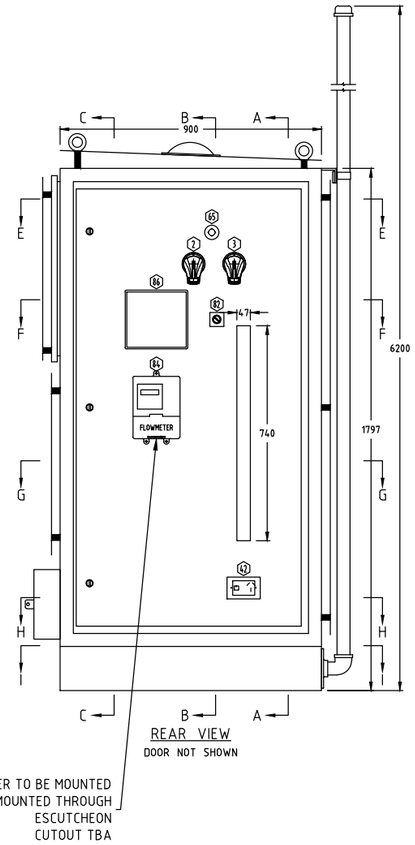
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-014

AMEND. D









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EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

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QUEENSLAND UrbanUtilities

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D	12.13	AS INSTALLED	L.L.	M.F.		

FUNDING			
DESIGN W.O. No.	QUUXXX	DRAFTED	LIEN LE
CONSTRUCTION W.O. No.	SOA XXXXX-XXX	DRAFTING CHECK	LUCAS WEDLEY
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	CAD FILE	49-1194-015&16-D.DWG
		Q.U.U. FILE No.	

LUCAS WEDLEY	24/01/13			
DESIGN	R.P.E.Q. No. DATE	APPROVED BY	SIGNATURE	DATE
ORIGINAL SIGNED BY				
DESIGN CHECK	R.P.E.Q. No. DATE	CONSTRUCTION MANAGER	SIGNATURE	DATE

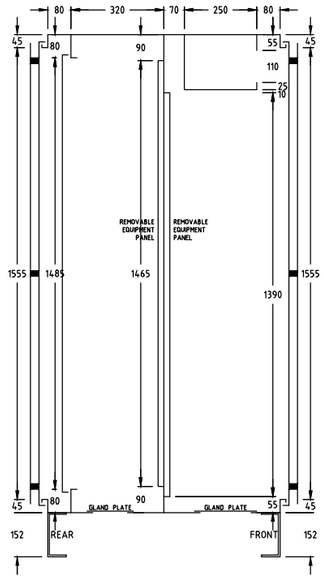
ASSET/PROJECT WB196
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
SWITCHBOARD GENERAL ARRANGEMENT

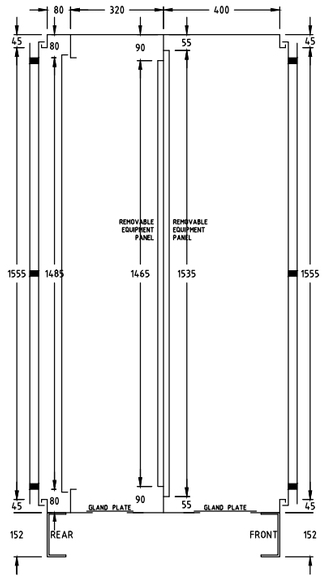
SHEET No. 15 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-015

AMEND. D

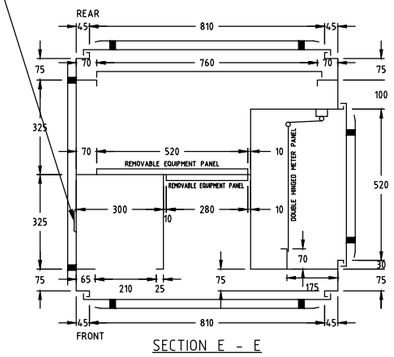


SECTION A - A

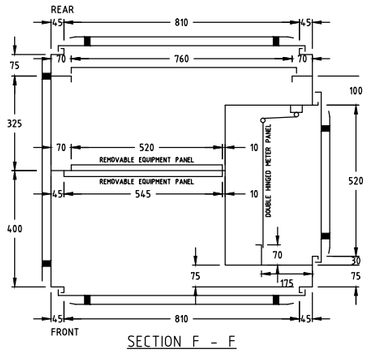


SECTION B - B

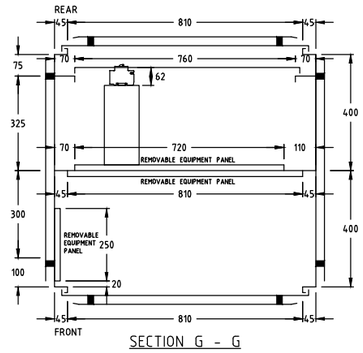
FIT MODIFIED VENT TO SIDE OF BATTERY COMPARTMENT S/S MESH GAUZE AND REMOVABLE FILTER MATERIAL



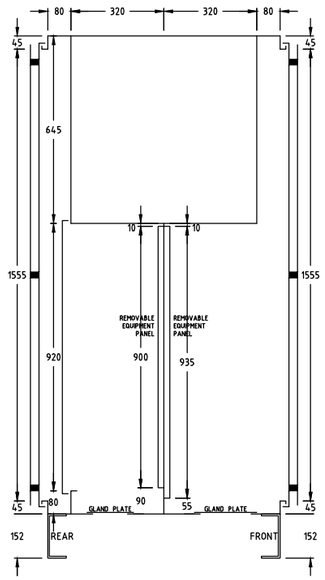
SECTION E - E



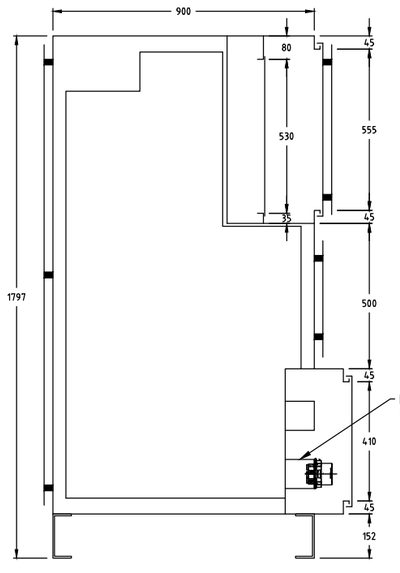
SECTION F - F



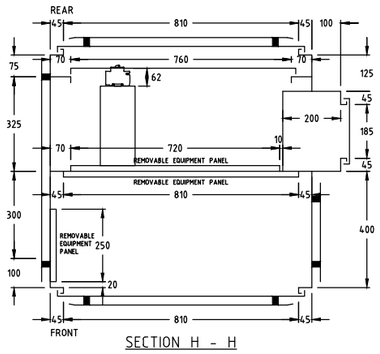
SECTION G - G



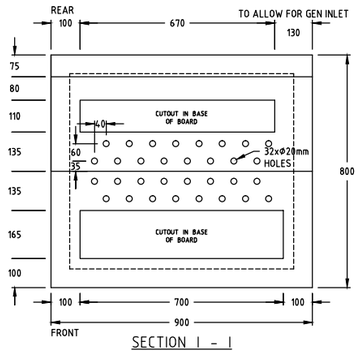
SECTION C - C



SECTION D - D



SECTION H - H



SECTION I - I

AS CONSTRUCTED DETAILS

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SIGNED: DATE:

NAME of SIGNATORY:

RPEQ No. or LICENCE:

COMPANY NAME:

START DATE: FINISH DATE:

J. & P. RICHARDSON
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ELECTRICAL CONTRACTORS AND ENGINEERS
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PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities

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FUNDING			
DESIGN W.O. No.	QUUXXX	DRAFTED	LIEN LE
CONSTRUCTION W.O. No.	SOA XXXXX-XXX	DRAFTING CHECK	LUCAS WEDLEY
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	CAD FILE	49-1194-015&16-D.DWG
		Q.U.U. FILE No.	

LUCAS WEDLEY	24/01/13		
DESIGN	R.P.E.Q. No. DATE	APPROVED BY	SIGNATURE DATE
ORIGINAL SIGNED BY			
DESIGN CHECK	R.P.E.Q. No. DATE	CONSTRUCTION MANAGER	SIGNATURE DATE

ASSET/PROJECT WB196
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE
SWITCHBOARD
GENERAL ARRANGEMENT

SHEET No. 15 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-016

AMEND. D

REF TO DWG

486-4-9-1194-030

AS CONSTRUCTED DETAILS

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

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NAME of SIGNATORY:

RPEQ No. or LICENCE:

COMPANY NAME:

START DATE: FINISH DATE:

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JPR Project No.: E12-C63100

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D	12.13	AS INSTALLED	L.L.	M.F.		

FUNDING					
DESIGN W.O. No.	QUUXXX	DRAFTED	LIEN LE	LUCAS WEDLEY	24/01/13
CONSTRUCTION W.O. No.	SOA XXXXX-XXX	DRAFTING CHECK	LUCAS WEDLEY	DESIGN R.P.E.Q. No. DATE	
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	CAD FILE	49-1194-017-D.DWG	ORIGINAL SIGNED BY	
		Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No. DATE	

APPROVED BY SIGNATURE DATE	
CONSTRUCTION MANAGER SIGNATURE DATE	

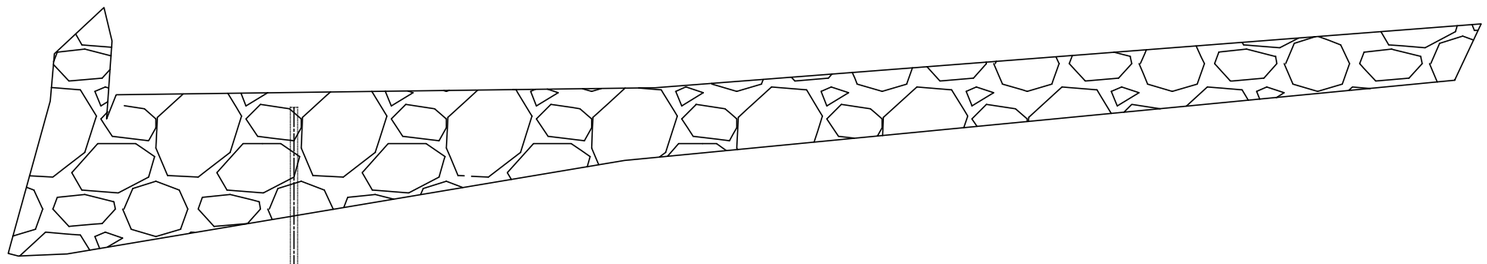
ASSET/PROJECT WB196
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE
SWITCHBOARD
SITE ARRANGEMENT

SHEET No. 16 OF 16

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-017

AMEND. D



EDGE OF ROAD

EDGE OF DRIVEWAY

3450 | 5500 | 2300

75 200 3050 CLEAR OPENING 200 75

1900 CLEAR OPENING

SUB CONTRACTOR TO PROVIDE 1 x Ø500 CORED HOLE AS SHOWN AT RL____

SUB CONTRACTOR TO PROVIDE 1 x Ø500 CORED HOLE AS SHOWN AT RL____

2037 | 425 | 200 | 75 | 705 | 1450 | 1145 | 1850 | 440 | 575 | 1300 | 900 CLEAR OPENING | 1596 | 4000 | 3830

1000 CLEAR OPENING

SUB CONTRACTOR TO PROVIDE 1 x Ø500 CORED HOLE AS

150 | 1 x Ø150 VENT EDUCT PIPE | 1 x Ø150 VENT INDUCT PIPE

POWER POLE No.P101048

2 x Ø100 CONDUIT FOR BOOSTER PUMP

1 x Ø63 CONDUIT

2 x Ø50 CONDUITS FOR FLOWMETER

1 x Ø32 CONDUIT FOR EARTH CONCRETE SLAB

900x750x1800 SWITCHBOARD

995 | 2300 | 3100 | 150 | 1005 | 1425 | 250 | 1025 | 2250 | 1600 | 5100

CENTRIFUGAL ROOF FAN MOUNTED ON STAINLESS PIPE WITH STAINLESS COWL

WATER METER WATER SERVICE TO BE RE-DIRECTED

STAINLESS PIPE WITH STAINLESS COWL

BOUNDARY PEG

NOTES:

1. PUMPS GRUNDFOS MOB 3xCRNE 45-2 7.5kW 415V PT80 VARIANT
2. ✱ CIVIL CONTRACTOR TO MAINTAIN THESE DIMENSIONS

SCALE 1:20 (A1 SHEET)

0.2 0 0.2 0.4 0.6 0.8 1.0 SCALE OF METERS

AS CONSTRUCTED DETAILS

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QUEENSLAND Urban Utilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
4	9-13	AS CONSTRUCTED	P.C.	P.C.		
3	8-13	ADD THRUST BLOCK & NOTE	P.C.	P.C.		
2	5-13	VENT INDUCT & EDUCT PIPE MODIFIED	P.C.	P.C.		

FUNDING

DESIGN W.O. No. QUU065

CONSTRUCTION W.O. No. SOA C1011-045

FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	P. CRISTEA	B. CLARKE	20-2-13
DRAFTING CHECK	P. HOUSTON	DESIGN R.P.E.Q. No.	DATE
CAD FILE	486-4-9-1194-030-2	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No.	DATE

APPROVED BY SIGNATURE DATE

CONSTRUCTION MANAGER SIGNATURE DATE

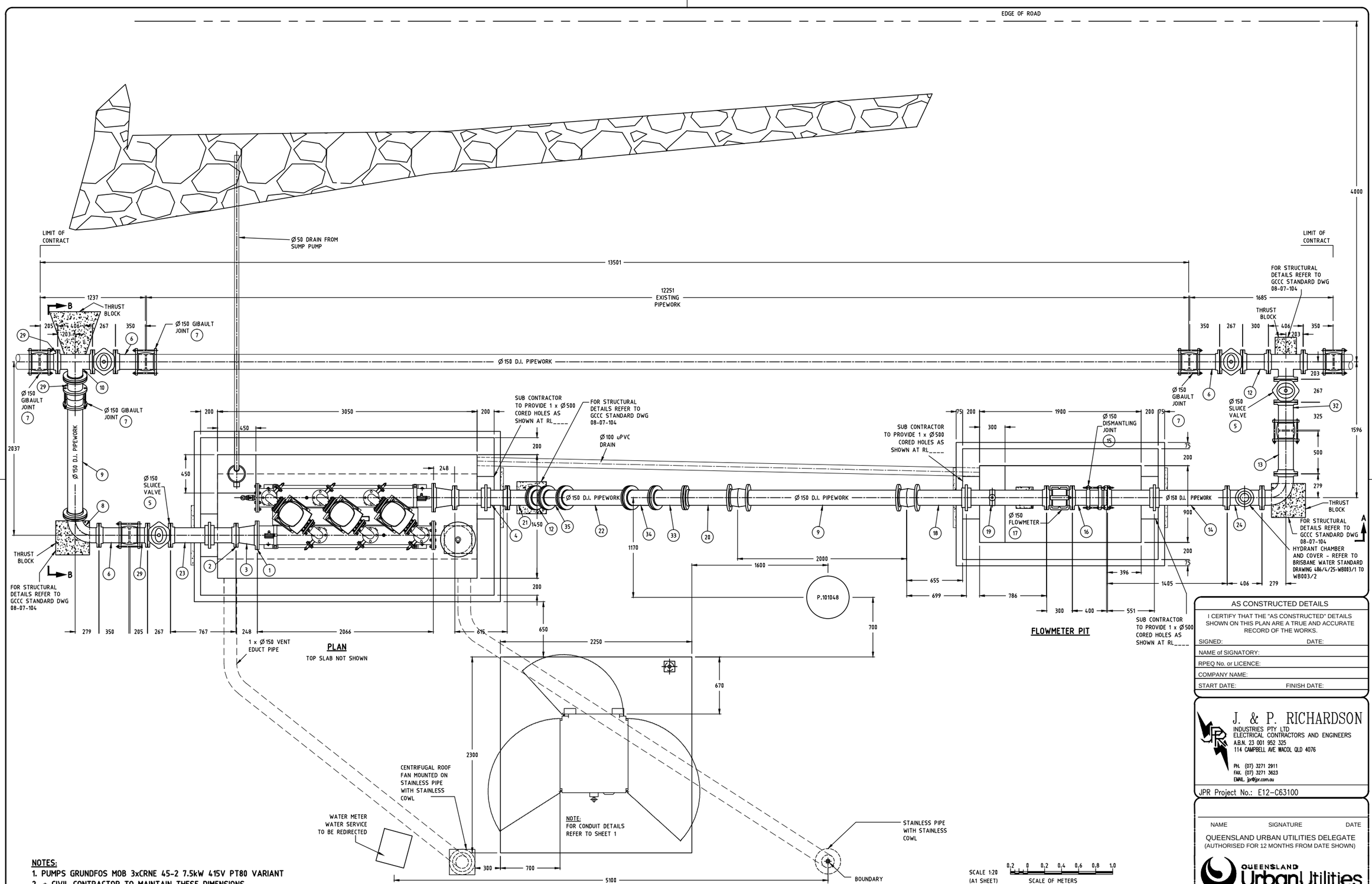
ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
SITE LAYOUT

SHEET No. 1 OF 5

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-030

AMEND. 4



NOTES:
1. PUMPS GRUNDFOS MOB 3xCRNE 45-2 7.5kW 415V PT80 VARIANT
2. * CIVIL CONTRACTOR TO MAINTAIN THESE DIMENSIONS

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
4	9-13	AS CONSTRUCTED	P.C.	P.C.		
3	8-13	ADD THRUST BLOCK & NOTE	P.C.	P.C.		
2	5-13	VENT INDUCT & EDUCT PIPE MODIFIED	P.C.	P.C.		

FUNDING
DESIGN W.O. No. QUU065
CONSTRUCTION W.O. No. SOA C1011-045
FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	P. CRISTEA	B. CLARKE	20-2-13
DRAFTING CHECK	P. HOUSTON	DESIGN R.P.E.Q. No.	DATE
CAD FILE	486-4-9-1194-031-2	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No.	DATE

APPROVED BY SIGNATURE DATE
CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
PIPEWORK LAYOUT

SHEET No. 2 OF 5
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-031
AMEND. 4

AS CONSTRUCTED DETAILS

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

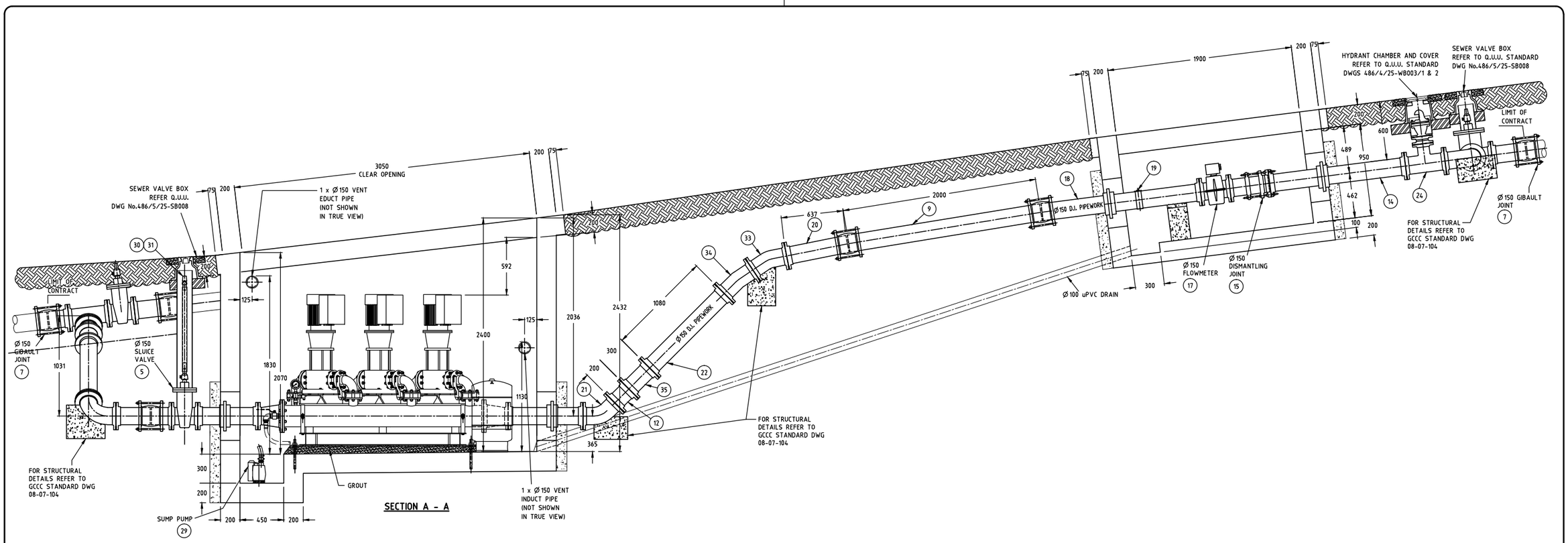
SIGNED: DATE:
NAME of SIGNATORY:
RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

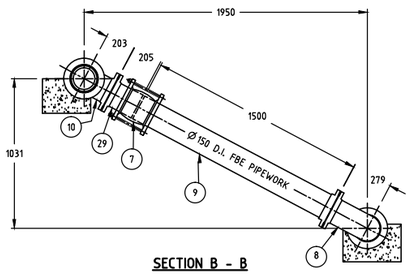
J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH: (07) 3271 2811
FAX: (07) 3271 3623
EMAIL: jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE
QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND Urban Utilities





NOTES:

1. PUMPS GRUNDFOS MOB 3xCRNE 45-2 7.5kW 415V PT80 VARIANT
2. * CIVIL CONTRACTOR TO MAINTAIN THESE DIMENSIONS

SCALE 1:20 (A1 SHEET)

SCALE OF METERS

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
4	8-13	AS CONSTRUCTED	P.C.	P.C.		
3	9-13	ADDED THRUST BLOCK & NOTE	P.C.	P.C.		
2	5-13	VENT INDUCT & EDUCT PIPE MODIFIED	P.H.	P.H.		

FUNDING	
DESIGN W.O. No.	QUU065
CONSTRUCTION W.O. No.	SOA C1011-045
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )

DRAFTED	P. CRISTEA	B. CLARKE	20-2-13
DRAFTING CHECK	P. HOUSTON	DESIGN R.P.E.Q. No.	DATE
CAD FILE	486-4-9-1194-032-2	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No.	DATE

APPROVED BY	SIGNATURE	DATE
CONSTRUCTION MANAGER	SIGNATURE	DATE

ASSET/PROJECT: WB065
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE: PIPEWORK LAYOUT

SHEET No. 3 OF 5

QUEENSLAND URBAN UTILITIES DRAWING No.: 486/4/9-1194-032

AMEND.: 4

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:

RPEQ No. or LICENCE:

COMPANY NAME:

START DATE: FINISH DATE:

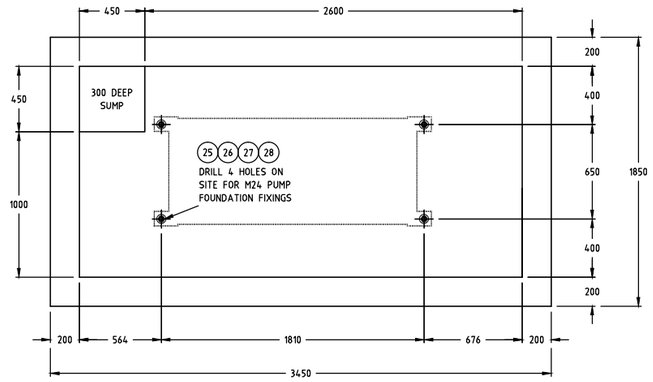
J. & P. RICHARDSON
INDUSTRIES PTY LTD
ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
EMAIL. jpr@jpr.com.au

JPR Project No.: E12-C63100

NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities



Item	Qty	Make & Number	Req. No.
1	2	200dia. BNWG SET 316SS TC	
2	29	150dia. BNWG SET 316SS TC	
3	2	200dia. - 150dia. DF CONCENTRIC TAPER	
4	1	150dia. DF PIPE 615Lg c/w WEEP AT 335 FROM FL	
5	4	150dia. DF R.S. SLUICE VALVE ACC.	
6	5	150dia. FL/SP PIPE 350Lg	
7	9	150dia. EZIGIB EZL10	
8	2	150dia. DF 90deg. BEND	
9	2	150dia. FL/SP PIPE 2000Lg C.O.S	
10	2	150dia. ALL FL TEE	
11			
12	1	150dia. DF PIPE 200Lg	
13	1	150dia. FL/SP PIPE 1000Lg C.O.S.	
14	1	150dia. DF PIPE 1405Lg c/w WEEP AT 551 FROM FL	
15	1	150dia. THRUST DISMANTLING JOINT	
16	1	150dia. FL/SP PIPE 400Lg	
17	1	150dia. ABB FLOWMETER	
18	1	150dia. FL/SP PIPE 1641Lg c/w WEEP AT 942 FROM FL	
19	1	150dia. 1" BSP TAPPING BAND	
20	1	150dia. FL/SP PIPE 635Lg	
21	1	150dia. DF 45deg. BEND	
22	1	150dia. DF PIPE 1080Lg	
23	1	150dia. DF PIPE 767Lg c/w WEEP AT 450 FROM FL	
24	1	150dia. - 100dia. ALL FL TEE	
25	2m	M24-316SS BROOKER ROD	
26	12	M24-316SS NUTS	
27	4	M24-316SS FLAT WASHERS	
28	8	M24 GALV. SQUARE WASHERS	
29	3	150dia. FL/SP CONNECTOR	
30	1	VZDXA0375S VALVE EXTENSION SPINDLE	
31	1	40dia. 316SS SCH.40 PIPE 1300g	
32	1	150dia. FL/SP PIPE 325Lg	
33	1	150dia. DF 22.5deg BEND	
34	1	150dia. DF 11.25deg BEND	
35	1	150dia. DF PIPE 300Lg	
36			
37			
38			
39			

NOTES:
1. PUMPS GRUNDFOS MOB 3xCRNE 45-2 7.5kW 415V PT80 VARIANT
2. * CIVIL CONTRACTOR TO MAINTAIN THESE DIMENSIONS

SCALE 1:20 (A1 SHEET)
0.2 0 0.2 0.4 0.6 0.8 1.0
SCALE OF METERS

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
4	9-13	AS CONSTRUCTED	P.C.	P.C.		
3	8-13	ADDED THRUST BLOCK & NOTE	P.C.	P.C.		
2	5-13	VENT INDUCT & EDUCT PIPE MODIFIED	P.C.	P.C.		

FUNDING
DESIGN W.O. No. QUU065
CONSTRUCTION W.O. No. SOA C1011-045
FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	P. CRISTEA	B. CLARKE	20-2-13
DRAFTING CHECK	P. HOUSTON	DESIGN R.P.E.Q. No.	DATE
CAD FILE	486-4-9-1194-033-2	ORIGINAL SIGNED BY	
Q.U.U. FILE No.		DESIGN CHECK R.P.E.Q. No.	DATE

APPROVED BY SIGNATURE DATE
CONSTRUCTION MANAGER SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY WATER BOOSTER

DRAWING TITLE
PUMP FOUNDATION DETAIL & MATERIAL LIST

SHEET No. 4 OF 5
QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-033
AMEND. 4

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:
RPEQ No. or LICENCE:
COMPANY NAME:
START DATE: FINISH DATE:

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ELECTRICAL CONTRACTORS AND ENGINEERS
A.B.N. 23 001 952 325
114 CAMPBELL AVE WACOL QLD 4076
PH. (07) 3271 2911
FAX. (07) 3271 3623
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JPR Project No.: E12-C63100

NAME SIGNATURE DATE
QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND UrbanUtilities

EDGE OF ROAD

EDGE OF DRIVEWAY

4000

1596

W

POWER POLE
No.P101048

130

131

WATER METER
WATER SERVICE
TO BE RE-DIRECTED

CENTRIFUGAL ROOF FAN MOUNTED ON STAINLESS PIPE WITH STAINLESS COWL

STAINLESS PIPE WITH STAINLESS COWL

BOUNDARY PEG

SCALE 1:20 (A1 SHEET)

0.2 0 0.2 0.4 0.6 0.8 1.0
SCALE OF METERS

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:

RPEQ No. or LICENCE:

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START DATE: FINISH DATE:

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NAME SIGNATURE DATE

QUEENSLAND URBAN UTILITIES DELEGATE
(AUTHORISED FOR 12 MONTHS FROM DATE SHOWN)

QUEENSLAND Urban Utilities

No.	DATE	AMENDMENT	DRAFTED	DESIGNED	RPEQ NO.	APPROVED
4	9-13	AS CONSTRUCTED	P.C.	P.C.		
3	8-13	ADDED THRUST BLOCK & NOTE	P.C.	P.C.		
2	5-13	VENT INDUCT & EDUCT PIPE MODIFIED	P.C.	P.C.		

FUNDING		DRAFTED	P. CRISTEA
DESIGN W.O. No.	QUU065	DRAFTING CHECK	P. HOUSTON
CONSTRUCTION W.O. No.	SOA C1011-045	CAD FILE	486-4-9-1194-034-2
FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	Q.U.U. FILE No.	

B. CLARKE	20-2-13		
DESIGN	R.P.E.Q. No. DATE	APPROVED BY	SIGNATURE DATE
ORIGINAL SIGNED BY			
DESIGN CHECK	R.P.E.Q. No. DATE	CONSTRUCTION MANAGER	SIGNATURE DATE

ASSET/PROJECT WB065
SEIB STREET - KILCOY
WATER BOOSTER

DRAWING TITLE
SITE LAYOUT &
LAND CONTOURS

SHEET No. 5 OF 5

QUEENSLAND URBAN UTILITIES DRAWING No. 486/4/9-1194-034

AMEND. 4

8 Service and Maintenance

This product is designed to operate under specific environmental, supply and load conditions. Should these conditions change, consult a licenced electrician or electrical engineer before operating this product.

These procedures are to be performed only by a licenced electrician as they may expose live equipment.

The Switchgear and Controlgear Assembly is essentially maintenance free, however the following safety measures and routine maintenance is recommended.

- Where fitted, ensure cabinet vents and filters are clear and clean.
- During operation, ensure all doors and covers are secure and closed.
- All faults are to be investigated and repaired by an appropriately licenced electrician.
- All components to be operated in accordance with manufacturers data.
- The protective devices within switchboards are designed to operate in the event of a short circuit or overload condition. In the event of these devices operating under such conditions the device or devices must be inspected and tested by a suitably trained person to ascertain its condition prior to reconnecting the protective device to the supply.

<u>Periodic checks should ensure</u>

- The switchboard is clean and free of any contaminants, which could reduce the insulation properties of the switchboard.
- All entries are sealed to ensure no vermin can enter.
- There is no evidence of overheating, arcing or moisture.
- The earthing system is maintained and is adequate to allow correct operation of protective devices.
- Insulation resistance is maintained to appropriate levels.
- Check terminations for correct tension.
- Test operation of protective devices.
- Re-calibrate instrument loops as required.

Refer to AS-INSTALLED electrical drawings for details of protection equipment settings.

No special tools or equipment are required to perform routine maintenance.